

無線網路多媒體系統 Wireless Multimedia System



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<http://wmlab.csie.ncu.edu.tw/course/wms>
2006 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?

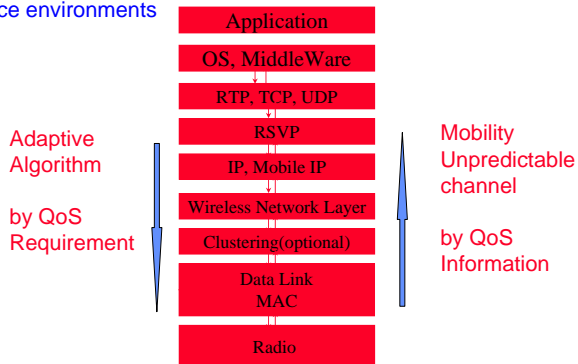


Course Contents

- ◆ 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



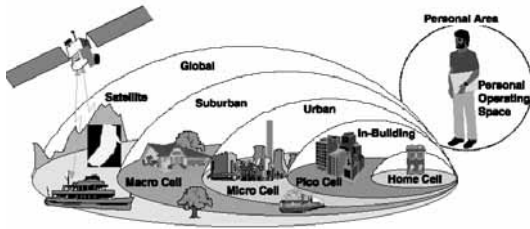
New Interests

- ◆ 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

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Adaptive Applications

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Varied type of service

Video Audio Graph Text



Adaptive application coding

High Quality Low

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Expectation of the Class

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

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Aeronautical Communications

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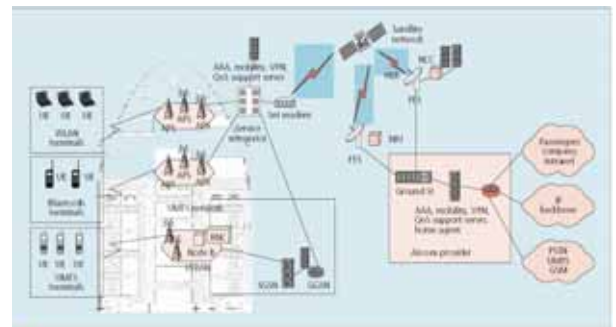


Figure 2. Aeronautical communication network architecture.

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Situation-Aware Wireless Networks

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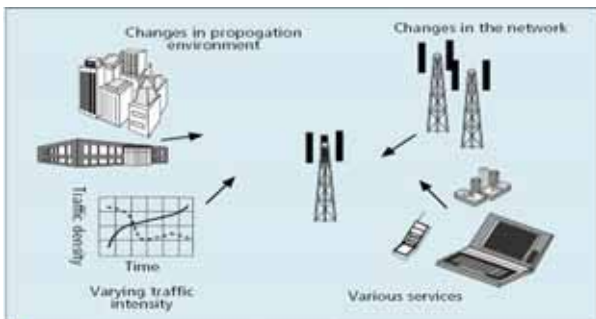


Figure 4. Situation-awareness functionality.

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Network Mobility Management

CS/E

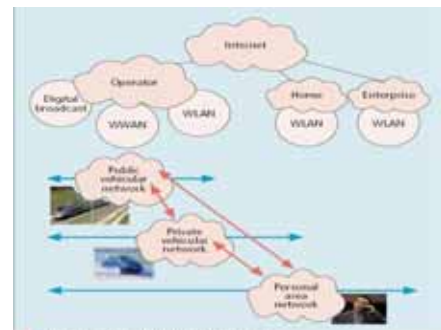
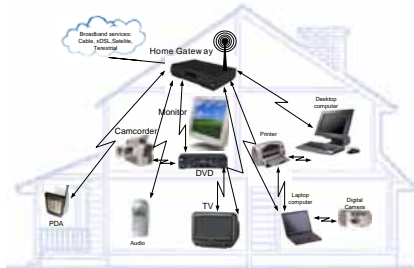


Figure 1. A mobile network in a B3G system.

