

Performance Evaluation of Connectionless Service for ATM Networks

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Abstract

This paper investigates the performance of the *direct* approach to connectionless service over ATM. The direct approach utilizes connectionless servers, attached to or incorporated in a subset of the ATM switches, to provide a packet switching service. The number of connectionless servers and ATM connections utilized by the direct approach is found analytically and compared to alternative approaches. Furthermore, the effects of two architectural options that significantly impact the performance of connectionless servers, the packet forwarding scheme (packet-based and cell-based) and the flow control scheme (static rate control and a dynamic proportional rate control) are also evaluated.

1 Introduction

While emerging Asynchronous Transfer Mode (ATM) networks must be capable of supporting future applications such as digital voice and video, many of the design choices made to optimize ATM for voice and video render the transport of traditional connectionless data traffic difficult. If ATM is to be widely accepted, it must efficiently support diverse data applications. However, there are substantial differences between ATM and existing data networks. Two major differences are the connection-oriented service of ATM versus the connectionless nature of many existing LANs and the small fixed cell size employed by ATM versus larger variable sized datagrams.

There are two main approaches to providing connectionless data service in ATM networks. One approach is to use the connection-oriented service of ATM to provide trunks between each pair of communicating ATM end systems. An example in Figure 1(a) illustrates ATM end systems, the ATM-to-LAN interworking units, maintaining ATM connections to other interworking units. Note that a separate connection is required for each destination ES. This approach is called the *indirect* or *connection based* approach since the network only indirectly achieves connectionless service through the use of connections provided by ATM.

A second approach is based on the deployment of connectionless servers (CLS) throughout the network, interconnected to form a virtual connectionless network [1]. Unlike ATM switches, which operate at the cell level, connectionless servers operate at the packet level offering a

datagram routing service. By attaching connectionless servers to a subset of the ATM switches and using ATM connections between the CLS's, various topologies may be formed [2]. An example configuration is shown in Figure 1(b). With this approach, an end system needs only one open connection to send packets to any number of destinations. This method is called the *direct* or *server based* approach because the ATM network provides connectionless service directly to the end systems using connectionless servers.

The direct and indirect approaches require different sets of resources. The direct approach may require significantly fewer connections than the indirect approach but requires connectionless servers to be deployed. The number of connections may become a significant factor in large networks where the number of VPI/VCI's a switch can process may be limited. It may also require significantly fewer connection set-ups. These issues are explored in Section 2.

The effectiveness of the direct approach also depends on the performance of the connectionless servers themselves. Two factors that significantly affect CLS performance, the packet forwarding method and the flow control method, are explored in Section 3.

Concluding remarks are presented in section 4.

2 Comparison of Direct and Indirect Approaches

This section presents a quantitative comparison of the direct and indirect approaches utilizing a simple analytical model. As one of the major advantages of the direct approach is the fewer number of ATM connections required, this issue will be explored below.

It is assumed that the indirect approach sets up an ATM connection when a conversation¹ begins between a pair of ATM end systems for which no connection is currently open. A single connection may carry more than one conversation between a pair of end systems. The connection is torn down when there are no longer any active conversations to use it.

For the direct approach, it is assumed that a single ATM connection is opened between an end system and a connectionless server whenever the end system has any active conversations. The connectionless servers are assumed to maintain permanent connections between each other.

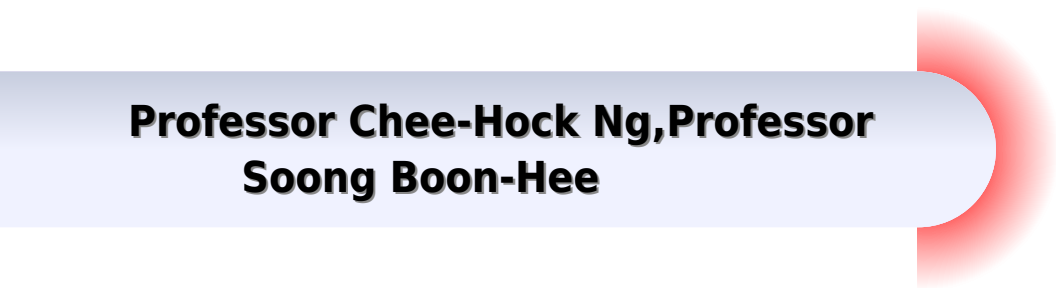
The conversations are independently generated at each end system according to a Poisson process with mean rate λ . Conversation durations are assumed to be exponentially distributed with mean β . The probability, c_i , that

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¹A conversation is a series of packets between two hosts, such as during a file transfer or telnet session.

