Advance Program

MobiCom '99

The Fifth Annual International Conference on Mobile Computing and Networking

August 15-19, 1999
Seattle, Washington

http://mobicom99.research.microsoft.com

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MobiCom '99
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MobiCom '99
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MobiCom '99
Conference Overview

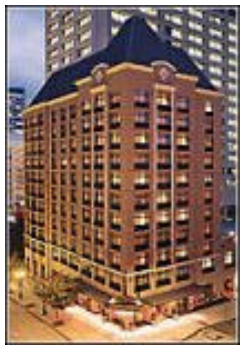
The explosive growth of wide-area cellular systems and local-area wireless networks and the emergence of home area radio networks and personal area body networks are just the beginning of "The Wireless Revolution". The ultimate goal - uncompromised connectivity and performance for mobile computing devices - requires that we meet the challenge of creating fully integrated, seamless, fault-tolerant and heterogeneous networks composed of fully distributed, energy efficient, and ubiquitous mobile computing platforms. The realization that wireless connectivity profoundly affects the way we compute, communicate, and interact motivates us to better comprehend all the aspects of the enabling underlying systems and the interactions between them. Making truly tetherless computing possible demands that we carefully evaluate, enhance and perhaps re-design our networks, systems, algorithms, and applications.

MobiCom'99 is the fifth of an annual series of international conferences dedicated to addressing the challenges of the wireless revolution. By bringing together researchers, practitioners, and visionaries from all over the world, MobiCom provides an environment where ideas flow freely and intellectual discussions happen easily between individuals instrumental in shaping the world of tomorrow.

MobiCom is a highly selective conference where the quality of its technical program is ensured by an outstanding technical program committee. A number of social and technical events, such as speeches by visionary and informed leaders in the field, panels on timely and controversial topics, tutorials on the basics and advances in the field, and workshops focussed on pressing issues of the day provide ample opportunities for learning, educating, debating, and exchanging information between users, providers, and researchers.

MobiCom '99
Hotel Accommodations

Arrangements have been made with **The Roosevelt** and **The Paramount** for giving MobiCom'99 attendees special discounted rates until July 23rd, 1999. Please reserve your room under the room block name "ACM / MobiCom". Both hotels will honor the conference room block for 3 days before and after the conference. The hotels are located in the heart of downtown Seattle and offer immediate access to Seattle's premiere attractions.



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MobiCom 99 Rate - $142

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MobiCom '99
About Seattle

Beautifully situated on Puget Sound, Seattle has a reputation for being outdoorsy...and wet. The rain produces lush vegetation that gives the place its nickname-The Emerald City (although contrary to popular belief, the city actually receives less annual rainfall (36 inches) than New York and Atlanta). Seattle has become one of the most livable cities in the U.S., with a mild climate, affordable housing, a full range of arts, cultural and sporting events, an abundance of shops and restaurants. Surrounded by lakes, rivers, the Puget Sound, and mountains, Seattle is a recreation enthusiast's dream throughout the year. In the summer, water sports

are only 10 minutes away, and winter sports, such as snow skiing, are only 45 minutes away.

The city's indoor scene rivals the one outdoors. Home to 2.7 million people, Seattle is also known as the birthplace of recent crazes for grunge rock and espresso coffee. More than a dozen of Seattle's most popular in-city diversions don't cost a cent. The Seattle Center, Pioneer Square and the Pike Place Market are three of the top tourist attractions in the downtown area. Window shoppers can fill a day at downtown stores, including complexes like Westlake Center, City Centre and, especially if it rains, the underground shops of Rainier Square.

Besides grass, flowers and evergreens, major industry also flourishes in this region. The Seattle/Washington State region has become a leading center for advanced technology in computer software, biotechnology, electronics, medical equipment, and environmental engineering. Aerospace and high-tech have spawned such corporate giants as Boeing and Microsoft, turning Seattle into one of the business capitals of the Pacific Rim.

MobiCom '99

A Message from the General Chairs

It gives us great pleasure in welcoming you to our emerald city of Seattle, Washington and to the Fifth International Conference on Mobile Computing and Networking - MobiCom'99.

We believe that this will be the best MobiCom thus far. We base this assertion on several noteworthy facts: (1) This year's conference received the highest number of paper submissions in its history, up 121% from just four years ago, and the highest number of tutorial proposals, up 184% from last year. (2) A record number of professional organizations from around the world endorsed and cooperated with MobiCom, several for the first time like - the IEE (UK), the IEICE (Japan), the USENIX Association (US) and ACM SIGMOD (US). (3) A record number of corporations are financially supporting this year's conference and a record number are participating in the exhibition that we are trying out for the first time, and (4) the number and variety of tutorials and co-located workshops being offered at MobiCom this year is the highest ever.

These accomplishments would not have been possible without the commitment, professionalism, and hard work of the organizing team. The committee members clearly worked well together sharing a common goal of creating a memorable event. In particular, we wish to acknowledge Dr. Martha Steenstrup and Prof. Tomasz Imielinski for their strong leadership in putting together an excellent technical program. We thank Professors Krishna Sivalingam and Michele Zorzi for the careful deliberation and thought they put into organizing the tutorial program. Thanks are due to Rahul Tewari for coordinating the four workshops that are co-located with MobiCom this year. Two of these are new and all are on the cutting edge of technology. We thank Dr. Roy Want for organizing the four interesting and timely panels. We can't say enough about the effort and time he put into setting up these panels and lining up a cast of credible panelists. Our kudos to Dr. Jason Redi and Prof. Jorge Cobb, these two gentlemen were given the enormous task of overcoming a three month deficit in getting the word out to the most number of people in a short amount of time - which they did with great vigor, energy, and success. We thank Dr. Sampath Rangarajan, our registration chair, and Randy Granovetter, our local chair, for their role, and finally, we applaud Aaron Woodman and his team of experts – Eric Gosnell, Ruth Williams, Christina Shires, Michael Silva and Todd Peterson who helped ensure that the conference logistics were taken care of.

Overall we are very proud of MobiCom'99. We are honored to be a part of the team that put this conference together and are delighted that you have joined us for this event. We hope that this last MobiCom of the century will be an intellectually stimulating and enjoyable experience for you.

Harel Kodesh
Productivity Appliances
Microsoft Corporation

Victor Bahl
Microsoft Research
Microsoft Corporation

MobiCom '99

A Message from the Technical Program Committee Co-Chairs

We take great pleasure in welcoming you to MobiCom'99, the Fifth Annual ACM/IEEE International Conference on Mobile Computing and Networking in Seattle, Washington. As world-wide interest in mobile computing and networking intensifies, we bring you even more informative tutorials, stimulating discussions, and excellent research presentations, all at the technical cutting edge.