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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:

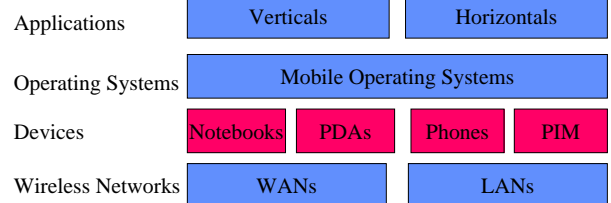
- (Cfox95) D. Cox, "Wireless Personal Communications: What is it?," IEEE Personal Communication Magazine, (April 1995) pp.20-35
- (S.2001) M. Satyanarayanan, "Pervasive Computing: Vision and Challenges", IEEE Personal Communication Magazine, (August 2001), pp.10-17
- (Bi2001) Qi Bi, George I. Zysman, 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



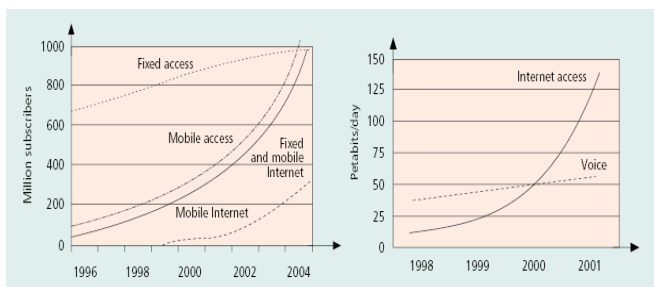
Why should we care ?



- ◆ 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

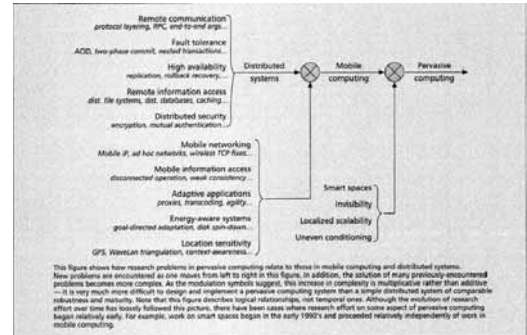
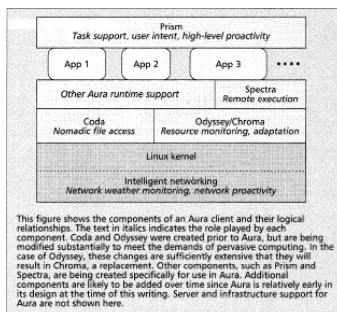


Figure 1. Taxonomy of computer systems research problems in pervasive computing.



Aura Client



This figure shows the components of an Aura client and their logical relationships. The text in *italics* indicates the role played by each component. Coda and Odyssey were created prior to Aura, but are being modified substantially to meet the demands of pervasive computing. In the case of Odyssey, these changes are sufficiently extensive that they will result in Chroma, a replacement. Other components, such as Prism and Spectra, are being created specifically for use in Aura. Additional components are likely to be added over time since Aura is relatively early in its design at the time of this writing. Server and infrastructure support for Aura are not shown here.

Figure 2. The structure of an Aura client.



Wireless Communications



Mobile Communications
Fixed Broadband Wireless Communications



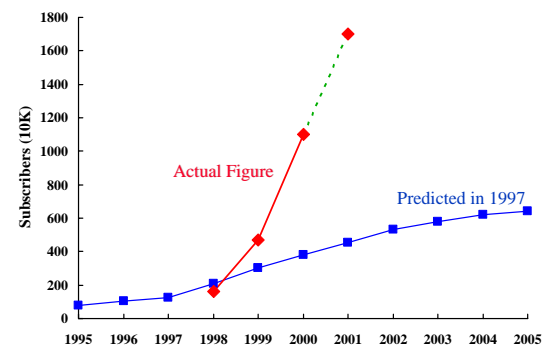
Evolution of Mobile Wireless Systems



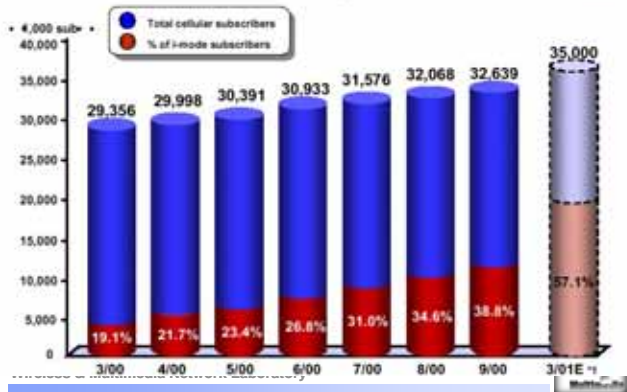
- ♦ First Generation : Analog – Voice
 - Analog modulation
 - Cellular phone (AMPS) with manual roaming
 - Cordless phones
 - Packet radio networks
- ♦ Second Generation : Digital - Voice & Data
 - WAP (wireless application protocol)
 - 2.5 G GPRS
 - Wireless data LANs (802.11), MANs (Metricom), WANs (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

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2000 Market Share

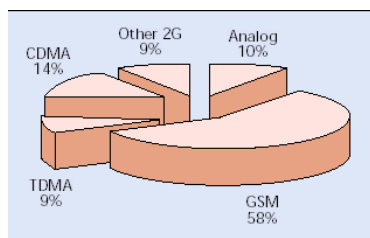


Figure 5. Estimated market shares of 1G and 2G wireless mobile systems in 2000.

