

無線網路多媒體系統 Wireless Multimedia System



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2012 Fall

First Week Agenda

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

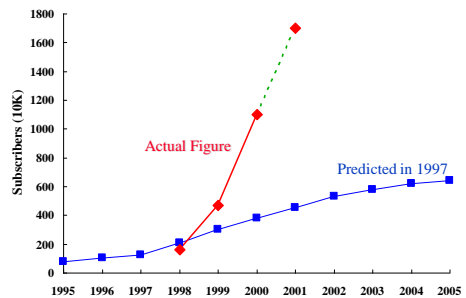


Course Contents

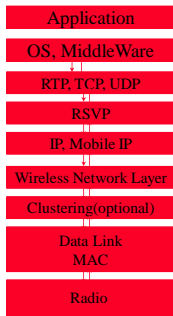
- ◆ Fundamental Wireless Technology
 - Propagation Model
 - Wireless Medium Access
 - Transport Solutions
 - Ad hoc/Mesh Wireless System
 - Cellular System
 - Middleware Systems
 - Multimedia System
- ◆ Advanced Wireless Technology
 - Multicasting
 - Beyond 3G
 - Routing Algorithms/Mesh Network/VANET
 - QoS/ Reliable Multimedia Transmissions



台灣行動電話發展趨勢圖



Roaming Across a variety of heterogeneous network and service environments

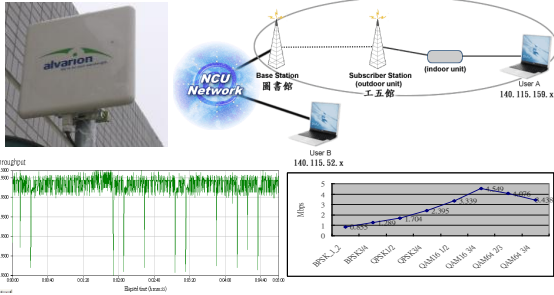


WiMAX Nomadic and Portable



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

WiMAX 802.16



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WiMAX

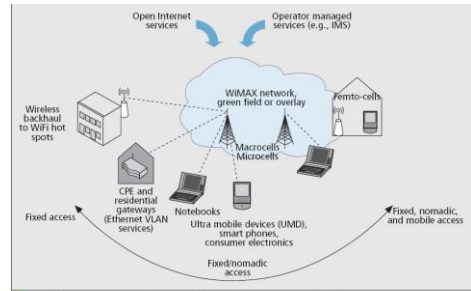


Figure 1. Mobile WiMAX enabling a variety of usage models in the same network.

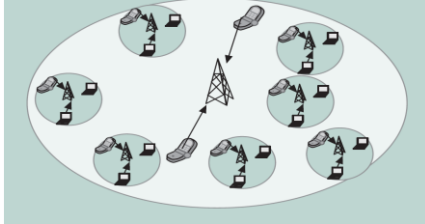
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Femtocell



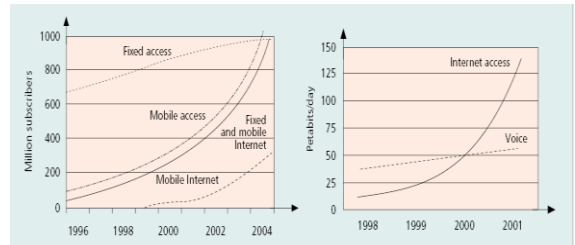
Femtocell: Consumer installed wireless data access point inside homes, which backhauls data through a broadband gateway (DSL/cable/Ethernet/WiMAX) over the Internet to the cellular operator network.



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



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25Gb/s(km²)

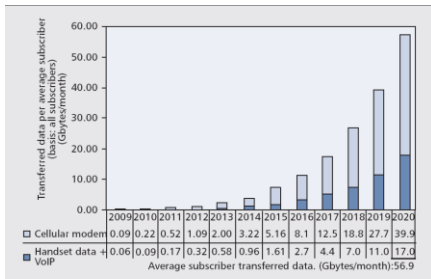


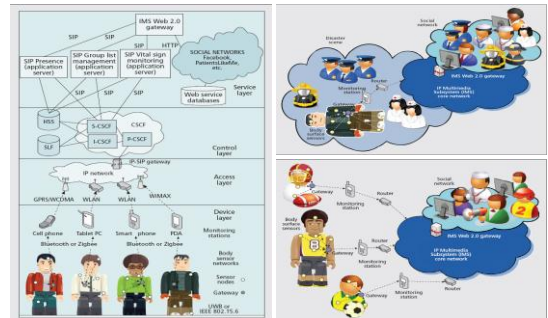
Figure 1. Growth of transferred data in Western Europe.

