

T1 Technologies for Wireless Packet Telephony
 Date: Monday 18th September
 Duration: Half-day
 Presenters: Dr Prathima Agrawal (Telcordia, Inc., USA)
 Prof Cormac J Sreenan (University College Cork, Ireland)

Summary:
 The emergence of packet telephony will create new services and allow greater flexibility and efficiency in the way people communicate. At the same time, demand for cellular telephony is exploding, with the number of subscribers predicted to exceed 500 Million in the year 2000. The marriage of these two technologies promises the benefits of packet telephony combined with the freedom of user mobility. It does, however, raise a set of difficult technological challenges. The aim of this tutorial is to explain the key concepts and technologies involved in designing a wireless packet telephony system. Topics covered will include quality of service in wireless networks, Mobile-IP, protocols for real-time transport (RTP), and call signalling (H.323, SIP). The tutorial will include discussions of emerging wireless systems and recent research developments.

Outline:

Introduction	Protocols and services	Networking	Conclusion
• Market for Packet Telephony	• Real-time transport	• Quality of Service	• Emerging wireless technologies
• Telephony concepts	• Signaling protocols	• Medium Access Control	• Research developments
• Voice-over-IP fundamentals	• Services, Directories	• Mobile IP	

Dr Prathima Agrawal is Executive Director of the Computer Networking Research Department as well as Assistant Vice-President of the Internet Architecture Research Laboratory at Telcordia Technologies, Morristown, New Jersey. Prior to joining Telcordia, she worked for 20 years in Bell Laboratories in Murray Hill, NJ. She has published over 150 papers. Dr Agrawal is a Fellow of the IEEE and a member of the ACM. Presently, she chairs the IEEE Fellow Selection Committee.

Cormac J Sreenan is a Professor of Computer Science at University College Cork in Ireland. Prior to taking up his current position in August 1999, he was a Principal Technical Staff Member at AT&T Labs Research in Florham Park, NJ, USA. He holds a Ph.D. from Cambridge University.

T2 Ad-Hoc Radio Connectivity via the Bluetooth™ System
 Date: Monday 18th September
 Duration: Half-day
 Presenter: Dr Jaap C Haartsen (Ericsson Radio Systems B.V., The Netherlands)

Summary:
 In the last decades, progress in radio and VLSI technology has fostered the widespread use of computing and communication devices for commercial usage. The success of consumer products like PCs, laptops, PDAs, cell phones, cordless phones, and their peripherals has been based on continuous cost and size reduction. Recently, a new universal radio interface has been developed enabling these electronic devices to communicate wirelessly via short-range ad-hoc radio connections. The Bluetooth™ technology eliminates the need for wires, cables and the corresponding connectors between cordless or mobile phones, modems, headsets, PDAs, computers, printers, projectors, and so on, and paves the way for new and completely different devices and applications. The technology enables the design of low-power, small-sized, and low-cost radios that can be embedded in existing (portable) devices. Eventually, these embedded radios will lead towards ubiquitous connectivity and truly connect everything to everything. Radio technology will allow this connectivity to occur without any explicit user interaction. This tutorial present an in-dept technical overview of the Bluetooth™ system. Items that will be discussed are

- general design issues of ad-hoc radio systems
- Physical layer
- MAC and DLC layer
- Bluetooth™ network topology
- Bluetooth™ hardware design
- Example of Bluetooth™ applications

Dr Jaap C Haartsen joined Ericsson Mobile Communications in 1991 and has since worked at sites in RTP, USA and in Lund, Sweden in the area of Wireless Technology. In Sweden, he worked on the foundations of the Bluetooth™ radio concept. Currently, he is located in Emmen, the Netherlands where he is working with the Bluetooth™ system both for current and future applications. Dr Haartsen is chair of the Bluetooth™ air protocol group. He earned a MSc and PhD degree (both with honors) in electrical engineering from the Delft University of Technology, the Netherlands. He holds over 25 patents.