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Mobile Terminal Growth

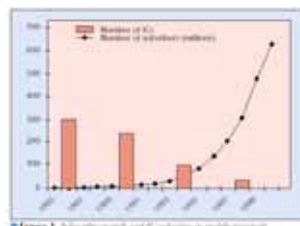
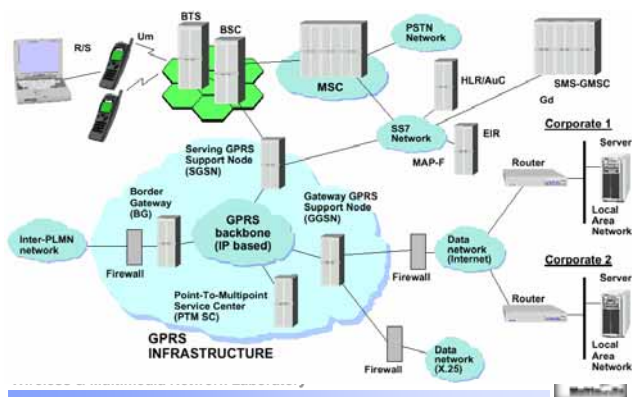


Figure 1. Subscriber growth and 2G adoption in mobile terminals.



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GPRS Architecture



RS Spectrum Allocation

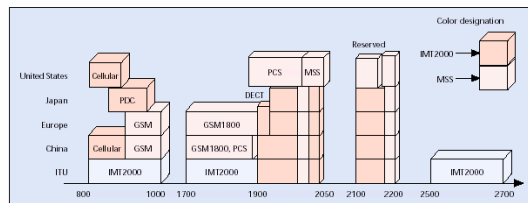
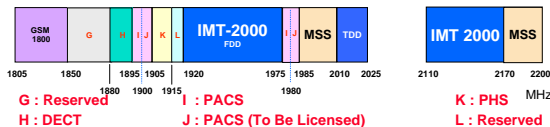


Figure 2. RF spectrum allocation in major regions.



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Wireless Mobile Interface

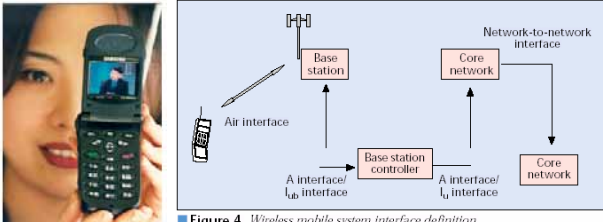
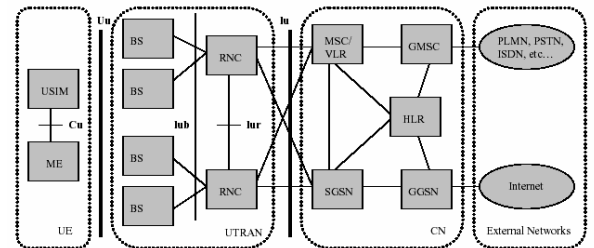


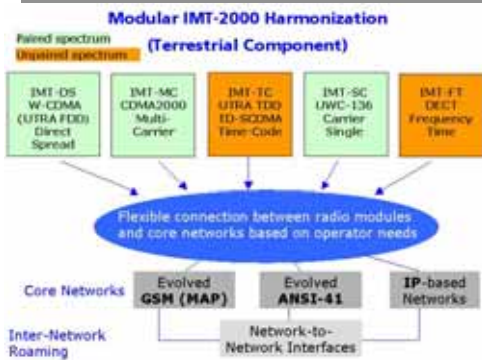
Figure 4. Wireless mobile system interface definition.



