

# 無線網路多媒體系統

# Wireless Multimedia System



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<http://wmlab.csie.ncu.edu.tw/course/wms>

2005 Fall



# First Week Agenda

- ◆ Course Preview
- ◆ Wireless Multimedia/Mobile Computing / Pervasive Computing
- ◆ Wireless Mobile Communications
- ◆ System Review and Fundamental Problems
- ◆ Next Week



# Course Preview



## What is Going to Happen in the Course?

# Course Contents

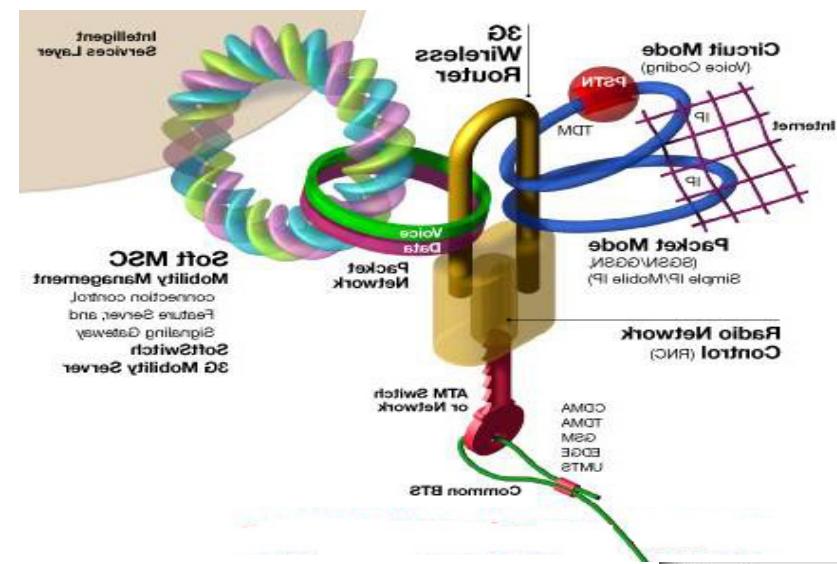
## ◆ Fundamental Wireless Technology

- Propagation Model
- Wireless Medium Access
- Transport Solutions
- Ad hoc Wireless System
- Cellular System
- Middleware Systems
- Multimedia System



## ◆ Advanced Wireless Technology

- Multicasting
- Heterogeneous System
- Routing Algorithms
- QoS/ Reliable Transmissions



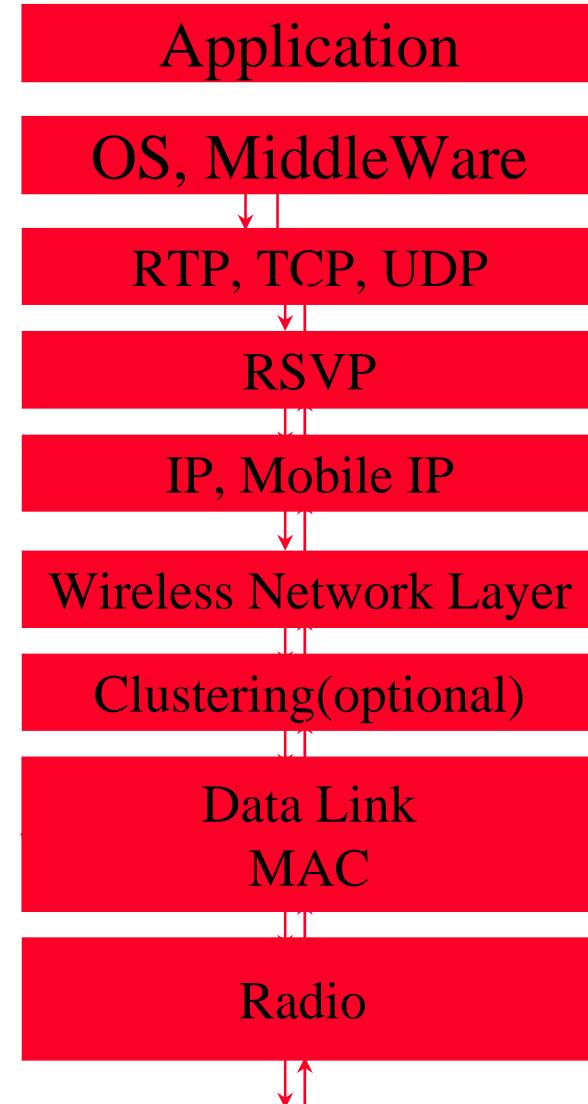
# Roaming Across a variety of heterogeneous network and service environments

Adaptive  
Algorithm

by QoS  
Requirement

Mobility  
Unpredictable  
channel

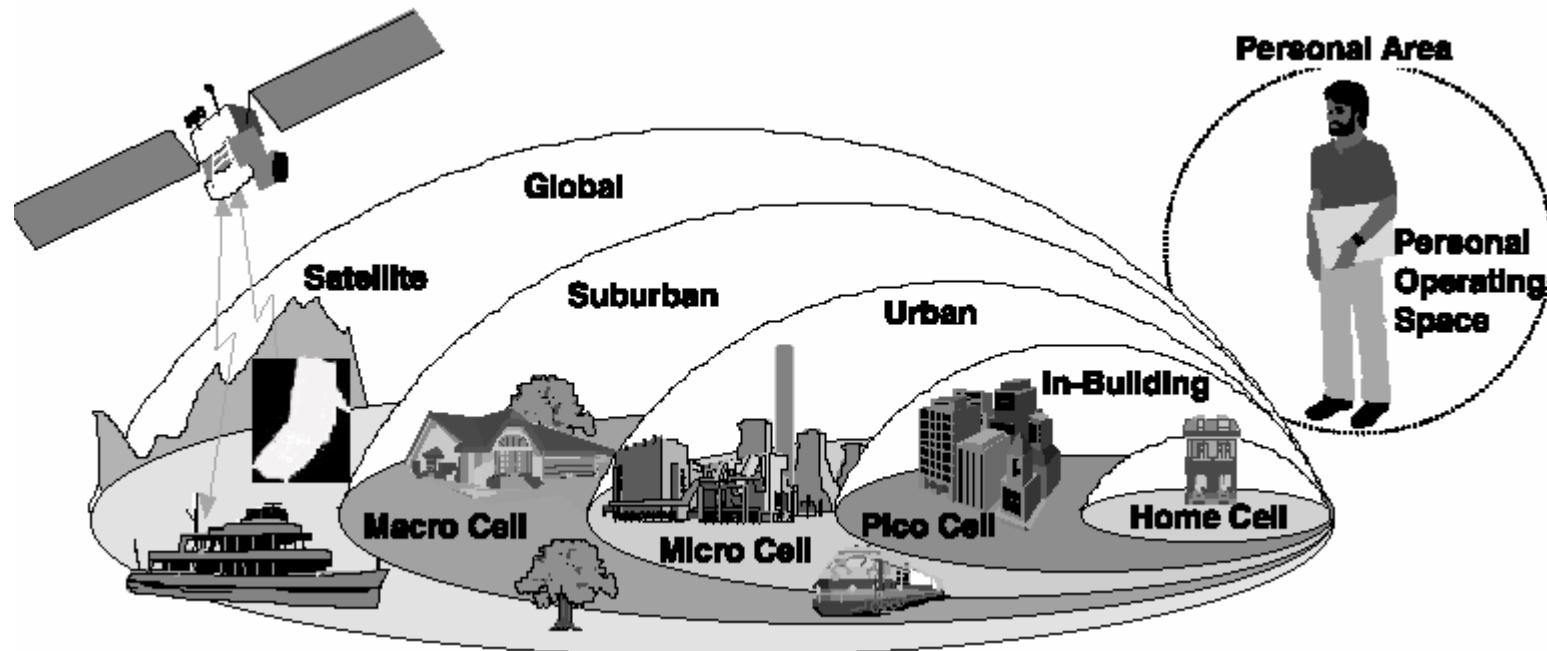
by QoS  
Information



# New Interests

- ◆ Provision of Sufficient Transmission Capacity for Broadband Mobile Multimedia: A Step Toward 4G
- ◆ Future Broadband Radio Access Systems for Integrated Services with Flexible Resource Management
- ◆ QoS Support for an All-IP system Beyond 3G
- ◆ Enhancing IP Service Provision over Heterogeneous Wireless Network
- ◆ Re-configurable Terminals: An Overview of Architectural Solutions

# Ubiquitous Services



# Adaptive Applications



Varied type  
of service

Video

Audio

Graph

Text



High

.....

# Quality

.....

Low

Adaptive  
application  
coding

# Expectation of the Class

- ◆ Basic Understanding of PCS world
- ◆ Being able to do the wireless research
- ◆ Developing the capability to invent the key wireless applications

# Aeronautical Communications

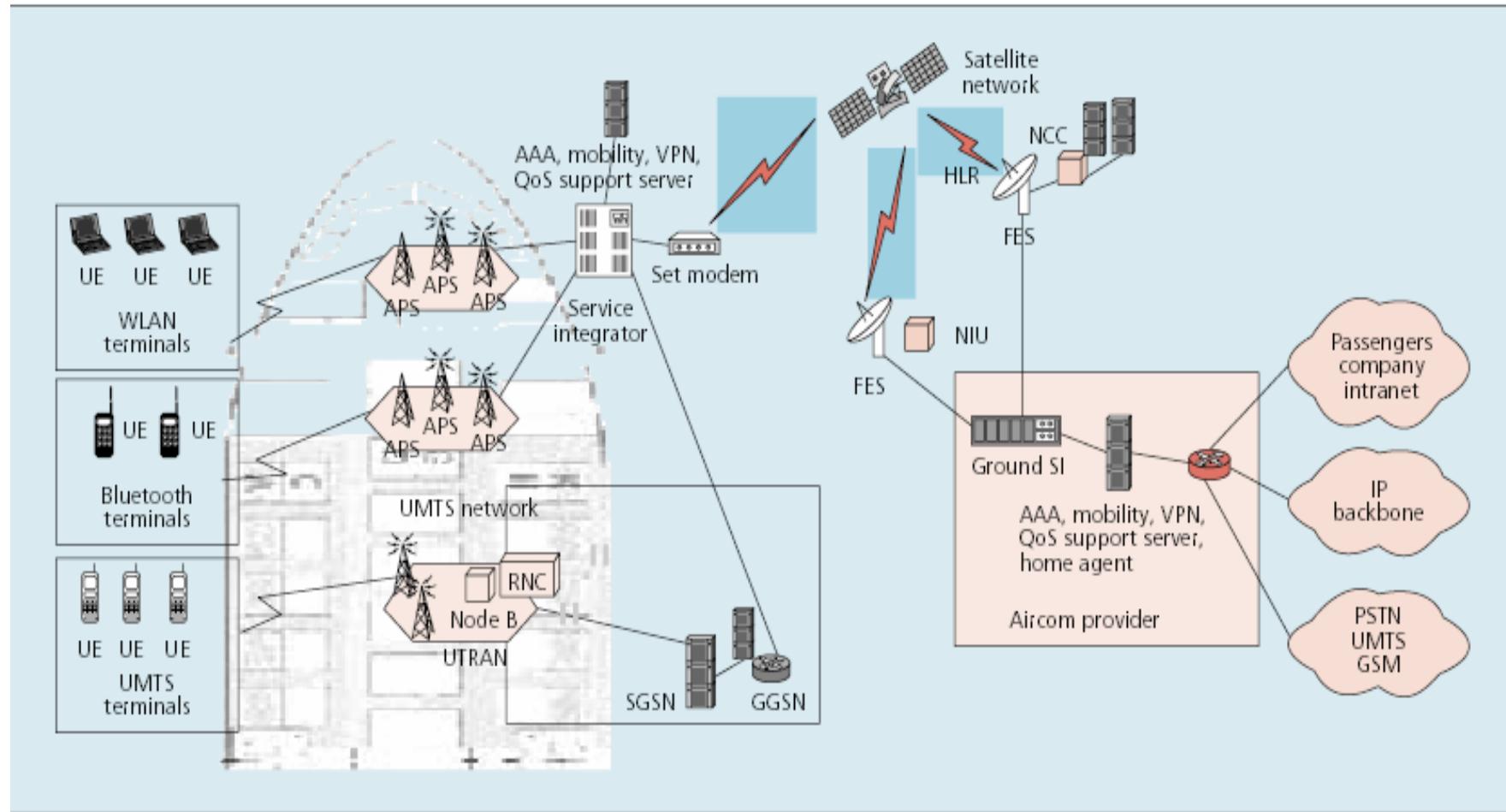
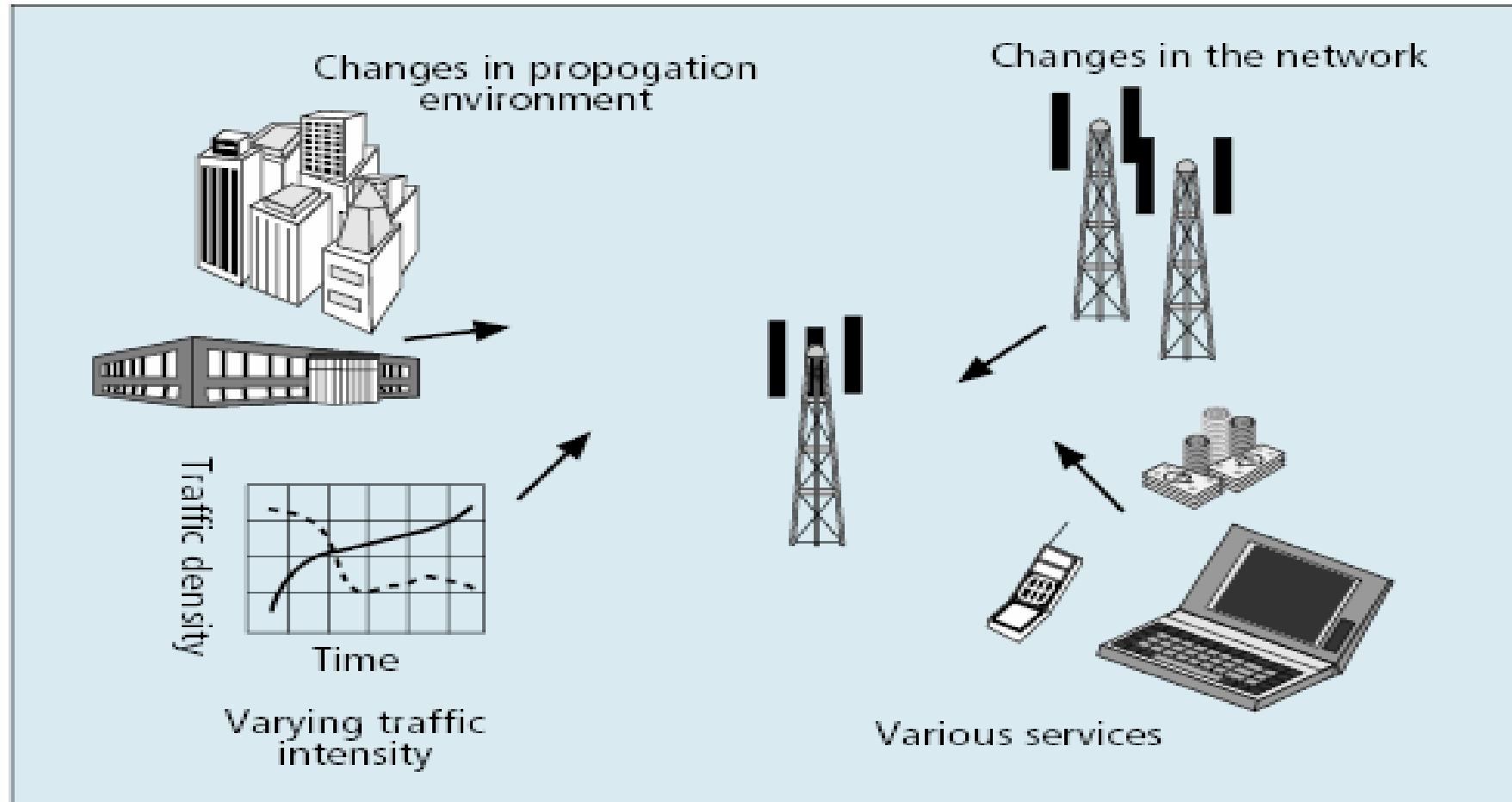


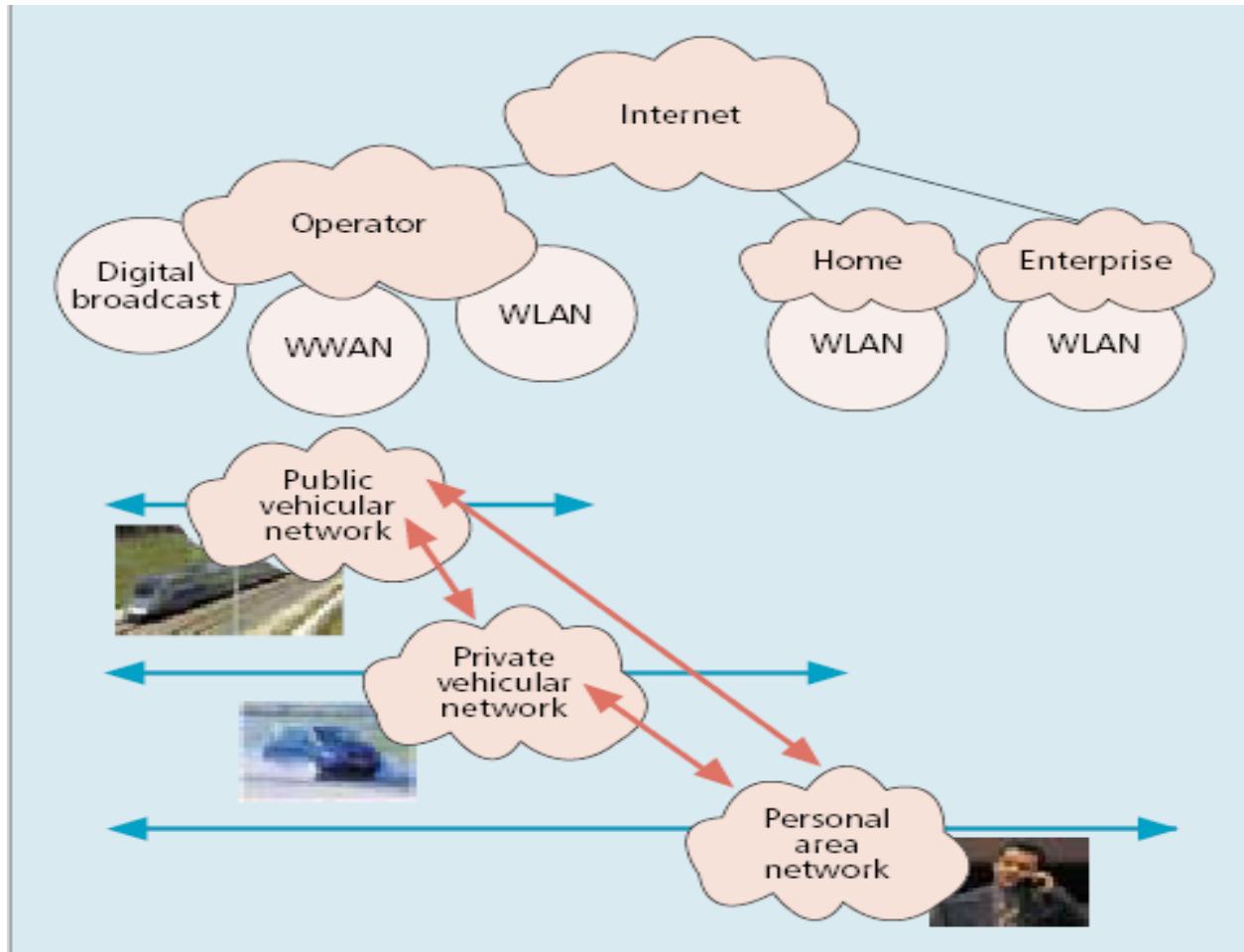
Figure 2. Aeronautical communications network architecture.

# Situation-Aware Wireless Networks



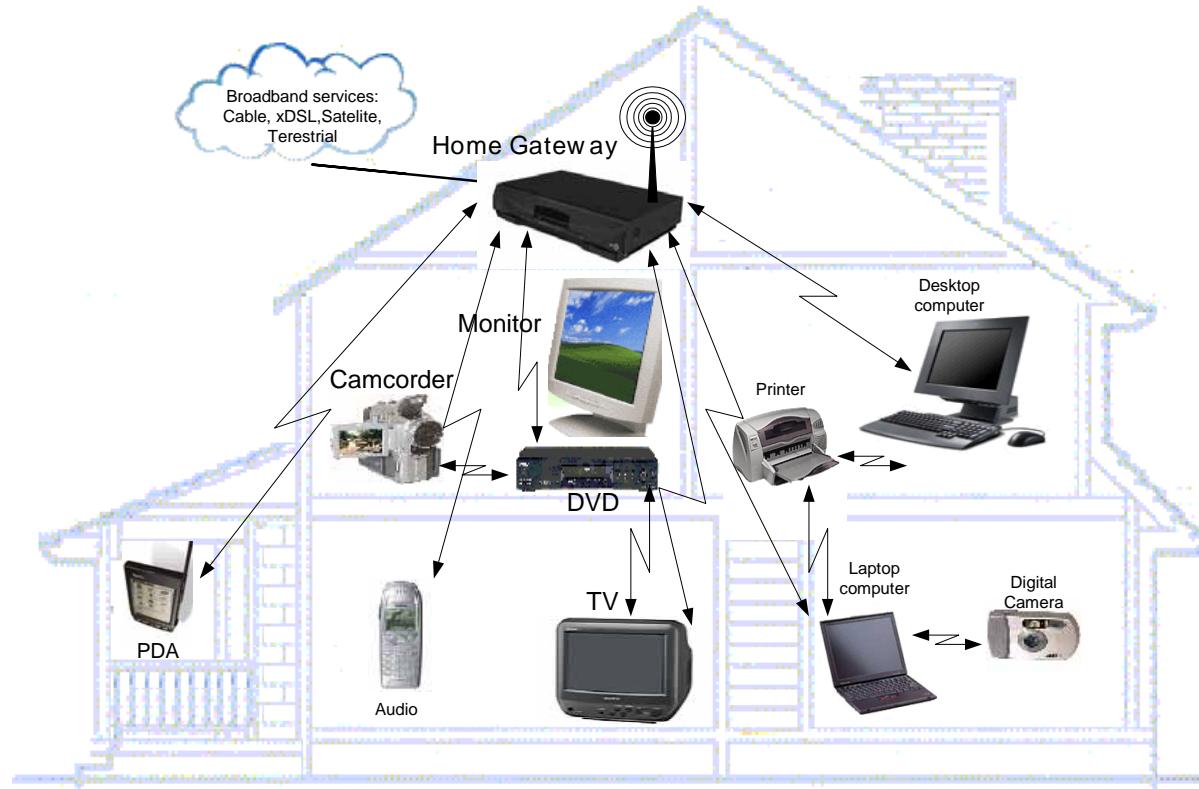
■ **Figure 4.** Situation awareness functionality.

# Network Mobility Management



■ Figure 1. A mobile network in a B3G system.