IEEE Communications Magazine • February 2011

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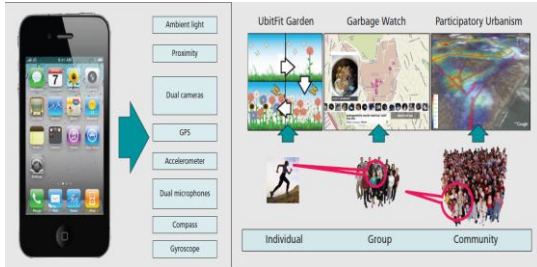
Context Aware Services



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Mobile Sensing



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Recent Wireless Technologies

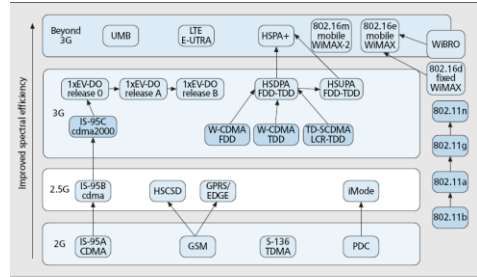
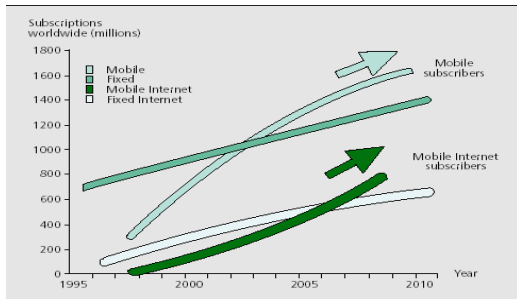


Figure 1. Evolution and backward compatibility of air interface technologies.

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Forecast number of subscribers



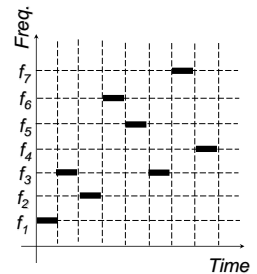
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Frequency Hopping Spread Spectrum



- Transmitted signal is spread over a wide range of frequencies. (i.e. 2.400-2.485 GHz)
- Transmission usually hop 35 times per second.



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Direct Sequence Spread Spectrum



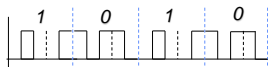
To transmit a 0 the station use a unique "chip sequence":



To transmit a 1 the station use the one's complement of its chip sequence:



Therefore if data is 1010 it will transmit:



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DS-CDMA

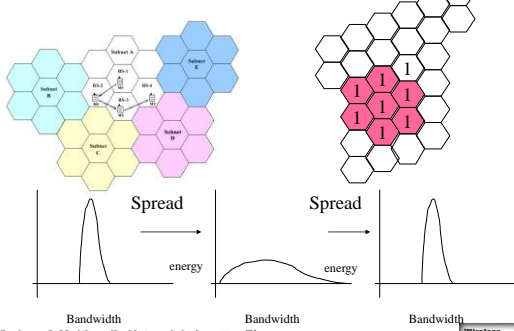


- Processing Gain:
- SF=2 cases:
 - $(1, 1) \otimes (1, 1) = 1+1=2$ (Processing Gain)
 - $(1, 1) \otimes (1, -1) = 1-1=0$ (orthogonal)
- SF=4 cases:
 - $(1, 1, 1, 1) \otimes (1, 1, 1, 1) = 1+1+1+1=4$ (Processing Gain)
 - $(1, 1, 1, 1) \otimes (1, 1, -1, -1) = 1+1-1-1=0$ (Orthogonal)
- SIR = Pr * Processing Gain / Interference
- = Pr * (Total_Radio_Frequencyband / Bitrate) / Interference