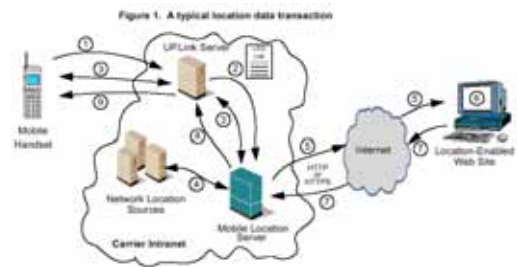
Elements of UMTS Architecture



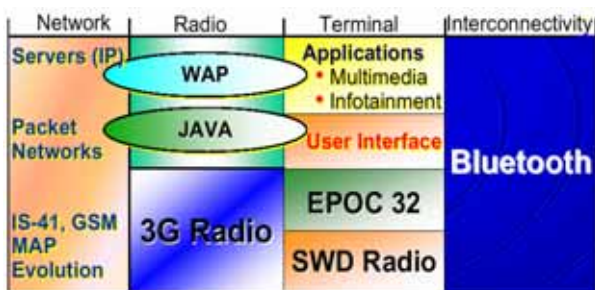
第三代行動電話之技術標準



Location-Based Applications



3G-Network integration



Mobile Broadband System

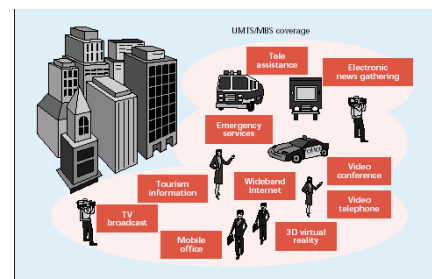
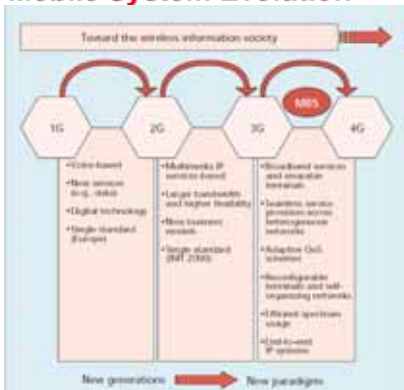


Figure 1. ABS and UMTS coverage and applications.



Mobile System Evolution

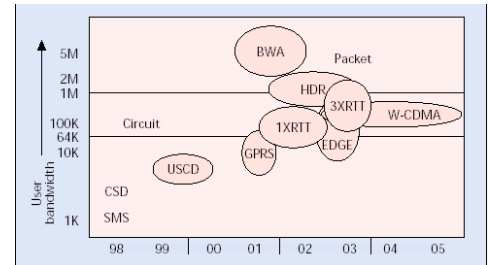
CS/E



Wireless & Multimedia Network Laboratory™ Figure 5. Mobile communication system evolution

Wireless
Multimedia

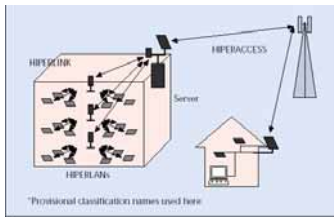
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Multimedia

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Wireless
Multimedia

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WiMAX Nomadic and Portable



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

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19

Wireless
Multimedia

CS/E

AIRreach™
BROADBAND

National Central University
&
Hughes Network Systems
LMDS Demo Briefing

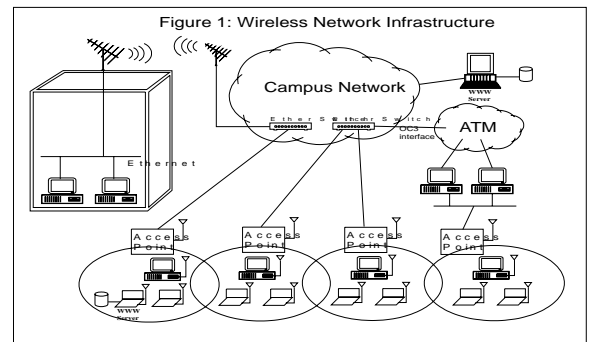
November 1999

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Wireless
Multimedia

CS/E

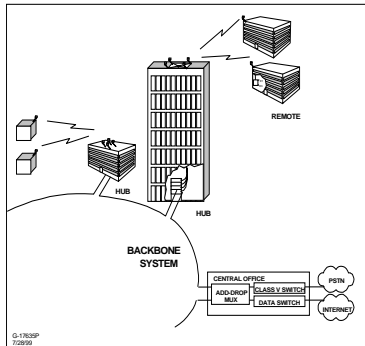
Campus Network



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Wireless
Multimedia

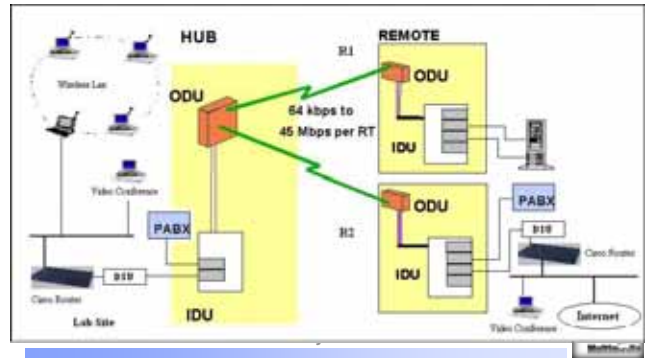
LMDS NCU Test-bench



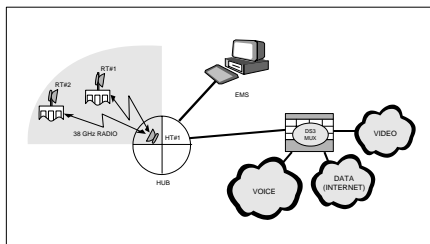
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Architecture of the Demo