MobiCom'99 marks the fifth consecutive year of growth for this conference series. We received 170 paper submissions from 22 different countries, a growth in number of submissions of 15% over last year and an indication of the continued excitement in the field. The quality of the submissions was generally excellent and hard choices had to be made. An access-controlled Technical Program Committee web page was provided where TPC members could peruse submissions and select the papers they felt most qualified to review. The review process was double blind (reviewers were not provided author information), and almost all papers received three or more independent detailed reviews from TPC members. The TPC then met in New York City and after long debate selected 28 papers for presentation at MobiCom'99.

We congratulate the winners of the MobiCom'99 Best Student Paper Award: "LeZi-Update: An Information-Theoretic Approach to Track Mobile Users in PCS Networks" by Amiya Bhattacharya and Sajal K. Das from the University of North Texas. Over one quarter of the submissions this year qualified as student papers. Not only was the winning paper the highest-ranked student paper submitted, it was also the highest-ranked paper of the entire conference.

This year for the first time we are introducing the "MobiCom Challenges" session with five papers describing "wild ideas" and challenges for mobile computing and communication for the next century. These papers will be presented in the special "MobiCom Challenges" session at the end of the conference.

The main program is arranged as eleven non-overlapping sessions: nine paper presentation sessions, including the MobiCom Challenges session, and two panel sessions.

Each of the two panel sessions comprises two panels running in parallel but all paper presentation sessions remain single-track. Thus, conferees may attend all paper presentations and two of the four panels. In addition, there are two days of tutorials preceding the main program, and one day of workshops following the main program.

In all, we are extremely pleased with the technical program and applaud the efforts of the authors and the TPC in delivering such an excellent program under severe time constraints. We especially thank our authors, who chose ACM/IEEE MobiCom'99 as a forum for presenting their work. Particular thanks go the TPC members who reviewed many more than their quota of 14 papers and found time to attend the 11-hour TPC meeting in NYC. The quality of MobiCom'99 is a testament to their expertise and dedication. Finally, we thank the conference attendees, whose collective intense and vocal interest is fueling the growth of mobile computing and networking throughout the world. We hope you find the conference both interesting and enjoyable.

Tomasz Imielinski
Dept. of Computer Science
Rutgers University

Martha Steenstrup
Internetworking Research
BBN Technologies

MobiCom'99
Exhibits

See the latest mobile communication products and services first-hand and find out about breakthroughs in mobile networks, systems and applications that support mobile computers and wireless networks,. Meet with the people and companies who are designing and developing the new mobile systems and setting the standards.

What to exhibit at MobiCom'99?

If you have a mobile communication product or services to market, don't miss this chance to reach an international audience of senior mobile computing and communications decision makers at MobiCom'99. The number of exhibition spaces is limited, and will be allocated on a first-come, first serve basis. To reserve exhibit space at MobiCom'99, contact Randy Granovetter at randygr@microsoft.com

MobiCom'99
Keynote Speaker Biography

Richard F. Rashid, is the Vice President of Microsoft Research. He holds a M.S (1977) and a Ph. D. (1980) degree in Computer Science from the University of Rochester and a degree in Mathematics (awarded with Honors) from Stanford University (1974).

Dr. Rashid joined Microsoft as the Director of Research in 1991 focussing on operating systems, computer networking and multiprocessors. In that role he was responsible for creating several key technologies which led to the development of Microsoft's interactive TV system. Prior to joining Microsoft, Dr. Rashid held the position of Professor of Computer Science at Carnegie Mellon University. As a CMU faculty member (since 1979) he directed the design and implementation of several influential network operating systems including the CMU Mach Operating System Project. The Mach kernel is in use worldwide by companies such as NeXT, organizations such as the Open Software Foundation, and corporate and University research laboratories.

Dr. Rashid's research interests are in the areas of artificial intelligence, operating systems, computer networking, and multiprocessors. Over the years, he has participated in the design and implementation of the University of Rochester RIG operating system (1975-79), the Rochester Virtual Terminal Management System (1976-79), the CMU Distributed Sensor Network Testbed (1980-1983), and the CMU's SPICE distributed personal computing environment which included the Accent network operating system (1981-1985). He has published dozens of papers in the areas of computer vision, operating system, programming languages for distributed processing, network protocols and communication security. He is credited with the co-development of one of the earliest networked computer games, Alto Trek, during the mid-1970s.

Dr. Rashid is a past member of the DARPA UNIX Steering Committee and CSNet Executive Committee. He is also a former chairman of the ACM System Awards Committee.

MobiCom'99
1999 ACM SIGMOBILE Award Recipient
Dr. Mark D. Weiser (1952 – 1999)

The 1999 ACM SIGMOBILE award for Outstanding Contributions to Research on Mobility of Systems, Users, Data, and Computing went to Dr. Mark D. Weiser, the Chief Technology Officer of Xerox Palo Alto Research Center (PARC). The award was given in recognition of Dr. Weiser's numerous contributions and visionary leadership in the field of Ubiquitous Computing.

This award is given by ACM SIGMOBILE to recognize an individual who has made significant and lasting contribution to the research on mobile communications and wireless networking. The contribution can be a single event or a life-time of achievement.

Biography

Dr. Mark Weiser, Chief Technology Officer at Xerox Palo Alto Research Center (PARC), was best known for his contributions to the field of mobile computing. He was often referred to as the father of "ubiquitous computing". He coined that term in 1988 to describe a future in which PCs will be replaced with invisible computers embedded in everyday objects. He believed that this will lead to an era of "calm technology," in which technology, rather than panicking us, will help us focus on what is really important to us.

Other research interests included garbage collection, operating systems and user interface design. Dr. Weiser, who held several U.S. and foreign patents, wrote or co-wrote more than 75 technical publications on such subjects as the psychology of programming, program slicing, operating systems, programming environments, garbage collection and technological ethics. He taught graduate and undergraduate courses on human factors, systems, and programming. He was a popular speaker at scientific symposia and conferences, and a frequent subject of media interviews.

Dr. Weiser, who founded three companies, was the drummer with rock band Severe Tire Damage, the first band to perform live on the Internet. He was born on July 23rd, 1952 in Chicago, Illinois. He was married with two children. For more details, please see http://www.ubiq.com/weiser/.

