Lecture Notes
in Control and Information Sciences 249

Editor: M. Thoma

Springer
London
Berlin
Heidelberg
New York
Barcelona
Hong Kong
Milan
Paris
Santa Clara
Singapore
Tokyo

G. Cooperman, E. Jessen and G. Michler (Eds)

Workshop on Wide Area Networks and High Performance Computing

With 136 Figures

Springer

Series Advisory Board

A. Bensoussan · M.J. Grimble · P. Kokotovic · A.B. Kurzhanski · H. Kwakernaak · J.L. Massey · M. Morari

Editors

G. Cooperman, Professor
College of Computer Science, Northeastern University, 215 Culliane Hall, Boston, Massachusetts 02115, USA

E. Jessen, Professor
Institut für Informatik, Lehrstuhl VIII, TU München, 80290 München, Germany

G. Michler, Professor
Institut für Experimentelle Mathematik, Universität GH Essen, Ellernstrasse 29, 45326 Essen, Germany

ISBN 1-85233-642-0 Springer-Verlag London Berlin Heidelberg

British Library Cataloguing in Publication Data
Workshop on wide area networks and high performance computing. - (Lecture notes in control and information sciences)
1.Wide area networks (Computer networks) - Congresses
2.High performance computing - Congresses
I.Cooperman, G. (Gene), 1952- II.Jessen, E. III.Michler, G.
O. (Gerhard O), 1938-
004.6'7
ISBN 1852336420

Library of Congress Cataloging-in-Publication Data
A catalog record for this book is available from the Library of Congress

Apart from any fair dealing for the purposes of research or private study, or criticism or review, as permitted under the Copyright, Designs and Patents Act 1988, this publication may only be reproduced, stored or transmitted, in any form or by any means, with the prior permission in writing of the publishers, or in the case of reprographic reproduction in accordance with the terms of licences issued by the Copyright Licensing Agency. Enquiries concerning reproduction outside those terms should be sent to the publishers.

© Springer-Verlag London Limited 1999
Printed in Great Britain

The use of registered names, trademarks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant laws and regulations and therefore free for general use.

The publisher makes no representation, express or implied, with regard to the accuracy of the information contained in this book and cannot accept any legal responsibility or liability for any errors or omissions that may be made.

Typesetting: Camera ready by contributors
Printed and bound at the Athenæum Press Ltd., Gateshead, Tyne & Wear
69/3830-543210 Printed on acid-free paper SPIN 10715908

Preface

A workshop on "High Performance Computing and Gigabit Wide Area Networks" was held from 1 until 5 September 1998 at the Institute for Experimental Mathematics of Essen University, Gemany. It was organized by Professor Gene Cooperman (Northeastern University, Boston), Professor E. Jessen (Technical University, Munich) and Professor G. Michler (Institute for Experimental Mathematics, Essen). The 36 participants came from Australia, Germany, the Netherlands, Norway, Spain, Switzerland and the United States.

Distributed high performance computation in wide area high speed networks is a new interdisciplinary area of research. It requires the co-operation of mathematicians with computer scientists and communication engineers, because the technical problems caused by the latency cannot be solved by the mathematicians. The mathematical problems produce large amounts of data which have to be communicated quickly and correctly between the different computers at the various locations. Therefore new protocols and management tools have to be developed. Also it turns out that the network hardware has to be chosen carefully, and in particular routers should be avoided wherever possible. The main aim of the meeting was a careful analysis of the interplay between computer network technology, communication software and the performance of mathematical algorithms used for large scale computations in wide area high speed computer networks.

At least in the United States the number of supercomputer centers is shrinking, and also in Germany it will be difficult to provide enough resources for high performance computations in basic University research areas. It has been known for a long time that distributed high performance computing offers an alternative to demanding parallel computations on supercomputers. There are many mathematical problems for which it is possible to develop efficient algorithms which are suitable for distributed computations on middle sized parallel computers of different institutions connected by means of a high speed network. However, so far only a few scientists have access to such wide area high speed networks.

Another goal of the meeting was to give a survey about the existing and planned high speed networks in the United States, Europe, and in particular in Germany.

By bringing together scientists working in computer networks, network protocols and numerical and linear algebra, the meeting has given new insights that would not have been attainable otherwise. Only by interdisciplinary research through the co-operation of electrical engineers, mathematicians and computer scientists will it be possible to determine the most efficient combinations of parallel algorithms, protocols and network hardware. This is a

new and fruitful research area to which the 22 refereed research articles of these proceedings contribute.

At the end of these proceedings we list the titles of the 29 original invited lectures of the workshop, along with the addresses of all the participants.

The conference was supported in part by the Volkswagen Foundation, Deutsche Forschungsgemeinschaft, National Science Foundation (USA) and the University of Essen. The editors of these proceedings thank these institutions and corporations for their generous help.

Boston, München, Essen, June 30, 1999
G. Cooperman
E. Jessen
G. Michler

Contents

Introduction: Distributed High Performance Computing and Gigabit Wide Area Networks
G. Cooperman, E. Jessen and G. Michler 1

Advanced Computing and Communications Research under NSF Support
S. Kamal Abdali 5

SRP: a Scalable Resource Reservation Protocol for the Internet
W. Almesberger, T. Ferrari and J.-Y. Le Boudec 21

Differentiated Internet Services
F. Baumgartner, T. Braun, H.J. Einsiedler and I. Khalil 37

A Portable Subroutine Library for Solving Linear Control Problems on Distributed Memory Computers
P. Benner, E.S. Quintana-Ortí and G. Quintana-Ortí 61

ParaStation User Level Communication
J. M. Blum, T.M. Warschko and W.F. Tichy 89

TOP-C: Task-Oriented Parallel C for Distributed and Shared Memory
G. Cooperman 109

Metacomputing in the Gigabit Testbed West
T. Eickermann and F. Hommes 119

High Performance Metacomputing in a Transatlantic Wide Area Application Testbed
E. Gabriel, M. Resch, P. Christ, A. Geiger and U. Lang 131

MILESS – A Learning and Teaching Server for Multi-Media Documents
H. Gollan, F. Lützenkirchen and D. Nastoll 143

Rural Educational System Network (RESNET): Design and Deployment
S. Hariri, W. Wei, S.-Y. Park and H. Janelli 151

Some Performance Studies in Exact Linear Algebra
G. Havas and C. Wagner 161

Performance Analysis of Wavefront Algorithms on Very-Large Scale Distributed Systems
A. Hoisie, O. Lubeck and H. Wasserman 171

The DFN Gigabitwissenschaftsnetz G-WiN
E. Jessen 189

On Network Resource Management for End-to-End QoS
I. Matta 199

A Prototype of a Combined Digital and Retrodigitized Searchable Mathematical Journal
G.O. Michler 219

Gigabit Networking in Norway
Infrastructure, Applications and Projects
T. Plagemann 237

Low Speed ATM over ADSL and the Need for High Speed Networks
G.J.A. Schneider 257

The NRW Metacomputing Initiative
U. Schwiegelshohn and R. Yahyapour 269

Design and Evaluation of ParaStation 2
T.M. Warschko, J.M. Blum and W.F. Tichy 283

Broadcast Communication in ATM Computer Networks and Mathematical Algorithm Development
M. Weller 297

Highly Available Distributed Storage Systems
L. Xu and J. Bruck 307

List of Lectures 331

List of Registered Participants 333