Research Experiences:

1. Expert Researcher at National Institute of Information and Communications Technology (NICT), Tokyo, 2006 October - date.
2. Research Assistant at National Institute of Informatics (NII), Tokyo, 2003 October - 2006 September
3. Research Assistant at Multimedia and Communication Lab (MMLab), Seoul National University, Korea, 2001 March - 2003 August

Resent research topics (2006 October - date):

- **New generation network architecture:**
  - design the architecture of a global network that would overcome the limitations of the existing Internet and telecom networks and that would be deployed around 2020 to optimally serve the future society.
- **Ubiquitous access system:**
  - design the architecture of a mobile-centric universal access system that would leverage all the existing network concepts such as multi-hop ad hoc networks, sensor networks, local area networks (LAN), personal area networks (PAN), body area networks (BAN), cellular wireless networks, and wire or fiber connected networks. The universal access system would provide pervasive network connectivity to users and devices to obtain or exchange intended information effectively.
- **Node identifying and locating architectures**
  - design a new network architecture by using separate sets of entities for communication device identifying and locating purposes so that effective and efficient security, mobility, multihoming, and routing mechanisms can be implemented in the network.

Research during my graduate study (2001 March -2006 September):

I did research under the supervisions of Prof. Yanghee Choi (Seoul National University) and Prof. Shigeki Yamada and Prof. Eiji Kamioka (National Institute of Informatics). My main research topic was mobility management of mobile devices (such as hand phones, PDAs, and laptop or palmtop computers) in wireless networks. Wireless networks (such as 3G networks, Wireless LAN, WiMAX, and PHS networks) are composed of many small units of coverage called cells. When a mobile device moves from one cell to another, it has to carry out a number of tasks to remain connected to the network and to continue an ongoing communication service. The process of managing these tasks is called mobility management of mobile nodes. The mobility management operation should be carried out transparently to the mobile users, that is, users are unaware of the process and time of changing cells. Moreover, it should be very efficient in terms of the network resource (such as bandwidth) consumption and the mobile devices' battery and computation power consumption.

I was designing, modeling, evaluatiing, and optimizing mobility management solutions for different networking environments,

such as heterogeneous overlapped networks and moving networks. My solutions used Mobile IP and its derivative protocols to maintain IP-layer connectivity of mobile devices in the IP-based mobile networks. The summary of my work is as follows.

Network Mobility (NEMO) support

I have researched on efficient mobility managment techniques for moving networks (also called mobile networks).

Mobile networks can be installed in vehicles such as trains, aeroplanes, buses, and cars, so that passengers with a mobile device can hook up to the vehicular mobile network and access the Internet for communication services. Since all passengers move together with the vehicle, the mobility management function of the vehicular mobile network trasparently entails mobility management of all the mobile devices carried by the passengers. That is, the passengers would feel that they are accessing a wireless fixed network available on the vehicle.

Providing the Internet access through a vehicular network and keeping the vehicle's movement transparent to mobile devices possessed by passengers have a great potential of generating new and lucrative communication services. However, there are many issues to be resolved for the efficient mobility management of mobile networks.

I have addressed some of those issues like route optimization, handover management, and multihoming of vehicular networks.

Access Network Selection

My focusse was also on a fundamental problem of mobility management in heterogeneous overlay wireless networks: network selection.

An overlay network system consists of different types of wireless networks, such as 3G networks, Wireless LANs, WiMAX networks, and PHS networks, covering the same areas. If a user's mobile device is equipped with facilities to allow the user to access any network, a problem of selecting the best network from the available ones may arise. In such as a case, deciding which network is the optimal for a user depends on several parameters such as the type of application the user wants to run, capabilities of available networks, and the user's preferences. All these parameters collectively influence the satisfaction that a user obtains from the use of network services.

To address the network selection problem, I have therefore modeled a user's satisfaction function of the above mentioned parameters and the mobility behavior of mobile users. I designed an algorithm that estimates the user's satisfaction function of each network and helps to select a network that provides the highest satisfaction for the communication service.

Graceful Vertical Handover

Another area of my research was smooth vertical handover in heterogeneous overlay networks..

As explained in the previous paragraphs, we are experiencing that heterogeneous wireless networks are becoming prevalent scenarios for providing communication services to mobile users. In such networking environments, to have an uninterrupted communication service, a mobile user may require to change its association from one type of network to another (this process is called a vertical handover) when the previous network becomes sub-optimal or unavailable at some place or time. An example of vertical handover is the transfer of a connection from a Wireless LAN to the 3G network or vice versa. A vertical handover is more challenging to manage than a horizontal handover (i.e., handover between two cells of the same type of network).

I have researched on this topic to impart a gracefulness to a vertical handover process so that the quality of service being perceived by a mobile user changes very smoothly during handover. We call this type of vertical handover as graceful vertical handover.

My research at Seoul National University, Korea (2001-2003).

During my study for a master's degree at the School of Computer Science and Engineering at Seoul National University, I was affiliated with the Multimedia and Mobile Communication Lab. (MMLab) to do researches under the guidance of Prof. Yanghee Choi. I got opportunities to work in many areas of networking like designing TCP-friendly protocols, evaluating MPEG-2 video transmission over Ethernet networks, designing IP paging protocols and power save schemes for mobile nodes, etc. Under the dynamic leadership of Prof. Choi, MMLab was (and is still) having many projects from the government agencies as well as private companies, and the students could simultaneously work on many projects. The regular research meetings with professor and project members were helping us to instantly solve any problem. Besides, there were weekly seminars to discuss the research progresses of students as well as to discuss new concepts or ideas being pursued by other researchers around the world.

My stay in MMLab was very fruitful not only in terms of the research achievements but also learning Korean language and culture.