MobiCom'99
Technical Program

Sunday, August 15, 1999

8:00 a.m. – 12:00 p.m.–Half Day Tutorials

T1 - Understanding the Physical Layer and its impact on other Layers in Wireless Communications
Magda El Zarki, University of Pennsylvania, USA

T2 – Understanding Code Mobility
Gian Pietro Picco, Washington Univ, St Louis, USA

1:00 p.m. – 5:00 p.m. – Half Day Tutorials

T3 – Wireless Ad Hoc Networking Protocols
David A. Maltz and Josh Broch
Carnegie Mellon University, USA

8:00 a.m. – 5:00 p.m. – Full Day Tutorials

T4 – Mobile IP and Mobile Networking in the Internet
David B. Johnson[a] and Charles Perkins[b]
[a] Carnegie Mellon University, USA
[b] Sun Microsystems, CA, USA

Monday, August 16, 1999

8:00 a.m. – 12:00 p.m.–Half Day Tutorials

T5 – Designing Energy Efficient Mobile Systems
Mani B. Srivastava, UCLA, USA

1:00 p.m. – 5:00 p.m. – Half Day Tutorials

T6 – Multicast Communications Over Wireless Networks
Upkar Varshney, Georgia State Univ., USA

8:00 a.m. – 5:00 p.m. – Full Day Tutorials

T7 – TCP for Wireless and Mobile Hosts
Nitin Vaidya, Texas A&M University, USA

T8 – Wide Area Wireless Data Communications
Satyajit P. Doctor and Jennifer Yin
Award Solutions, TX, USA

5 p.m. – 10 p.m. Chairman's Welcome Reception (and exhibition)

Tuesday, August 17, 1999

8:30 a.m. – Opening Ceremonies

Introductions – MobiCom Steering Committee Chair
Imrich Chlamtac, University of Texas at Dallas

Welcome Remarks – General Chair
Harel Kodesh, Microsoft

Program Highlights and Best Student Paper Award –
Program Committee Co-Chairs
Tomasz Imielinski, Rutgers University
Martha Steenstrup, BBN Technologies

SIGMOBILE Outstanding Contributions Award Ceremony – Award Winner: Mark D. Weiser
Victor Bahl, Microsoft Research
SIGMOBILE Vice-Chair

Keynote Speech –
"Personal Computing – The New Future"
Richard F. Rashid
Vice President, Microsoft Research

10:00 a.m. - Refreshment Break

10:30 a.m. – Location Management and Service Discovery
Chair: Ram Ramanathan (BBN Technologies)

Winner of MobiCom'99 best student paper award:
LeZi-Update: An Information-Theoretic Approach to Track Mobile Users in PCS Networks
Amiya Bhattacharya and Sajal K. Das
University of North Texas, USA

Analysis of a Metropolitan-Area Wireless Network
Diane Tang and Mary Baker
Stanford University, USA

An Architecture for a Secure Service Discovery Service
Steven Czerwinski, Ben Y. Zhao, Todd Hodes, Anthony D. Joseph, and Randy Katz
University of California at Berkeley, USA

1:30 p.m. – Mobile Computing
Chair: Nigel Davies (Lancaster University)

Supporting CORBA Applications in a Mobile Environment
Mads Haahr, Raymond Cunningham, and Vinny Cahill
Trinity College Dublin, Ireland

Using Code Mobility to Create Ubiquitous and Active Augmented Reality in Mobile Computing
Kari Kangas and Juha Röning
University of Oulu, Finland

The Anatomy of a Context-Aware Application
Andy Harter[b], Andy Hopper[a,b] , Pete Steggles[b], Andy Ward[b], and Paul Webster[b]
[a] Cambridge University, United Kingdom
[b] AT&T Laboratories - Cambridge, United Kingdom

3:00 p.m. – Refreshment Break

3:30 p.m. - Panels I

Panel A: The Future of Local Area Wireless Networking
Moderator: Marvin Theimer
Microsoft Research, USA

Panel B: Electronic Books
Moderator: Dan Russell
Xerox, Palo Alto Research Center, USA

6:30 p.m. – 10:00 p.m. – Student, Faculty Social Cruise on Puget Sound

Wednesday, August 18, 1999

8:30 a.m. – Handheld Devices
Chair: C-K. Toh (Georgia Institute of Technology)

BlueSky: a cordless networking solution for palmtop computers
Pravin Bhagwat[a], Chatschik Bisdikian[a], Ibrahim Korpeoglu[a], Mahmoud Naghshineh[a], Satish Tripathi[b]
[a] IBM, Thomas J. Watson Research Center, USA
[b] University of California at Riverside, USA

Octopus: Embracing the Energy Efficiency of Handheld Multimedia Computers
Paul J.M. Havinga and Gerard J.M. Smit
University of Twente, Netherlands

Importance of a Battery Pulsed Discharge in Portable Radio Devices
Carla-Fabiana Chiasserini[a] and Ramesh R. Rao[b]
[a] Politecnico di Torino, Italy
[b] University of California at San Diego, USA

10:30 a.m. – Power and Error Control
Chair: James Freebersyser (Office of Naval Research)

Power Control for Link Quality Protection in Integrated (Packet And Circuit) Services in DS-CDMA Networks
Deepak Ayyagari[a] and Anthony Ephremides[b]
[a] GTE Laboratories, USA
[b] University of Maryland at College Park, USA

Optimality of Bang-Bang Power Control in CDMA Mobile Networks
Seong-Jun Oh and Kimberly M. Wasserman
University of Michigan at Ann Arbor, USA

Optimizing the End-to-End Performance of Reliable Flows over Wireless Links
Reiner Ludwig[a] , Almudena Konrad[a] , and Anthony Joseph[b]
[a] Ericsson Research, Germany
[b] University of California at Berkeley, USA

12:00 Noon - Conference Luncheon
Speaker: Phil Karn, Qualcomm

1:30 p.m. - Traffic Scheduling
Chair: Kimberly Wasserman (University of Michigan)

Reversing the Collision-Avoidance Handshake in Wireless Networks
J.J. Garcia-Luna-Aceves and Asimakis Tzamaloukas
University of California at Santa Cruz, USA

A Unified Architecture for the Design and Evaluation of Wireless Fair Queueing Algorithms
Thyagarajan Nandagopal, Songwu Lu, Vaduvur Bharghavan
University of Illinois at Urbana-Champaign, USA

Performance Evaluation of PRADOS: A Scheduling Algorithm for Traffic Integration in a Wireless ATM Network
G. Colombo[a], L. Lenzini[a], E. Mingozzi[a], B. Cornaglia[b], and R. Santaniello[b]
[a] Università di Pisa, Italy
[b] CSELT, Italy

3:30 p.m. – Panels II

Panel A: Global Satellite Communication Networks
Moderator: Satchandi Verma
Satellite Systems Div., Motorola, USA

