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 part of the course (8 hours) will provide a comparative assessment of the standards and technologies underpinning promising broadband wireless access solutions. 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 part of the course (6 hours) focuses 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 (2 hours) 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.