T3 Wireless Internet: Networking & Protocol Aspects
 Date: Monday 18th September
 Duration: Full-day
 Presenter: Li Fung Chang (AT&T Labs -Research, USA)

Summary:
 The core network architecture and air interface of the third generation (3G) wireless systems enable packet-switching, in contrast to the current 2G systems which are circuit-based. Key challenges in the packet-based wireless network includes protocol/mechanism to offer higher voice capacity with quality that is comparable to that of the 2G system and to provide wireless subscribers with full scope of the Internet services such as Web Browsing, Internet video/audio entertainment, etc.. Furthermore, the interworking of the high speed wireless access and the Internet backbone need to be designed and developed to efficiently support a range of integrated end-to-end wireless Internet services.

In the past, much attention has given to the designs of high-speed air interface for wireless Internet services. Lately, protocol designs and networking aspect of the 3G wireless networks to support a range of services including real time, streamline video/audio, Web browsing, etc. have been discussed in various standard committees. In ETSI SMG2, efforts on modifying/enhancing General Packet Radio Service (GPRS) to support real-time applications have been started. In 3GPP, various inter-working scenarios of Mobile IP and 3G wireless network are included in release 99. In IETF, cellular-IP, IP mobility using HAWAII have been proposed. With all these different approaches, the most efficient/feasible design for IP host mobility remains to be developed.

Outline:

- Overview of PCS mobility management
- IS-41 MAP & GSM-MAP
- Overview of Internet mobility management
- Mobile Internetworking protocol (Mobile IP)
- Basic Mobile IPv4
- Mobile IPv4 with route optimization
- Mobile IPv6
- Current/evolving industry approaches for wireless Internet services
- GPRS/EGPRS (Enhanced GPRS)
- CDMA-2000
- UMTS
- Internetworking of wireless access to Internet
- UMTS/GPRS+Mobile IP
- Cellular IP
- Other approaches
- Future Directions

Dr Li Fung Chang has been with the broadband wireless systems research department, AT&T Labs - Research since Feb. 1999. Prior to joining AT&T, she spent 13 years at Bellcore wireless research department where she was the director of the broadband wireless networking research group and was project manager for several government funded research works on tactical wireless communications. Her current research interests are in the area of wireless networking including wireless access to the Internet and system designs to support high speed wireless packet data communications.

T4 Broadband Radio Access Systems & LANs for Multimedia Applications
 Date: Monday 18th September
 Duration: Full-day
 Presenter: Dr Jamshid Khun-Jush (Ericsson Eurolab, Germany)

Summary:
 Massive growth in wireless and mobile communications, the emergence of multimedia applications as well as high-speed Internet access are the key drivers towards a new demand for radio-based broadband access and local area networks. Third generation mobile cellular systems aim at networks providing instantaneous user bit rates up to 2 Mbit/s per radio channel while it is expected, that many future real-time and multimedia services require such networks that can provide users in geographically limited areas with data rates exceeding 2 Mbit/s. As a response to this need, different standards have been or currently are being developed for such broadband systems at 2.4 GHz and 5 GHz, as in Europe (HiperLANs type 1 and 2), in the U.S. (802.11) and in Japan (MMAC Systems). This tutorial deals with these systems, their similarities and differences, in particular with respect to

- access network topology
- physical layer (e.g. modulation techniques: single carrier versus OFDM)
- medium access control (MAC)
- data link control and error recovery
- radio network management functions (e.g. handover, link adaptation, dynamic frequency selection and power control).

In addition, the capability of these systems to interwork with different core networks (e.g. IP, ATM, third generation cellular) will be addressed.

Dr Jamshid Khun-Jush received the B.Sc. degree from the Sharif Technical University in Tehran, IRAN in 1978 and the Dipl.-Ing. and Dr.-Ing. degrees from the Technical University of Darmstadt, Germany in 1989 and 1995 respectively, all in electrical engineering. Since 1996, he has been with Ericsson Eurolab in Nuremberg, Germany, engaged in research and development of broadband radio access systems. He leads the physical layer specification work of HIPERLAN type 2 standard within the ETSI Project BRAN (Broadband Radio Access Networks) and acts as the co-ordinator of all working groups related to this standard. In addition, he chairs the BRAN project since May 1999. He has been a key player in the close co-operation between three projects BRAN, the IEEE 802.11 and the Japanese MMAC resulting in closely aligned specifications for a 5GHz radio for wireless broadband LAN applications.