Panel B: Wearable Computing
Moderator: Chris Schmandt
Media Lab, MIT, USA

5:15 p.m. – SIGMOBILE Business Meeting

7:00 p.m. – 9:30 p.m. - Conference Dinner Banquet
Speaker: Steve Mann, University of Toronto, Canada
"Eye am a camera: Mediated Reality, WearComp, and the EyeTap camera"

Thursday, August 19, 1999

8:30 a.m. – Data Dissemination
Chair: Andrew Campbell (Columbia University)

The Broadcast Storm Problem in a Mobile Ad Hoc Network
Sze-Yao Ni, Yu-Chee Tseng, Yuh-Shyan Chen, and Jang-Ping Sheu
National Central University, Taiwan

Performance Evaluation of a Wireless Hierarchical Data Dissemination System
Qinglong Hu[a], Dik Lun Lee[a] and Wang-Chien Lee[b]
[a] University of Science and Technology, Hong Kong
[b] GTE Laboratories, USA

Adaptive Protocols for Information Dissemination in Wireless Sensor Networks
Wendi Rabiner Heinzelman, Joanna Kulik, and Hari Balakrishnan
Massachusetts Institute of Technology, USA

10:30 a.m. – Routing
Chair: David Johnson (Carnegie Mellon University)

Query Localization Techniques for On-demand Routing Protocols in Ad Hoc Networks
Robert Castaneda and Samir R. Das
University of Texas at San Antonio, USA

Scenario-Based Performance Analysis of Routing Protocols for Mobile Ad-hoc Networks
Per Johansson[a], Tony Larsson[a], Niklas Hedman[b], Bartoszc Mielczarek[c] and Mikael Degermark[d]
[a] Ericsson Radio Systems AB, Sweden
[b] Ericsson Erisoft AB, Sweden
[c] Chalmers University of Technology, Sweden
[d] Luleå University of Technology, Sweden

Multicast Operation of the Ad-hoc On-Demand Distance Vector Routing Protocol
Elizabeth M. Royer[a] and Charles E. Perkins[b]
[a] University of California at Santa Barbara, USA
[b] Sun Laboratories, USA

12:00 Noon – Conference Luncheon
David Tennenhouse, MIT
Director, DARPA/ITO

1:30 p.m. – Transport Protocols
Chair: Ramón Cáceres (AT&T Research Labs)

Analysis of TCP Performance over Mobile Ad Hoc Networks
Gavin Holland and Nitin Vaidya
Texas A&M University, USA

WTCP: A Reliable Transport Protocol for Wireless Wide-Area Networks
Prasun Sinha, Narayanan Venkitaraman, Raghupathy Sivakumar, and Vaduvur Bharghavan
University of Illinois at Urbana-Champaign, USA

3:30 p.m. – Next Century Challenges
Chair: Tomasz Imielinski (Rutgers University)

Next Century Challenges: RadioActive Networks
Vanu G. Bose[a], David J. Wetherall[b] and John Guttag[c]
[a] Vanu, Inc., USA
[b] University of Washington, USA
[c] Massachusetts Institute of Technology, USA

Next Century Challenges: Nexus - An Open Global Infrastructure for Spatial-Aware Applications
Fritz Hohl, Uwe Kubach, Alexander Leonhardi, Kurt Rothermel and Markus Schwehm
University of Stuttgart, Germany

Next Century Challenges: Data-Centric Networking for Invisible Computing
Michael Esler, Jeffrey Hightower, and Gaetano Borriello
University of Washington, USA

Next Century Challenges: Scalable Coordination in Sensor Networks
Deborah Estrin, Ramesh Govindan, John Heidemann and Satish Kumar
USC/Information Sciences Institute, USA

Next Century Challenges: Mobile Networking for "Smart Dust"
J. M. Kahn, R. H. Katz, K. S. J. Pister
University of California at Berkeley, USA

MobiCom 99
Panels

The Future of Local Area Wireless Networking

Tuesday, August 17, 1999, 3:30 – 5:00 p.m.

Moderator: Marvin Theimer, Microsoft Research

Panelists: Vinit Nijhawan (President, Kinetic Computer Corporation), Scott Ruck (Manager, High Speed Products, Proxim Corporation), Jim Lansford (Wireless Systems Architect, Intel Corporation), Parviz Kermani (IBM Research, IBM), Mary Baker (Assistant Professor, Dept. of Computer Science, Stanford University)

Today's wireless warrior can equip himself with a pager, a cell phone, a PDA and/or laptop with built-in IrDA port, and PCMCIA cards that provide access to wireless RF LANs. The truly extreme can even plug into one of several burgeoning satellite networks.

Does it have to be this way? Do we have to have both RF and IR connections, or will one end up killing the other in the market place? What about the cell phone networks? Might we be able to get away with just having cell phone connectivity for all our portable devices?

Then again, "one size fits all" might end up displeasing everyone. Will a single solution do well both indoors and outdoors, providing high bandwidth in your office as well as good connectivity on a train or in a plane? And what about the home environment? Will ordinary consumers be willing to pay for the kinds of solutions that business users might demand? If not, will all the various devices we carry ever communicate with each other in a smooth and seamless fashion?

Electronic Books

Tuesday, August 17, 1999, 3:30 – 5:00 p.m.

Moderator: Dan Russell, Xerox, Palo Alto Research Ctr

Panelists: Niall McKay (Freelance Writer), Devin McKinney (Director of Content Applications, Softbook Press), Bill Schilit (Research Scientist, FXPAL), Walt Johnson (Director of Business Development, Uppercase), Martin Eberhard (CEO, Nuvomedia Inc.)

E-books are coming! But will they make it? Those slim, sub-3 pound, display-centric computers for reading are on either the verge of making it big, or vanishing into the dreamworld of hope-filled ideas. Question is, which will it be? Is there really a market for these things? And if so, what set of features will be compelling?

As currently devised, e-books are only momentarily connected to networks for adding to the online book collection. But connectivity for downloading might be just the beginning. What is an e-book with a fully operable wireless network connection? And how does it change how we think of books?

Our panelists represent an array of perspectives on e-books. From implementers and system designers at leading e-book companies, to cultural critics and professional cynics, this panel will shed light onto the newest wave of small computers, and consider where these devices are heading in the years ahead.

Global Satellite Communication Networks

Wednesday, August 18, 1999, 3:30 - 5:00 p.m.

