

Performance Analysis of Random Multiple Access Protocols used in Wireless Communication

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Abstract—A Multiple Access Protocol is an access mechanism and a set of rules for successful transmission of information using a common medium. In this paper, the multiple access protocols studied are those used in communication systems in which the resource to be shared is the communication channel. For wireless communication efficient resource utilization relies upon effective sharing of the available medium. Contention based random multiple access protocols, specifically the repeated contention based random multiple access protocols such as pure-ALOHA, slotted-ALOHA, Carrier Sense Multiple Access and Inhibit Sense Multiple Access protocols, are studied and the results presented. The protocols have been evaluated based on the quality of service parameters such as offered traffic, throughput, delay and capture effect. The simulations were carried out using MATLAB v7.0.

Keywords—Multiple Access Protocol; Pure-Aloha; Slotted-Aloha; non-persistent CSMA; ISMA; MATLAB.

I. INTRODUCTION

For wireless communications the multiple access protocols should be more robust with respect to changing conditions such as the hidden terminal problem, the near-far effect, and the effects of multipath fading, shadowing and the effect of co-channel interference. In this paper several typical wireless communication protocols are introduced and evaluated for various conditions. It is assumed that the mobile terminals communicate with a centrally located base station using packet radio. The best known method for contention based random multiple access packet communication is ALOHA [3]. As traffic increases in an ALOHA system collisions among packets leads to a performance drop. The Carrier Sense Multiple Access (CSMA) protocol [4,5] offers higher capacity, but its performance is affected by the hidden terminals problem. A third variation known as Inhibit Sense Multiple Access (ISMA) [6-11], in which the central base station controls the flow of packets from the mobile terminals, reduces the two problems: (1) collisions among data packets; and (2) hidden terminals. The inhibit delay fraction [6-11] is a decisive parameter in designing a packet communication system using ISMA, and is defined as a fraction of the packet duration necessary to inhibit other mobile packet transmissions by a broadcast outbound-signaling channel (base to terminal) in the event that the inbound multiple access channel (terminal to

base) is already busy. The ISMA protocols can be divided into two subclasses: (1) the non-persistent ISMA and (2) the p-persistent ISMA protocols.

In the non-persistent ISMA protocols, if the inbound channel is idle, a user can transmit a packet; otherwise, the user will wait a random time and then try again. At first sight it seems that it totally avoids collision, however due to propagation delay between two users, it is possible that a user considers the inbound channel idle and starts transmission while another transmission is already in progress. A user is informed of a collision by the absence of an acknowledgment packet from the receiving station. Upon detecting a collision, the packet is rescheduled for transmission at a randomly selected time later.

The remainder of the paper is organized as follows: Section II is the related background including a discussion of the basic performance parameters; Section III provides a list of the simulation parameters used; Section IV provides simulation results for Pure-Aloha, Slotted-Aloha, non-persistent CSMA and ISMA; and Section V provides a summary, conclusion and discussion of future work.

II. BACKGROUND

Each user terminal connects to an access point by using an access protocol. Performance parameters affected by the access protocol utilized may be analyzed to identify overall system performance. The performance parameters offered traffic, throughput and average transmission delay have been identified as key parameters and analyzed in this study.

Offered Traffic. The total quantity of packets that include newly generated packets and retransmission packets at the access point in a time interval is called offered traffic and the normalized offered traffic by transmission data rate is shown in (1).

$$G = T/R \quad (1)$$

If no packets are generated, $G=0$. R is the transmission data rate and T , (bit) is the total traffic to be transmitted.

Throughput. The total quantity of packets that is successfully transmitted to the access point is called throughput and the normalized throughput by transmission data rate is shown in (2). The transmission data rate is R (bps), the quantity of information in a packet is T (bit) and n packets are successfully transmitted.