# Ultra-Wideband Radio



# Course Process

- ◆ Paper reading and your presentations
- ◆ Wireless Multimedia Applications Exercises

# Mobile Computing



# Mobile phone today = multipurpose terminal for ...



# Reading list for This Lecture

- ◆ Required Reading:

(Cfox95) D. Cox, "Wireless Personal Communications: What is it?", IEEE Personal Communication Magazine, (April 1995) pp.20-35

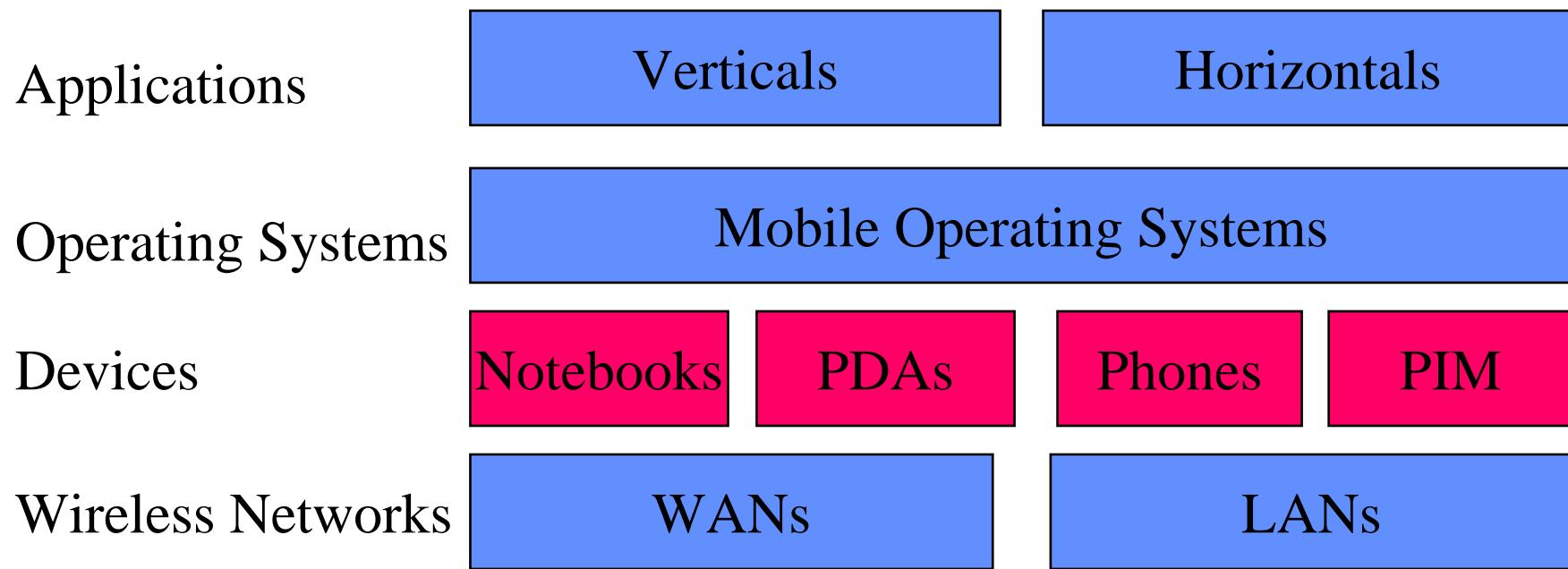
(S.2001) M. Satyanarayanan, "Pervasive Computing: Vision and Challenges", IEEE Personal Communication Magazine, (August 2001), pp.10-17

(Bi2001) Qi Bi, George I. Zysman, and Hank Menkes, "Wireless Mobile Communications at the Start of the 21 Century", IEEE Communication Magazine (January 2001), pp. 110-116

## Further Reading

(Bolcskei2001) H. Bolcskei, A. J. Paulraj, K. V. S. Hari, and R. U. Nabar, "Fixed Broadband Wireless Access: State of the Art, Challenges, and Future Directions", IEEE Communication Magazine

# Mobile Computing



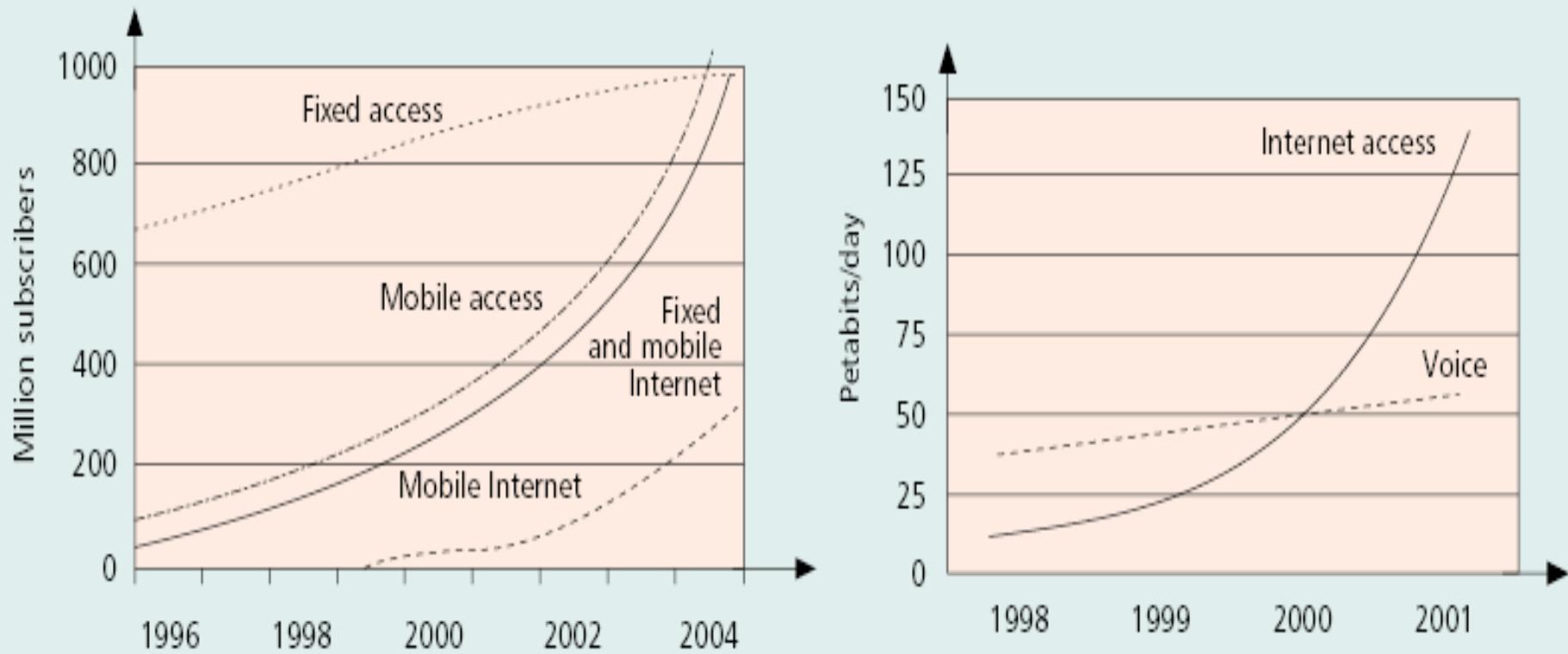
# Mobile Computing

- ◆ information processing in general
  - not just communication or just computing, but both
- ◆ Any medium or combination of medium
  - process not just telephone voice or just data, but multimedia
- ◆ Mobility
  - components of the systems may be
    - ◆ moving, tether-less (wireless), portable
  - uses of the system may be moving

# Why should we care ?

- ◆ Reason # 1 : \$\$\$ & jobs
- ◆ Explosive growth of wireless voice, paging, and data services
  - 35-60 percent annual growth in the past decade
  - mobile phones in US will be 42 % of fixed -line phones by 2000
  - 700 million mobile users at the end of 2000
  - One billion expected by 2003
- ◆ Big demand for portable communicators and computers
  - 2 M portable computer in 1988 to 74.1 M units in 1998

# Growth in traffic in different access system and voice and data services



# Is there a more “academic” reason ?

- ◆ Reason # 2: a next step in the evolution of information system
- ◆ Evolution from personal computing to networked computing to mobile computing
- ◆ Evolution from wired telephony to cordless telephony to mobile cellular telephony
- ◆ At the same time, unification of computing and communication



# Mobile Multimedia Systems

- ◆ Ubiquitous information access (everybody else)
  - e.g. wireless computing, mobile computing, nomadic computing
  - information distributed everywhere by “the net”
  - users carry (wireless) terminals to access the information services
  - terminal is the universal service access device
  - terminals adapt to location and services
  - Knowledge-based society
- ◆ Flexible Users Choices
  - In terms of access, service, content
  - Any where, anytime, any terminal equipments
- ◆ Wearable Computing terminal / Mobile Broadband services (MBS)



# Pervasive Computing

- ◆ Technology that disappears
  - The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it".
- ◆ Ubiquitous (Invisible) Computing (Xerox PARC)
  - Cheap computers of different scale and types embedded everywhere
  - Potentially 100s of computers per room that disappear into background (e.g. active badge, tabs, pads, live boards..)
  - User centric, not terminal centric
  - Computers swapped and shared among users
- ◆ Effective Use of Smart Spaces
- ◆ Invisibility
- ◆ Localized Scalability
- ◆ Masking Uneven Conditioning

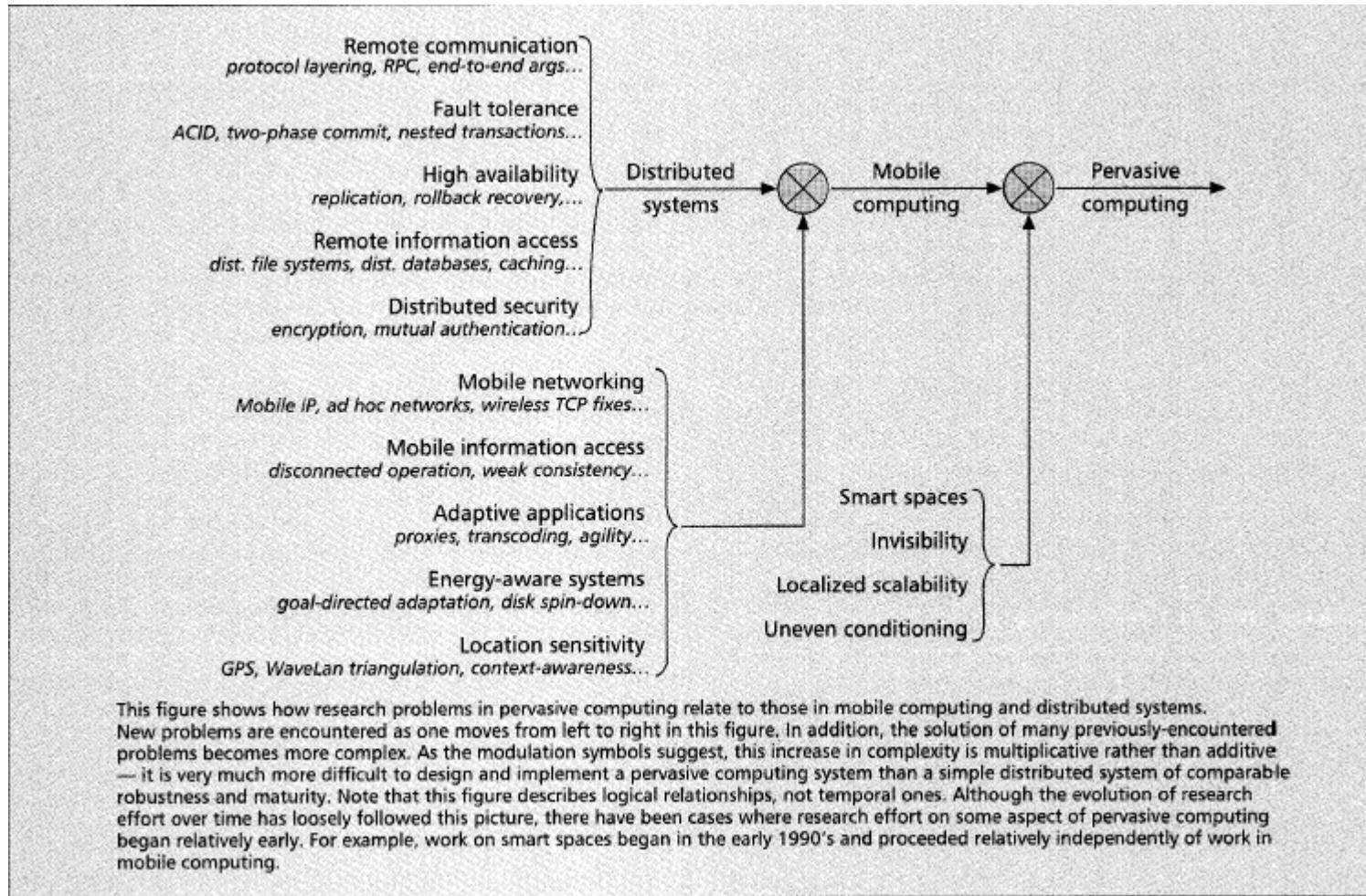


# Support for Pervasive Computing

- ◆ User Intent
- ◆ Cyber Foraging
- ◆ Adaptation Strategy
- ◆ High-Level Energy Management
- ◆ Balancing Pro-activity and Transparency
- ◆ Privacy and Trust
- ◆ Impact on Layering

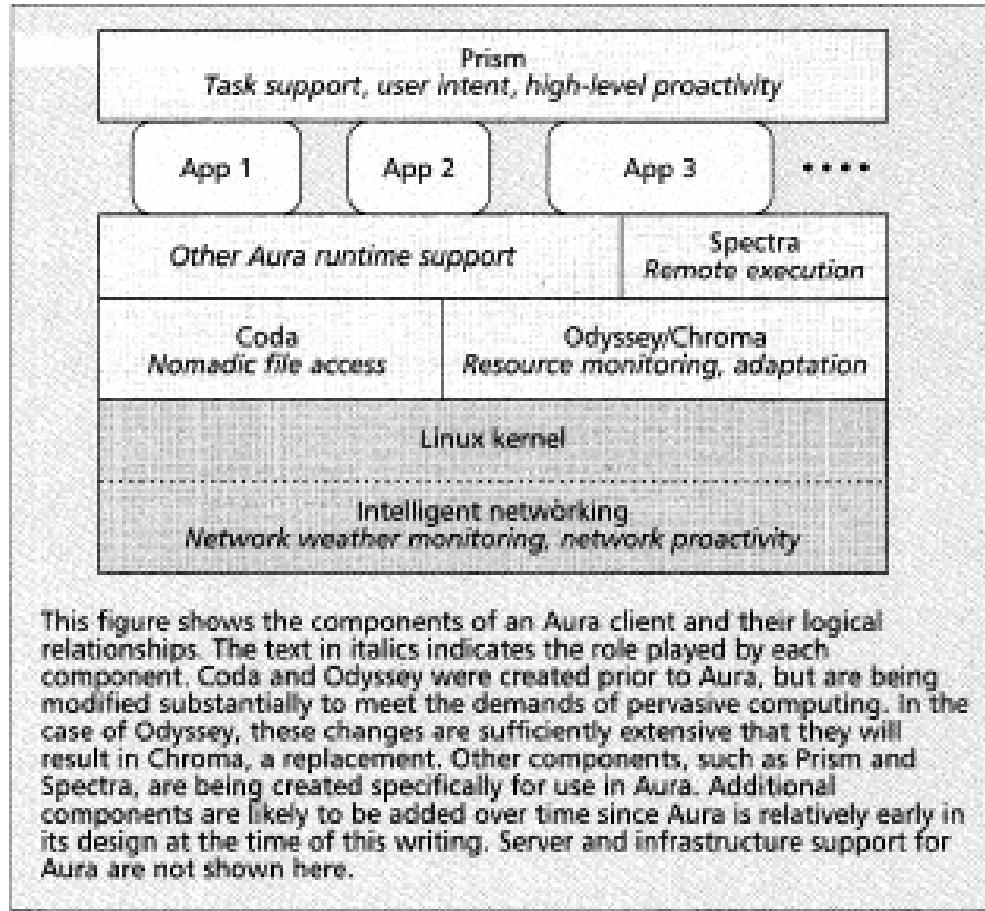


# Pervasive Computing



■ Figure 1. *Taxonomy of computer systems research problems in pervasive computing.*

# Aura Client



■ Figure 2. The structure of an Aura client.



# Wireless Communications



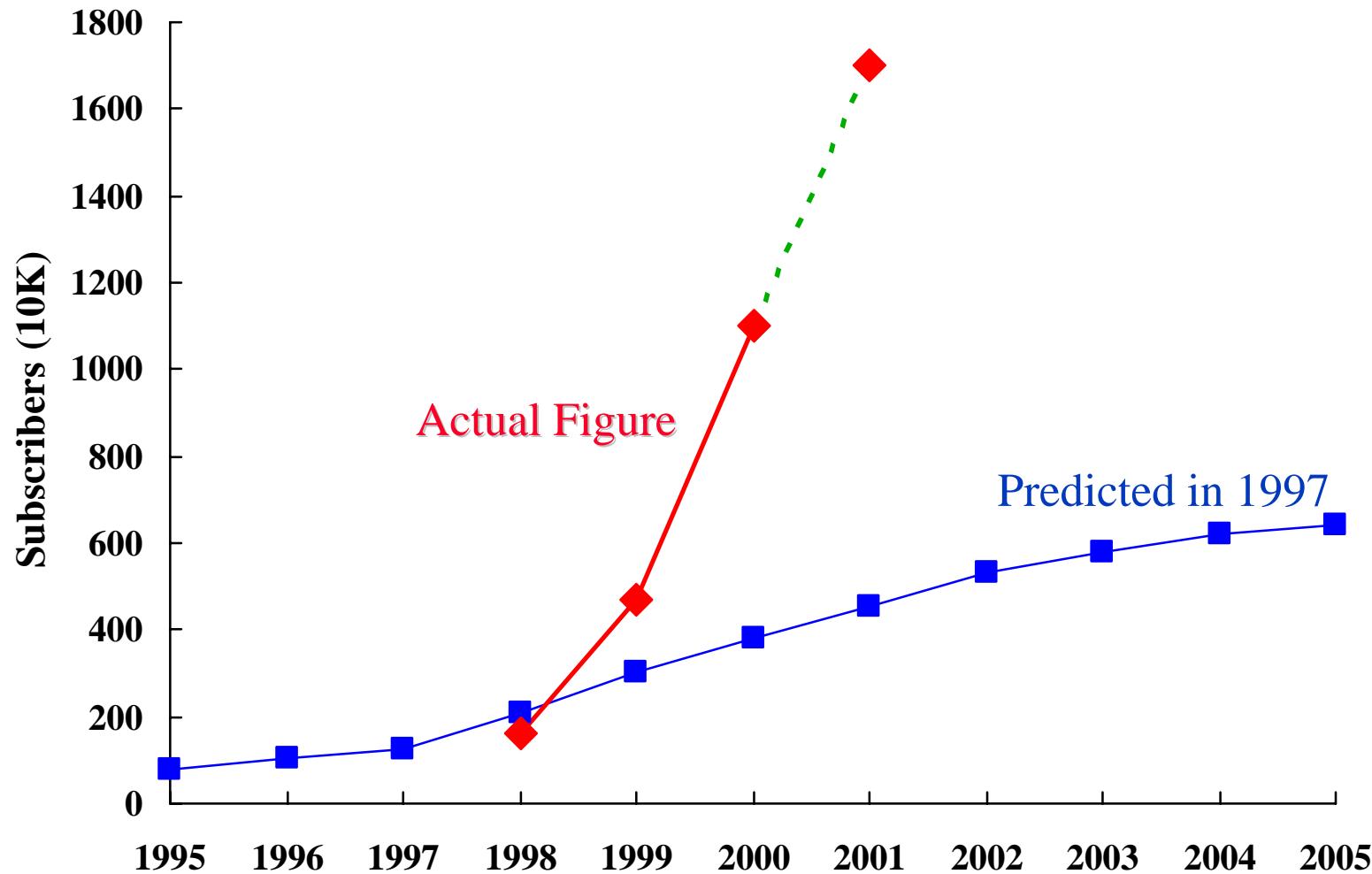
Mobile Communications

Fixed Broadband Wireless Communications

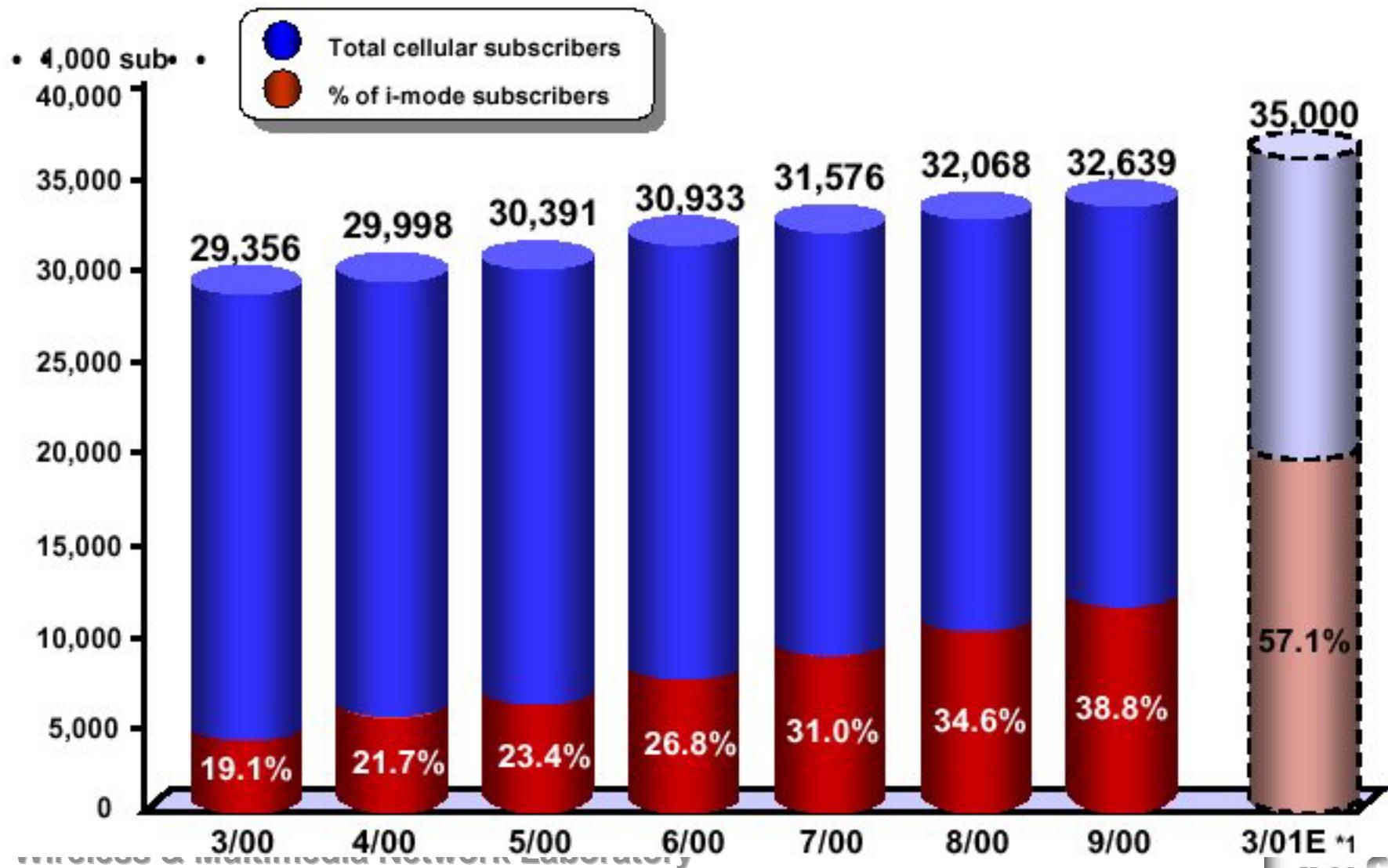
# Evolution of Mobile Wireless Systems

- ◆ First Generation : Analog – Voice
  - Analog modulation
  - Cellular phone (AMPS) with manual roaming
  - Cordless phones
  - Packet radio networks
- ◆ Second Generation : Digital - Voice & Data
  - WAP (wireless application protocol)
  - 2.5 G GPRS
  - Wireless data LANs (802.11), MANs (Metricom), WANs (CDPD, ARDIS, RAM)
- ◆ Third Generation: Digital – Multimedia
  - Unified digital wireless access anytime, anywhere
  - Voice, data, images, video, music, sensor etc.
- ◆ 4G~ Life after Third-Generation Mobile Communications

# 台灣行動電話發展趨勢圖



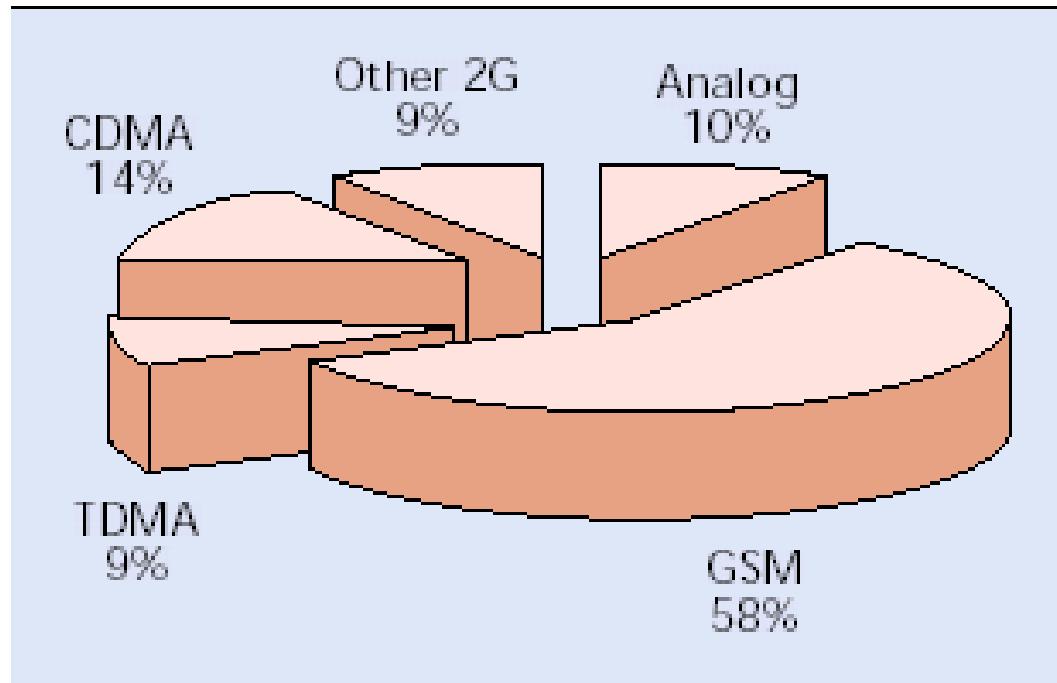
# ***Cellular Service Subscription***



# Wireless Personal Communications

- ◆ What is it?
  - Cellular telephone
  - Cordless telephone
  - Paging systems
  - Wide area data networks
  - Local area data networks
- ◆ Many ways to segment PCS
  - Applications
  - Extent of coverage
  - Degree of mobility (speed, area)
  - Circuit switched voice vs. packet-switched data
  - Mode of communication (messaging, two-way real time, paging, agents)
  - User location (indoor vs. outdoor, train, airplane)
- ◆ Common ingredients in all PCS activity
  - Desire for mobility in communications
  - Desire to be free from tethers

# 2000 Market Share



■ **Figure 5.** Estimated market shares of 1G and 2G wireless mobile systems in 2000.