Moderator: Satchandi Verma
Tech. Staff, Satellite Systems Div, Motorola

Panelists: Kul B. Bhasin (Chief, Satellite Networks and Architecture, NASA), Dan Kohn (Director of Strategy,Teledesic and NEXTLINK), Prakash Chitre (Vice President, Technology Development, COMSAT), Sastri Kota (Technical Consultant, Interactive Technology Center, Lockheed Martin Mission Systems)

Several mobile and fixed satellite communication networks are being developed for use in the year 2000 and beyond. The satellites use a wide variety of system architectures and range of operational orbits (LEO, MEO, GEO and HEO satellite orbits) to provide cost effective regional and global communication services. These networks employ advanced modulation and channel access techniques (TDMA, CDMA) in conjunction with the Optical, Ku and Ka band satellite links for transmission of wide and narrow band network signals. Currently, bent-pipe satellite communication systems are playing a major role in providing fixed and mobile Internet services in the different regions of the globe. During the next decade, several narrow and broad-band global satellite networks will be deployed to provide Internet at various speeds to any part of the globe. connections, or will one end up killing the other in the market place? What about the cell phone networks? So what's the deal? How will these networks effect the end users? Which interesting mobile services will emerge from such networks? Why are companies creating both: fixed and mobile satellite in communication networks? Might we be able to use both type of satellites in providing network connectivity for all kind of services? Why can't a single solution perform well for both low and high bandwidth services in office, car, train or in a plane? Would ordinary consumers be able to afford the kinds of solutions that business users are expected to demand? Why should users choose a satellite network over a cellular network? What type of business and service models makes sense? Is providing QoS in satellite networks important? What are the key challenges in the technology, inter operability. protocol and standards areas and how will they be met in the near future?

Wearable Computing

Wednesday, August 18, 1999, 3:30 – 5:00 p.m.

Moderator: Chris Schmandt
Principal Res. Scientist, Media Lab, MIT

Panelists: Mark Billingshurst (HIT Lab, University of Washington), Allen Milewski (AT&T Research), Thad Starner (Assistant Professor, College of Computing, Georgia Tech), Roy Want (Manager, Embedded Systems, Xerox PARC)

What is a wearable computer? Something inside your clothing, worn on your body, clipped onto your belt, or part of your hat? Why would you wear a computer? What are the benefits of a computer that is always with you and always on? What services might it provide, and what user interfaces are appropriate? Is it self-contained, or merely an interface to data and services embedded in a ubiquitous network? How does it feel to live with a wearable computer, and what do others think of you when you do?

The wearable computers to be discussed in this panel use a variety of user interface technologies and different degrees of connectivity. User interfaces consist of buttons and simple displays, speech and auditory channels, video display, and immersive audio/visual environments. Some are location-aware, using either IR beacons or GPS coordinates. They communicate over wireless LAN, wireless telephone services, IR, and paging frequencies.

This panel consists of early adopters and researchers into wearable computing of a wide variety. They will talk about their wearables, research activity using these devices, and their personal experiences using them in day-to-day life.

MobiCom 99

Tutorial Descriptions

T1 - Understanding the Wireless Physical Layer and its Impact on Other Layers

Sunday, August 15, 1999, 8:00 a.m. – 12:00 Noon
Magda El Zarki, Univ. of Pennsylvania

This tutorial will provide a simple and brief introduction to the wireless physical layer for non communication experts. The purpose is to convey some of the important underlying issues that impact the performance of the layers above the physical link.

Outline:

1. Overview of radio channel environment - path loss, shadow fading, multipath fading noise and interference.
2. Receiver signal statistics - coherence bandwidth, level crossing rate, duration of fades and power spectrum.
3. Combating Fading - diversity including sectored antennas and antenna arrays, coding/interleaving, equalization and spread spectrum.
4. Modeling the radio channel
5. Interference limited vs. resource limited environments.
6. Design considerations for wireless channels

Intended Audience: Non-Electrical Engineers or Non-Communication Systems Experts. For most researchers and scientists that do not have an EE background, the wireless channel is very little understood. However it does have a major impact on the performance of the link as seen by the applications/services that use it. It is therefore very important that people understand this environment so that they can abstract for it the components that are critical to the operation of the layers above it and the services that need to be transported over it.

Magda El Zarki received the B.E.E. from Cairo University, Cairo, Egypt in 1979 and the M.S. degree in Electrical Engineering from Columbia University, New York City, NY in 1981. She worked from 1981-1983 as a communications network planner in the Department of International Telecommunications at Citibank in New York City. She received her Ph.D. degree in Electrical Engineering in December 1987. Currently she holds the position of associate professor in the Department of Electrical Engineering at the University of Pennsylvania in Philadelphia. She is editor of 3 international journals in telecommunications and wireless networking.

T2 – Understanding Code Mobility

Sunday, August 15, 1999, 8:00 a.m. – 12 Noon

Gian Pietro Picco, Dept. of Computer Science
Washington University in St. Louis, MO

Code mobility can be defined as the capability of a distributed application to relocate its components at run-time. This possibility has been made popular by Java and by a myriad of other languages and systems. However, such systems differ in the way they provide support to code mobility, as they rely on different conceptual and terminological backgrounds, design choices, and abstractions. In general, the research area is still immature, and there is a strong need for a systematic approach to understanding the key characteristics of code mobility as well as for a careful analysis of the benefits provided.

The tutorial will illustrate a taxonomy of mobile code technologies, architectural paradigms, and applications. The taxonomy will provide a terminological basis, as well as a precise characterization of the founding concepts of the research area. Finally, the tutorial will also present an quantitative assessment of mobile code technologies and paradigms in the context of network management.

Intended Audience: Practitioners can benefit from the extensive coverage of mobile code technology and get insights from our analysis of the applicative domains that could benefit of code mobility. Researchers working on the subject can discuss their views against our particular taxonomic coverage of the area, and get insights on our particular approach to the development of mobile code applications. Researchers working outside this research area can, together with teachers and students, learn the basics of this rapidly expanding research field.

Gian Pietro Picco (http://swarm.cs.wustl.edu/~picco/) is a Visiting Assistant Professor at Washington University, St.Louis, MO, USA. His current research interests are in distributed systems that exhibit logical mobility of code or physical mobility of hosts, and in the relationships between these two forms of mobility. On this subject, he has published research work that spans from the investigation of the theoretical aspects of mobile systems to the development of middleware supporting mobile applications.

T3 – Wireless Ad Hoc Networking Protocols

Sunday, August 15, 1999, 1:00 p.m.– 5:00 p.m.

David A. Maltz and Josh Broch
Computer Science Dept., Carnegie Mellon University

An ad hoc network is a collection of wireless mobile nodes that dynamically form a temporary network without the need for any pre-existing network infrastructure or centralized administration. Due to the limited transmission range of wireless network interfaces, multiple network "hops" may be needed for one node to exchange data with another across the network. In recent years, a variety of new routing protocols targeted specifically at this environment have been developed.