Performance Analysis Of Multiple Access Protocols

**Krishna M. Sivalingham, Suresh
Subramaniam**



Performance Analysis Of Multiple Access Protocols:

Performance Analysis of Multiple Access Protocols Shūji Tasaka,1986 Broadcast media such as satellite ground radio and multipoint cable channels can easily provide full connectivity for communication among geographically distributed users One of the most important problems in the design of networks referred to as packet broadcast networks that can take practical advantage of broadcast channels is how to achieve efficient sharing of a single common channel Many multiple access protocols or algorithms for packet broadcast networks have been proposed and much work has been done on the performance evaluation of the protocols A variety of techniques have been used to analyze the performance however this is the first book to provide a unified approach to the performance evaluation problem by means of an approximate analytical technique called equilibrium point analysis Two types of packet broadcast networks satellite networks and local area networks are considered and eight multiple access protocols are studied and their performance analyzed in terms of throughput and average message delay Contents Part I Fundamentals Multiple Access Protocols and Performance Equilibrium Point Analysis Part II Satellite Networks S ALOHA R ALOHA ALOHA Reservation TDMAReservation SRUC TDMA Performance Comparisons of the Protocols for Satellite Networks Part III Local Area Networks Buffered CSMA CD BRAM Performance Analysis of Multiple Access Protocols is included in the Computer Systems Series Research Reports and Notes edited by Herb Schwetman Multiple Access Protocols Raphael Rom,Moshe Sidi,2012-12-06 Computer communication networks have come of age Today there is hardly any professional particularly in engineering that has not been the user of such a network This proliferation requires the thorough understanding of the behavior of networks by those who are responsible for their operation as well as by those whose task it is to design such networks This is probably the reason for the large number of books monographs and articles treating relevant issues problems and solutions in this field Among all computer network architectures those based on broadcast multiple access channels stand out in their uniqueness These networks appear naturally in environments requiring user mobility where the use of any fixed wiring is impossible and a wireless channel is the only available option Because of their desirable characteristics multiple access networks are now used even in environments where a wired point to point network could have been installed The understanding of the operation of multiple access network through their performance analysis is the focus of this book **Performance Analysis**

of Multiple Access Protocols Shūji Tasaka,1986 *Performance Analysis of Multiple Access Protocol* Shuji Tasaka,1986-04-01 Broadcast media such as satellite ground radio and multipoint cable channels can easily provide full connectivity for communication among geographically distributed users One of the most important problems in the design of networks referred to as packet broadcast networks that can take practical advantage of broadcast channels is how to achieve efficient sharing of a single common channel Many multiple access protocols or algorithms for packet broadcast networks have been proposed and much work has been done on the performance evaluation of the protocols A variety of techniques

have been used to analyze the performance however this is the first book to provide a unified approach to the performance evaluation problem by means of an approximate analytical technique called equilibrium point analysis Two types of packet broadcast networks satellite networks and local area networks are considered and eight multiple access protocols are studied and their performance analyzed in terms of throughput and average message delay Contents Part I Fundamentals Multiple Access Protocols and Performance Equilibrium Point Analysis Part II Satellite Networks S ALOHA R ALOHA ALOHA Reservation TDMA Reservation SRUC TDMA Performance Comparisons of the Protocols for Satellite Networks Part III Local Area Networks Buffered CSMA CD BRAM Shuji Tasaka is Associate Professor in the Department of Electrical and Computer Engineering Nagoya Institute of Technology Japan Performance Analysis of Multiple Access Protocols is included in the Computer Systems Series Research Reports and Notes edited by Herb Schwetman

Communication Networking
Anurag Kumar,D. Manjunath,Joy Kuri,2004-05-07 This book focuses on the three building blocks of communication networking namely multiplexing switching and routing The approach is analytical with the discussion being driven by mathematical analyses of and solutions to specific engineering problems back cover

Multiple Access Protocols for Mobile Communications Alex Brand,Hamid Aghvami,2002-04-12 A comprehensive discussion of multiple access protocols for cellular systems and the consideration of the specific constraints and capabilities of second and third generation systems regarding the multiple access protocols Beginning by introducing the cellular concept and discussing second and third generation cellular communication systems including the evolution from these systems to IP based systems the authors then identify the requirements for and problems related to multiple access In accordance with ETSI and 3GPP standards a split is made into basic multiple access schemes such as CDMA TDMA and FDMA and multiple access protocols The pros and cons of CDMA and TDMA for third generation systems are discussed as well as medium access in GSM GPRS and UMTS essentially based on R ALOHA protocols in all these systems Data access delay and voice dropping performance is assessed and the different UTRA modes are considered Provides an accessible text for individuals with little prior knowledge of cellular communication systems or multiple access protocols Provides an overview of existing material on cellular communications multiple access protocols and a combination of the two Presents extensive research carried out by the authors including extended packet reservation multiple access protocols for TDMA CDMA and hybrid CDMA TDMA air interfaces protocol enhancements and modelling of the physical layer A valuable reference resource for researchers and engineers in the field of cellular communications and packet based communications as well as postgraduate and research students in this rapidly evolving field