Performance Evaluation And Applications Of Atm Networks

**Professor Chee-Hock Ng, Professor
Soong Boon-Hee**



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Performance Evaluation and Applications of ATM Networks Demetres D. Kouvatsos, 2000-05-31 Information Highways are widely considered as the next generation of high speed communication systems These highways will be based on emerging Broadband Integrated Services Digital Networks B ISDN which at least in principle are envisioned to support not only all the kinds of networking applications known today but also future applications which are not as yet understood fully or even anticipated Thus B ISDNs release networking processes from the limitations which the communications medium has imposed historically The operational generality stems from the versatility of Asynchronous Transfer Mode ATM which is the transfer mode adopted by ITU T for broadband public ISDN as well as wide area private ISDN A transfer mode which provides the transmission multiplexing and switching core that lies at the foundations of a communication network ATM is designed to integrate existing and future voice audio image and data services Moreover ATM aims to minimise the complexity of switching and buffer management to optimise intermediate node processing and buffering and to bound transmission delays These design objectives are met at high transmission speeds by keeping the basic unit of ATM transmission the ATM cell short and of fixed length

Communication Systems Lyman Chapin, 2013-03-09 Communication Systems The State of the Art captures the depth and breadth of the field of communication systems Architectures and Protocols for Distributed Systems Network and Internetwork Architectures Performance of Communication Systems Internet Applications Engineering Management of Networks and Distributed Systems Smart Networks Wireless Communications Communication Systems for Developing Countries Photonic Networking Communication Systems in Electronic Commerce This volume s scope and authority present a rare opportunity for people in many different fields to gain a practical understanding of where the leading edge in communication systems lies today and where it will be tomorrow

Applied System Simulation Mohammad S. Obaidat, Georgios I. Papadimitriou, 2012-12-06 Simulation and molding are efficient techniques that can aid the city and regional planners and engineers in optimizing the operation of urban systems such as traffic light control highway toll automation consensus building public safety and environmental protection When modeling transportation systems such as freeway systems arterial or downtown grid systems the city planner and engineer is concerned with capturing the varied interactions between drivers automobiles and the infrastructure Modeling and simulation are used to effectively optimize the design and operation of all of these urban systems It is possible that in an urban simulation community workshop citizens can work interactively in front of computers and be able using the click of the mouse to walk up to their own front porch looking at the proposed shopping mall alternatives across the street from virtually any angle and proposed bridge or tunnel and see how it can reduce traffic congestion Buildings can be scaled down or taken out their orientation can be changed in order to check the view and orientation in order to have better site with efficient energy conservation The stone or brick material on a building can be replaced by colored concrete or more trees and

lampposts can be placed on the site Such flexibility in simulation and animation allows creative ideas in the design and orientation of urban sites to be demonstrated to citizens and decision makers before final realization

The Fundamental Role of Teletraffic in the Evolution of Telecommunications Networks J. Labetoulle, J.W. Roberts, 2013-10-22 The International Teletraffic Congress ITC is a recognized international organization taking part in the work of the International Telecommunications Union The congress traditionally deals with the development of teletraffic theory and its applications to the design planning and operation of telecommunication systems networks and services The contents of ITC 14 illustrate the important role of teletraffic in the current period of rapid evolution of telecommunication networks A large number of papers address the teletraffic issues behind developments in broadband communications and ATM technology The extension of possibilities for user mobility and personal communications together with the generalization of common channel signalling and the provision of new intelligent network services are further extremely significant developments whose teletraffic implications are explored in a number of contributions ITC 14 also addresses traditional teletraffic subjects proposing enhancements to traffic engineering practices for existing circuit and packet switched telecommunications networks and making valuable original contributions to the fundamental mathematical tools on which teletraffic theory is based The contents of these Proceedings accurately reflect the extremely wide scope of the ITC extending from basic mathematical theory to day to day traffic engineering practices and constitute the state of the art in 1994 of one of the fundamental telecommunications sciences

High-Speed Networking for Multimedia Applications Wolfgang Effelsberg, Otto Spaniol, André Danthine, Domenico Ferrari, 2012-12-06 High Speed Networking for Multimedia Applications presents the latest research on the architecture and protocols for high speed networks focusing on communication support for distributed multimedia applications This includes the two major issues of ATM Networking and quality of service for multimedia applications It is to be expected that most of the bandwidth in future high speed networks will be taken up by multimedia applications transmitting digital audio and video Traditional networking protocols are not suitable for this as they do not provide guaranteed bandwidth end to end delay or delay jitter nor do they have addressing schemes or routing algorithms for multicast connections High Speed Networking for Multimedia Applications is a collection of high quality research papers which address these issues providing interesting and innovative solutions It is an essential reference for engineers and computer scientists working in this area It is also a comprehensive text for graduate students of high speed networking and multimedia applications

Application and Theory of Petri Nets 1998 Jörg Desel, Manuel Silva, 2003-06-26 This volume contains the proceedings of the 19th annual International Conference on Application and Theory of Petri Nets The aim of the Petri net conference is to create a forum for the dissemination of the latest results in the application and theory of Petri nets It always takes place in the last week of June Typically there are 150 200 participants About one third of these come from industry while the rest are from universities and research institutions The conferences and a number of other activities are

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Proceedings of the International Workshop on Applications of Neural Networks to Telecommunications Joshua Alspector, Rodney Goodman, Timothy X.

