

Advanced Short Course

NEXT-GENERATION BROADBAND NETWORKS

First Announcement

Lecturer: **Prof. Dr. B. BING**
School of ECE, Georgia Institute of Technology, Atlanta, GA, USA
(See enclosed bio)

Contents: See enclosed resume and syllabus

Intended audience: Faculty, Ph. D. students and engineers working in the corresponding Telecom area.

Dates: March 24th and 25th, 2008
Hours: 9:00 am – 1.00 pm and 2.00 pm – 5:00 pm
Place: Room B-323
Building B
ETSI Telecomunicación-UPM
Ciudad Universitaria
28040 Madrid

Sponsors:

- * Proyecto “PRO-MULTIDIS” (Comunidad de Madrid)
 - * Cátedra Telefónica-UCIIM
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(PLEASE REGISTER: number of participants is limited to 30)

(To register: mcal@tsc.uc3m.es)

Next-Generation Broadband Networks

Broadband wireless access is viewed by many telephone and cable operators as a "disruptive" technology and rightly so. The broadcast nature of wireless transmission offers ubiquity and immediate access for both fixed and mobile users, clearly a vital element of quadruple play services involving voice, video, data, and mobility. Unlike wired access (copper, coax, fiber), a large portion of the deployment costs is incurred only when a subscriber signs up for service. The first day of the course, a comparative assessment of the standards and technologies underpinning promising broadband wireless access solutions will be presented. Key standards include 802.16 (Wi-Max), 3G/4G/LTE, mobile digital TV broadcast, and 802.22 (wireless regional area network) with emphasis on the 802.16 standard. Key technologies include multimedia support, multiple antenna transmission, cognitive radio, and fixed-mobile convergence.

Wireless LAN applications have blossomed tremendously over the last few years. What started out as cable replacement for static desktops in indoor networks has been extended to fully mobile broadband applications involving moving vehicles, high-speed trains, and even airplanes. Wi-Fi data rates have also continued to increase from 2 to 54 Mbit/s with the current 802.11n draft topping 600 Mbit/s. This development may eventually render wired Ethernet redundant in the enterprise network. An increasing number of municipal governments around the world and virtually every major city in the U.S. are financing the deployment of Wi-Fi mesh networks with the overall aim of providing ubiquitous Internet access and enhanced public services. In addition, cheap phone calls using Wi-Fi voice over IP may become one of the biggest benefits of a citywide municipal network. This has led some technologists to predict that eventually we are more likely to see meshed Wi-Fi cells that are linked together into one network rather than the widespread use of high-powered WAN handsets cramming many bits into expensive and narrow slices of radio spectrum. The second day of the course will start focusing on emerging Wi-Fi technologies. Specifically, it will cover mesh networks, Wi-Fi/cellular interworking, security, quality of service (QoS), new applications, high-rate systems, and emerging 802.11 standards.

Many service providers must deal with peer-to-peer applications (e.g., Skype and Bit Torrent) and other popular but bandwidth-intensive applications such as Sling Media. Currently, peer-to-peer traffic occupies over 80% of backbone Internet traffic. However, the star topology that is common in many broadband access deployments creates a local bottleneck at the central headend when handling such applications. Another key challenge facing operators with legacy access networks (e.g., DSL, cable) is the bandwidth crunch associated with video transmission. Despite the efficiency of new video compression standards such as MPEG-4/H.264 AVC, many cable operators in the U.S. are migrating towards a switched digital video architecture that send channels only to set-top boxes (STBs) that tune in to them, thereby conserving network bandwidth by not broadcasting signals to all STBs all the time. Service providers have also started to focus on video content and end-user quality of experience (QoE) to complement network-based QoS monitoring in order to meet rising customer expectations. The last part of the course will focus on bandwidth management and prediction, video traffic analysis, smoothing, and multiplexing, video quality metrics and QoE, and optimized video transmission for emerging access networks.

Biography

Dr. Benny Bing is a research faculty member with the School of ECE at the Georgia Institute of Technology. He has published 60 technical papers and 10 books. In early 2000, his book on wireless LANs was adopted by Cisco Systems to launch Cisco's first wireless product, the Aironet Wi-Fi product. He was subsequently invited by Qualcomm and the Office of Information Technology to conduct customized Wi-Fi courses. Dr. Bing is an editor for the IEEE Wireless Communications Magazine. He has guest edited for the IEEE Communications Magazine (2 issues) and the IEEE Journal on Selected Areas on Communications. In October 2003, he was invited by the National Science Foundation to participate in a workshop on Residential Broadband. Dr. Bing is a Senior Member of IEEE and an IEEE Communications Society Distinguished Lecturer. He is a recipient of the Lockheed-Martin Fellowship for his Ph.D studies at the University of Maryland (College Park).

Syllabus

March 24

Part 1: Broadband Wireless Access

- Broadband Wireless Access Overview
- Emerging standards: 802.11, 802.16, 802.22, 3G/4G/LTE, Mobile TV, Digital Video Broadcast
- Broadband Convergence
- IEEE 802.16 Standard Overview
- Frequency Bands
- Physical Layer Transmission
- Adaptive Modulation and Coding
- OFDM, OFDMA, and Subcarrier Allocation
- Multiple Antenna Systems
- Medium Access Control, Duplexing, and Frame formats
- Service Flows and Scheduling Types
- Security
- Mobility Support
- WiMax Forum
- Ongoing 802.16 projects
- Deployment Considerations
- OPNET performance Evaluation

Part 2: Bandwidth Management and H.264 AVC Network Transport

- Policy-based Bandwidth Management
- Peer-to-peer Applications
- Video Streaming and Multiplexing
- Real-Time Transport Protocols
- H.264 Packetization Architecture
- H.264 Loss Resilience and Error Containment
- H.264 Traffic Characterization and Bandwidth Prediction
- H.264 Video Smoothing with Rate Control
- Video Quality Assessment
- Optimized Video Transmission Framework

Part 3: Discussion

March 25

Part 1: Wireless Local Area Networks

- Introduction to WLANs
- Frequency Bands
- Emerging 802.11 Standards and Amendments
- Physical Layer Transmission
- Medium Access Control and Frame Format
- Quality of Service
- Security
- Multiple Antenna Systems
- Radio Resource Measurements
- Mobility Support
- Mesh Networks
- WLAN/Cellular Interworking
- Co-existence
- Applications

Part 2: Discussion