Performance Analysis of Multi-Channel and Multi-Traffic on Wireless Communication Networks Wuyi Yue,Yutaka Matsumoto,2007-05-08 With the rapidly increasing penetration of laptop computers and mobile phones which are primarily used by mobile users to access Internet s vices like e mail and World Wide Web WWW access support of Internet services in a mobile environment is an emerging requirement Wireless n works have been used for communication among fully distributed

users in a multimedia environment that has the needs to provide real time bursty traffic such as voice or video and data traffic with excellent reliability and service quality To satisfy the huge wireless multimedia service demand and improve the system performance efficient channel access methods and analytical methods must be provided In this way very accurate models that faithfully reproduce the stochastic behavior of multimedia wireless communication and computer networks can be constructed Most of these system models are discrete time queueing systems Queueing networks and Markov chains are commonly used for the performance and reliability evaluation of computer communication and manufacturing systems Although there are quite a few books on the individual topics of queueing networks and Markov chains we have found none that covers the topics of discrete time and continuous time multichannel multiplexed traffic queueing networks On the other hand the design and development of multichannel multiplexed hop network systems and interconnected network systems or integrated networks of multimedia traffic require not only such average performance measures as the throughput or packet delay but also higher moments of traffic departures and transmission delay

Performance Analysis of Telecommunications and Local Area Networks Wah Chun Chan, 2000 Performance Analysis of Telecommunications and Local Area Networks presents information on teletraffic engineering with emphasis on modeling techniques queueing theory and performance analysis for the public switched telephone network and computer communication networks Coverage includes twisted pair cables and coaxial cables subscriber loops multistage network switching modeling techniques for traffic flow and service time random access networks and much more End of chapter problems with solutions are also included Performance Analysis of Telecommunications and Local Area Networks is also a useful reference for practicing engineers but is intended as a textbook in advanced level courses

International Reference Guide to Space Launch Systems Steven J. Isakowitz, Joseph P. Hopkins, Joshua B. Hopkins, 1999 This best selling reference guide contains the most reliable and up to date material on launch programs in Brazil China Europe India Israel Japan Russia Ukraine and the United States Packed with illustrations and figures the third edition has been extensively updated and expanded and offers a quick and easy data retrieval source for policymakers planners engineers launch buyers and students

Systems Modeling and Simulation: Theory and Applications Doo-Kwon Baik, 2005-01-31 This book constitutes the refereed post proceedings of the third Asian Simulation Conference AsiaSim 2004 held in Jeju Island Korea in October 2004 The 78 revised full papers presented together with 2 invited keynote papers were carefully reviewed and selected from 178 submissions after the conference the papers went through another round of revision The papers are organized in topical sections on modeling and simulation methodology manufacturing aerospace simulation military simulation medical simulation general applications network simulation and modeling e business simulation numerical simulation traffic simulation transportation virtual reality engineering applications and DEVS modeling and simulation

Mobile Multimedia Communications Jonathan Rodriguez, Rahim Tafazolli, Christos Verikoukis, 2012-10-29 This book constitutes the thoroughly refereed post conference proceedings of the 6th International

ICST Conference on Mobile Multimedia Communications MOBIMEDIA 2010 held in Lisbon Portugal in September 2010 which was accompanied by the First International Workshop on Cognitive Radio and Cooperative Strategies for POWER Saving C2POWER 2010 the Workshop on Impact of Scalable Video Coding on Multimedia Provisioning SVCVision 2010 and the First International Workshop on Energy efficient and Reconfigurable Transceivers EERT 2010 The 59 revised full papers presented were carefully reviewed and selected from numerous submissions and are organized in topical sections on advanced techniques for video transmission multimedia distribution modelling of wireless systems cellular networks mobility concepts for IMT advances MOBILIA media independent handovers MIH 4 MEDIA and IP based emergency applications and services for next generation networks PEACE