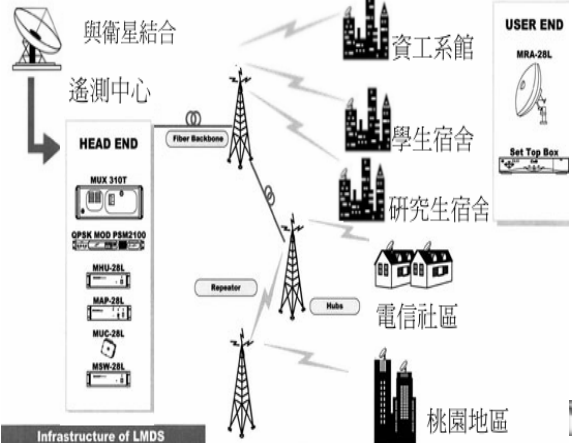
National Central University Demo Layout



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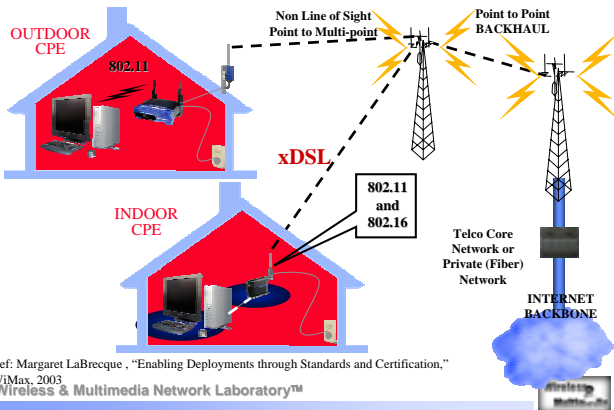
Step.1 LMDS Architecture



Infrastructure of LMDS

11

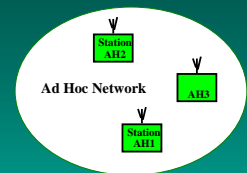
WiMAX Consumer Last Mile



Ref: Margaret LaBrecque, "Enabling Deployments through Standards and Certification," WiMax, 2003
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18

IEEE 802.11 Configurations - Independent



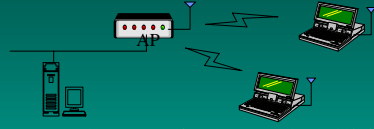
- Independent
 - one Basic Service Set - BSS
 - Ad Hoc network
 - direct communication
 - limited coverage area

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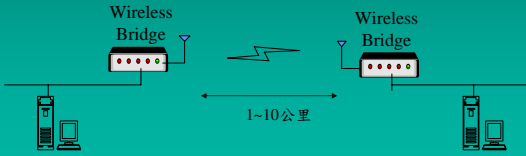