# Mobile Terminal Growth

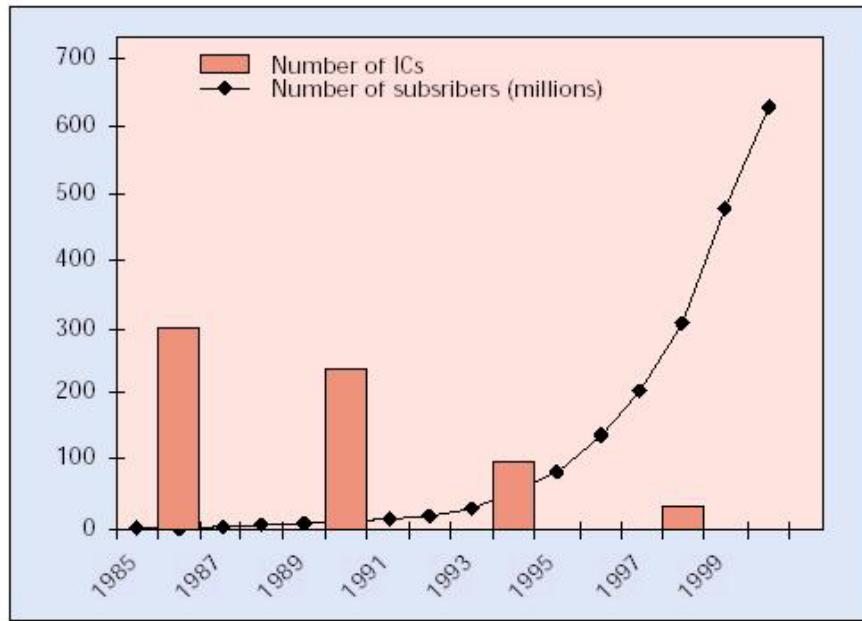


Figure 1. Subscriber growth and IC reduction in mobile terminals.

QUALCOMM

> Easy Migration  
from cdmaOne  
to 3G

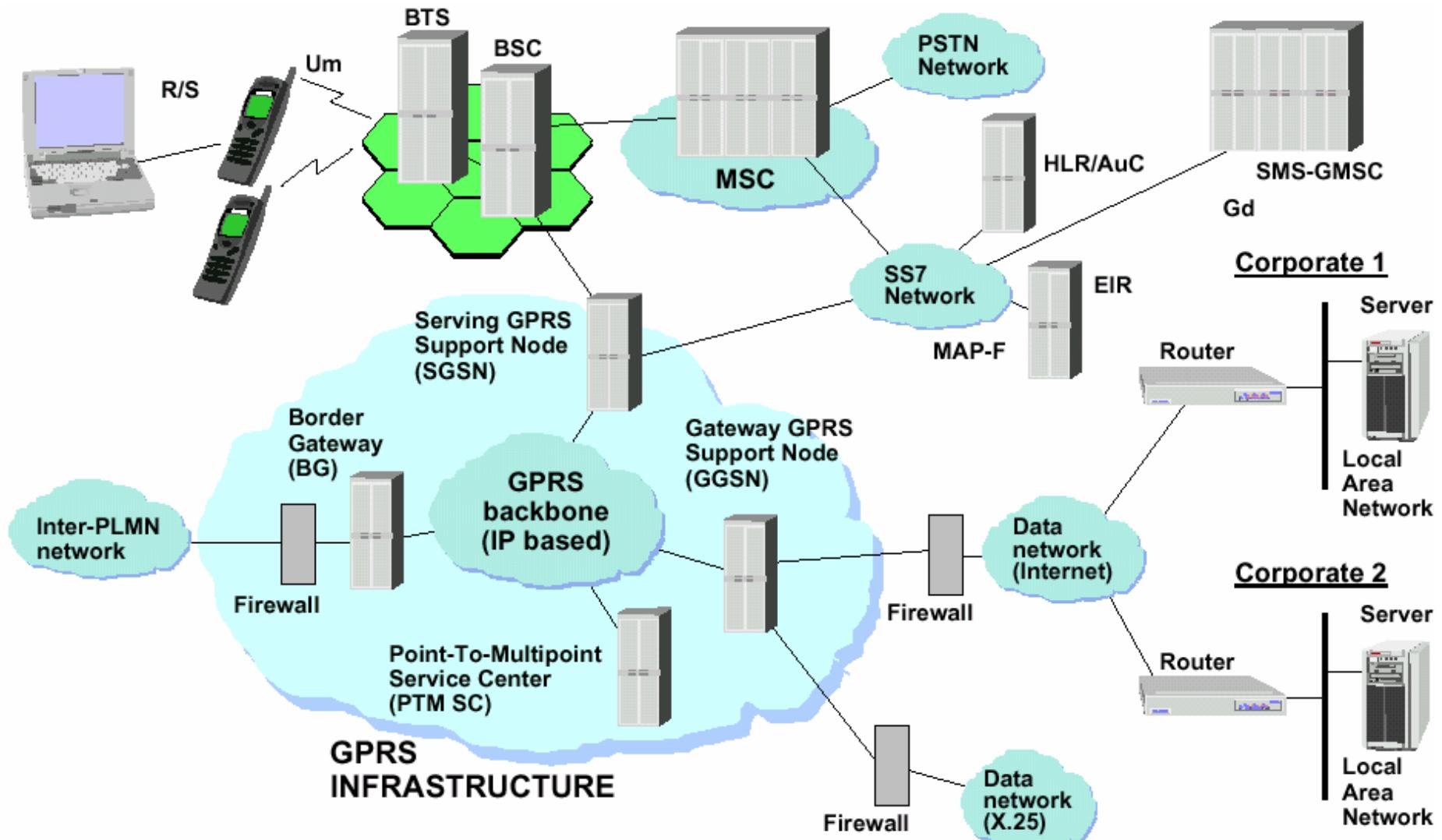


Time to Market



Simple IS-95 to cdma2000 conversion

# GPRS Architecture



# RS Spectrum Allocation

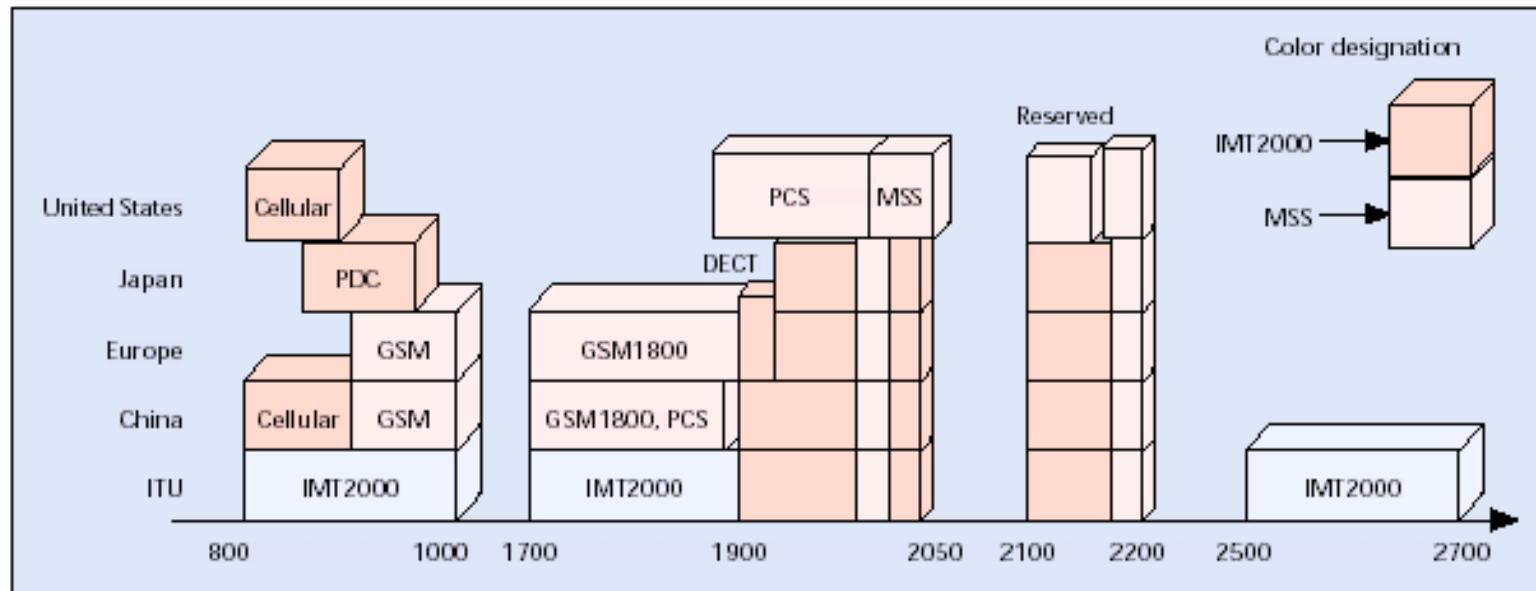
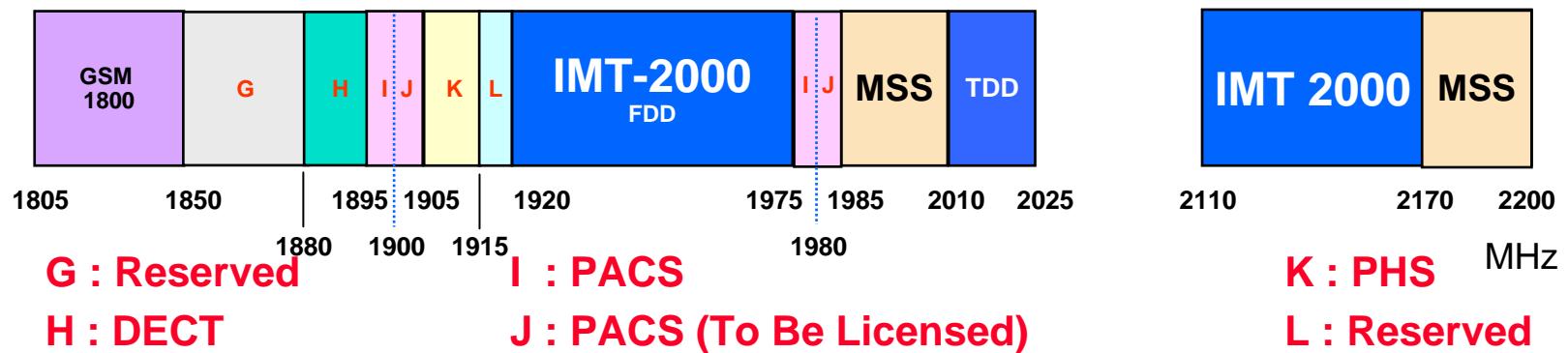
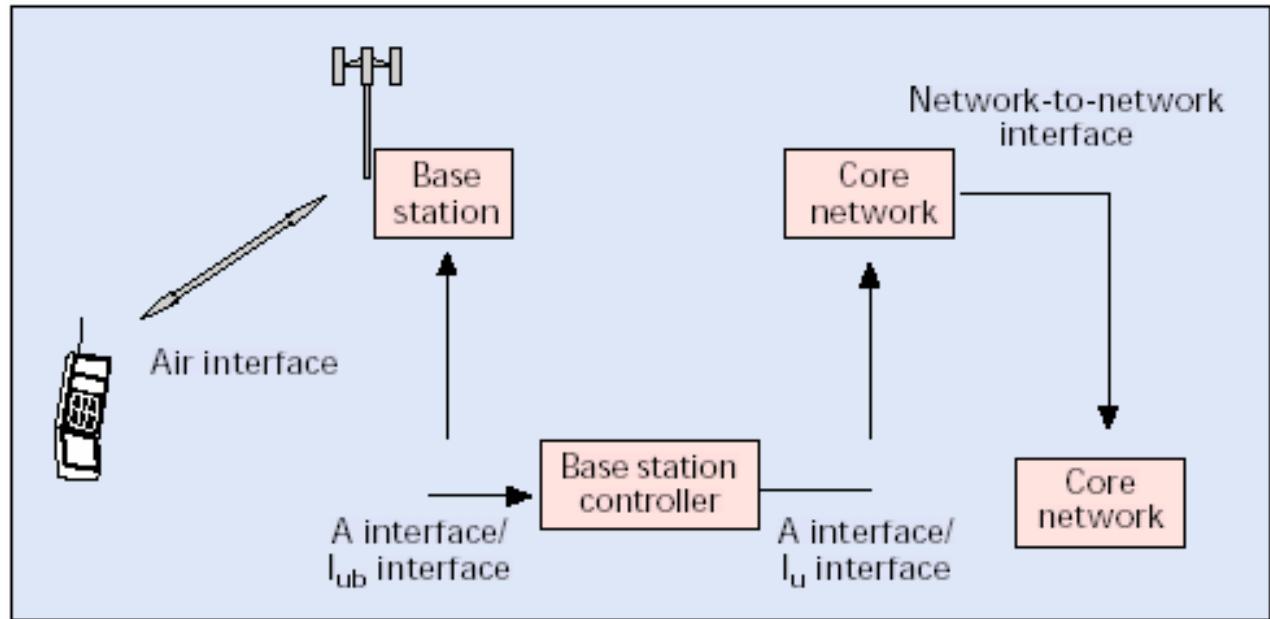


Figure 2. RF spectrum allocation in major regions.

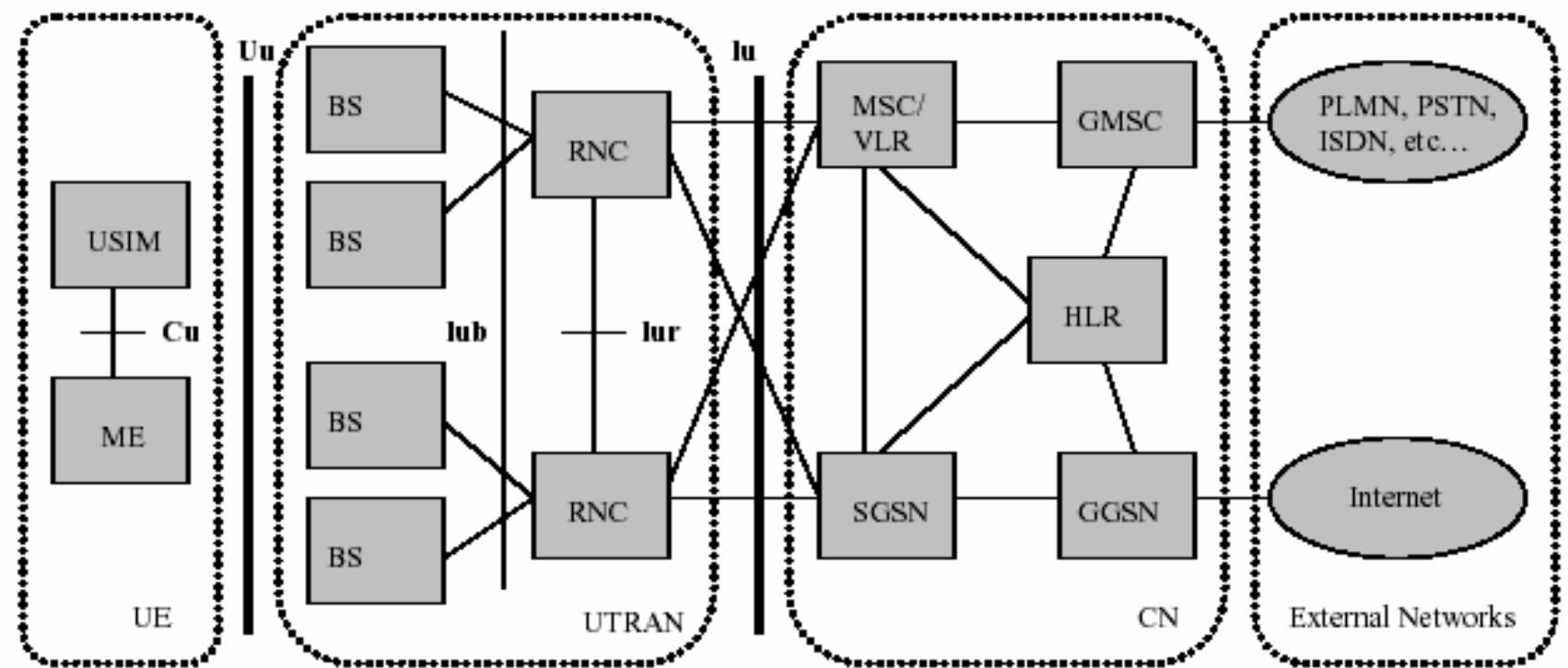


# Wireless Mobile Interface



■ **Figure 4.** Wireless mobile system interface definition.