Brown, 2013-06-17 The world is witnessing the rapid evolution of its own nervous system by an unparalleled growth in communication technology Like the evolution of the nervous systems in animals this growth is being driven by a survival of the fittest mechanism In telecommunications the entities that fuel this growth are companies and nations who compete with each other Companies with superior information systems can outrun and outsmart others because they serve their customers better On the threshold of an explosion in the variety speed and usefulness of telecommunication networks neural network researchers can make important contributions to this emerging new telecommunications infrastructure The first International Workshop on Applications of Neural Networks to Telecommunications IWANNT was planned in response to the telecommunications industry's needs for new adaptive technologies This workshop featured 50 talks and posters that were selected by an organizing committee of experts in both telecommunications and neural networks These proceedings will also be available on line in an electronic format providing multimedia figures cross referencing and annotation

Database and Data Communication Network Systems, Three-Volume Set Cornelius T. Leondes, 2002-07-02 Database and Data Communication Network Systems examines the utilization of the Internet and Local Area Wide Area Networks in all areas of human endeavor This three volume set covers among other topics database systems data compression database architecture data acquisition asynchronous transfer mode ATM and the practical application of these technologies The international collection of contributors was culled from exhaustive research of over 100 000 related archival and technical journals This reference will be indispensable to engineering and computer science libraries research libraries and telecommunications networking and computer companies It covers a diverse array of topics including Techniques in emerging database system architectures Techniques and applications in data mining Object oriented database systems Data acquisition on the WWW during heavy client server traffic periods Information exploration on the WWW Education and training in multimedia database systems Data structure techniques in rapid prototyping and manufacturing Wireless ATM in data networks for mobile systems Applications in corporate finance Scientific data visualization Data compression and information retrieval Techniques in medical systems intensive care units

Issues in Software Research, Design, and Application: 2011 Edition, 2012-01-09 Issues in Software Research Design and Application 2011 Edition is a ScholarlyEditions eBook that

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European Optical Communications and Networks: Papers on networks Conference on European Fibre Optic Communications and Networks (11, 1993, 's-Gravenhage), 1993

Advances in Databases and Information Systems Johann Eder, Ivan Rozman, Tatjana Welzer, 1999-09 This book constitutes the refereed proceedings of the Third East European Conference on Advances in Databases and Information Systems ADBIS 99 held in Maribor Slovenia in September 1999 The 26 revised full papers presented together with two invited papers were carefully reviewed and selected from a total of 94 submissions The papers are organized in topical sections on information retrieval and multimedia integration transactions index structures agent technology data mining data modeling incomplete data queries database theory and performance issues

Broadband Communications Paul J. Kühn, Roya Ulrich, 2013-06-29 New Services such as for Internet data and multimedia applications have caused a fast growing demand for broadband communications The fundamental technologies for the integration of these services have been developed in the last decade optical communications photonic switching high speed local area networks Asynchronous Transfer Mode ATM ISDN and B ISDN Internet packet networks and mobile communications The development was possible through the dynamic progress in communication and computer technologies and through worldwide standardization activities within ITU T the ATM Forum the IETF IEEE ANSI ETSI and other bodies These developments have been supported by research and field trial programmes Past developments such as about LAN Internet or ISDN networking technologies have shown that it needs a time span of 10 years for a new technology from its research stage to its full application Broadband Communications is just at its onset for full deployment It will have a dramatic effect not only on the networking situation but on the whole development of information technology throughout our social and economic life which is expressed by the conference theme The Future of Telecommunications The Broadband Communications conference series of IFIP WG 6.2 addresses the fundamental technical and theoretical problems related with these technologies BC 98 is the fourth meeting in a series on conferences being held in Stuttgart Germany The previous conferences were held in Estoril Portugal in 1992 in