In this tutorial we will describe the idea of ad hoc networking and scenarios where this technology will make an impact. In the morning session we will explain how the environment of an ad hoc network is very different from the wired environment, and the effect this has on the design and operation of routing protocols for ad hoc networks. We follow this with a description of a number of the different approaches to ad hoc networking, including the prominent protocols under consideration for standardization by the IETF.

We will review the experiences of several groups that have actually built and deployed multi-hop ad hoc networks. We will discuss the subtle issues, obstacles, and pitfalls encountered when building and deploying ad hoc networks by drawing on examples from the DARPA packet radio effort, the WINGS project, Task Force XXI, and our own ad hoc network testbed.

Dave Maltz and **Josh Broch** are the senior Ph.D. students of the Monarch Project at Carnegie Mellon University under David Johnson. Together with Professor Johnson, the speakers designed the Dynamic Source Routing Protocol for multi-hop wireless ad hoc networks, which has been proposed to the IETF Mobile Ad Hoc Network (MANET) Working Group for standardization. Josh and Dave have designed and implemented a framework for studying wireless ad hoc networks using the ns simulator, and authored the first comparative analysis of several of the ad hoc routing protocols currently under consideration by the IETF. They have also designed and implemented a physical test bed for ad hoc networks, and are currently leading an effort to analyze and improve its performance.

David A. Maltz received the S.B. and S.M. in Electrical Engineering and Computer Science from the Massachusetts Institute of Technology in 1994. He has interned at the Xerox Palo Alto Research Center, Lotus Development Corporation,and

the IBM T.J. Watson Research Center. He has held fellowships from IBM and the Intel Corporation.

Josh Broch received a B.S. in Mathematics and Computer Science from Barry University in 1995 and a M.S. in Information Networking from Carnegie Mellon University in 1996. He worked for five years as a Systems Engineer at Connections for Business (Hollywood, FL) and has interned at Oak Ridge National Lab and Microsoft.

T4 – Mobile IP and Mobile Networking in the Internet

Sunday, August 15, 1999, 8:00 a.m. – 5:00 p.m.

David B. Johnson
Computer Science Dept., Carnegie Mellon University
and
Charles E. Perkins
SUN Microsystems, Mountain View, CA

The global Internet is growing at a tremendous rate. There are now about 40 million hosts connected to the Internet, and this number is doubling approximately every year. At the same time, portable computing devices such as laptop and palmtop computers have become widely available at very affordable prices, and many new wireless networking products and services are becoming available based on technologies such as spread spectrum radio, infrared, cellular, and satellite. With these dramatic increases in portability and ease of network access, it becomes natural for users to expect to be able to access the Internet at any time and from anywhere, and to transparently remain connected and continue to use the network as they move about. However, without specific support for mobility in IP, packets destined to a mobile node would not be able to reach it while the mobile node is away from its home network due to the nature of IP (and indeed, any inter-network) routing. Mobile IP is a technology that has been developed to solve this problem. The area of Mobile IP has seen rapidly increasing interest among researchers and has already become the basis of some commercial mobile network systems, with more expected to follow in coming years. Indeed, with the development of IPv6 to replace the current version of IP in use in the Internet today, Mobile IP is expected to become a standard feature of all IP implementations.

Intended Audience: The tutorial is intended for networking and computer science research personnel, wireless product engineers, cellular telephony engineers, and anyone interested in mobile networking. It is also intended for end users working with or considering deploying Mobile IP systems or related protocols. Participants should come away with an understanding of the underlying concepts of Mobile IP, the design and use of the protocol, and the current state and future directions for the area.

David B. Johnson is an Associate Professor in the School of Computer Science at Carnegie Mellon University where he currently leads the Monarch Project at Carnegie Mellon University. He is one of the principal designers of the IETF Mobile IP protocol for IPv4, recently has been the primary designer of the IETF Mobile IP protocol for IPv6, and is the designer of one of the leading proposed protocols in the IETF Mobile Ad Hoc Networks (MANET) Working Group. Professor Johnson was Program Chair for MobiCom'97 and Technical Vice Chair for Mobile Systems for ICDCS'99, and has served as a member of the Technical Program Committee for over 15 international conferences and workshops. He is an Executive Committee member and the Treasurer for ACM SIGMOBILE, is an Area Editor for the ACM/Baltzer journal Mobile Networks and Applications (MONET) and the ACM SIGMOBILE magazine Mobile Computing and Communications Review (MC2R), and is a Guest Editor for an upcoming issue of IEEE Journal on Selected Areas in Communications (J-SAC) on mobile ad hoc networking.

Charles E. Perkins is a Senior Staff Engineer at Sun Microsystems, developing Service Location Protocol and investigating dynamic configuration protocols for mobile networking. He has served as document editor for the Mobile IP Working Group of the Internet Engineering Task Force (IETF), and is author or co-author of standards-track documents in the mobile-ip, svrloc, dhc (Dynamic Host Configuration) and IPng working groups, as well as serving on the Internet Architecture Board (IAB). Charles has authored a book on Mobile IP, and has published a number of papers in the areas of mobile networking, ad hoc networking, and automatic configuration for mobile computers. Charles is a feature editor for Mobile Computing and Communications Review, the official publication of ACM SIGMOBILE, and area editor for the journals Wireless Networks, Mobile Networking and Applications, IEEE/ACM Transactions on Networking, and IEEE Internet Computing magazine.

T5 – Designing Energy Efficient Mobile Systems

Monday, August 16, 1999, 8:00 a.m. – 12:00 Noon

Mani B. Srivastava, UCLA

Energy efficiency directly affects battery life and portability, and is perhaps the single most important design metric in mobile and wireless network computing systems. The increasing mismatch between the user expectations from wireless devices on one hand, and the glacial pace of improvement in battery technology on the other hand makes energy efficient wireless system design a particularly challenging problem.

The tutorial will provide the attendees with a comprehensive view of battery technology, sources of power consumption in computing and communication, energy efficiency metrics, and low power design techniques across all layers of mobile and wireless networked systems. Going beyond the generic hardware and software low power design techniques such as voltage reduction and shutdown management, the tutorial will also describe techniques such as low power network protocols that are specific to wireless systems design. With its balanced treatment of both design techniques and research issues, the tutorial should be of interest to practicing engineers as well as researchers.