# Elements of UMTS Architecture



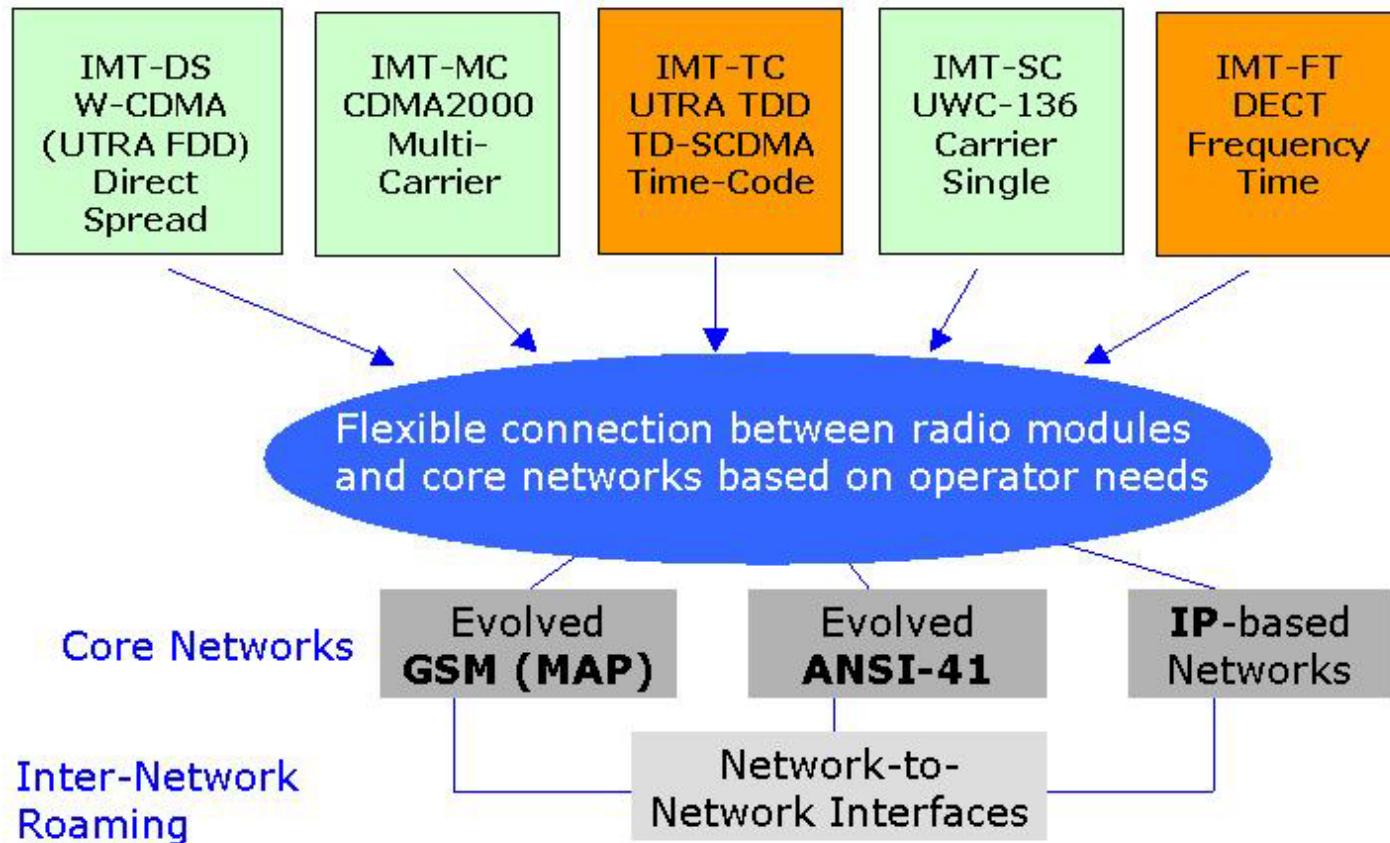
# 第三代行動電話之技術標準

## Modular IMT-2000 Harmonization

Paired spectrum

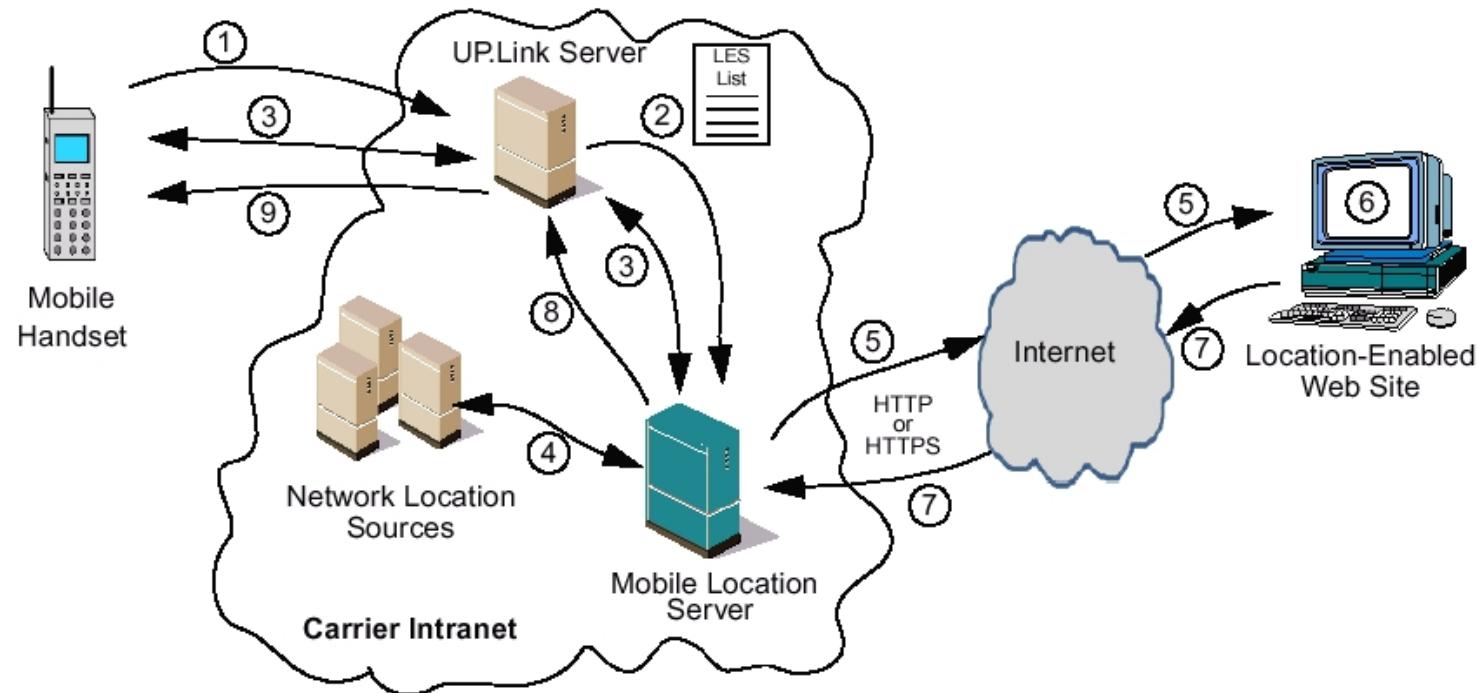
Unpaired spectrum

### (Terrestrial Component)

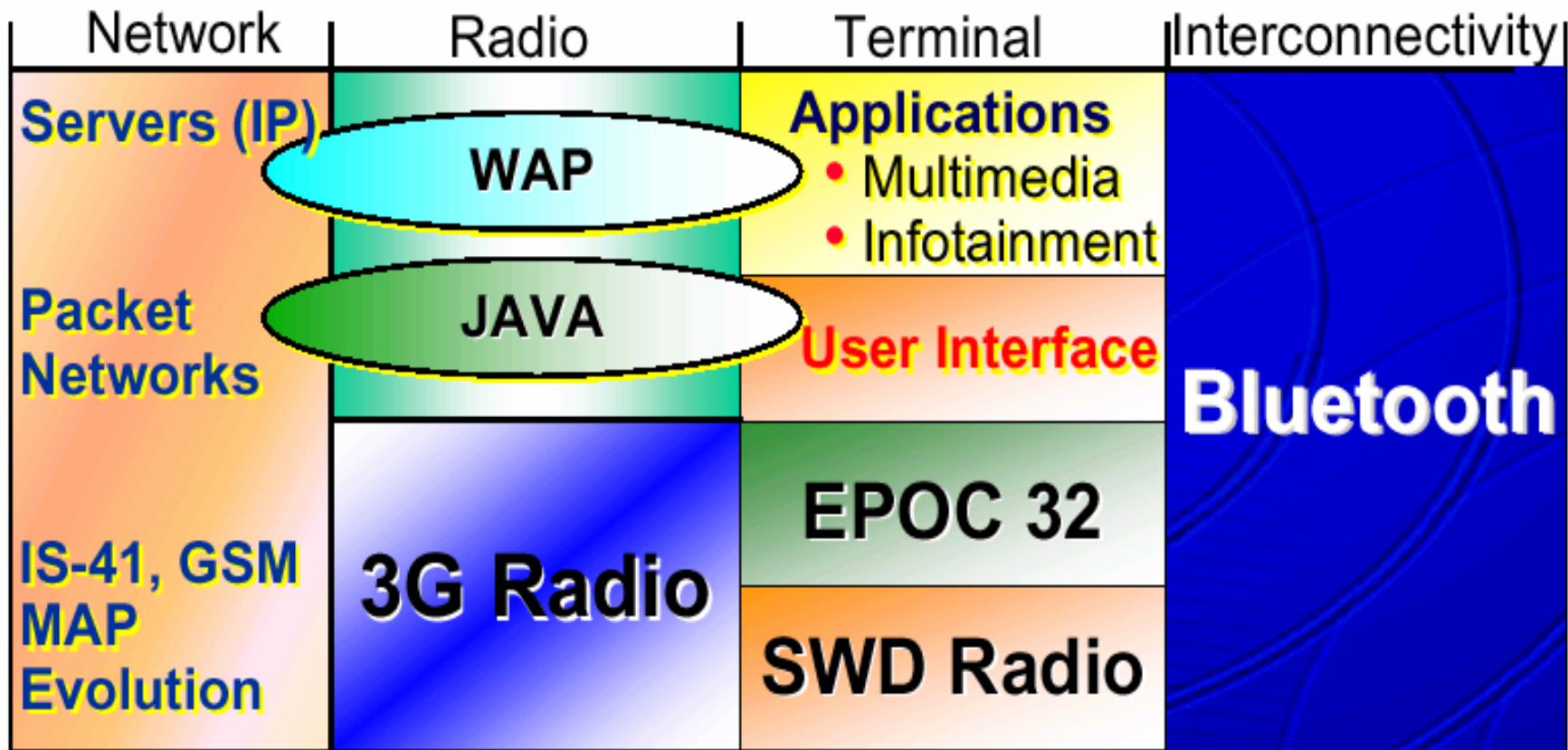


# Location-Based Applications

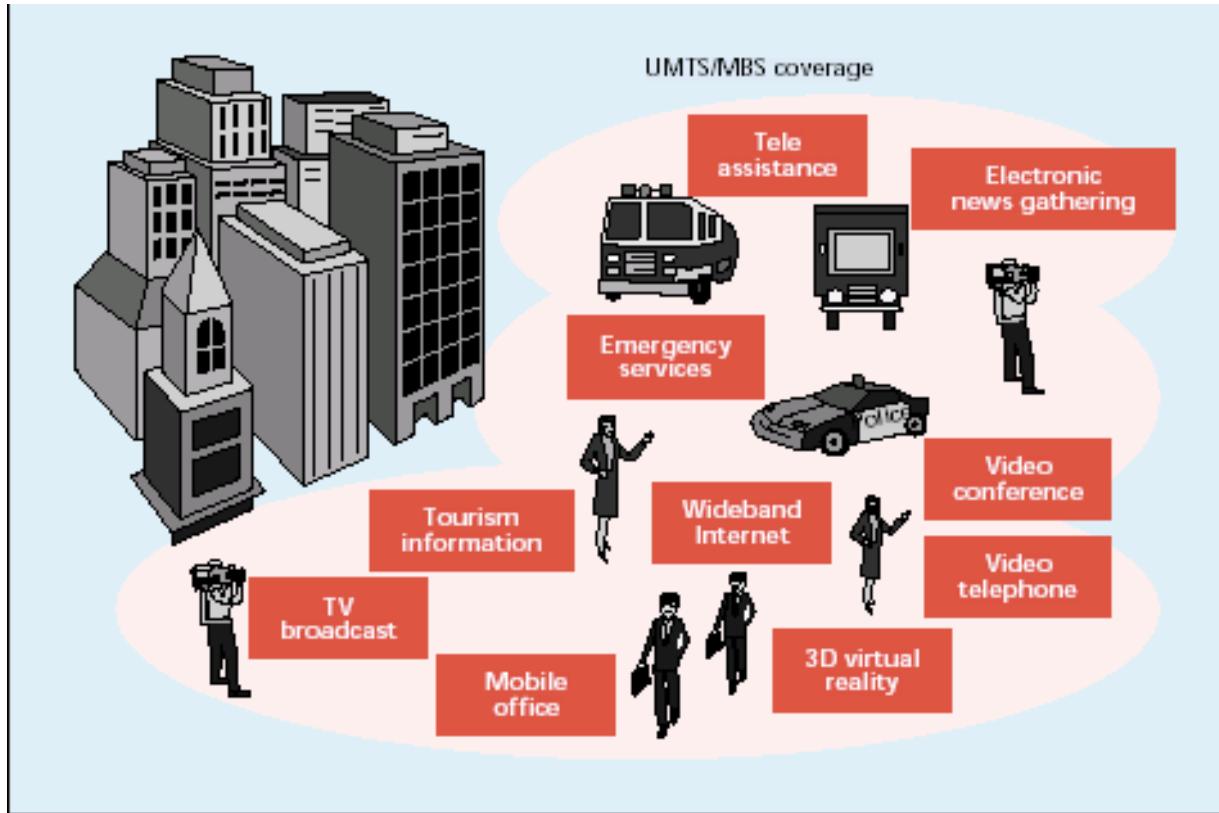
Figure 1. A typical location data transaction



# 3G-Network integration

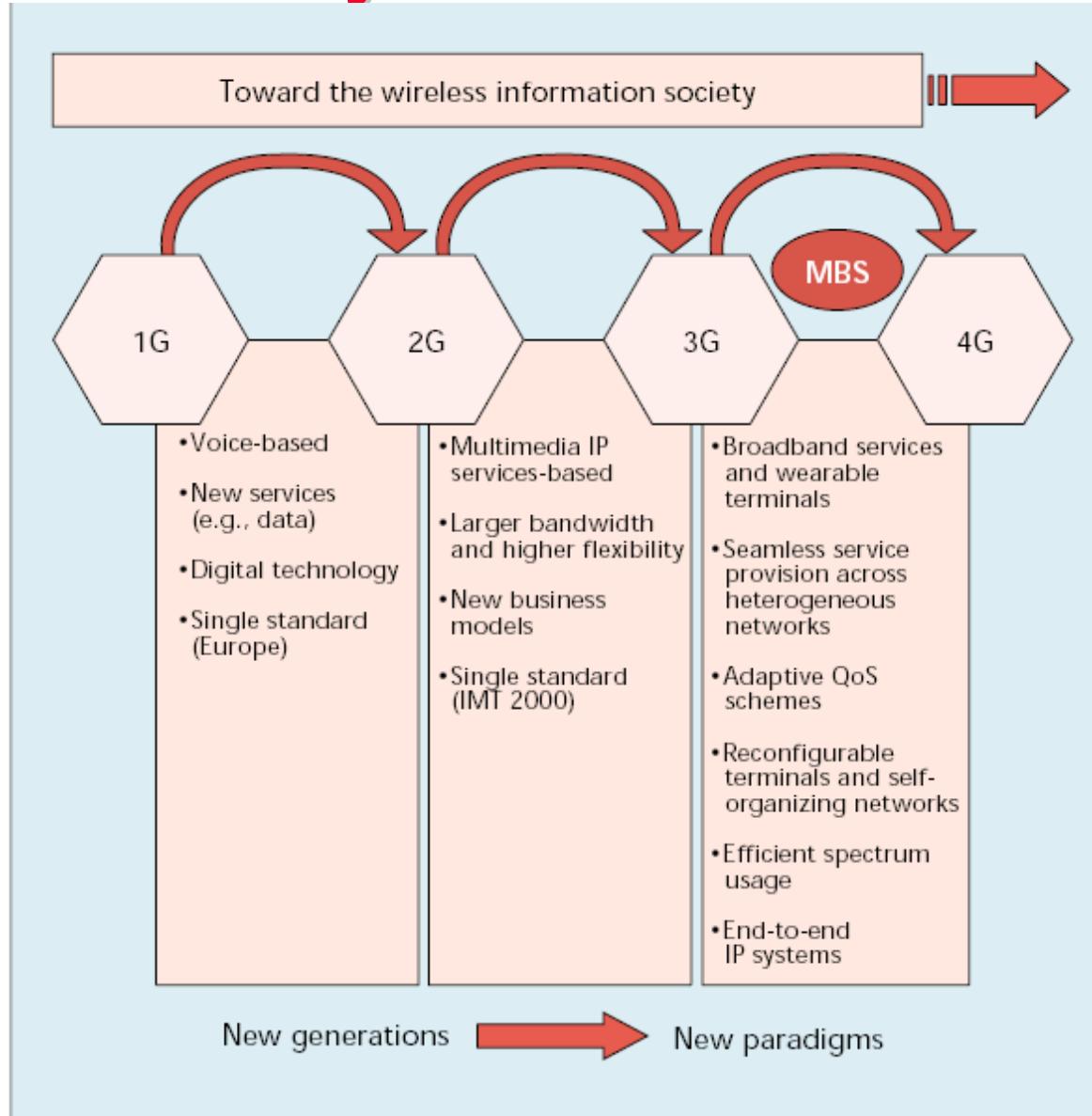


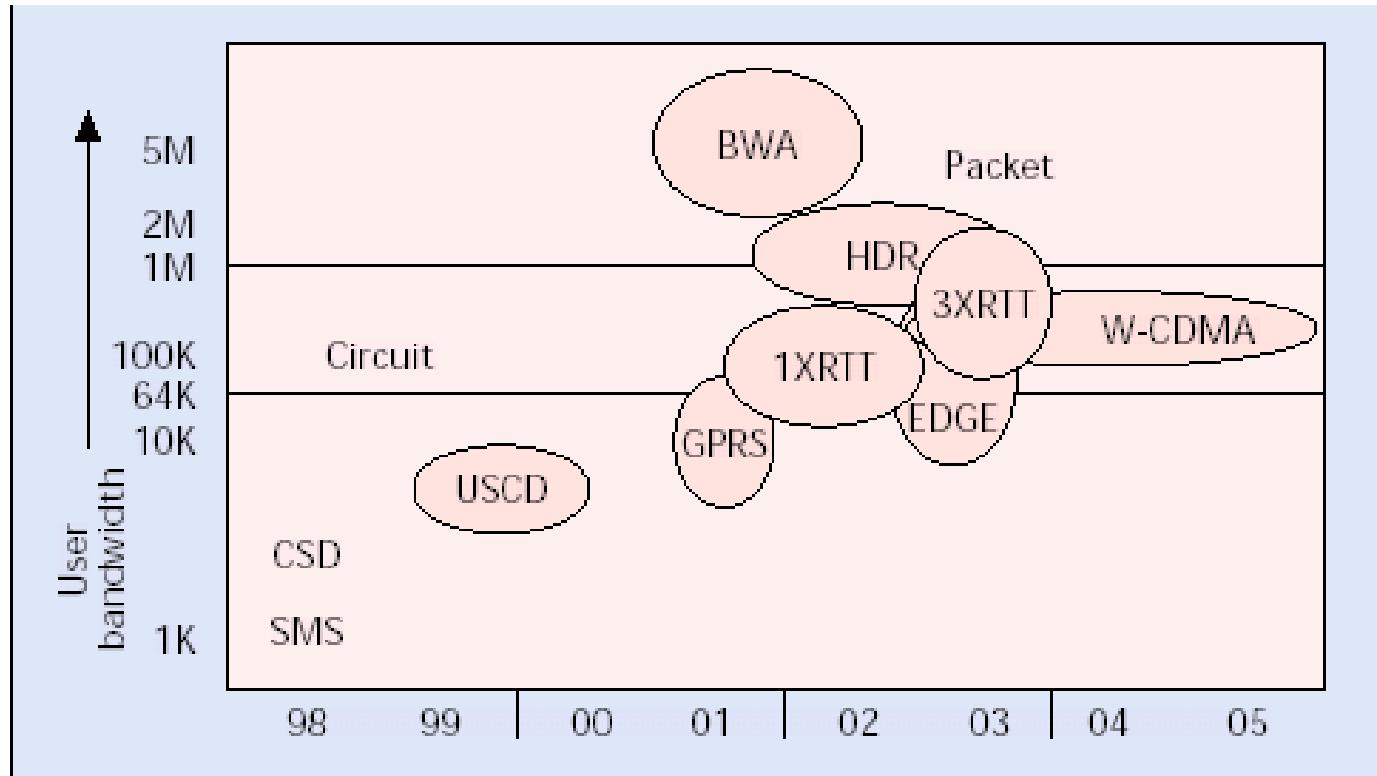
# Mobile Broadband System

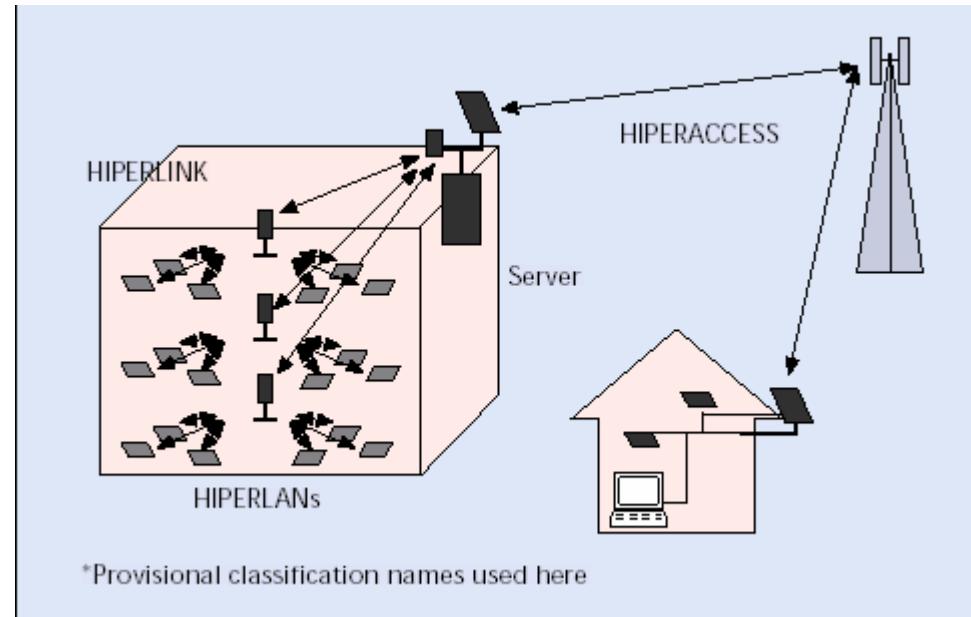


■ Figure 1. MBS and UMTS coverage and applications.

# Mobile System Evolution



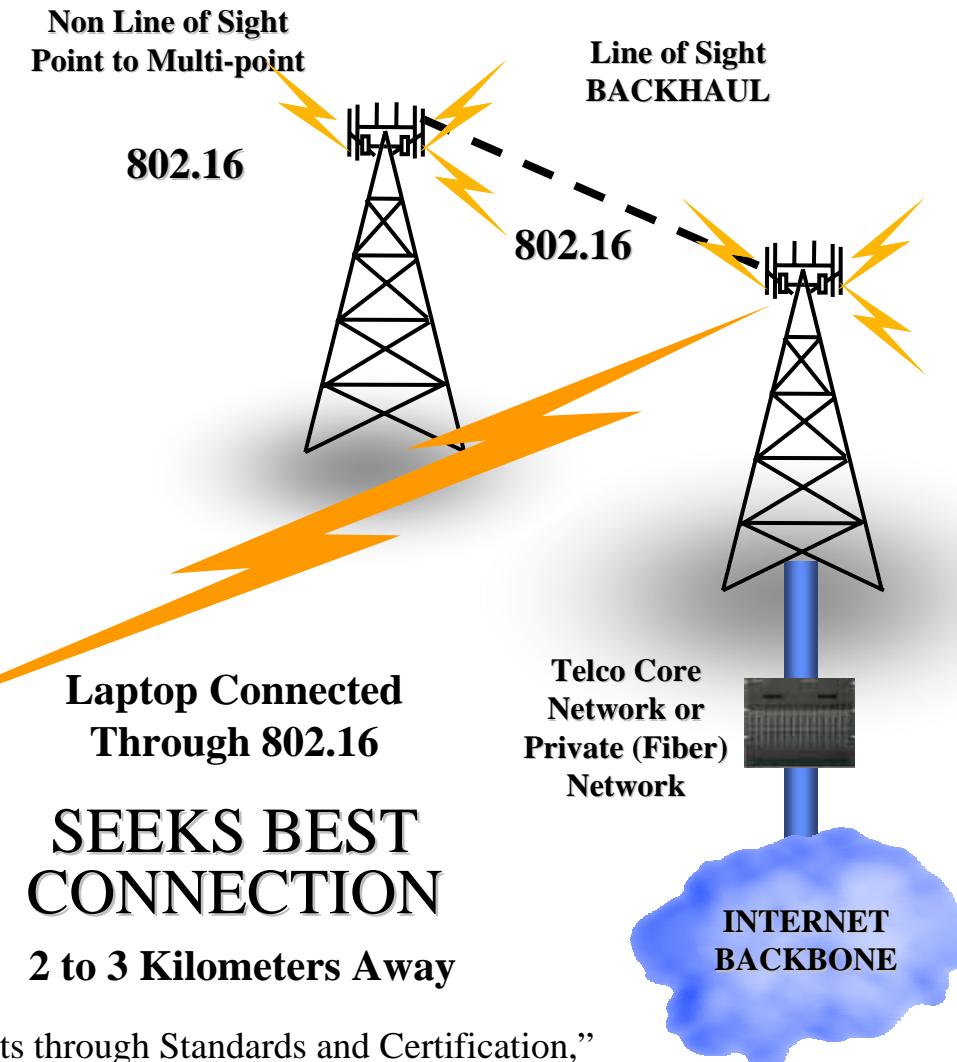




# WiMAX Nomadic and Portable



802.16e PC Card



Ref: Margaret LaBrecque , “Enabling Deployments through Standards and Certification,”  
WiMax, 2003