T5 OFDM for Mobile Multimedia Communications
 Date: Monday 18th September
 Duration: Full-Day
 Presenters: Prof Ramjee Prasad (Aalborg University, Denmark)
 Dr Richard van Nee (Lucent Technologies, Netherlands)

Summary:

This tutorial presents a comprehensive look at OFDM, providing the design guidelines and needs to maximise benefits from this important new technology. The tutorial gives engineers a solid base for assessing the performance of wireless OFDM systems. It describes the new OFDM-based wireless LAN standards, examines the basics of DS- and FH-CDMA, helpful in understanding combinations of OFDM and CDMA. It also looks at applications of OFDM namely, mobile multimedia communications and home networks.

Prof. Dr. Ramjee Prasad is a distinguished educator and researcher in the field of wireless information and multimedia communications. Presently he is with Aalborg University, Denmark as co-director of Center for PersonKommunikation (CPK) and holds the chair of Wireless Information & Multimedia Communications. He has published over 300 technical papers and authored / co-authored 4 books "CDMA for Wireless Personal Communication", "Universal Wireless Personal Communications", "Wideband CDMA for Third Generation Mobile Communications", and "OFDM for Mobile Multimedia Communications" published by Artech House, Boston/London.

Dr. Richard van Nee: Since March 1995, Dr. van Nee has been working with AT&T - now Lucent Technologies, Bell Labs, in Utrecht, Netherlands. He was involved in the design of OFDM modems for the European Magic WAND project. Together with NTT, he made the original OFDM based proposal, which lead to the IEEE 802-11 wireless LAN high-rate extension for the 5-GHz band. He was also one of the original proposers of the 11 Mbps 802.11 extension for the 2.4 GHz band. He holds several patents and published 40 papers within the area of spread-spectrum tracking systems and OFDM. He has co-authored a book: "OFDM for Mobile Multimedia Communications" published by Artech House.

T6 The 3GPP System for IMT-2000

Date: Monday 18th September
 Duration: Full-day
 Presenter: Dr Werner Mohr (Siemens AG, Germany)

Summary

The international body 3GPP (Third Generation Partnership Project) is specifying the third generation radio access system, which is based on the UTRA (UMTS Terrestrial Radio Access Network) concept. ITU-R approved this concept as one of the IMT-2000 family members in December 1999. The UTRA concept corresponds in major parts to the proposals from ARIB (Japan), to one of the Korean proposals (TTA) and to one of the US proposals from TI.

The UTRA concept was originally designed in detail in the European standardization body ETSI SMG2 based on European research activities in the ACTS FRAMES Project and contributions from Japan and the US. The further development and harmonization of the close proposals from Europe, Japan, Korea and the US took place in 3GPP with members from all three regions America, Asia and Europe. Parallel activities are ongoing in 3GPP2 for the cdma2000 based concept. Both groups are cooperating based on the agreement of the Operators Harmonization Group to achieve a harmonized concept for a globally available concept.

This Tutorial will present the radio interface of the 3GPP concept which comprises an FDD and a TDD component, and the radio access network UTRAN. The FDD component is based on WCDMA and the TDD component is based on TD-CDMA.

Outline

- Introduction and market conditions
- Technical requirements on third generation mobile radio systems
- International frequency allocation and spectrum vision
- International standardization activities
- 3GPP system
- FDD component
- TDD component
- System simulations
- Harmonization activities
- Network infrastructure
- Developments beyond third generation

Dr. Werner Mohr is with Siemens AG, Mobile Network Division in Munich, Germany since 1991. He has been responsible for propagation measurements and channel modeling and he has been involved in the European RACE-II Project ATDMA and in ETSI SMG5 for standardization of UMTS. From December 1996 he was project manager of the ACTS FRAMES Project up to the project finished in August 1999. Since October 1, 1998 Werner Mohr is Vice-President Pre-Engineering in the Chief Technical Office of Siemens ICN CA. He is member of VDE and senior member of IEEE. 1990 he received the Award of the ITG of VDE.

