



PIMRC'92

**The Third IEEE International Symposium
on Personal, Indoor and Mobile Radio
Communications**

**The Westin Hotel, Copley Place
Boston, Massachusetts**

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Proceedings

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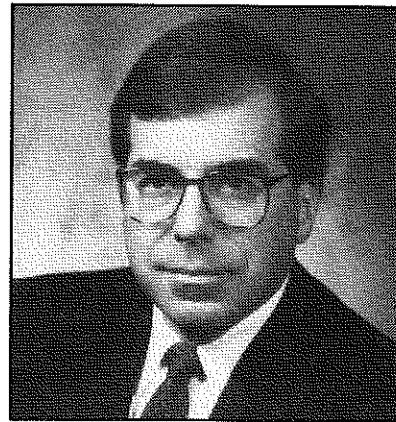
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The symposium is cosponsored by the IEEE Boston Section and Worcester Polytechnic Institute in cooperation with IEE of UK, IEICE of Japan, IEEE Communications Society, and GTE Laboratories Incorporated.



General Chairman's Message

C. David Decker
Vice President and
Director of Research
GTE Laboratories Incorporated



It gives me great pleasure on behalf of the IEEE Boston Section, Worcester Polytechnic Institute, IEE of the UK, IEICE of Japan, IEEE Communications Society, and GTE Laboratories Incorporated to welcome you to Boston for The Third IEEE International Symposium on Personal, Indoor and Mobile Radio Communications — PIMRC'92. The explosive growth of cellular mobile communications in the past five years portends the revolutionary impact that future digital wireless systems coupled with intelligent networks will have on all of our lives by the end of this century. The "personal communicator" of comic-book fame will be a reality in the not-too-distant future.

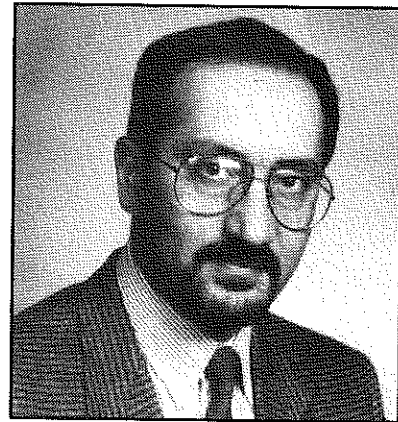
How soon ubiquitous personal communications systems enter all of our lives depends on a number of factors, including international agreements on standards, protocols, and radio spectrum, as well as on technological advances in areas as diverse as digital coding, battery technology, intelligent networks, voice recognition technology, and human factors. Progress on all these fronts is necessary to achieve economic viability for future wireless communications systems, thereby bringing the benefits of tetherless communications to large portions of the world's population. PIMRC'92 contributes toward these future capabilities by bringing together technical and scientific experts from the entire globe to share their knowledge and experience in developing and operating state-of-the-art wireless systems. Tutorials, contributed papers, and invited lectures will provide attendees with a formal means of learning about current wireless R&D, while informal discussions with experts will permit focused probing of mutual areas of interest.

Boston in October represents New England at its finest, and it provides a perfect setting for both the important technical symposium and for a wide variety of social events. I am pleased you are able to join us and contribute to this significant symposium.

Technical Program Chairman's Message

Kaveh Pahlavan

Director of the Center for Wireless
Information Network Studies
Worcester Polytechnic Institute



The occasion of the Third IEEE International Symposium on Personal, Indoor and Mobile Radio Communications marks its first occurrence in the United States. In keeping with its history of international sponsorship and participation, this third PIMRC offers an outstanding program of tutorials and papers which reflect the truly international nature of both the existing mobile communications industry and the emerging personal communications and wireless data industries. We have also tried to strike a balance between the diverse interests of academia and industry, both in the composition of the organizing committees and in the technical content of the program.

The first day of the symposium consists of 14 invited lectures in three tutorial and panel discussion sessions by distinguished experts in the field. These sessions present North American, European, and Japanese views of Personal Communication Networks, Digital Cellular Technology, and Wireless Local Area Networks. The tutorial and panel discussions in the first day are presented in nonoverlapping sessions to provide an opportunity for attendance at all lectures.

The second part of the symposium, consisting of the technical sessions, opens with a keynote speech by Mr. Alfred F. Boschulte, President of NYNEX Mobile Communications Company. Following the keynote address, 130 technical papers from 25 countries will be presented in five parallel sessions. These papers describe the latest research, development, and new concepts in various aspects of wireless information networks.

