1. The Subject and Aims of Research

My research focuses on wireless communication protocols and the quality of service (QoS) control mechanisms for multimedia services, with special interest in the implementation problems of the up-to-date wireless standards and possible solutions. The aim is to guarantee the quality of service requirements of different multimedia services in broadband wireless networks. My major research topics include the medium access control (MAC) protocols, QoS-guaranteed mechanisms, service architecture, and network performance analysis for WiFi, WiMAX, and IMT-Advanced (4th Generation Mobile Systems) Systems.

2. Related Recent Research Topics

My recently-research projects include “QoS Mechanisms for Consumer Networks,” “Multi-hop Relay (MR) Technology for WiMAX Systems,” “Next Generation Wireless Mesh Networks,” and “Cooperative Networking Techniques Supporting MBS for 4G System,” as summarized below:

**QoS Mechanisms for Consumer Networks**

This project is a three-year project (2005/8~2008/7) under the National Telecommunication Program supported by National Science Council, Taiwan. In this project, we propose QoS mechanisms for WiMAX and UWB systems. The proposed mechanisms are implemented by a micro-controller. In the first year, a QoS ensuring mechanism for multicast video over WiMAX will be proposed. In the
second year, the proposed QoS mechanism will be enhanced, in order to provide multimedia services. At the same time, another QoS ensuring mechanism for multicast video over UWB will be proposed. In the third year, we will work on the enhanced version of the UWB QoS mechanism. Finally, the proposed QoS mechanism will be implemented on top of a micro-controller.

Multi-hop Relay (MR) Technology for WiMAX Systems

This project is a two-year project (2006/8~2008/7) under the National Telecommunication Program supported by National Science Council, Taiwan. In this project, we have proposed a handover mechanism for supporting MS movement among transparent relay stations (RSs) in multi-hop relay systems. We have submitted several standard contributions and part of them have been accepted by IEEE 802.16j Standard.

Next Generation Wireless Mesh Networks

The enhanced spectral efficiency and wide network coverage are two of the main requirements specified in ITU’s IMT-Advanced program. The wireless mesh network is one of the economic solutions that can support hop-spot services in out-door environment given the two requirements. This project aims to develop key technologies for next generation wireless mesh networks adopting MIMO technology and with multiple RF channels.

We have proposed a three-year project to develop key technologies for next generation wireless mesh networks. In the first year, a scheduling mechanism will be developed on top of the proposed Ripple protocol in order to provide differentiated services for single channel wireless backhaul networks. In the second year, we will further extend our work and adopt the IPT concept to design the medium access control (MAC) protocol for wireless mesh networks adopting MIMO technology with multiple RF channels. In the third year, we will further design a routing protocol based on the QoS analytic model and the MAC protocol developed in the first and the second year, respectively.
This project will work with the MIMO-MESH project leaded by Kyushu University. With the international cooperation relationship, the protocols can be tested on top of the hardware platform provided by MIMO-MESH. Possible adjustment can be made based on the field test results.

**Cooperative Networking Techniques Supporting MBS for 4G System**

Multicast and broadcast service (MBS) (which is also known as multimedia broadcast and multicast services, MBMS, in 3GPP LTE) is one of the important services that will be supported by the 4th generation (4G) system. MBS aims to provide an efficient use of radio/spectrum resources via transmitted streaming services, file download services, and carousel services (combination of streaming and file download services aspects with repetition and update to reflect changing circumstances) through a common broadcast or multicast channel. It is a very challenging work to optimize the use of radio resources for MBS owing to a variety of channel conditions experienced by users ordering the same MBS service. The optimization may be done at the network level (e.g., utilizes different networks such as WLAN, UMTS, or WiMAX to deliver MBS traffic), service architecture level (e.g., uses dedicate channel, shared channel, or multicast channel to deliver MBS), or radio resource management level (e.g., employs techniques such as adaptive modulation and coding (AMC), power control, cooperative relaying, and/or layered video encoding).

The concept of cooperative networking may be utilized in the design of the 4G system for delivering widely available and efficiently transported high-speed multimedia services to users. Cooperative networking technologies allow different users or nodes in the same or different wireless network(s) to share resources or information through distributed transmission/processing and thus, create collaboration gain. We have proposed a three-year integration project to optimize the usage of radio/spectrum resources for MBS by adopting the concept of cooperative networking. Potential issues of different service architectures for MBS in both cellular and relay-based multi-hop networks will be first investigated. A dynamic service-architecture selection scheme and a dynamic radio resource management scheme will then be developed based on cooperative networking concepts. With the shared information among service, networks, and users, the proposed methods may support user's demand and utilize the spectrum in an efficient way.

3. Selected Publications and Projects

**Publications:**


Patents:


Projects:

- TW4G-R: Standard Proposals for Multihop Relay Technology Supporting IEEE 802.16, (Execution period: 95.8~97.7)

Awards:

- IEEE Senior Member, 2007.