T7 Spatial Channels and Smart Antennas

Date: Monday 18th September
 Duration: Full-day

Presenter: Dr. Andreas F. Molisch, Juha Laurila, Alexander Kuchar and Ernest Bonek (Technical University of Vienna, Austria)

Summary:

Smart antennas are a key technology for the increase of capacity and transmission quality in second- and third generation mobile radio systems. This tutorial will review the physical propagation mechanisms that form the basis for the exploitation of the spatial dimension, as well as the structure and signal processing methods of the smart antennas. After an introduction, the first part of the tutorial is devoted to spatial channel measurement techniques (rotating antennas, Fourier techniques, high-resolution methods), and various approaches to model the spatially resolved mobile radio channel (deterministic, stochastic, and geometry-based stochastic methods). Next, different smart antenna structures (switched beam, space-only processing, joint space-time processing) are explained. The philosophy and mathematics of different signal processing methods (optimum combining, spatial reference algorithms, and blind algorithms) are elucidated, followed by the example of a real-time testbed based on spatial-reference algorithms. A discussion of capacity aspects and multiple-input - multiple output systems concludes this tutorial.

Andreas F. Molisch received the Dipl. Ing., Dr. techn. and habilitation degrees from the Technical University Vienna in 1990, 1994, and 1999. Since 1991, he has been with the TU Vienna, where he is currently an Associate Professor and since 1999, a researcher at the research center for telecommunications in Vienna. His interests are smart antennas, characterisation of mobile radio channels, and bit error probability computations. He has participated in the European research initiatives "COST 231" and "COST 259", and is currently working in a European Union SMT project on spatial channel models. He is (co)author of two books and some 40 journal papers.

Alexander Kuchar received the Dipl.-Ing. degree in electrical engineering from the TU Wien, Austria in 1996. Since then he has been a research engineer at the Institut für Nachrichtentechnik und Hochfrequenztechnik, where he is finishing his PhD thesis field of smart antennas. This includes signal processing algorithms and DSP programming, capacity estimation of adaptive antenna systems, channel modeling, and channel measurements including smart antenna techniques.

Juha Laurila was born in Finland, in 1970. He received the M.Sc. degree from the Helsinki University of Technology in 1995. Since 1996, he has been at Vienna University of Technology. His current research interests are adaptive antennas for mobile communications in general, especially channel modelling and measurement, and blind estimation, where he is finishing his PhD thesis.

Ernst Bonek was born in Vienna, in 1942. He received the Dipl. Ing. and Dr.techn. degrees from the Technische Universität Wien. In 1984, he was appointed Full Professor of Radio Frequency Engineering at the TU Wien. His present field of interest is mobile communications. Recent contributions concern the characterization of mobile radio channels, cordless telephony, and advanced antennas and receiver designs. He authored or co-authored over 100 journal publications. He holds three patents. His current positions in scientific organizations include: chairman of the "Antennas and Propagation" working group in the European research initiative COST 259 "Wireless Flexible Personalized Communications"; Area Editor of "Wireless Personal Communications"; Chairman of URSI Commission C "Signals and Systems"; chairman of a COST 259/260 workshop on "Spatial channel models and adaptive antennas"; Senior Member of IEEE.

T08 Wireless Application Protocol for Service Developers

Date: Monday 18th September
 Duration: Half-day
 Presenter: Klaus Röhrle (Sony International, Europe)

Summary:

Wireless Application Protocol (WAP) is an application environment and set of communication protocols for wireless devices designed to enable manufacturer-, vendor-, and technology-independent access to the Internet and advanced telephony services. The WAP tutorial is targeted for developers which want to create new services or want to enhance existing internet services using WAP. The Tutorial starts with an overview of the WAP Technology, basic concepts, benefits and architecture. The focus of the tutorial lies in the Wireless Application Environment (WAE) including the Wireless Markup Language (WML) and WMLScript. Similarities and differences between Internet and WAP technology are described. Additionally an overview of useful WAP development tools is provided.

Klaus Röhrle received his degree in Computer Science at the University of Stuttgart, Germany. He mainly concentrated on networks and distributed systems. Since January 1998, Klaus Röhrle is working for Sony International (Europe) in the department for Telecommunication Research and Development Europe (TRDE). His research interests are mobile communication, distributed systems and mobile agents.