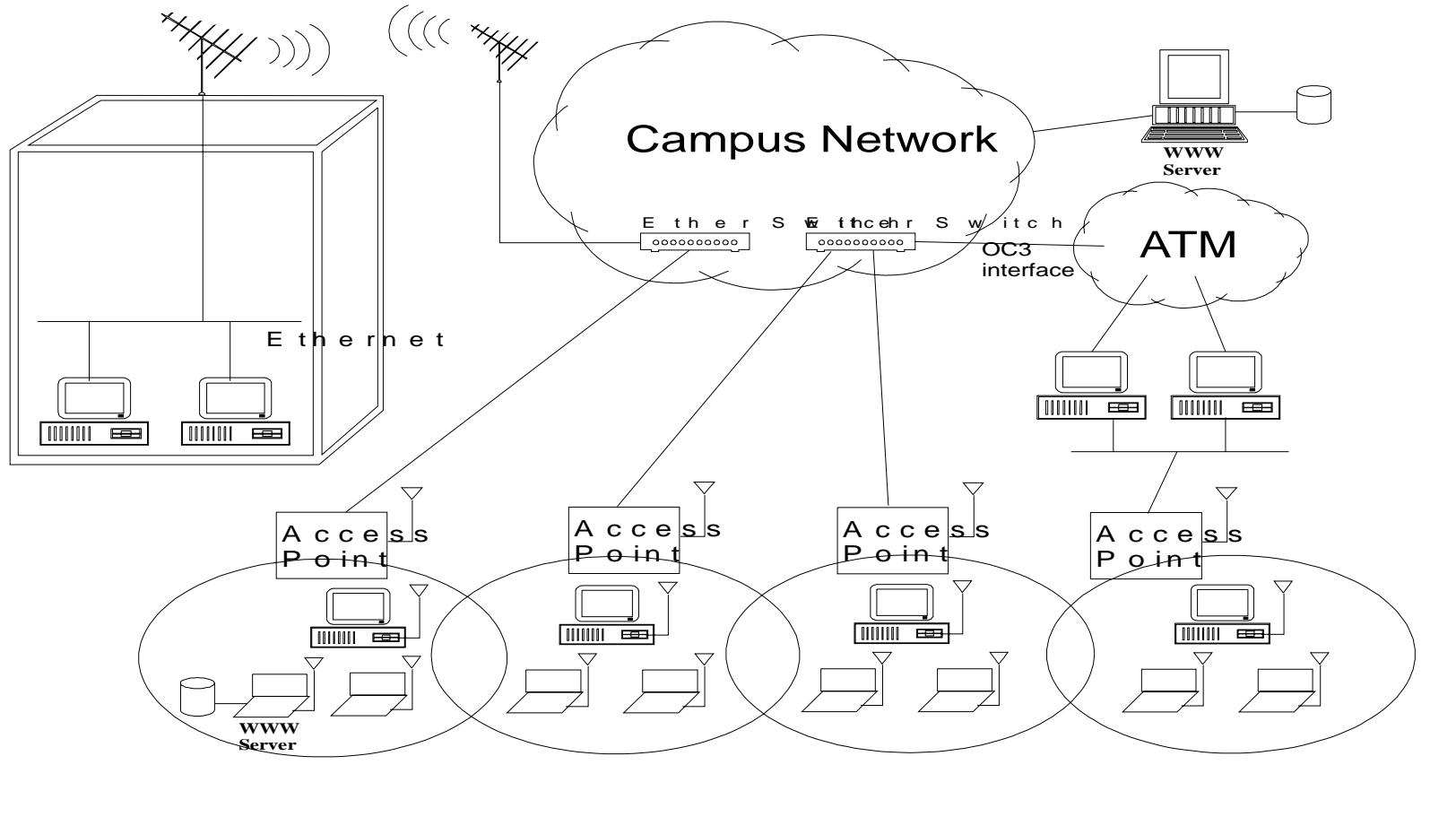


**National Central University**  
**&**  
**Hughes Network Systems**  
**LMDS Demo Briefing**

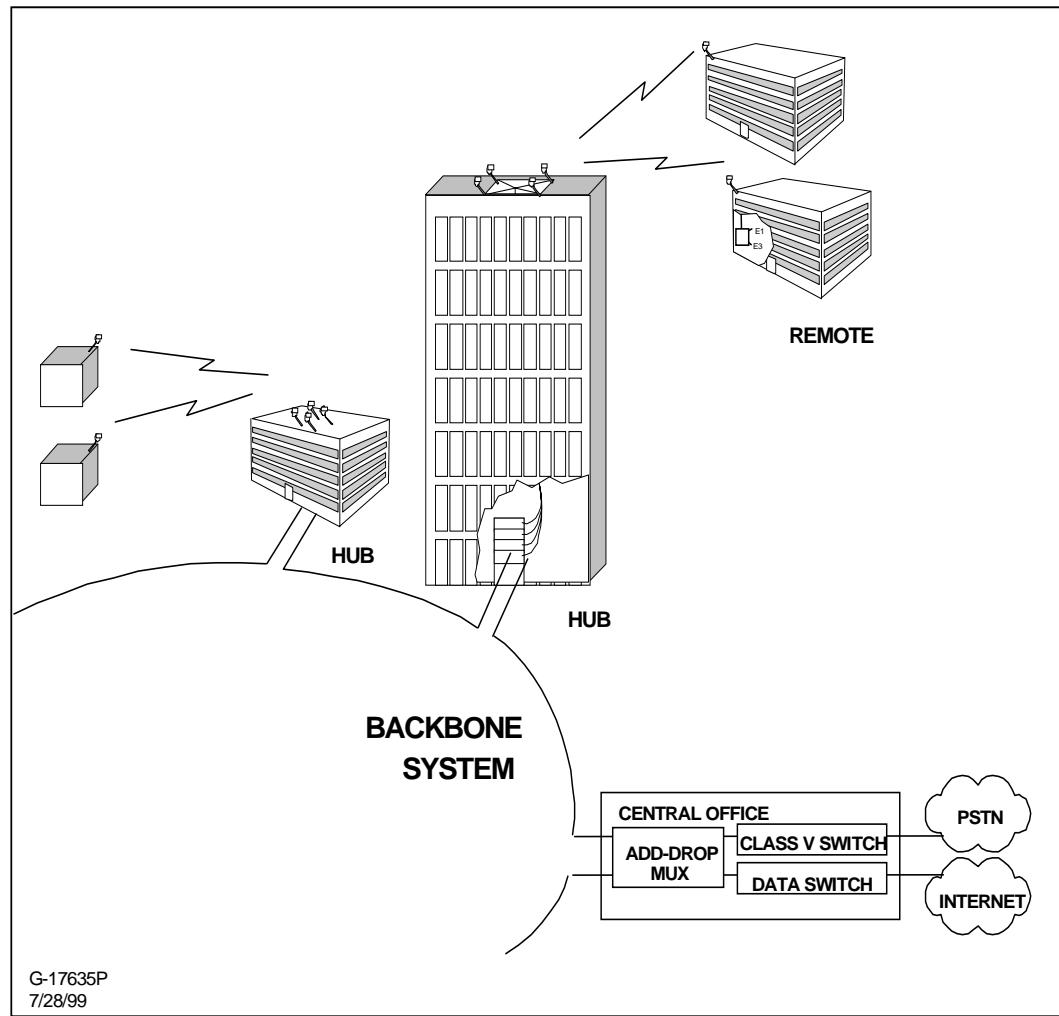
*November 1999*

# Campus Network

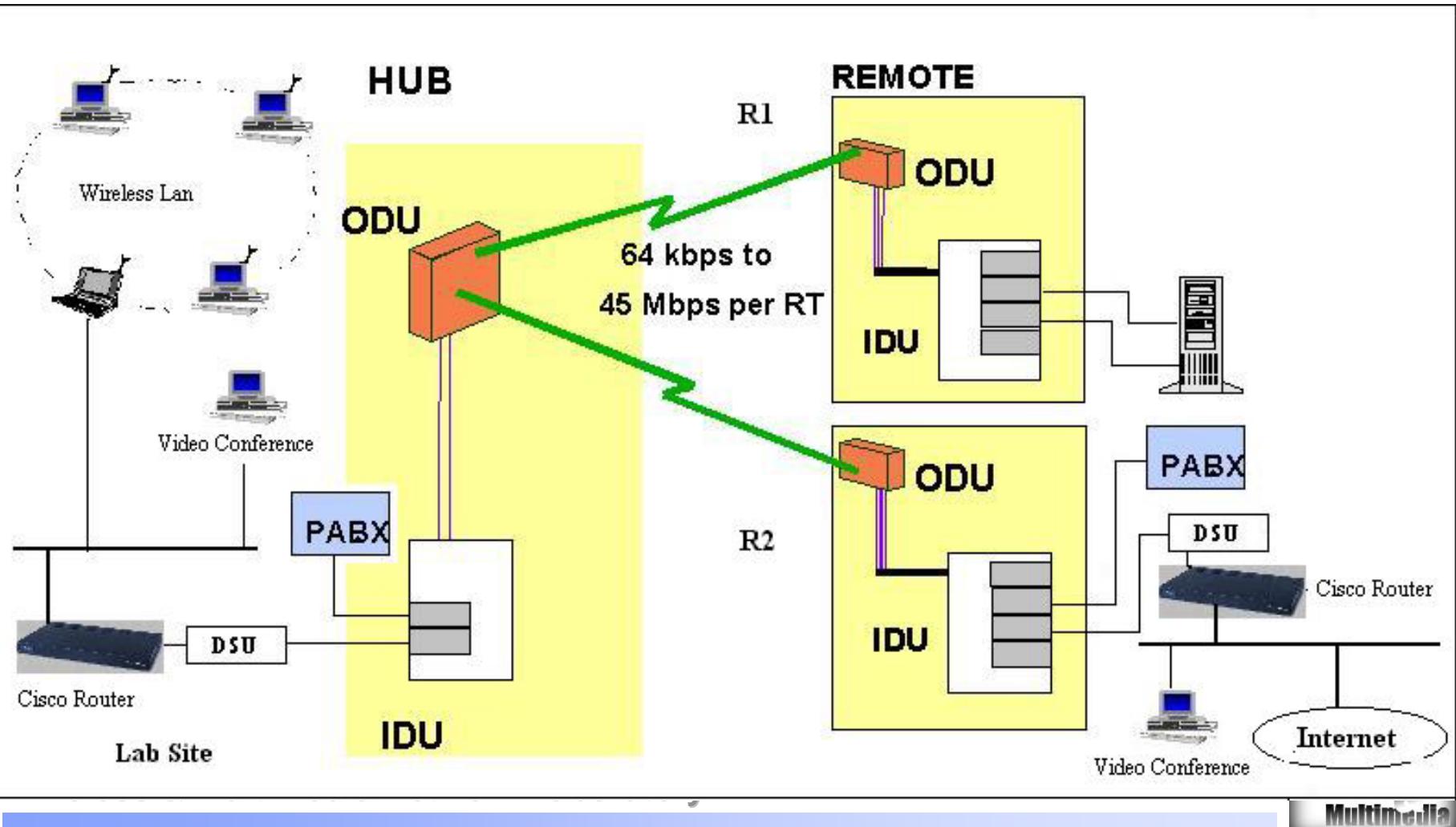
Figure 1: Wireless Network Infrastructure



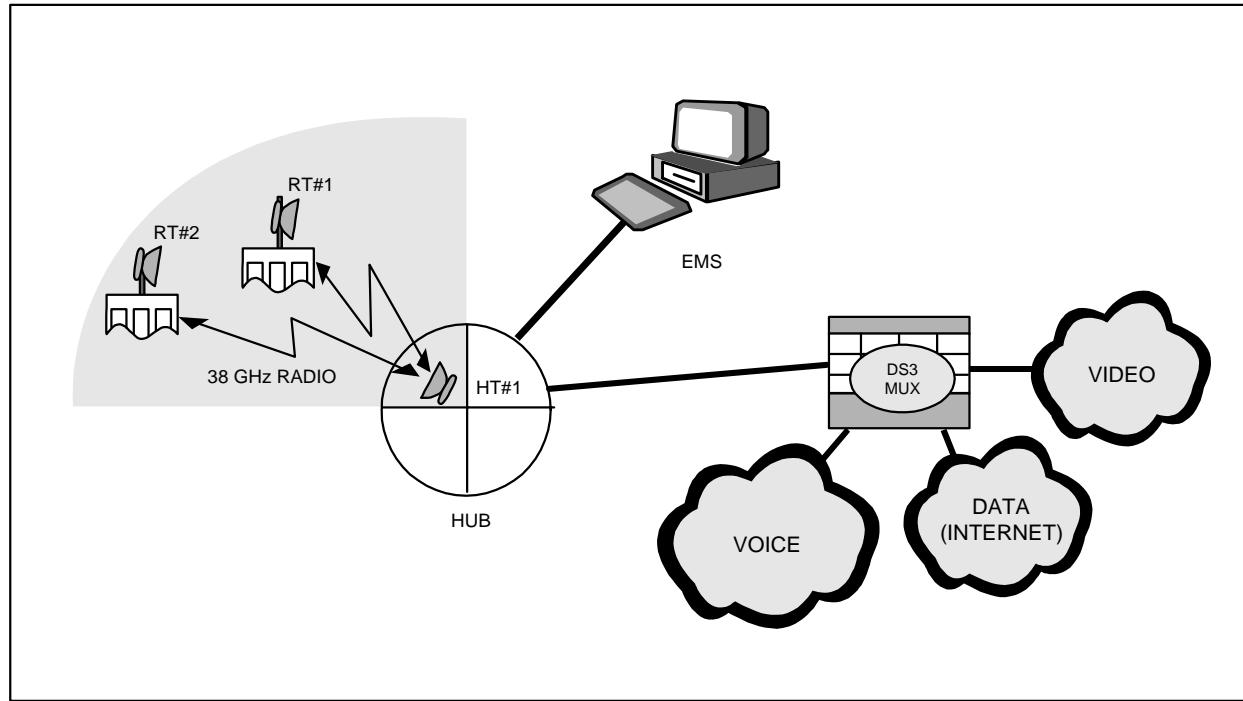
# LMDS NCU Test-bench



# Architecture of the Demo



# National Central University Demo Layout



G-17833P 8/19/99

# Step.1 LMDS Architecture

與衛星結合

遙測中心

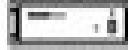
HEAD END

MUX 310T



QPSK MOD PSM2100

MHU-28L



MAP-28L



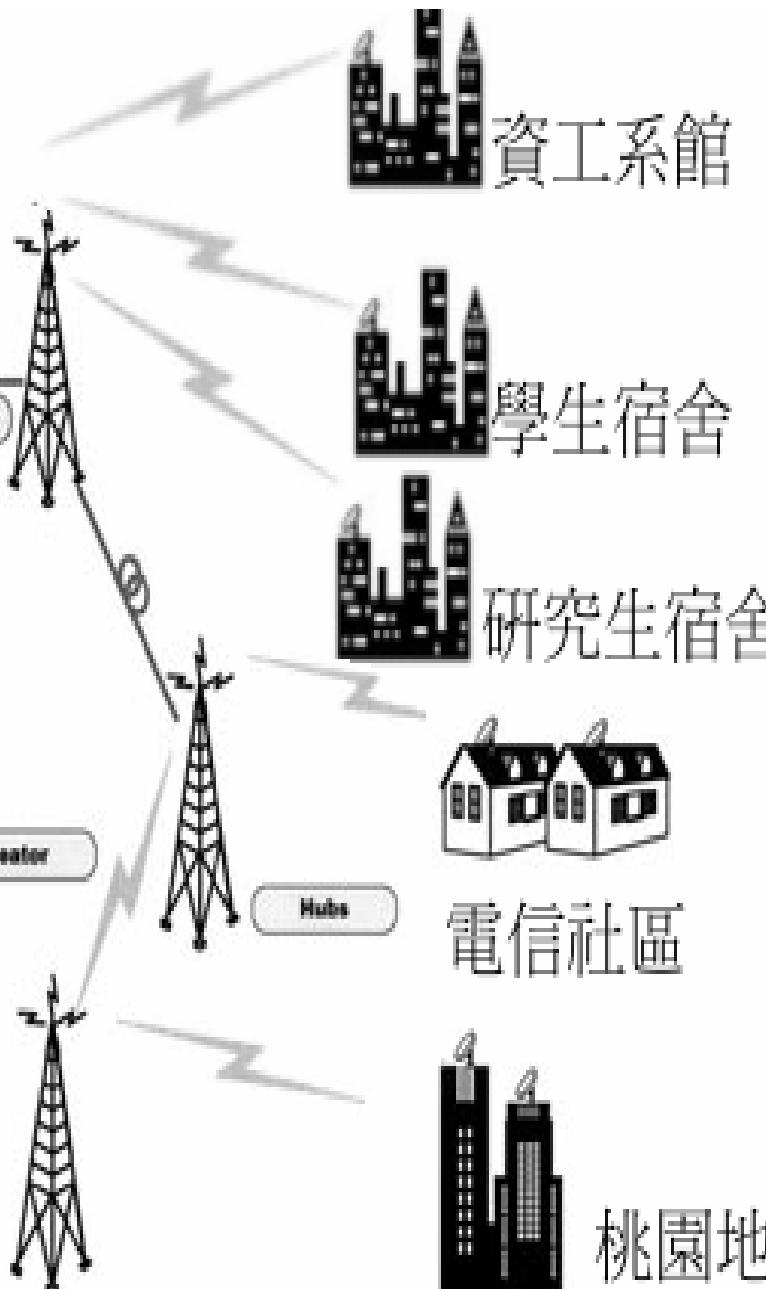
MUC-28L



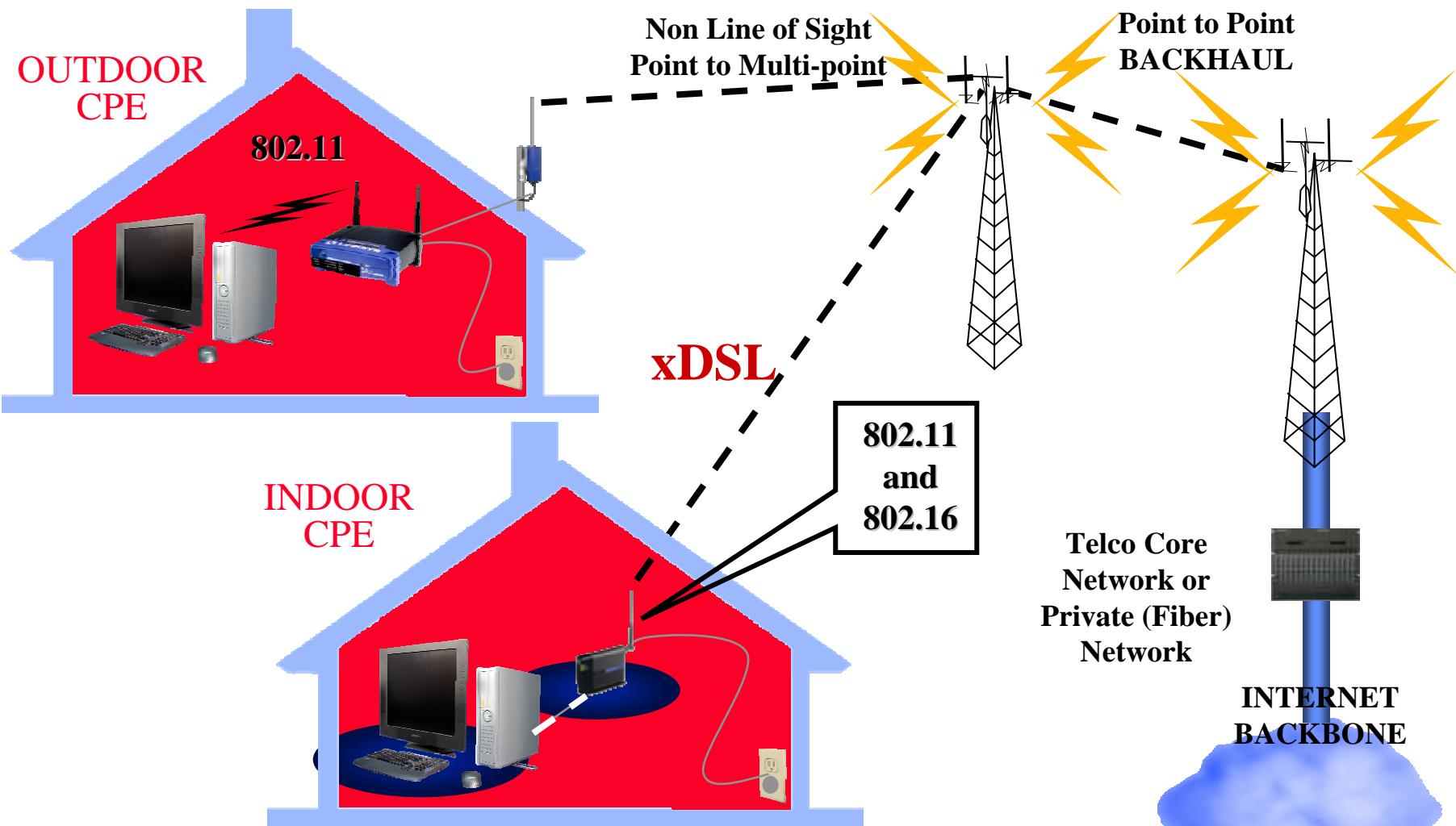
MSW-28L



Fiber Backbone



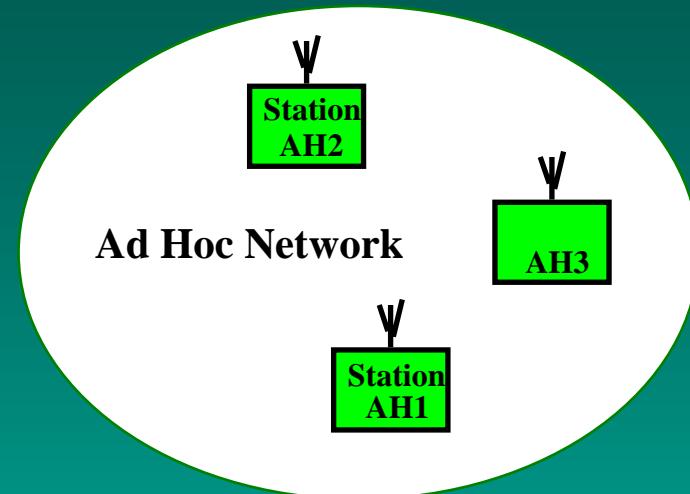
# WiMAX Consumer Last Mile



Ref: Margaret LaBrecque , “Enabling Deployments through Standards and Certification,”  
WiMax, 2003

Wireless & Multimedia Network Laboratory™

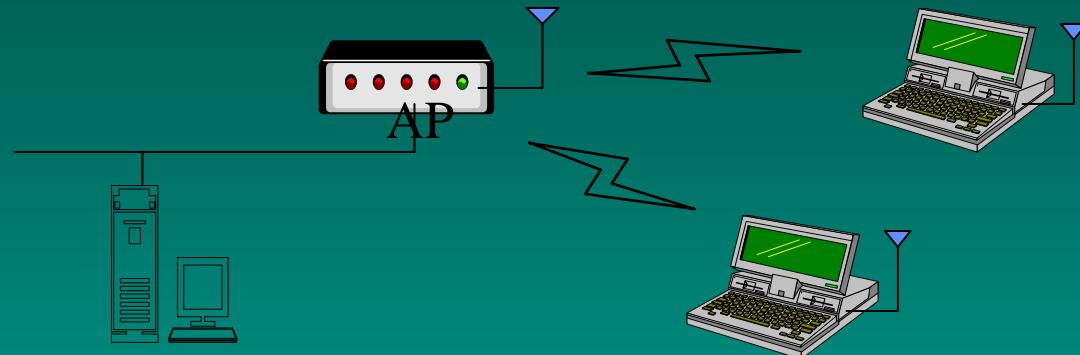
# IEEE 802.11 Configurations - Independent



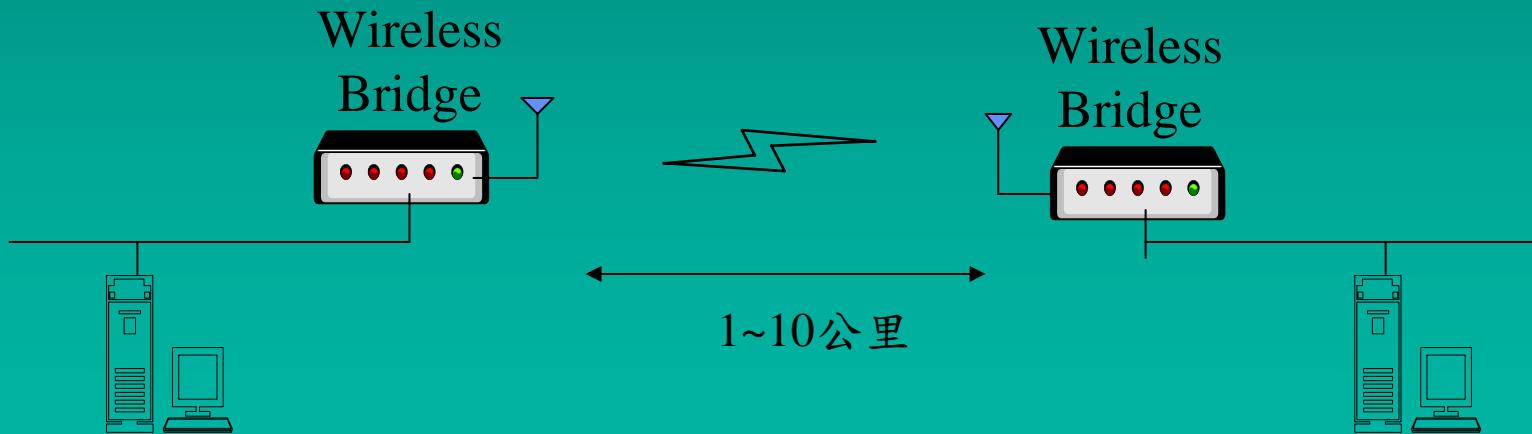
- ♦ Independent
  - one Basic Service Set - BSS
  - Ad Hoc network
  - direct communication
  - limited coverage area

# Topology of a Wireless LAN

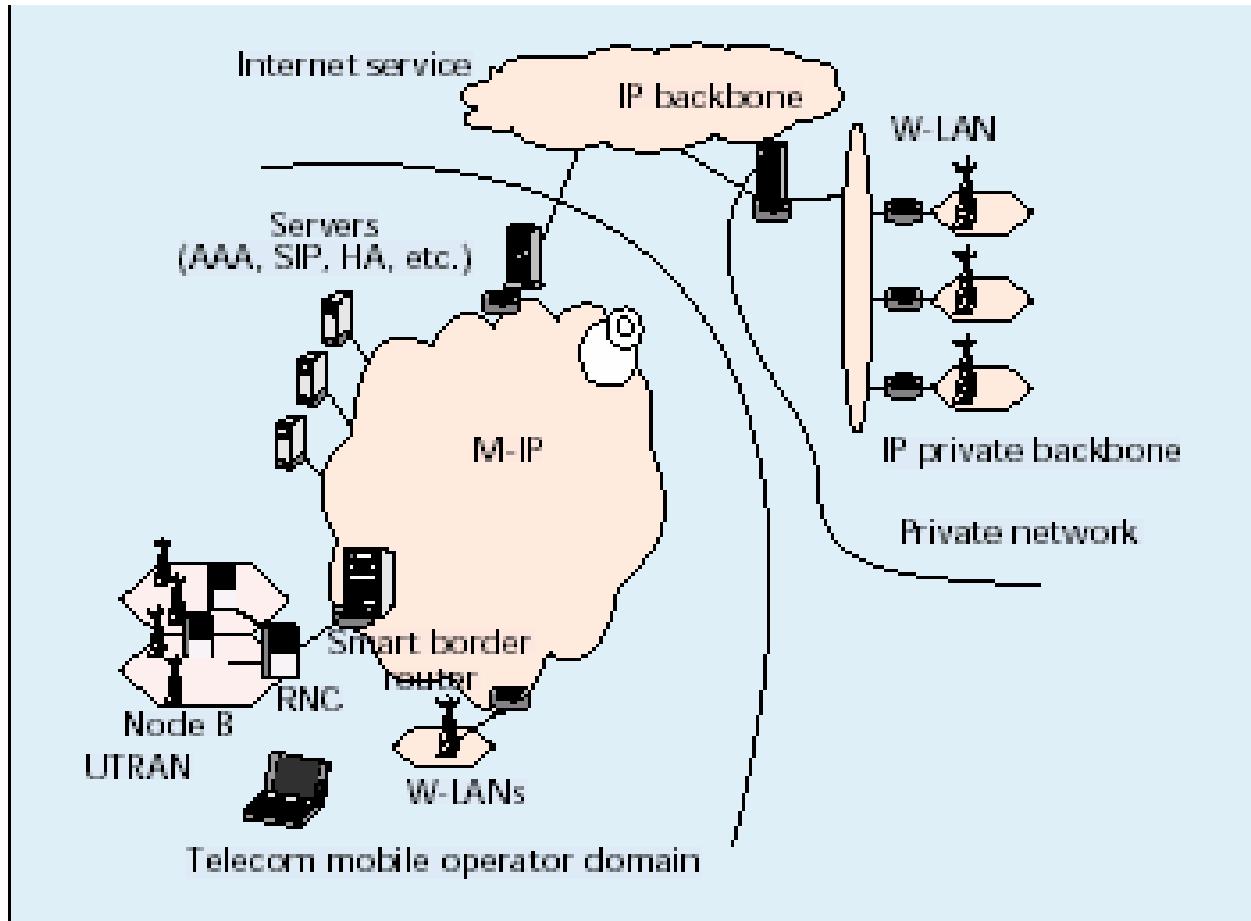
- ◆ 進接(Access)應用: 使用者與網路的連接



- ◆ 中繼(Trunk)或骨幹(Backbone)應用: 網路與網路之間的連接. 例如,大樓與大樓之間的通訊, 或是遠方網路的連接.