To encourage young researchers, the symposium has allocated a \$1,000 first prize and a \$500 second prize for the two best papers written and presented by students. Similar awards are being sponsored by the IEEE Communications Society of the UK and Republic of Ireland for students in their region.

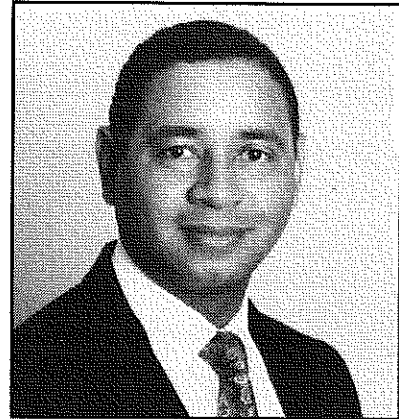
We are sure that our strong technical program and the charm and attraction of historical Boston will create an enjoyable technical experience for all participants in the symposium.

Keynote Speaker

Alfred F. Boschulte

President

NYNEX Mobile Communications Company



Alfred F. Boschulte was named President of NYNEX Mobile Communications Company in September 1990. He oversees NYNEX Corporation's cellular telephone service operations, including cellular franchises in New York City, Boston, Buffalo, and other communities throughout the Northeast.

Before joining NYNEX Mobile Communications, Mr. Boschulte was Vice President of Marketing and Planning at NYNEX Corporation.

Mr. Boschulte began his career in 1964 as an engineering assistant with New York Telephone and became the company's chief engineer in 1976. He held various managerial positions in marketing, planning, and distribution services until joining AT&T in 1982 as Director of Cross Industries. From January 1983 to May 1987, Mr. Boschulte was a vice president of Pacific Bell. In May 1987, Mr. Boschulte was named Vice President of Carrier Services at NYNEX Service Company.

Mr. Boschulte is third Vice Chairman of the Cellular Telecommunications Industry Association (CTIA) and a member of the Institute of Electrical and Electronic Engineers.

Mr. Boschulte holds a bachelor's degree in mechanical engineering from the City College of New York and a master's degree in engineering from the City University of New York. He is Chairman of the Board of Directors of INROADS Fairfield-Westchester Counties, Inc., and is a trustee of the National Board of Boys and Girls Clubs of America. He has served on the San Francisco Junior Achievement Board of Directors and as an honorary member of the Bay Area Chapter of Community Involvement Teams in Every Sector (CITIES).

In February 1988, *Black Enterprise* magazine named him one of the top 25 black executives in the United States.

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Tutorials

Monday, October 19

The first day of the symposium consists of invited tutorials given by distinguished experts in the field, representing North American, European, and Japanese views on Personal Communication Networks, Digital Cellular Technology, and Wireless Local Area Networks. The day consists of three sessions, featuring four to five speakers each, with time allowed at the end for questions and discussion.

Personal Communication Networks

Personal Communication Networks are expected to provide high-capacity, feature-rich mobile and portable service to customers using light-weight, low-power, pocketable terminals. However, many technical and regulatory issues must be resolved before widely available high-quality service can be deployed with minimum complexity. This session provides an overview of the issues from the point of view of North Americans, Europeans, and Japanese, including separate talks on CDMA and TDMA from Americans.

*J. Uddenfeldt, Moderator
Ericsson Radio Systems AB, Sweden*

- D. Cox, Bellcore, *Wireless Access: An Overview*
- P. Ramsdale, Mercury Personal Communications, *Personal Communications — PCN Implementation in Europe*
- K. Kohiyama, NTT, *Evolution Towards Personal Telecommunications in Japan*
- D. Schilling, City College of New York, *Personal Communication Services Using Broadband — CDMA*
- H. Arnold, Bellcore, *A Flexible TDMA Architecture for Wireless Access*

Digital Cellular Technology

The demand for mobile telephone service on existing, analog, systems has grown dramatically over the past decade, to the extent that capacity limits have been reached in many densely populated cities. Standards groups and industrial R&D organizations worldwide have engaged in efforts to develop high-capacity digital technologies which will provide superior capacity, quality, and services. This session will provide a review of trends in digital cellular technologies, including both TDMA and CDMA access methods, presented by North Americans, Europeans, and Japanese.