Intended Audience: The tutorial is targeted at both practicing engineers and researchers who want to learn about energy efficiency and design for low power across the various layers (physical, protocol, application) of mobile and wireless computing and networking systems. To the practicing engineers the tutorial will provide a comprehensive treatment of recent developments in design for low power at various layers in the system. To the researchers the tutorial will provide an opportunity to learn about low power related research issues in mobile computing, and particularly problems that arise from the strong interplay of physical, protocol, middleware, and application level considerations that is typical of wireless systems. The tutorial is self contained with an extended bibliography to guide the interested participants to later delve into more details, and would be accessible to participants with typical EE and CS backgrounds.

Mani Srivastava is an Associate Professor in EE at UCLA. He received MS and Ph.D. degrees from Berkeley, and worked for several years in Networked Computing Research at Bell Labs. At UCLA he leads a DARPA research project on adaptive and energy efficient wireless protocols and node architectures. He is also investigating reconfigurable architectures for wireless nodes and base stations, networks of wireless embedded systems, QoS issues in wireless, and low power design. He has several patents, and has extensively published in wireless networking, low power systems, and system level tools. His recent awards include the Okawa Foundation Grant, and the NSF CAREER Award.

T6 – Multicast Communications Over Wireless Networks

Monday, August 16, 1999, 1:00 p.m. – 5:00 p.m.

Upkar Varshney
Computer Information Systems, Georgia State University

In the last ten or more years, multipoint or multicasting communications has emerged as one of the most demanding and difficult networking challenges. Many solutions have been proposed for supporting multicast communications in the existing IP and ATM based networks. With emerging wireless and mobile networks, it is of great importance that support for multicast communications be incorporated in these networks. The multicast support becomes even more difficult in wireless and mobile networks due to mobility of users, and due to the use of wireless links of varying performance. Attempts are being made to support multicasting in wireless and mobile networks. The purpose of this tutorial is to discuss issues of multicasting support and how to support multicasting in emerging wireless and mobile networks. We will discuss both existing solutions and current research activities. We will cover a survey of protocols, services, and technologies for supporting multicasting in wireless and mobile networks.

Intended Audience: The tutorial will be very useful to people working or planning to enter in the areas of wireless and mobile networking or multicasting. University professors, graduate students, and industry professionals or anyone interested in these areas may want to attend the tutorial.

Upkar Varshney is on the faculty of Computer Information Systems at Georgia State University, Atlanta. He received a Bachelor of Engineering in Electrical Engineering with Honors from University of Roorkee, India, an MS in Computer Science and a Ph.D. in Telecommunications & Networking, from the University of Missouri-Kansas City. His research and teaching interests include mobile and wireless networking, wireless and mobile ATM, and the next generation Internet. Professor Varshney has authored or co-authored over 30 papers. He has presented some extremely well received tutorials and workshops at major international conferences. He has also been on the program committees of several major international conferences. He is a member of IEEE, ACM and several other professional organizations.

T7 – TCP for Wireless and Mobile Hosts

Monday, August 16, 1999, 8:00 a.m. - 5:00 p.m.

Nitin H. Vaidya, Texas A&M University

This tutorial deals with the impact of wireless transmission errors and host mobility on performance of the transmission control protocol (TCP). The tutorial begins with a brief overview of wireless technologies available today, and TCP and Mobile IP protocols. The tutorial is divided into three parts. First part deals with impact of wireless transmissions errors on TCP performance, and techniques for improving performance in presence of such errors. This is followed by a brief overview of the techniques targeted for the satellite environment. Second part of the tutorial deals with impact of mobility, and techniques to improve TCP performance with mobility. The third part deals with multi-hop wireless networks. The tutorial will provide the attendees with an overview of the state of the art, and an understanding of the basic approaches that may be used to improve TCP performance in wireless and mobile environments.

Intended Audience: The tutorial should benefit attendees from industry as well as academia, who work in areas related to telecommunication, wireless data, networking, and multimedia.

Nitin Vaidya received the Ph.D. degree from the University of Massachusetts at Amherst in 1992. He also received the M.E. degree from the Indian Institute of Science, Bangalore, in 1988 and the B.E (Hons) degree from the Birla Institute of Technology and Science, Pilani, in 1986. He is currently an Associate Professor of Computer Science at the Texas A&M University. His research interests include wireless networking, mobile computing, and fault-tolerant computing. Nitin Vaidya is a recipient of a 1995 CAREER award from the National Science Foundation. He has served on program and organizing committees of several conferences and workshops. Vaidya is a member of the ACM and the IEEE Computer Society.

T8 – Wide Area Wireless Data Communications

Monday, August 16, 1999, 8:00 a.m. – 5:00 p.m.

Satyajit P. Doctor and Jennifer Yin
Award Solutions, Richardson, TX, USA

Wireless data communications has become the hot topic of the telecom and datacom industry. This tutorial provides professionals in the communications industry with a broad overview of wireless data technologies, and technology forces behind wireless data, followed by a brief comparison of wireless and wired data concepts and networks. We take a look at how radio technologies including CDMA, GSM, and TDMA support wireless circuit data services, as well as alternative wireless solutions for packet data, such as GPRS and CDPD networks. We further analyze 3G networks and their mechanisms for supporting various wireless data services. The tutorial also introduces the topics of Cellular IP and describes Mobile IP and how it pertains to wireless networks. Other protocols including WAP and Bluetooth are also discussed.

Intended Audience: Basic knowledge of wireless access technologies and networks, and data communications is assumed. The tutorial covers basic concepts, various technologies, services, emerging applications and the future of wireless data. This tutorial covers both the technical and application aspects of mobile wireless data; hence, it is suitable for a relatively wide audience. The tutorial creates intense audience participation by including exercises and audience conducted reviews for each module. These activities increase the participants' interest and involvement throughout the tutorial.

Satyajit ("Doc") Doctor is the co-founder and president of AWARD Solutions, Inc. Doc has extensive industry experience in the areas of wireless and data communications and has been instrumental in the definition and design of several network architectures and products, including 2nd and 3rd generation CDMA, TDMA, IS-41/WIN, GPRS, CDPD, AMPS, Network Management strategies, and packet based (IP/Mobile IP/..) protocols. As a consultant, he has been involved in strategic technology and business planning with leading wireless equipment manufacturers. In his previous role as the Senior Manager of Wireless Systems Engineering at Nortel, he was responsible for network capacity, performance engineering and creating intellectual property.

Jennifer Yin is a consultant with AWARD Solutions, Inc., a provider of technical consulting and specialized training for wireless, web-based and wireline technologies and data communications. She has a broad background in wireless telecommunications systems, including areas such as mobile wireless data, call processing, handoffs, and networking. Jennifer has been a key member of numerous development teams working on projects involving CDMA, TDMA and AMPS wireless networks. She has hands-on experience in many aspects of the architecture, including base stations, base station controllers, and switching systems. She has also been involved in the implementation and testing of call processing and handoff functions, as well as design of OA&M systems in CDMA networks.