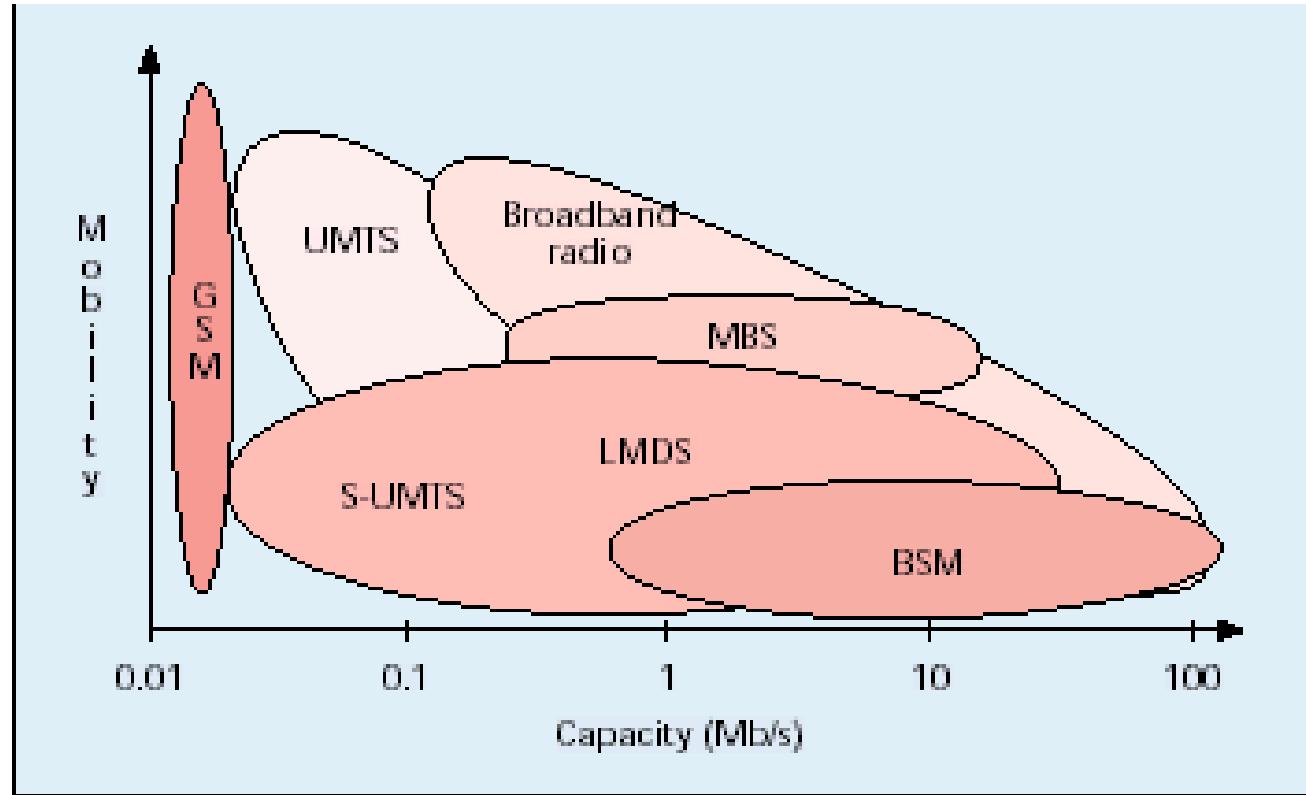
# IP integration



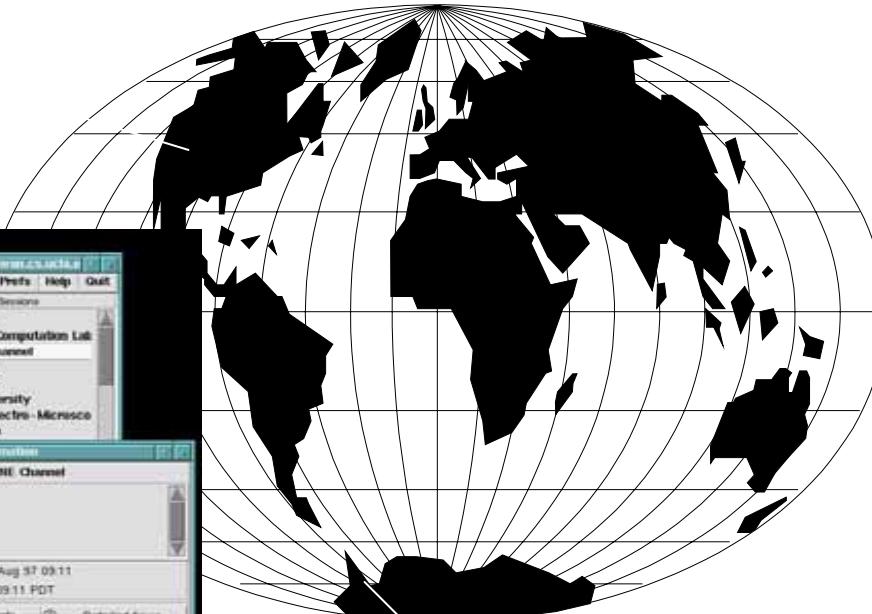
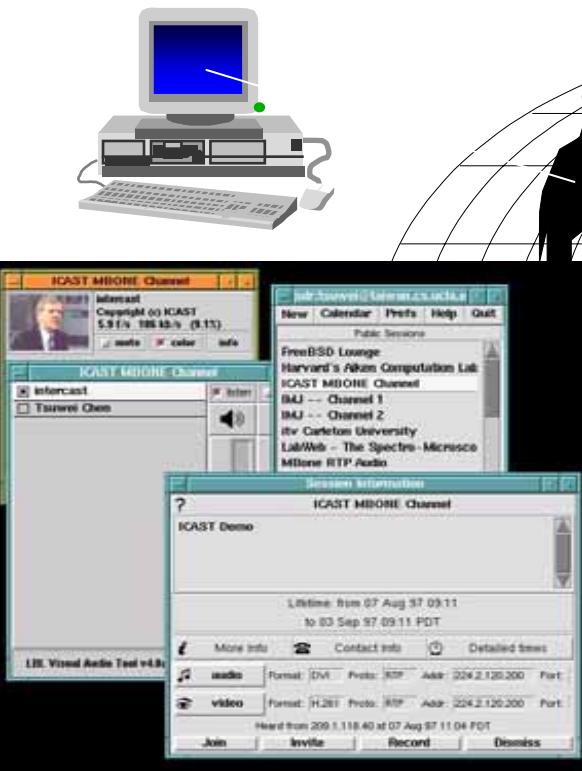
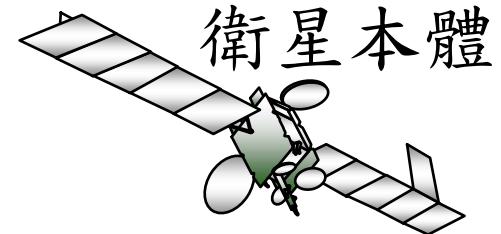
# WiMedia Solutions – Simple Usage



# Capacity and Mobility



# 地球村的建立



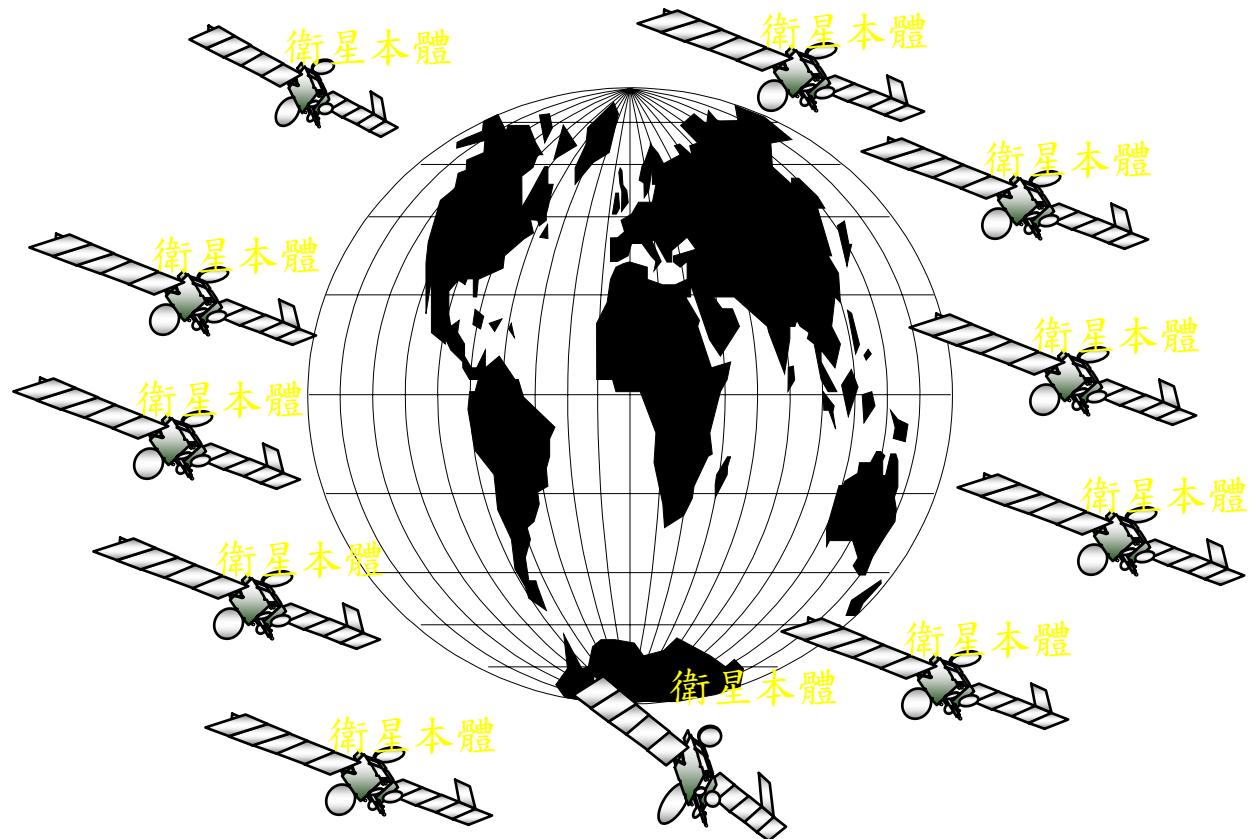
衛星本體

衛星本體

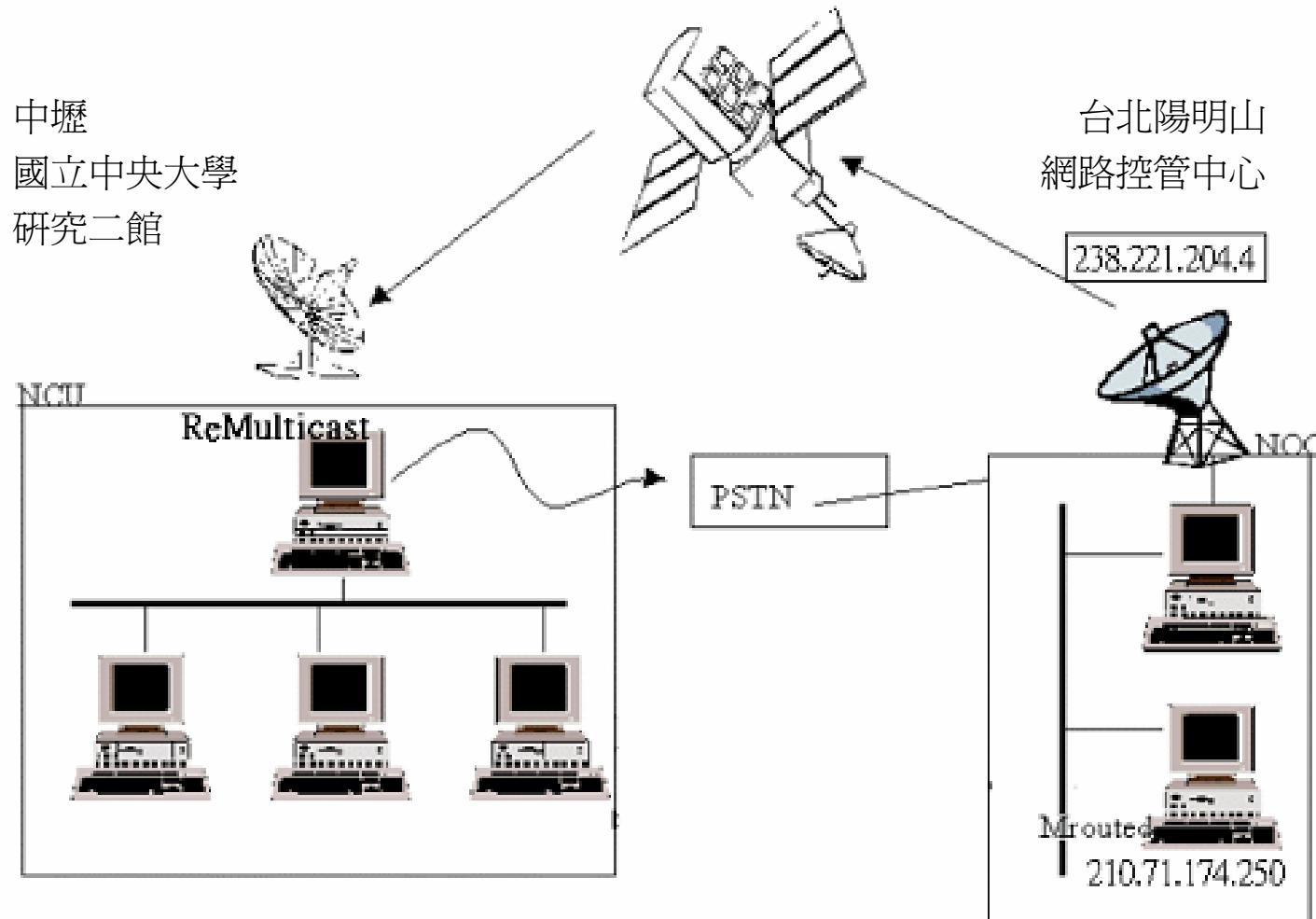
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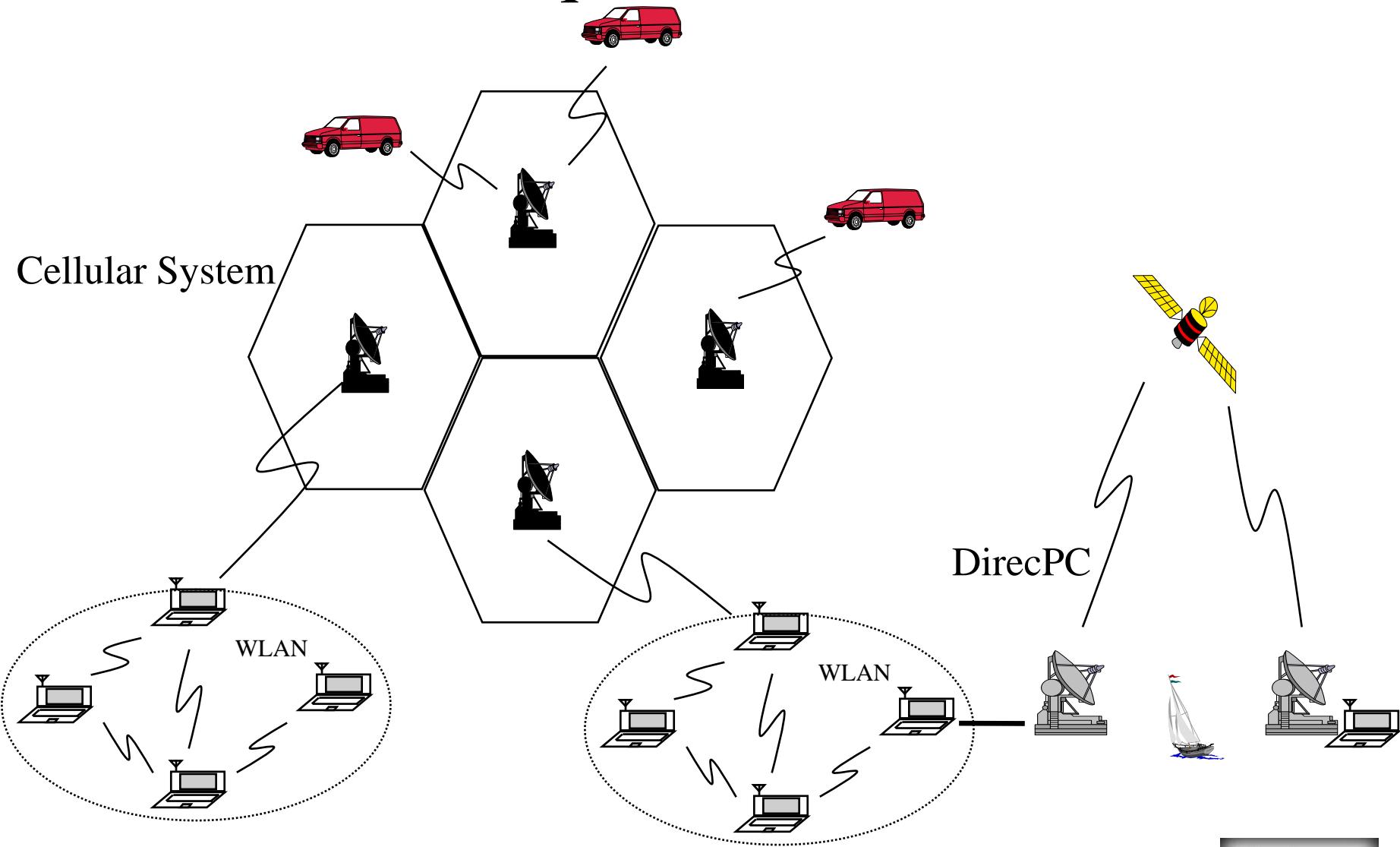
# Sky of Satellites



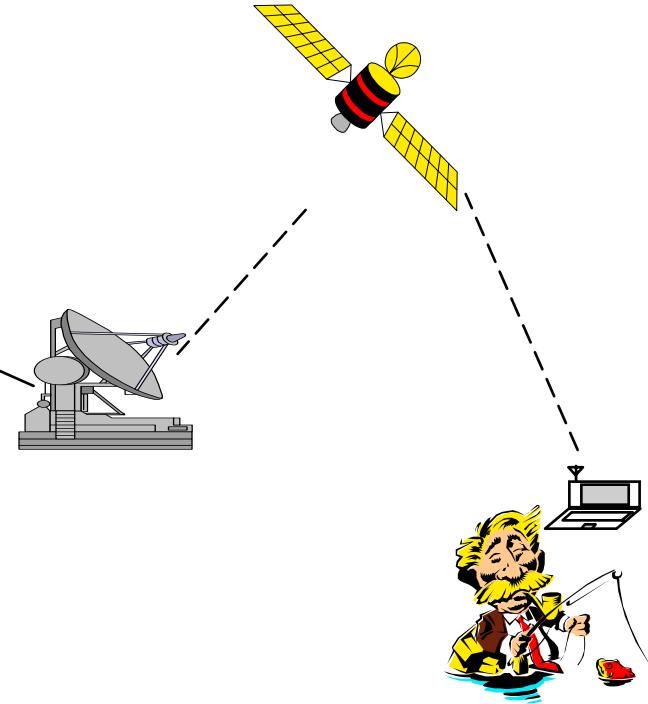
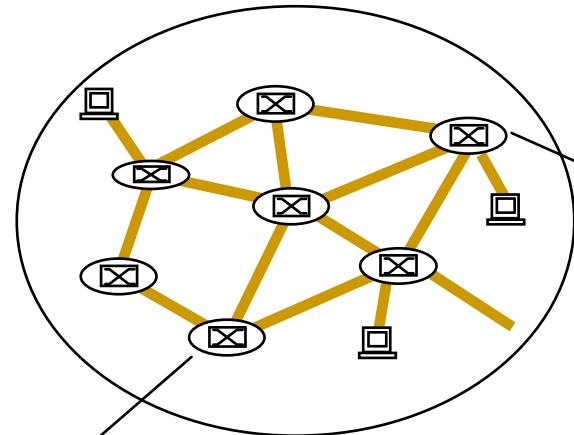
# DirecPC Satellite Experiments



# Ubiquitous Access



# “Anytime Anywhere” Information System



# Fundamental Issues

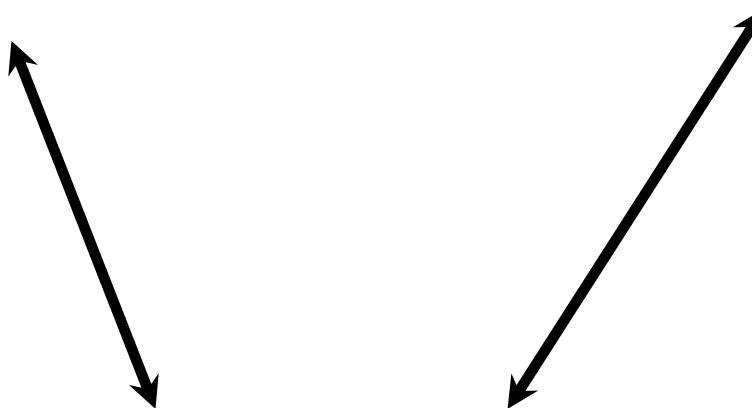


# Three System Components

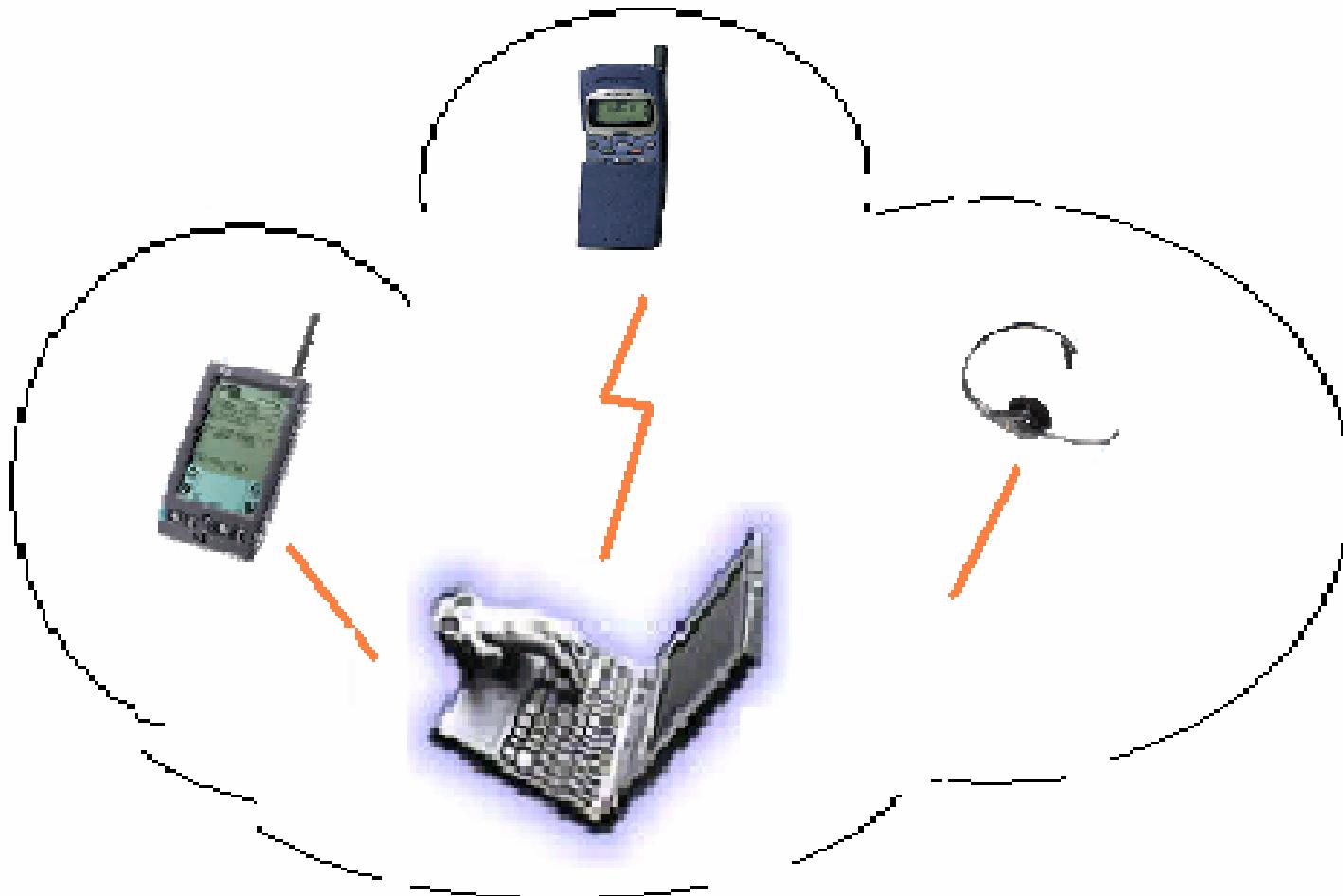
End-Point  
Terminal Architecture

Infrastructure  
Network architecture

Services  
OS & Middleware



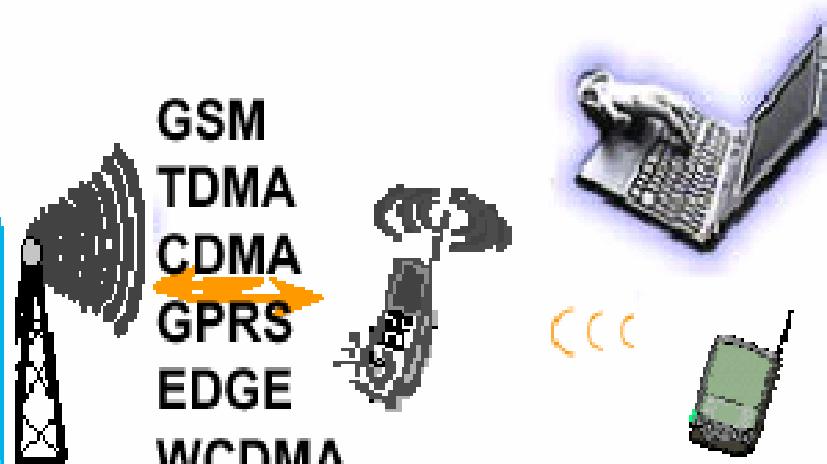
# Personal area network



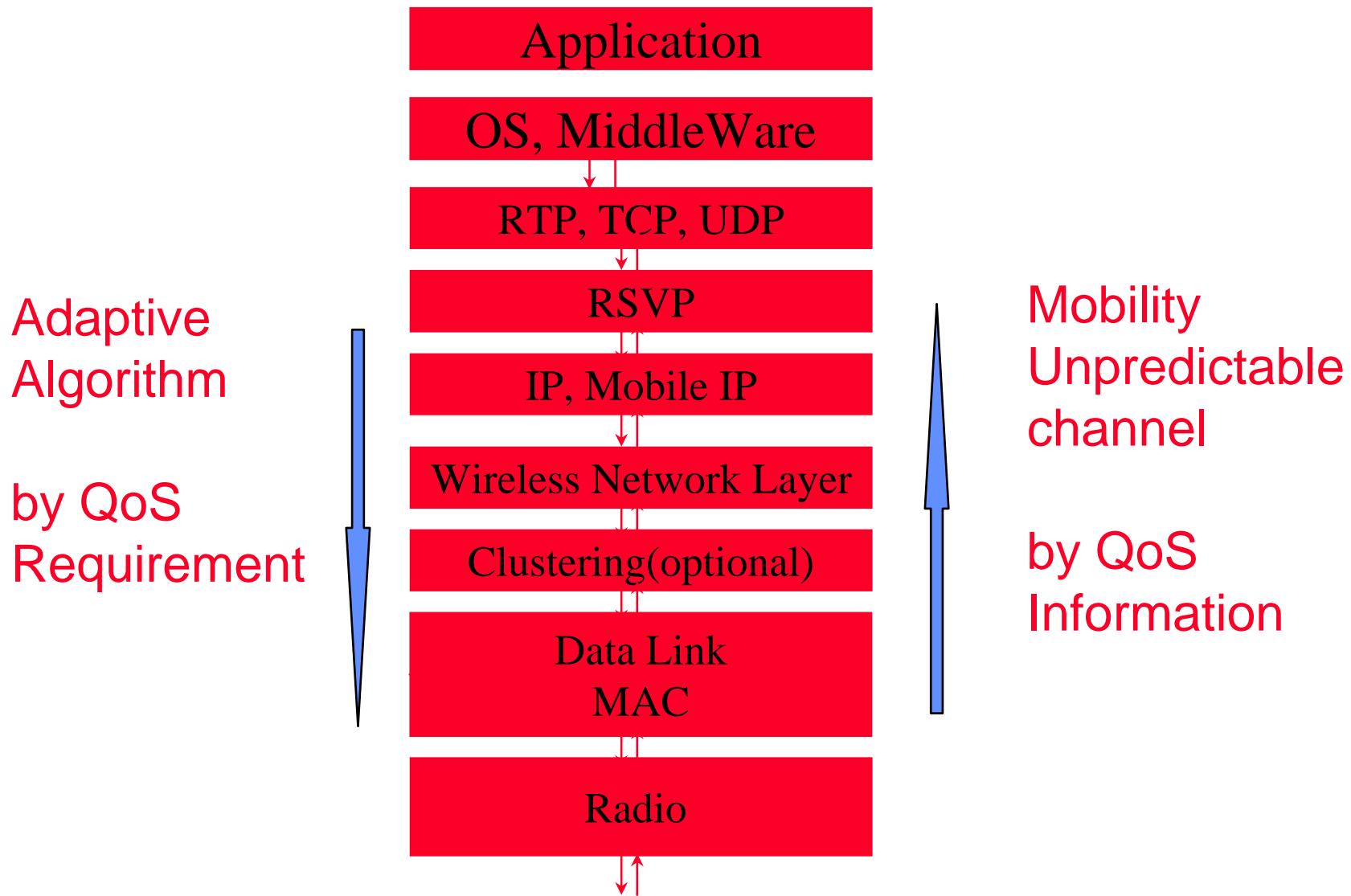
# Connect devices to internet on the mobile infrastructure world wide