J. Mikulski, Moderator
Motorola, Inc., USA

- T. Haug, Swedish Telecomm, *Trends in Digital Cellular Technology*
- A. Viterbi, Qualcomm, *Spread Spectrum CDMA for Digital Cellular and Beyond*
- M. Kuramoto, NTT, *Development of a Digital Cellular System Based on Japanese Standard*
- R. Swain, BT Labs, *DECT and a RACE View of Universal Mobile Telecommunications for the Year 2000*
- J. Russell, AT&T Bell Labs, *Digital Cellular Technology Evolution in the United States*

Wireless Local Area Networks

Wireless LAN technology provides an attractive alternative to conventional wired data networks in its support of portable terminals and decreased installation and reconfiguration costs. Today, several technologies are available, including high-frequency cellular, infrared, and spread spectrum, which are used mainly to complement existing wired networks. Future wireless LANs will extend access to portable terminals and provide many new services. This session presents an overview of the market and available technologies, followed by detailed coverage of broadband access, spread spectrum access in the ISM bands, and frequency allocation issues.

P.R. Chevillat, Moderator
IBM Rueschlikon Labs, Switzerland

- K. Pahlavan, WPI, *Overview of Wireless LAN Technology*
- T. Freeburg, Motorola, *Broadband Wireless Access Technologies — Beyond ISDN*
- B. Tuch, NCR, *Spread Spectrum Wireless LAN in ISM Bands*
- J. Lovette, Apple Computer, *Free Access for Data Terminals*

Panel Discussions

Tuesday, October 20, and Wednesday, October 21

Impact of Regulations

R.P. Newell, Chairperson, Microcell Report, USA

Mobile wireless technology has been advancing at a rapid pace, but improvements do not reach the market merely because of their merit. As with all telecommunications, wireless telephony is subject to intensive regulation and, in addition, must compete for scarce spectrum with many other claimants. To discuss the impact of regulation and spectrum allocation upon the development of personal communication services, the symposium has assembled a panel of experts to provide their views on the situation in the United States and Europe. Among the confirmed panelists are **T. Stanley**, Chief of the FCC's Office of Engineering and Technology; **A. Philips**, PCS Director of Telocator; **R. Wiley**, Former Chairman of the FCC, USA, and **R. Swain**, BT Labs.

Security and Privacy

R. Jueneman, Chairperson, GTE Laboratories Incorporated, USA

If PCS lives up to the potential that some foresee for it, in the relatively near future a very substantial portion of our society's voice and data communications may be carried by wireless transmission media. If so, we must carefully consider the security and privacy requirements of our society at large as we design and implement encryption, authentication, position locating and tracking, fraud control measures, voice mail, etc. It is no secret that drug dealers, arms smugglers, terrorists, and other nefarious people have enthusiastically adopted the new technology and are now capitalizing on some of the defects in current systems to make untraceable calls — with the side effect of causing a major fraud problem for the cellular carriers. To what extent, therefore, should we provide such people unbreakable communications facilities in our attempt to provide reasonable levels of privacy for our law-abiding citizens?

This panel discussion will attempt to define the boundaries of this problem and clarify some of the issues. Among the confirmed panelists are **J. Gillmore**, Cygnus; **D. Worthley**, FBI Engineering Research Facility; **H. Van Gelder**, Bureau of Export Administration, Department of Commerce; and **G. Collett**, President of Cycomm, Inc.

Banquet Speaker

Gregory F. Chapados
Assistant Secretary for
Communications and Information

Gregory F. Chapados serves as the Assistant Secretary of Commerce for Communications and Information and the Administrator of the National Telecommunications and Information Administration (NTIA).

Prior to joining NTIA, Mr. Chapados held the position of Chief of Staff to Senator Ted Stevens of Alaska. In that capacity, he handled all telecommunications issues for the senator in the Commerce and Appropriations Committees and worked with the Bush administration on cable television, radio spectrum, and common carrier issues.

Mr. Chapados has made implementation of spectrum management reforms, introduction of new telecommunications technologies, and promotion of domestic and international competition, particularly in the local exchange, his priorities at NTIA.

From 1983 to 1986, Mr. Chapados served as legislative assistant to Senator Stevens. Among the issues he handled were telecommunications, public lands and wildlife, energy and natural resources, ethics, and rules issues.

In 1982, Mr. Chapados worked as a summer clerk to Justice Jay A. Rabinowitz of the Supreme Court of Alaska.

Mr. Chapados received his Juris Doctor degree from Harvard Law School in 1983 and his bachelor's degree from Harvard College in 1979. He graduated from both schools magna cum laude.

Mr. Chapados resides in Washington, DC.