Simulation of Local Area Networks Matthew N. O. Sadiku, 2018-01-18 A fast growing area in the communications industry is the internetworking of an ever increasing proliferation of computers particularly via local area networks LANs The LAN is a resource sharing data communications network being used by many offices to interchange information such as electronic mail word processing and files among computers and other devices This unique book shows the user how to establish the performance characteristics of a LAN before putting it to use in a particular type of situation Simulation of Local Area Networks consists of eight chapters each with its own extensive list of references The first chapter provides a brief review of local area networks and the second chapter gives the analytical models of popular LANs token passing bus and ring networks CSMA CD LANs and star networks Chapter 3 covers general principles of simulation and Chapter 4 discusses fundamental concepts in probability and statistics relating to simulation modeling Materials in Chapters 3 and 4 are specifically applied in developing simulation models on token passing LANs CSMA CD LANs and star LANs in Chapters 5 through 7 The computer code in Chapters 5 6 and 7 is divided into segments and a detailed explanation of each segment is provided The last chapter reviews special purpose languages such as GPSS SIMSCRIPT GASP SIMULA SLAM and RESQ Helpful criteria for language selection are included The entire code is put together in the appendixes This book has two major advantages over existing texts First it uses C a well developed general purpose language that is familiar to most analysts Second the text specifically applies the simulation principles to local area networks No other book available shows the systems analyst how to evaluate the performance of existing or proposed systems under different kinds of conditions

Hybrid Intelligence for Smart Grid Systems Seelam VSV Prabhu Deva Kumar, Shyam Akashe, Hee-Je Kim, Chinmay Chakraborty, 2021-10-21 This book provides an overview of distributed control and distributed optimization theory followed by specific details on industrial applications to smart grid systems It discusses the fundamental analysis and design schemes for developing actual working smart grids and covers all aspects concerning the conventional and nonconventional methods of their use Hybrid Intelligence for Smart Grid Systems provides an overview of a smart grid along with its needs benefits challenges and existing structure and describes the inverter topologies adopted for integrating renewable power and provides an overview of its needs benefits challenges and possible future technologies

This pioneering book is a must read for researchers engineering professionals and students giving them the tools needed to move from the concept of a smart grid to its actual design and implementation Moreover it will enable regulators policymakers and energy executives to understand the future of energy delivery systems towards safe economical high quality power delivery in a dynamic and demanding environment

Adaptation and Cross Layer Design in Wireless

Networks Mohamed Ibnkahla,2018-10-08 Adaptive techniques play a key role in modern wireless communication systems The concept of adaptation is emphasized in the Adaptation in Wireless Communications Series through a unified framework across all layers of the wireless protocol stack ranging from the physical layer to the application layer and from cellular systems to next generation wireless networks Adaptation and Cross Layer Design in Wireless Networks is devoted to adaptation in the data link layer network layer and application layer The book presents state of the art adaptation techniques and methodologies including cross layer adaptation joint signal processing coding and networking selfishness in mobile ad hoc networks cooperative and opportunistic protocols adaptation techniques for multimedia support self organizing routing and tunable security services It presents several new theoretical paradigms and analytical findings which are supported with various simulation and experimental results Adaptation in wireless communications is needed in order to achieve high capacity and ubiquitous communications The current trend in wireless communication systems is to make adaptation dependent upon the state of the relevant parameters in all layers of the system Focusing on simplified cross layer design approaches this volume describes advanced techniques such as adaptive resource management adaptive modulation and coding 4G communications QoS diversity combining and energy and mobility aware MAC protocols The first volume in the series Adaptive Signal Processing in Wireless Communications cat no 46012 covers adaptive signal processing at the physical layer

Broadband Wireless Access

Benny Bing,2006-04-18 Bing satellite and hybrid communication networks U of Maryland discusses the design and development of wireless access protocols emphasizing how such protocols can efficiently support disparate classes of multimedia traffic After introducing and surveying the evolution of wireless access protocols he describes many important protocols that are deployed or experimented with in various broadband wireless environments such as asynchronous transfer mode satellite networks mobile cellular and personal communications systems local loops and local area and home networks Seeking a broad audience ranging from novices to veterans who are undertaking research in the area he does discuss engineering aspects but focuses on the physical understanding and keeps the mathematics to a minimum Annotation copyrighted by Book News Inc Portland OR

Automata, Languages and Programming Ugo

Montanari,Jose D.P. Rolim,Emo Welzl,2003-08-06 This book constitutes the refereed proceedings of the 27th International Colloquium on Automata Languages and Programming ICALP 2000 held in Geneva Switzerland in July 2000 The 69 revised full papers presented together with nine invited contributions were carefully reviewed and selected from a total of 196 extended abstracts submitted for the two tracks on algorithms automata complexity and games and on logic semantics and

programming theory All in all the volume presents an unique snapshot of the state of the art in theoretical computer science