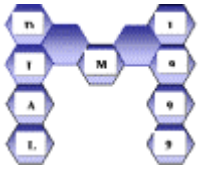
MobiCom'99

Co-located Workshops – August 20,1999

MobiDE'99
Data Engineering for Wireless and Mobile Access

Besides advances in communications and hardware, achieving pervasive mobile computing requires innovative theories, paradigms and applications in data management. The objective of this workshop is to provide a single forum for researchers and technologists to discuss the state-of-the-art, present their contributions, and set future directions in data management for mobile and wireless access.

http://www.cs.pitt.edu/mobide/



Dial M'99
Discrete Algorithms and Methods for Mobile Computing and Communications

The workshop Dial M for Mobility is devoted to discrete algorithms and discrete modeling in the context of mobile and wireless computing and communications. It is intended to be a lively meeting, covering many of the algorithmic and discrete aspects of this field extending from operations research to radio engineering problems. It aims, in particular, at fostering cooperation among practitioners and theoreticians in the field.

http://enpc710.eas.asu.edu/DialM.html

Graduate students attending the DIAL-M workshop may qualify for Student Grants to defray part of the cost of attending the workshop. For further information, please contact Arunabha Sen (arunabha.sen@asu.edu)

WoWMoM'99
Wireless Mobile Multimedia

The issues and challenges for the development of wireless multimedia networks not only encompass a broad spectrum of research topics such as quality-of-service provisioning, broadband wireless, network support, protocols, or handover, but also involves a way to envision the evolution of multimedia networks in the future. The objective of this workshop is to provide a forum for researchers and technologists to present new ideas and contributions in all areas related to wireless multimedia and its interfaces (or co-existence) with the conventional wireline networks.

http://www.cs.unt.edu/crew/wowmom99/

MSWiM'99 – Modeling and Simulation of Wireless and Mobile Systems

Wireless communication systems tend to grow fairly quickly. As a result, they become large, complicated, and difficult to analyze for capacity and performance calculation and tuning. Simulation is a well accepted alternative for analyzing, predicting performance, and determining the capacity of networks and is being increasingly used to evaluate wireless and mobile systems as well. This workshop serves as a forum for "simulationists" from academia, industry and research labs, to come together for the purpose of presenting recent advances and research results in wireless simulation systems. It targets the growing overlap between interests in large scale wireless systems and their simulation. The workshop will feature prominent invited speakers, as well as papers by well-known researchers and practitioners in the field.

http://www.cs.unt.edu/~boukerch/mswim99/

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May we include your name and contact address on the attendee list? ❑ Yes ❑ No

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MobiCom '99

Fees

(all amounts are in U.S. dollars)

August 17-19, 1999

	Before 7/23	After 7/23
Conference Registration[1]:		
ACM/SIG Members	❑ $450	❑ $550
Non-ACM/Non-SIG Members	❑ $510	❑ $610
Full Time Student	❑ $100	❑ $150
Additional Proceedings:	$50 Ea.	Num:
Additional Dinner Ticket	$55 Ea.	Num:

August 15-16, 1999

	Before 7/23	After 7/23
Half Day Tutorial[3] Registration (per tutorial):		
ACM/SIG Members	❑ $180	❑ $250
Non-ACM/Non-SIG Members	❑ $230	❑ $300
Full Time Student	❑ $60	❑ $100

T1 – Wireless Physical Layer	(8/15 AM)	❑
T2 – Code Mobility	(8/15 AM)	❑
T3 – Ad Hoc Networking	(8/15 PM)	❑
T5 – Energy Efficient Systems	(8/16 AM)	❑
T6 – Multicast for Wireless	(8/16 PM)	❑

	Before 7/23	After 7/23
Full Day Tutorial[3] Registration (per tutorial):		
ACM/SIG Members	❑ $300	❑ $375
Non-ACM/Non-SIG Members	❑ $360	❑ $435
Full Time Student	❑ $100	❑ $150

T4 – Mobile IP and Mobile Net	(8/15)	❑
T7 – TCP for Wireless	(8/16)	❑
T8 – Wide Area Wireless Data	(8/16)	❑

Additional Tutorial Notes: ❑ $50 Each
Which Tutorial(s)? _____

August 20, 1999

Workshop Registration[2]: (per workshop)	Before 7/23	After 7/23
ACM/SIG Members	❑ $150	❑ $200
Non-ACM/Non-SIG Members	❑ $175	❑ $225
Full Time Student	❑ $75	❑ $100

Workshop:

MobiDE'99	❑	Dial-M'99[5]	❑
WoWMoM'99	❑	MSWiM'99	❑

Addl. Workshop Proceedings: $35 Ea. Num:

NOTES:

1. Conference registration includes one copy of the conference proceedings, the Chairman's Welcome Reception on Monday, admittance to all paper and panel sessions, lunches and refreshment breaks on Tuesday, Wednesday and Thursday, one ticket for the Conference Dinner Banquet, and admittance to the exhibition. It does not include tutorials or workshops. Additional tickets for the Dinner Banquet and additional copies of the Conference Proceedings are available for additional cost.
2. Workshop registration for each workshop includes one copy of the workshop proceedings, admittance to all sessions of the workshop you have registered for, one lunch ticket, and refreshment breaks. Additional Workshop Proceedings may be purchased for additional cost. Conference Proceedings, conference admittance, tutorial notes and tutorial admittance are not included with workshop registration.
3. Tutorial registration includes a copy of the tutorial notes for the tutorial you have registered for and refreshment breaks. A lunch ticket is included with a full-day tutorial registration. You must pay for each tutorial you register for. Conference proceedings and workshop proceedings are not included with tutorial registration.
4. Discounted prices are available to members of ACM SIGMOBILE, SIGOPS, SIGCOMM, SIGMETRICS, and SIGMOD and to IEEE Communication Society members. If you are currently not a member of ACM SIGMOBILE, you should consider joining, getting your membership number, and then registering to get the discount prices.
5. Graduate students attending the DIAL-M workshop may qualify for Student Grants to defray part of the cost of attending the workshop. For further information, please contact Arunabha Sen (arunabha.sen@asu.edu)
6. Written requests for refunds must be postmarked no later than **August 1, 1999**. Refunds are subject to a US $75 service charge. Participants with confirmed registration who fail to attend or notify MobiCom registration of cancellation before the refund date are subject to the full fee.