Topology of a Wireless LAN

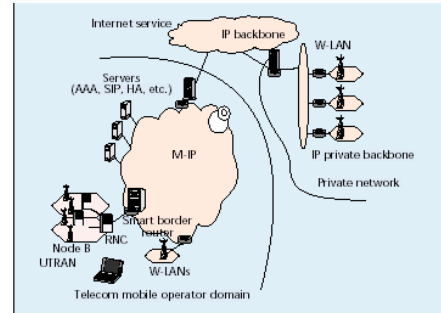
進接(Access)應用: 使用者與網路的連接



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。



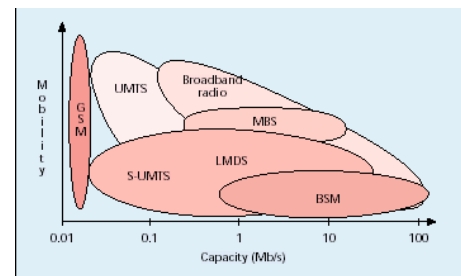
IP integration



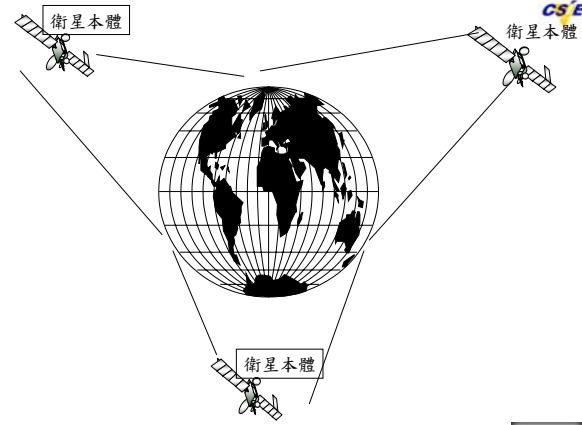
WiMedia Solutions – Simple Usage



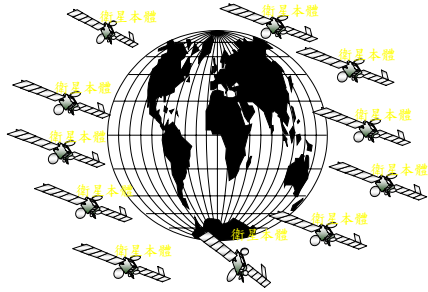
Capacity and Mobility



地球村的建立



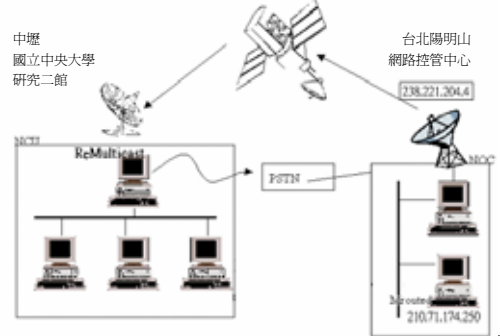
Sky of Satellites



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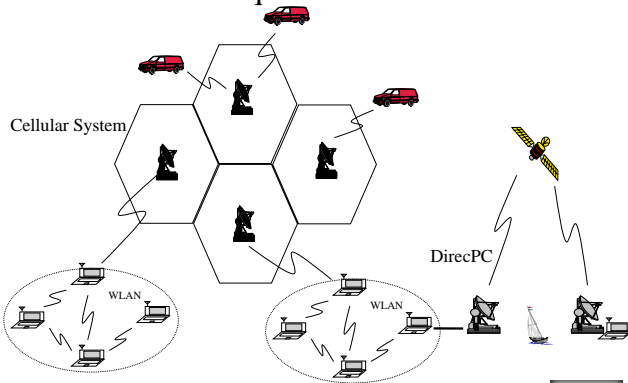
DirecPC Satellite Experiments



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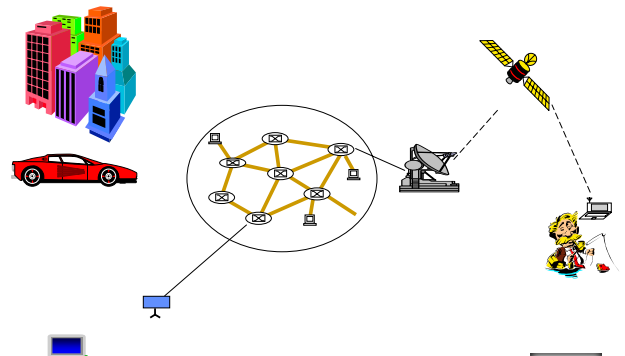
Ubiquitous Access



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"Anytime Anywhere" Information System



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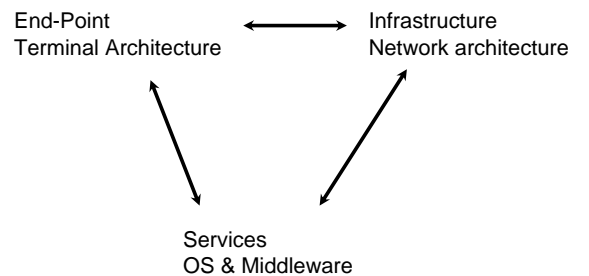
Fundamental Issues



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Three System Components



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Personal area network

CS'E



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Connect devices to internet on the mobile infrastructure world wide

CS'E

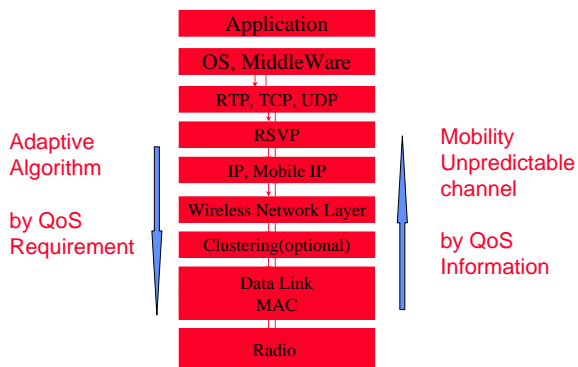


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QoS and Multimedia Traffic Support