Optical WDM Networks Krishna M. Sivalingam, Suresh Subramaniam, 2000-03-31 Optical WDM networking technology is spearheading a bandwidth revolution in the networking infrastructure being developed for the next generation Internet Rapid advances in optical components have enabled the transition from point to point WDM links to all optical networking Optical WDM Networks Principles and Practice presents some of the most important challenges facing the optical networking community along with some suggested solutions Earlier textbooks in optical networking have a narrower perspective and rapidly advancing research has created the need for fresh and current information on problems and issues in the field The volume editors and contributing authors have endeavoured to capture a substantial subset of the key problems and known solutions to these problems All of the chapters are original contributions from leading international researchers The chapters address a wide variety of topics including the state of the art in WDM technology physical components that make up WDM fiber optic networks medium access protocols wavelength routed networks optical access networks network management and performance evaluation of wavelength routing networks The chapters also survey critical points in past research and tackle more recent problems Practitioners and network product engineers interested in current state of the art information beyond textbook type coverage and graduate students commencing research in this area will appreciate the concise and pertinent information presented herein

Multiwavelength Optical LANs Georgios I.

Papadimitriou, Paraskevas A. Tsimoulas, Mohammed S. Obaidat, Andreas S. Pomportsis, 2005-08-19 During the last thirty years or so it has been widely recognised in the research community that the key transmission medium seeming capable of serving both the ever growing demand for bandwidth and the unceasing need for new services is optical fibre In this context Wavelength Division Multiplexing WDM is the most popular technique for introducing concurrency among multiple user transmissions into the network and thus exploiting the huge amount of fibre bandwidth available under the severe limitations imposed by electronics speed on the maximum network access rate This book extensively covers an important research area in optical networking enabling readers to fully understand the concepts of optical LANs and learn details of architecture issues and control protocols Through its careful focus on the local area the book covers the major architectural topological and protocol issues regarding optical Local Area Networks LANs today Considering that constant advances on optical component technology make all optical WDM LANs all the more feasible for a wide commercial deployment the book investigates thoroughly the crucial latter topic i e the Media Access Control MAC protocols that should be used Besides introducing a noteworthy part of the vast literature on such protocols and providing some helpful distinguishing key protocol characteristics the book is also innovative in focusing on a recent significant class of promising protocols whose operation is based on network feedback information In this way these adaptive protocols for optical LANs achieve an overall higher performance in comparison with many other non adaptive schemes Multiwavelength Optical LANs Enables readers to

understand the concepts of optical LANs and learn details of architecture issues and control protocols Focuses on the major architectural topological and protocol issues regarding optical local area networks Presents the important class of adaptive protocols for optical LANs No Optical systems network developers or engineers and scientists working in optical networking should be without this book The well considered approach also makes this recommended reading for undergraduate and graduate computer science computer electrical and telecommunications engineering students **Satellite**

Communication Engineering Michael Olorunfunmi Kolawole, 2017-07-12 An undeniably rich and thorough guide to satellite communication engineering Satellite Communication Engineering Second Edition presents the fundamentals of information communications systems in a simple and succinct way This book considers both the engineering aspects of satellite systems as well as the practical issues in the broad field of information transmission Implementing concepts developed on an intuitive physical basis and utilizing a combination of applications and performance curves this book starts off with a progressive foundation in satellite technology and then moves on to more complex concepts with ease What's New in the Second Edition The second edition covers satellite and Earth station design global positioning systems antenna tracking links and communications systems error detection and correction data security regulations and procedures for system modeling integration testing and reliability and performance evaluation Provides readers with the systems building blocks of satellite transponders and Earth stations as well as the systems engineering design procedure Includes the tools needed to calculate basic orbit characteristics such as period dwell time coverage area propagation losses antenna system features such as size beamwidth aperture frequency product gain tracking control and system requirements such as power availability reliability and performance Presents problem sets and starred sections containing basic mathematical development Details recent developments enabling digital information transmission and delivery via satellite Satellite Communication Engineering Second Edition serves as a textbook for students and a resource for space agencies and relevant industries Broadband Access and Network Management D. W. Faulkner, A. L. Harmer, 1998

Whispering the Strategies of Language: An Emotional Journey through **Performance Analysis Of Multiple Access Protocols**

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