Paris France in 1994 and in Montreal Canada in 1996 Queueing Modelling Fundamentals Professor Chee-Hock Ng, Professor Soong Boon-Hee, 2008-04-30 Queueing analysis is a vital tool used in the evaluation of system performance Applications of queueing analysis cover a wide spectrum from bank automated teller machines to transportation and communications data networks Fully revised this second edition of a popular book contains the significant addition of a new chapter on Flow Congestion Control and a section on Network Calculus among other new sections that have been added to remaining chapters An introductory text Queueing Modelling Fundamentals focuses on queueing modelling techniques and applications of data networks examining the underlying principles of isolated queueing systems This book introduces the complex queueing theory in simple language proofs to enable the reader to quickly pick up an overview to queueing theory without utilizing the diverse necessary mathematical tools It incorporates a rich set of worked examples on its applications to communication networks Features include Fully revised and updated edition with significant new chapter on Flow and Congestion Control as well as a new section on Network Calculus A comprehensive text which highlights both the theoretical models and their applications through a rich set of worked examples examples of applications to data networks and performance curves Provides an insight into the underlying queueing principles and features step by step derivation of queueing results Written by experienced Professors in the field Queueing Modelling Fundamentals is an introductory text for undergraduate or entry level post graduate students who are taking courses on network performance analysis as well as those practicing network administrators who want to understand the essentials of network operations The detailed step by step derivation of queueing results also makes it an excellent text for professional engineers *Mobile Telecommunications Protocols for Data Networks* Anna Hac, 2003-02-21 Mobile users are demanding fast and efficient ubiquitous connectivity supporting data applications This connectivity has to be provided by various different networks and protocols which guarantee that mobile networks function efficiently performing routing and handoff for mobile users Hac proposes a comprehensive design for mobile communications including mobile agents access networks application protocols ubiquitous connectivity routing and handoff It covers the entire spectrum of lower and upper layer protocols to evaluate and design modern mobile telecommunications systems Furthermore the aspects of modern mobile telecommunications for applications networking and transmission are described For mobile users and data applications these are new networking and communications solutions particularly for the local area network environment Describes the recent advances in mobile telecommunications their protocols and management Covers hot topics such as mobile agents access networks wireless applications protocols wireless LANs architecture routing and handoff Introduces and analyses architecture and design issues in mobile communications and networks Includes a section of questions problems answers after each chapter The book is written as a practical easily accessible tutorial with many figures and examples of existing protocols and architectures making it essential reading for engineers system engineers researchers managers senior graduate students **Information**

Highways for a Smaller World and Better Living Seon Jong Chung,1996 This work discusses the issues among people creating computer communication technology the people using computer communication the people impacted by it and the regulators responsible for balancing the interest of these multiple groups

Networked Data Acquisition Systems (DAQ 96) - Proceedings Of The Second International Data Acquisition Workshop Shuhei Ajimura,Masaharu Nomachi,1997-07-15 This workshop followed the First International Conference which was hosted by Fermilab on 26 28 October 1994 That conference discussed the switch type event builder Much intensive R D work ensued from it showing the importance of 1 data flow control and 2 high speed memory access on network adapters drivers Those two themes are involved in many networked data acquisition systems Therefore Networked Data Acquisition Systems was selected as the theme of DAQ 96 It includes a wide variety of data acquisition system presentations from present and near future experiments at high energy and nuclear physics laboratories

Multimedia Communications Francesco De Natale,Silvano Pupolin,2012-12-06 Multimedia Communications is at the core of the advanced interactive services that make up today s Information Society Videoconferencing teleworking teleshopping and video on demand will benefit from developments in broadband and mobile telecommunication systems intelligent multimedia terminals and digital signal processing The latest research findings from these fields are presented here in the proceedings of the 10th Tyrrhenian Workshop on Digital Communications held in Ischia Italy September 19 98 Focus is placed on the following four areas Signal Processing for Multimedia Communications Modeling Analysis and Simulation of Multimedia Traffic Sources Access Techniques Multimode Multimedia Terminals In particular multimedia services and applications are presented This comprehensive collection of papers will enable the reader to keep pace with the rapid changes that are taking place in this field Experts have co operated with top research centers worldwide on an academic and industrial level to make this an up to date reference volume for all those who are concerned with technological advances in Multimedia Distributed Systems

Multimedia Networking: Technology, Management and Applications Syed, Mahbubur Rahman,2001-07-01 In recent years rapid Internet growth has pushed the development of new multimedia applications in all aspects of life such as entertainment communication collaborative work and electronic commerce Future applications will make use of different technologies like voice data and video but in order to make such a wide variety of multimedia applications successful a number of technology and management issues must be addressed Multimedia Networking Technology Management and Applications addresses the dynamic and efficient uses of resources a fundamental aspect of multimedia networks Geared toward professionals educators and students alike this exciting new book will detail current research and the future direction of multimedia networking

Networks: The Next Millennium - Proceedings Of Singapore International Conference On Networks 1997 Hung Keng Pung,Jit Biswas,Lek Heng Ngoh,1997-06-16 SICON 97 is the fifth conference since the first SICON organized in 1989 It aims to provide a forum for the presentation and dissemination of results in computer communications and networking

research SICON 97 has a single track technical programme comprising less than half of the total number of full papers that were submitted to the International Programme Committee of well known and respected experts for review The technical programme covers original research and development in the following areas high speed networks ATM optical networks wireless and mobile networks performance measurement and modeling network security resource sharing and quality of service internetworking network architecture and protocols and distributed computing

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