GSM  
TDMA  
CDMA  
GPRS  
EDGE  
WCDMA



# QoS and Multimedia Traffic Support

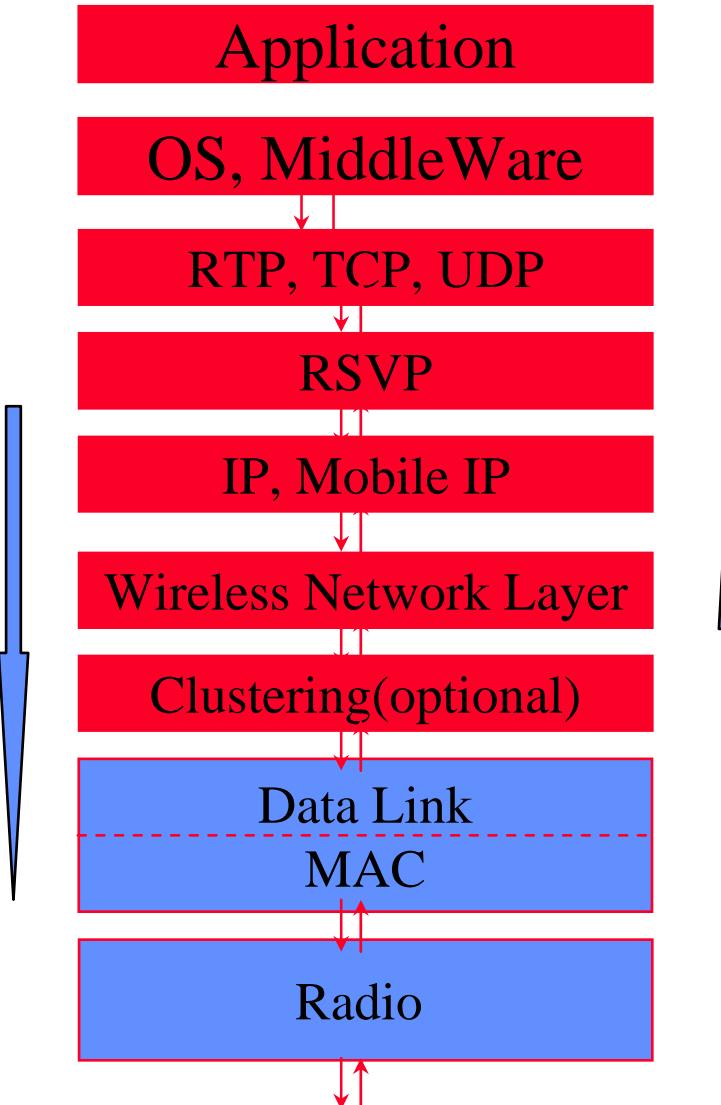


# QoS and Multimedia Traffic Support

Adaptive  
Algorithm  
by QoS  
Requirement

Mobility  
Unpredictable  
channel

by QoS  
Information



# Channel Propagation and Fading

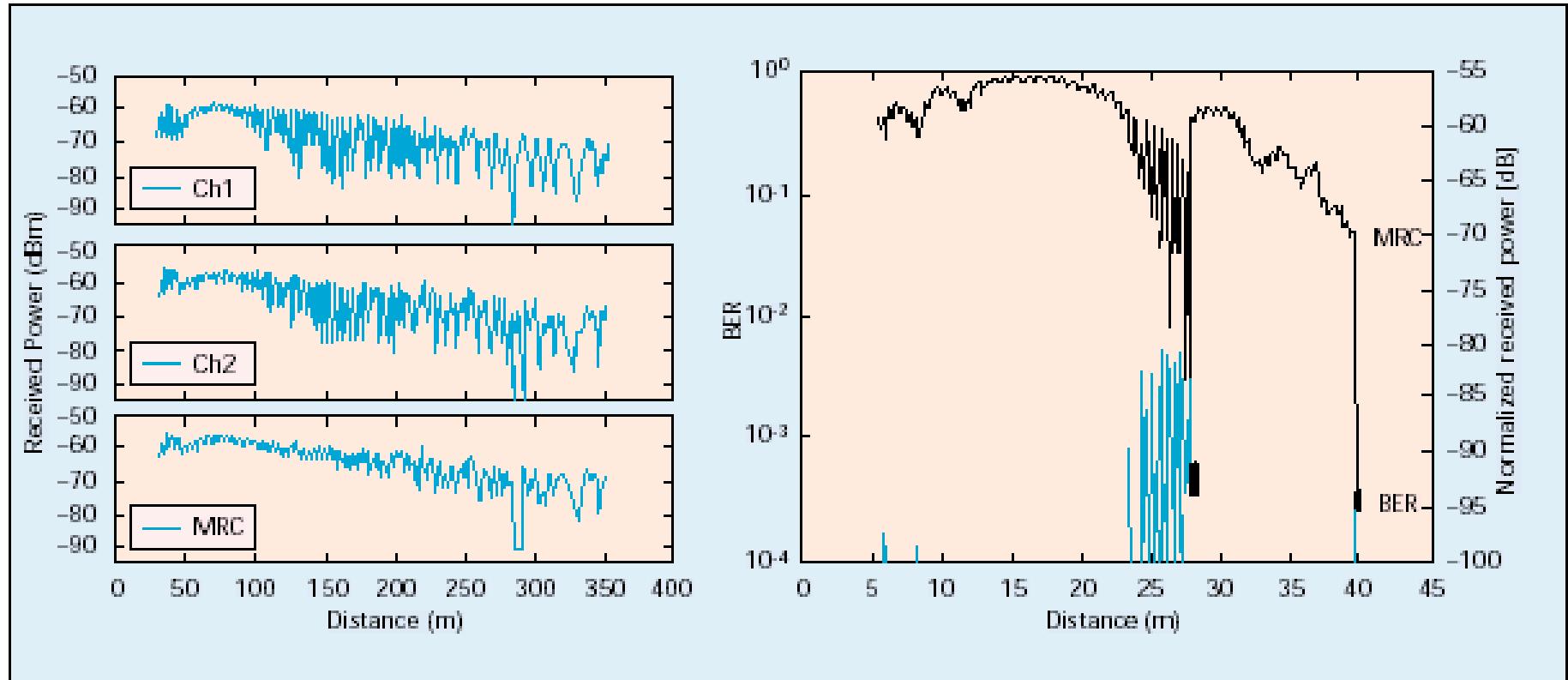
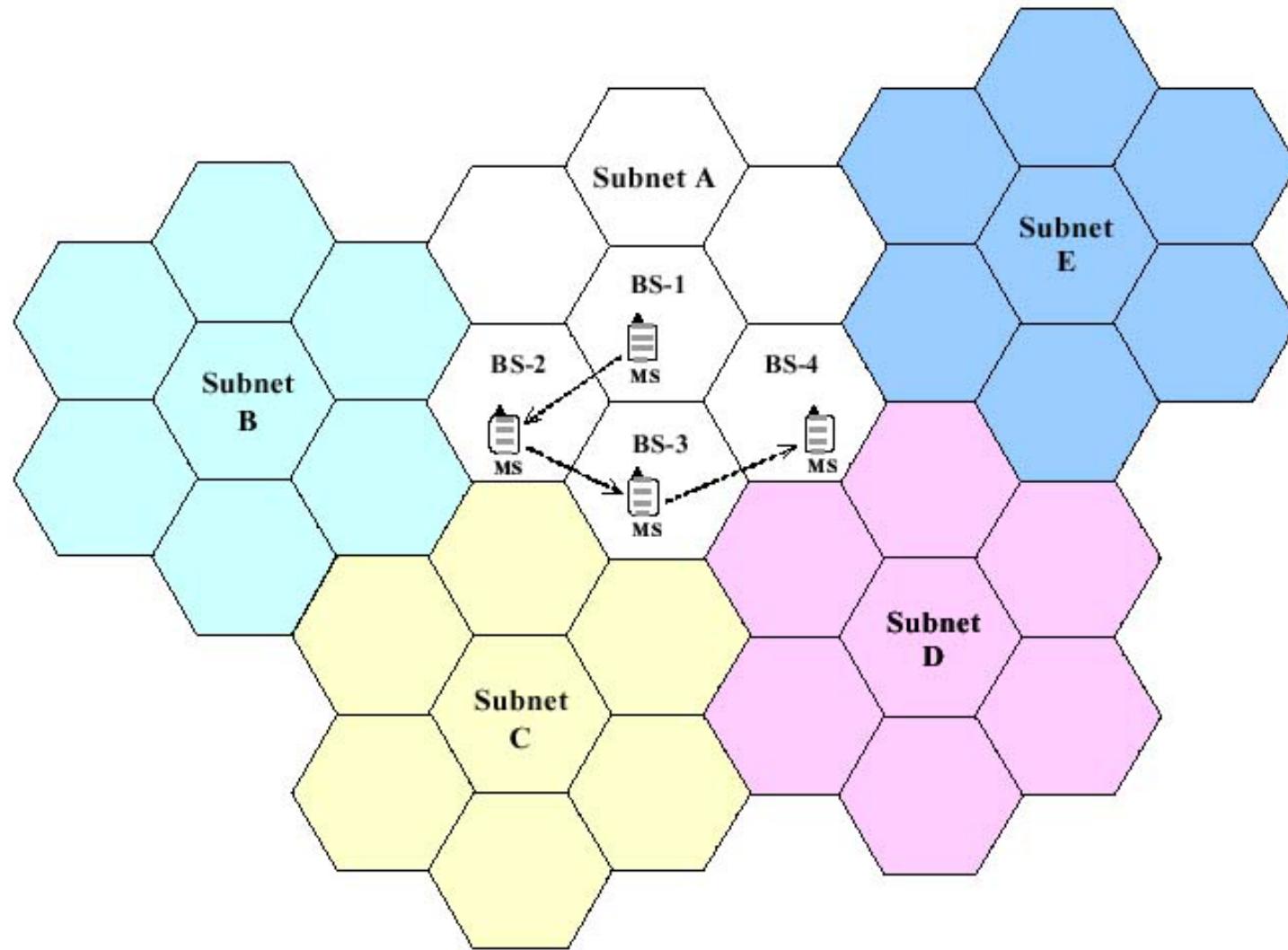


Figure 4. Received power as a function of distance: in a street (left), in a pavilion (right); BER and handover (right).

# Intra-Domain Handoff

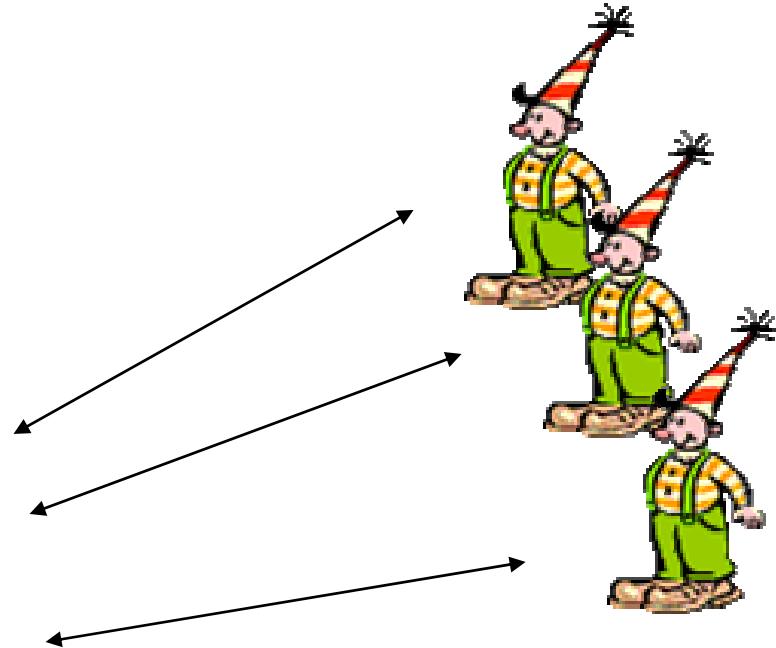
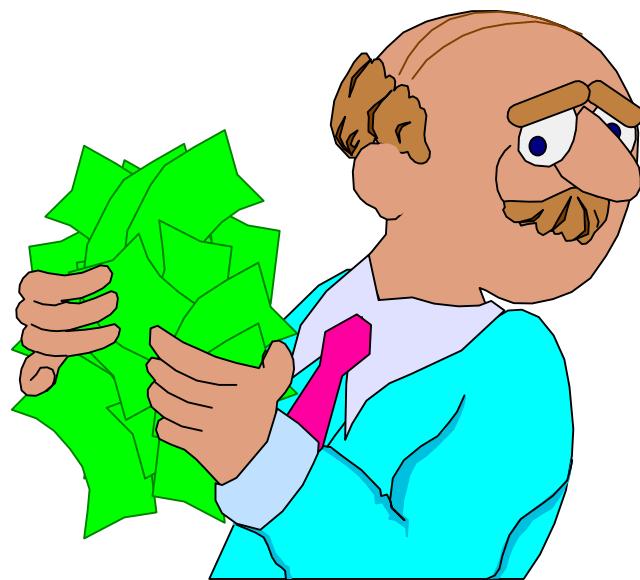


# Resource Sharing

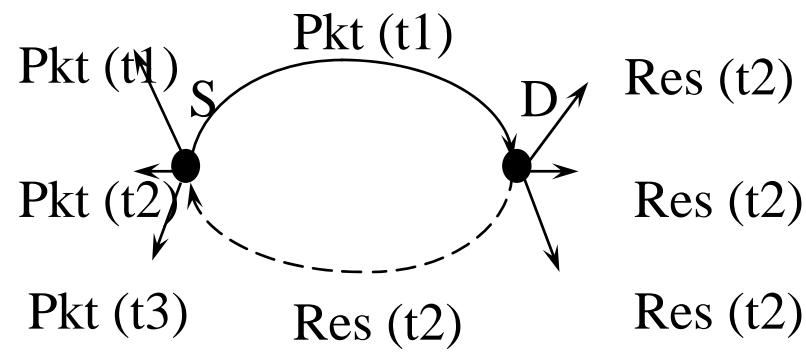
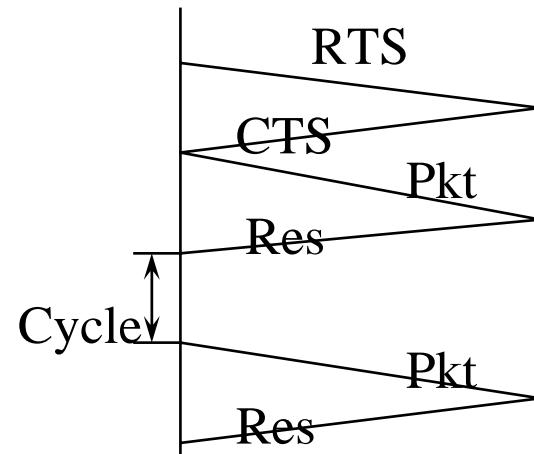
- ◆ Reservation Approaches
  - Centralized Control
  - token (round robin)
- ◆ Collision Approaches
  - fight for resource
  - distributed control