CS'E

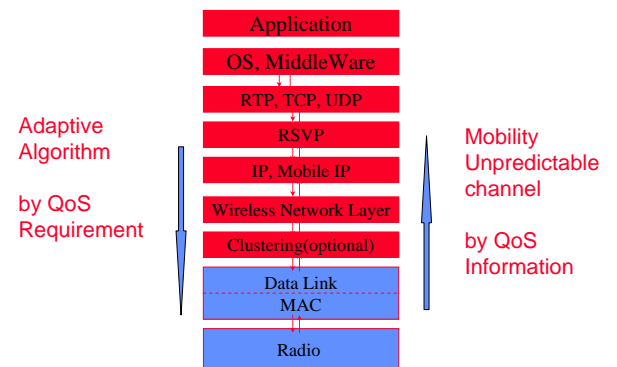


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QoS and Multimedia Traffic Support

CS'E



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Channel Propagation and Fading

CS'E

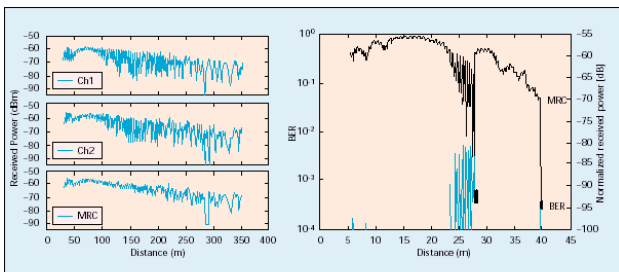


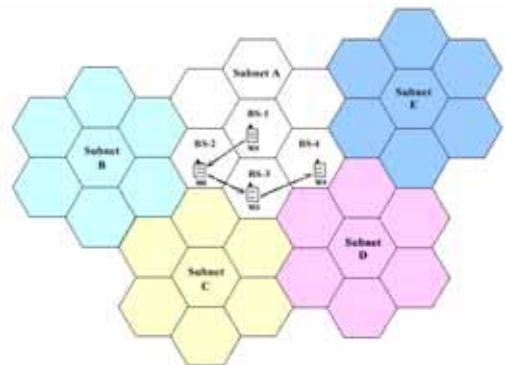
Figure 4. Received power as a function of distance: in a street (left), in a pavilion (right), BER and handover (right).

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Intra-Domain Handoff

CS'E



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Resource Sharing



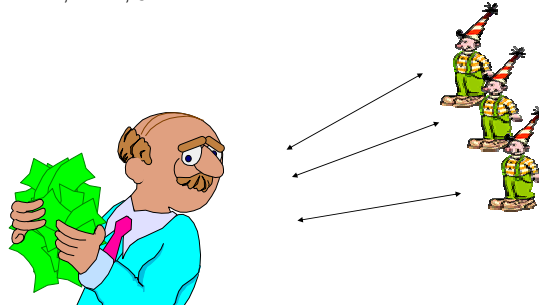
- ◆ Reservation Approaches
 - Centralized Control
 - token (round robin)
- ◆ Collision Approaches
 - fight for resource
 - distributed control