# Through A Centralized Control

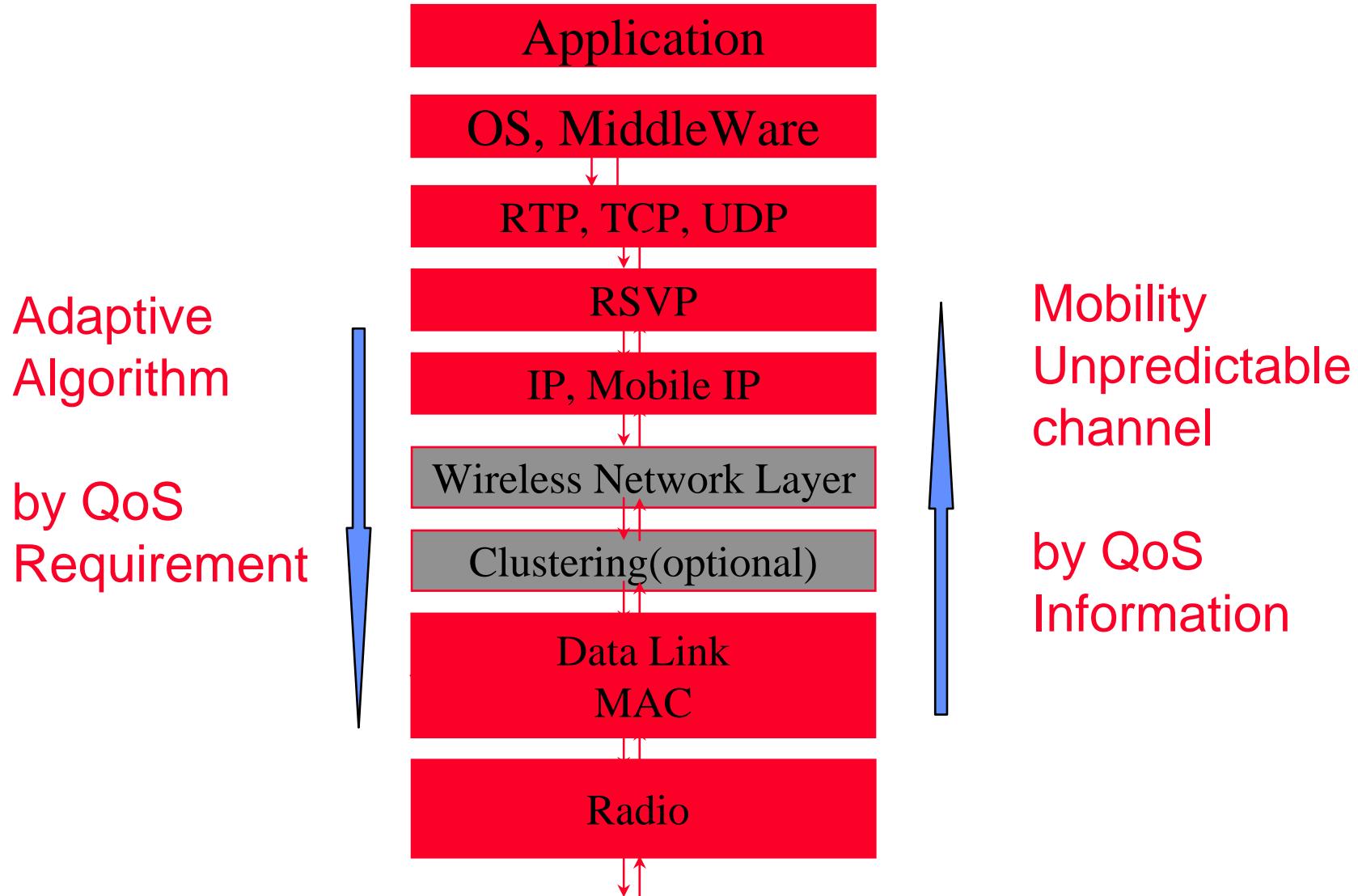
- ◆ TDMA, FDMA, CDMA



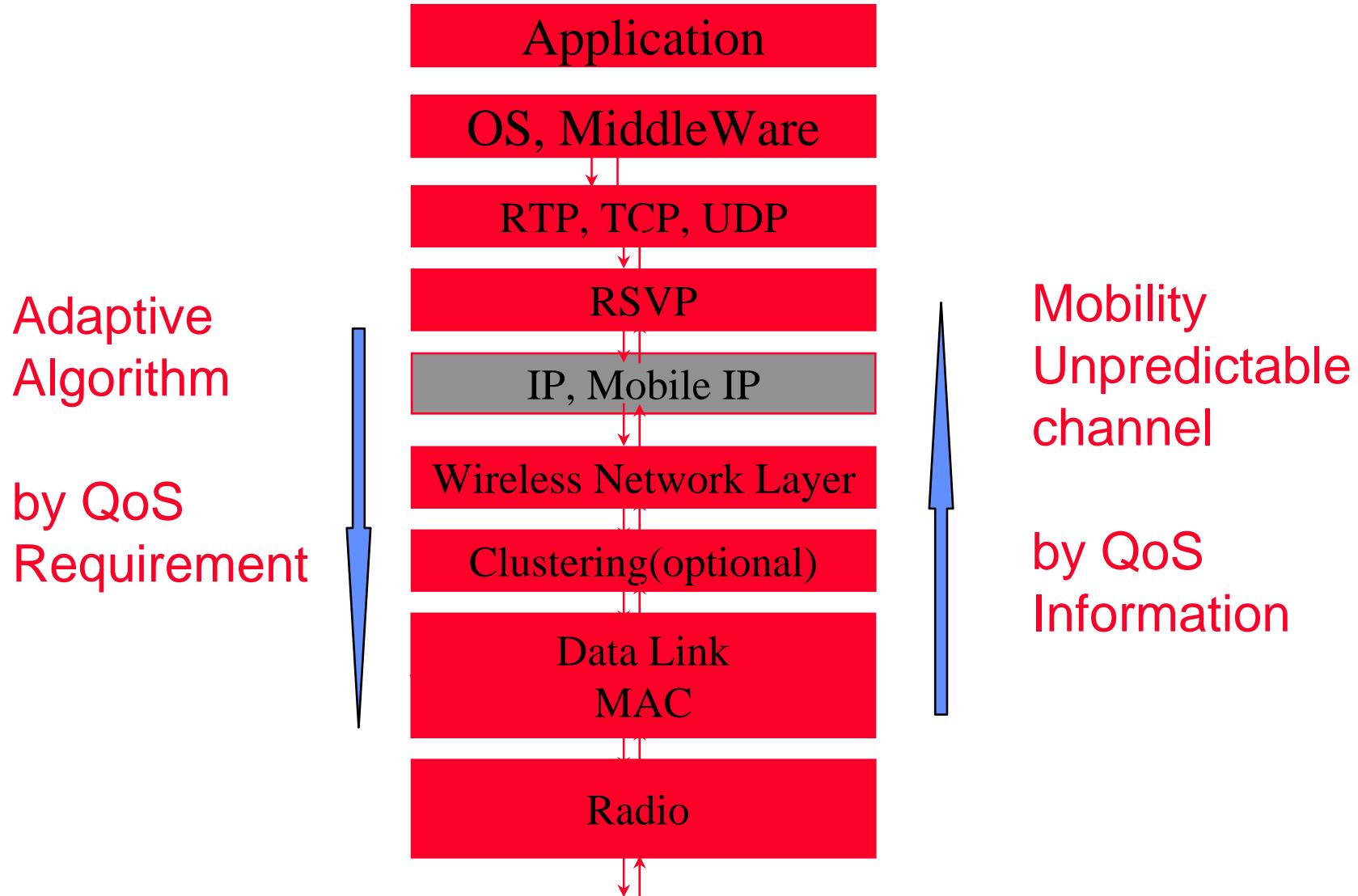
# MACA/PR



# QoS and Multimedia Traffic Support



# QoS and Multimedia Traffic Support



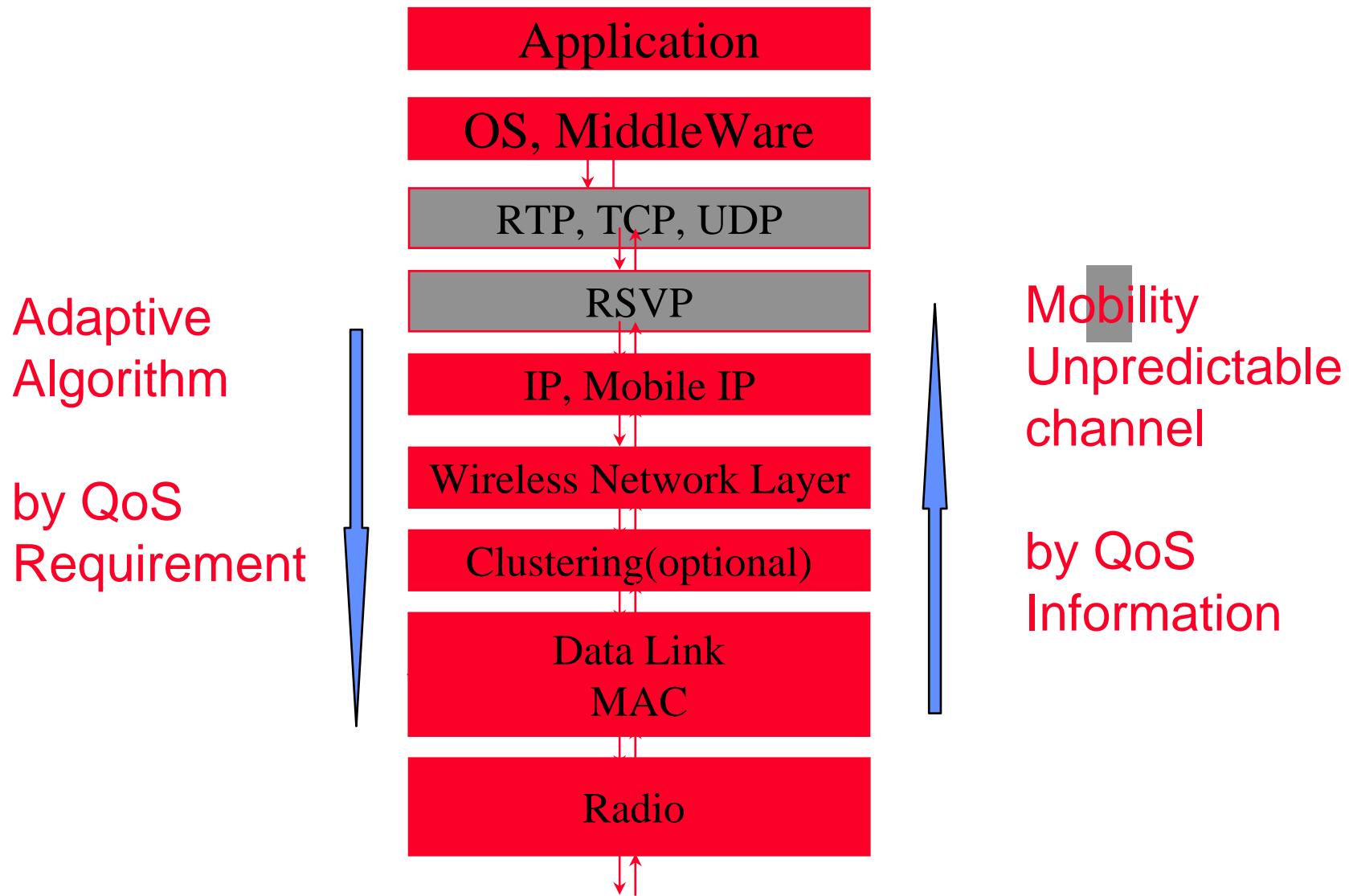
# Internetworking, IP, Mobile

## ◆ Internetworking

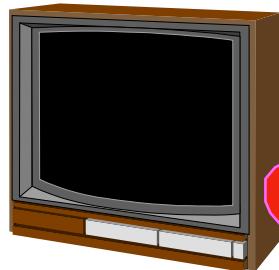
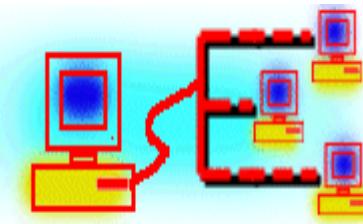
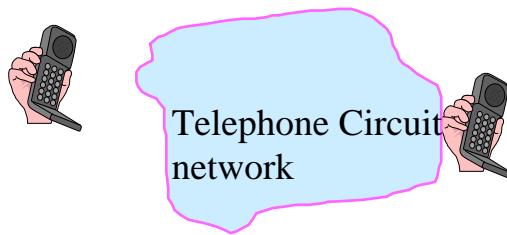
- roaming through different networks
- supporting IP format
- supporting IP portability



# QoS and Multimedia Traffic Support



# What problem does Multimedia Bring?



Integrated Service  
Packet Network



Emerging technologies:

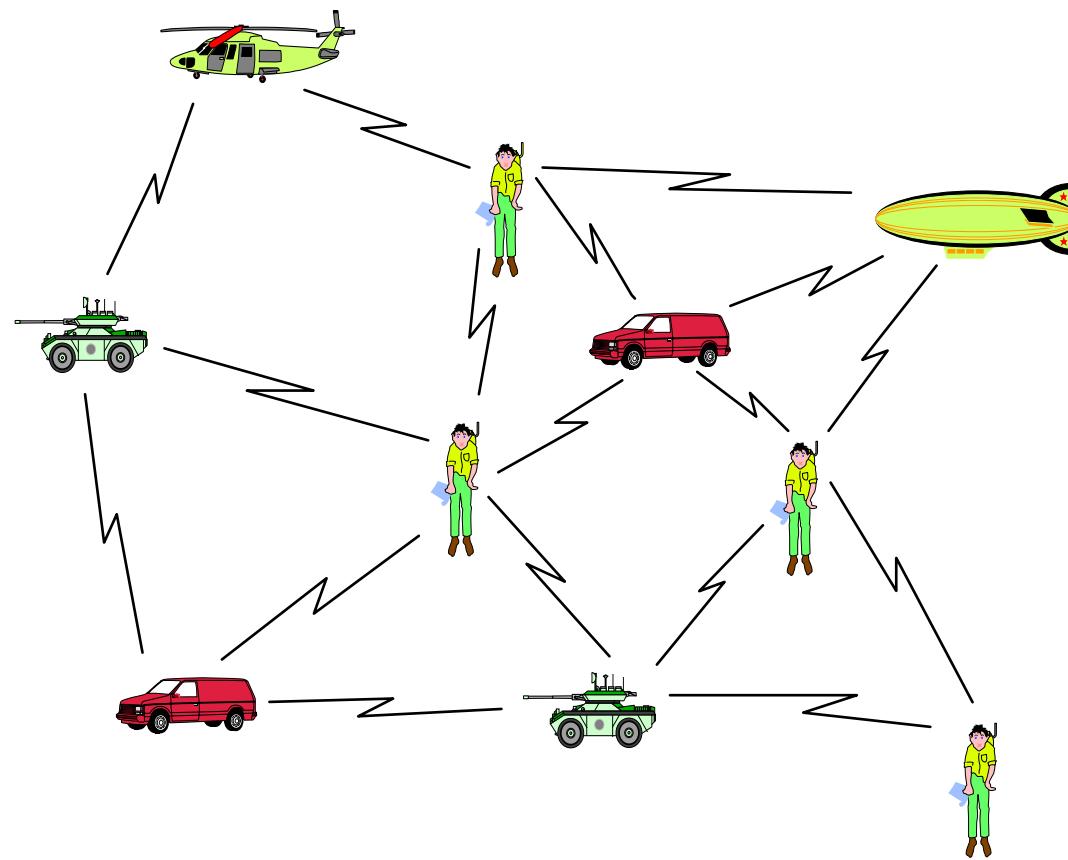
1. "Datagrams" + "Flows" IPv6
2. "Virtual Circuits" (ATM)

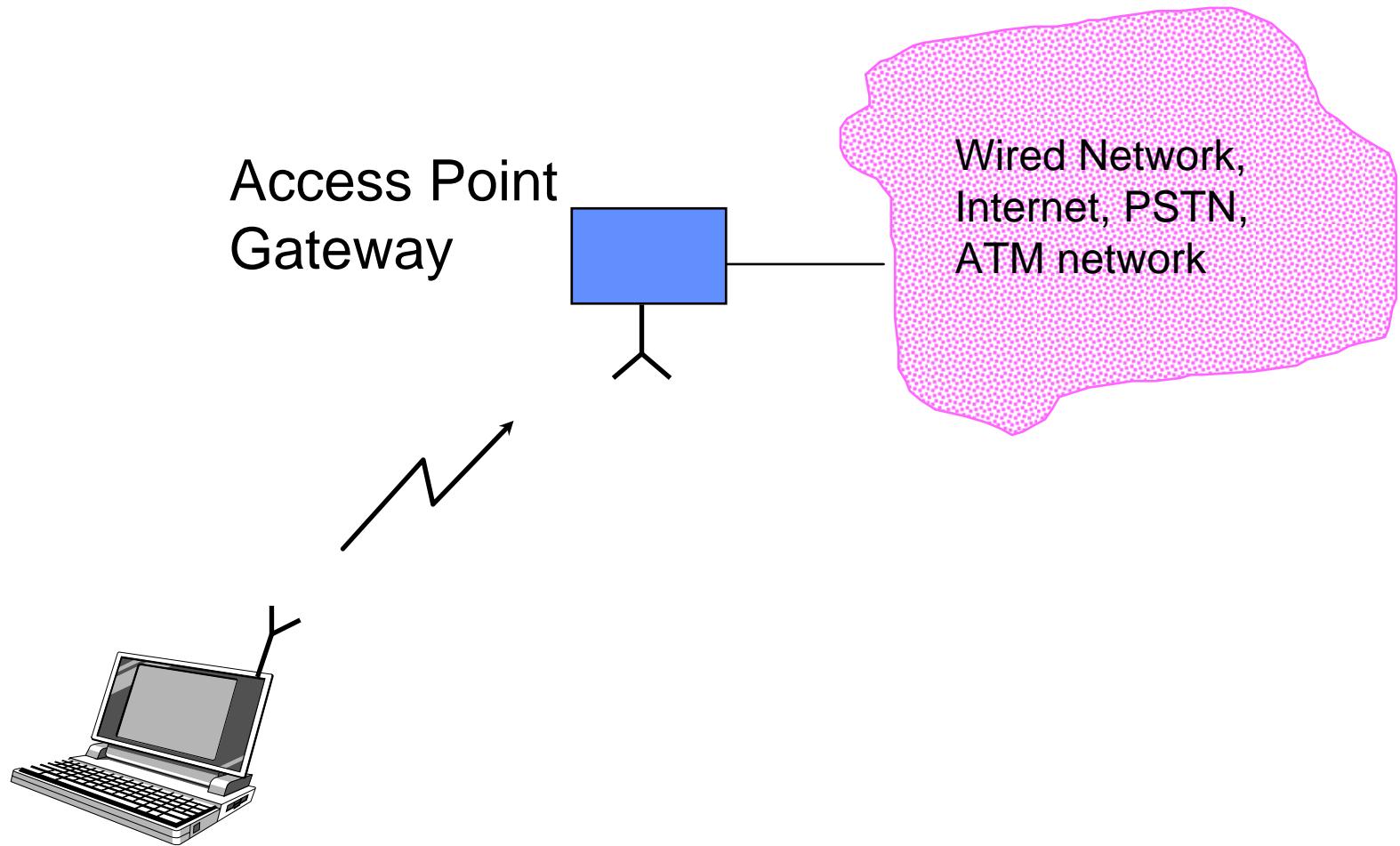
5

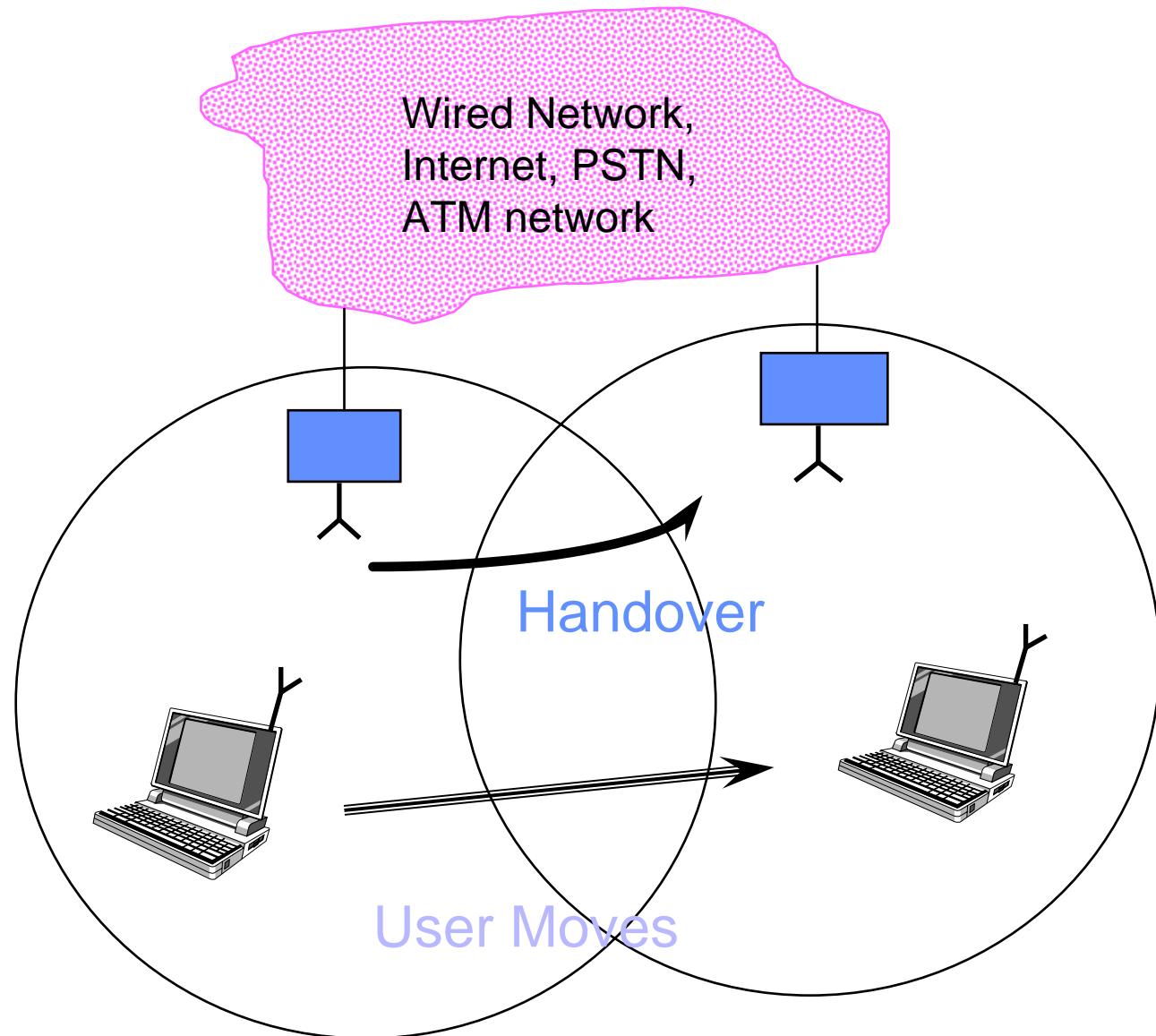
# System Configurations

- ◆ Ad hoc ~ Multi-hop
  - Wireless LAN
  - Blue-tooth
  - Packet Radio
  - WAMIS
- ◆ Cellular ~ GSM, WAP, GPRS, 3G
- ◆ Satellite ~ LEO, GEO

# Ad Hoc Wireless Network

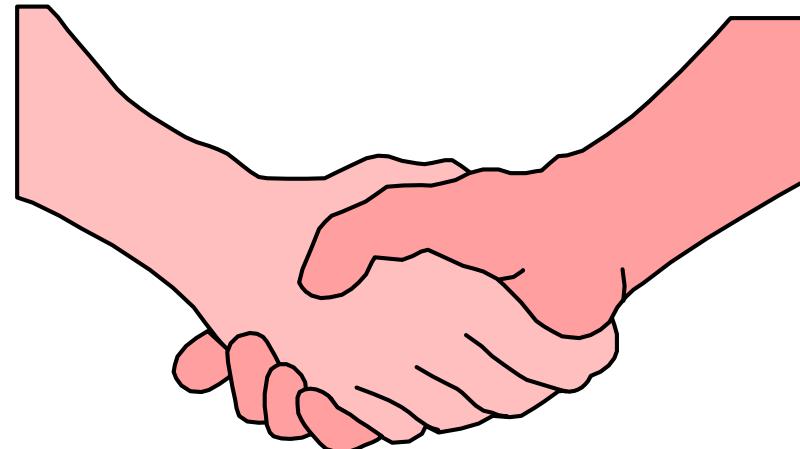






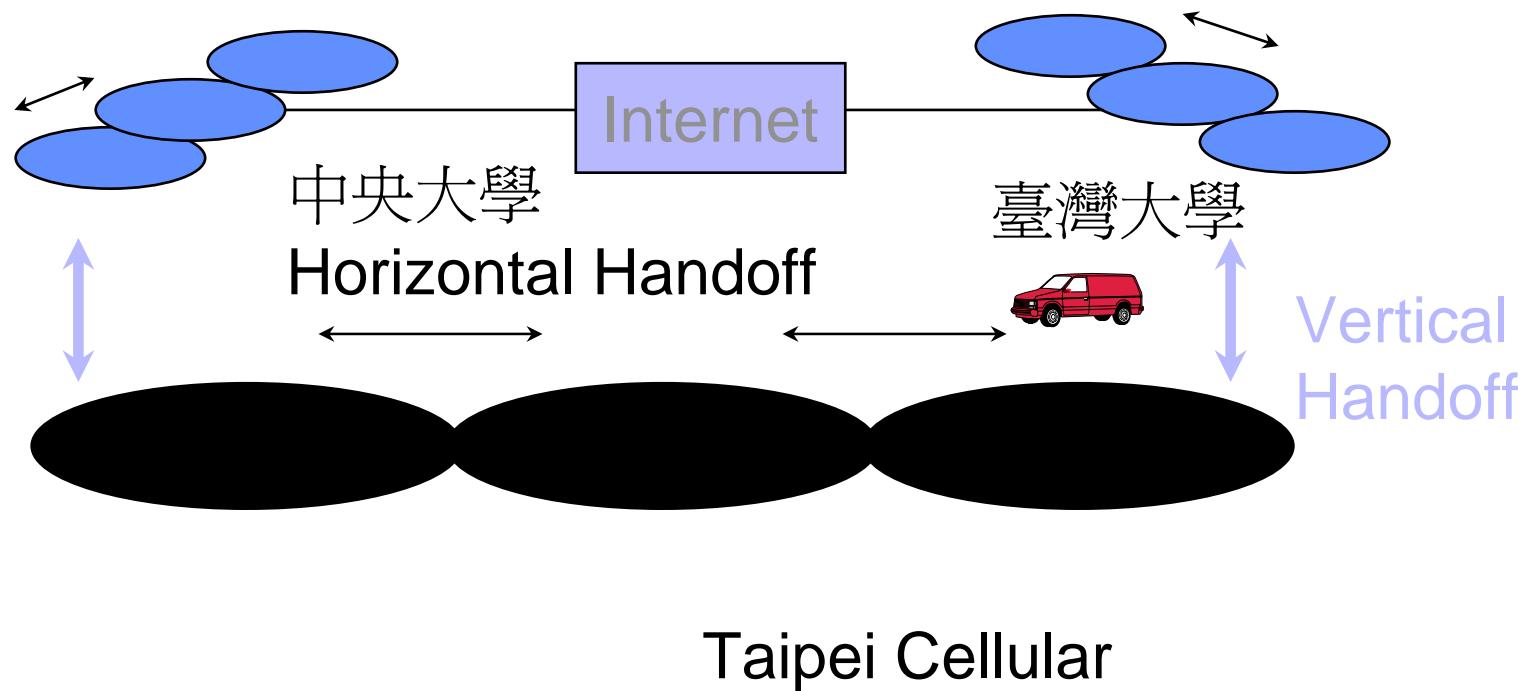
# Typical Cellular Call

- ◆ Initialization (find your base-station)
- ◆ Service Request
  - Location Level : Paging
  - Channel Assignments
- ◆ Handoff



# Wireless Comm: Heterogeneity & Security

- ◆ Heterogeneous networks



# Limited & Variable Bandwidth

- ◆ Low bandwidth compared to wired
- ◆ Highly variable bandwidth
- ◆ High latency

# Wireless Communication

- ◆ More difficult than wired communication
- ◆ Dis-connections

# Mobility

- ◆ Address migration
- ◆ Location-dependent information
- ◆ Migration locality

# Portability

- ◆ Light weight power
- ◆ Risks to data
- ◆ Small user interface
- ◆ Small storage capacity

# Challenges in Mobile Multimedia Infor- System

- ◆ Portable end-points
- ◆ End-to-end Quality of Services
- ◆ Seamless operation under context (location) changes
- ◆ Context-aware operation
- ◆ Secure operation

# Channel Propagation and Fading

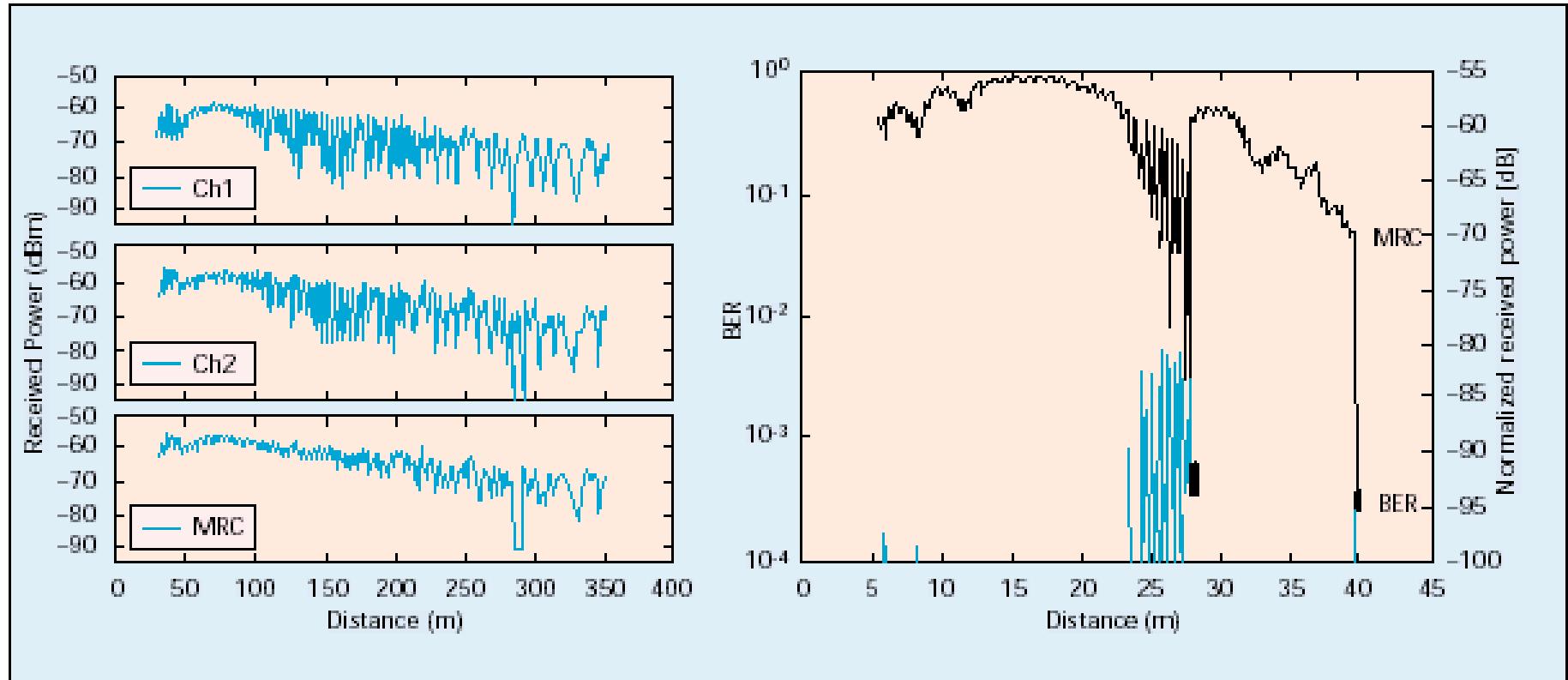


Figure 4. Received power as a function of distance: in a street (left), in a pavilion (right); BER and handover (right).