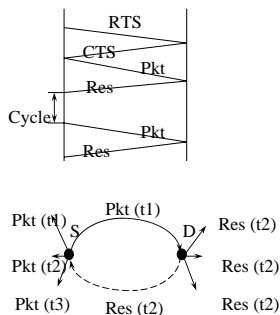
Through A Centralized Control



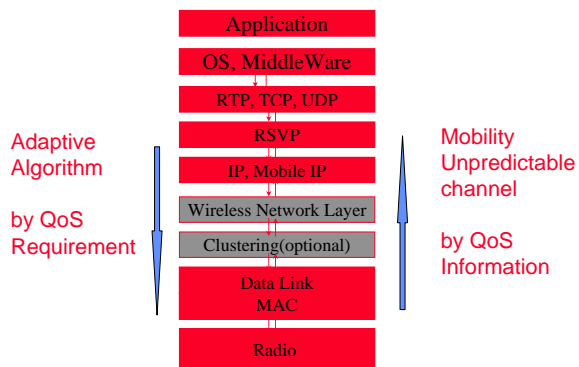
- ◆ TDMA, FDMA, CDMA



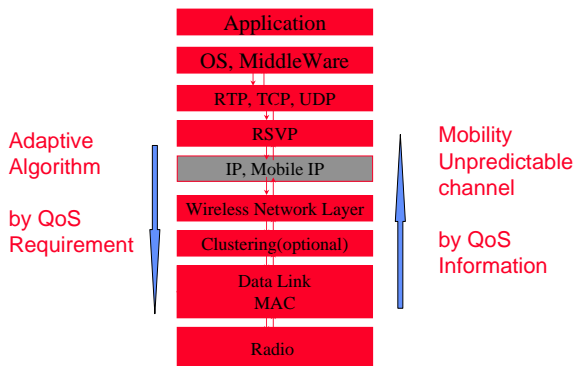
MACA/PR



QoS and Multimedia Traffic Support



QoS and Multimedia Traffic Support



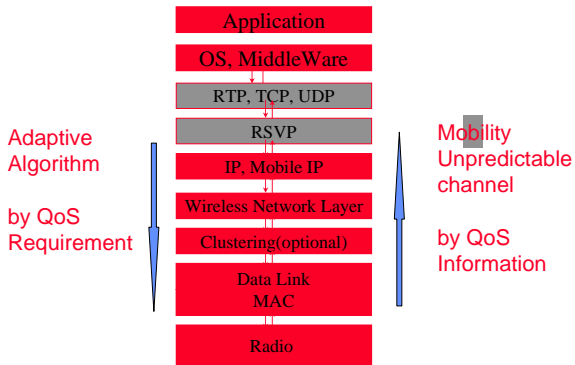
Internetworking, IP, Mobile



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



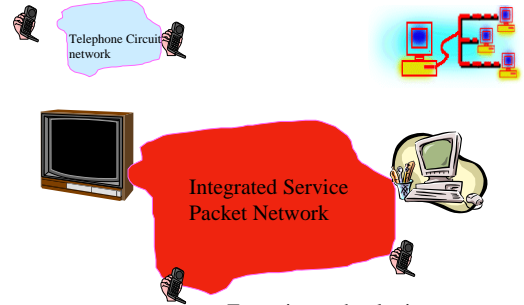
QoS and Multimedia Traffic Support



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What problem does Multimedia Bring?



Emerging technologies:

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

5

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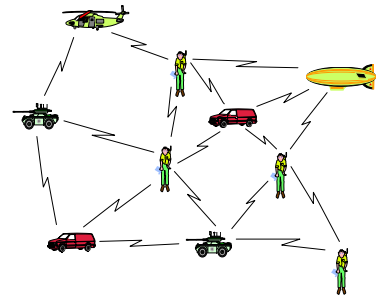
System Configurations

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

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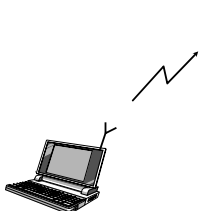
Ad Hoc Wireless Network



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Access Point Gateway

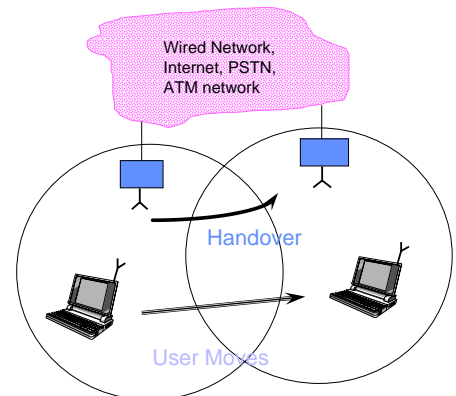


Wired Network, Internet, PSTN, ATM network

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Wired Network, Internet, PSTN, ATM network



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Typical Cellular Call



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



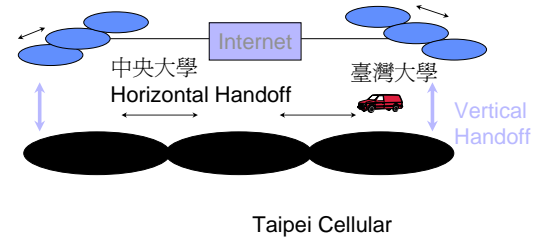
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Wireless Comm: Heterogeneity & Security



- ◆ Heterogeneous networks



Taipei Cellular

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Limited & Variable Bandwidth



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

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Wireless Communication



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

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Mobility



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

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Portability



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

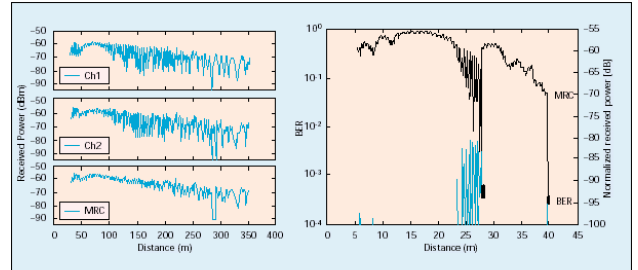
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Challenges in Mobile Multimedia Infor-^{CS'E} System

- ◆ 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).