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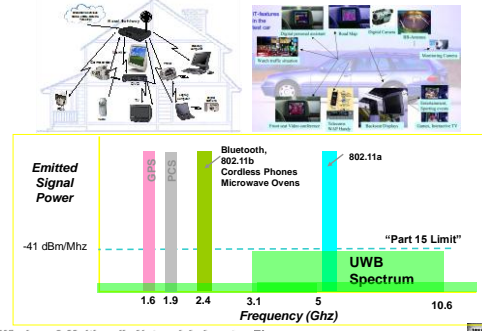
Narrowband vs. Wideband



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Wireless Multimedia

Ultra-Wideband Radio

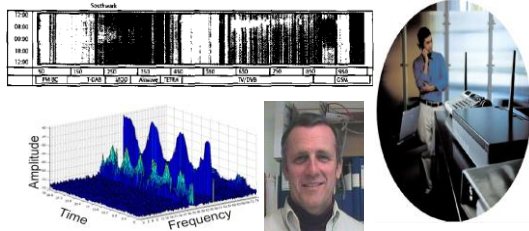


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Wireless Multimedia

CR (Cognitive Radio)

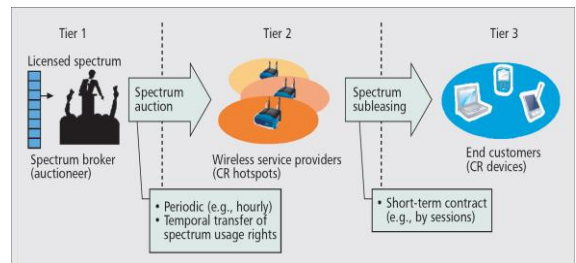
- The CR idea was initially introduced by Joseph Mitola. On average, only 2% of allocated spectrum in the U.S. is actually in use



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Wireless Multimedia

Wi-Fi 2.0



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Wireless Multimedia

A 60 GHz Wireless Network

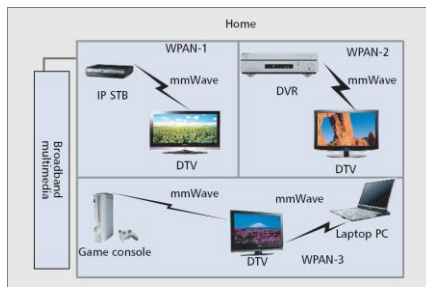
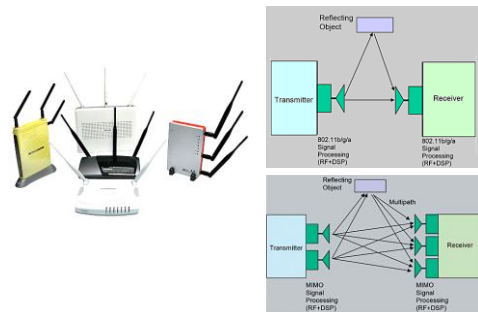


Figure 1. Configuration of gigabit WPANs in a typical home environment.

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Wireless Multimedia

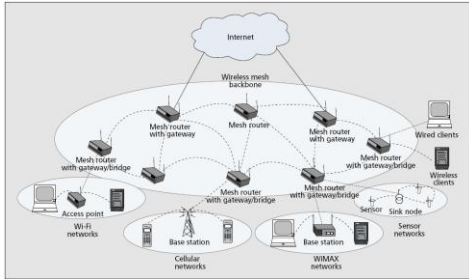
Multi-channel, Multi-Radio, MIMO



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Wireless Multimedia

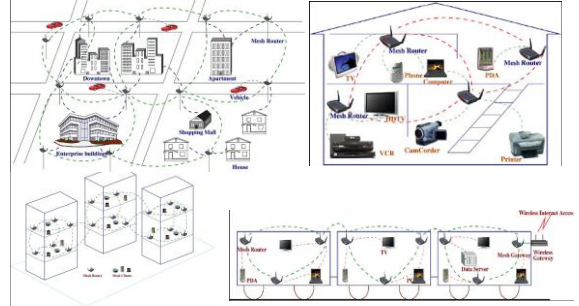
Wireless Mesh Network.



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Mesh Network Scenario



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Aeronautical Communications

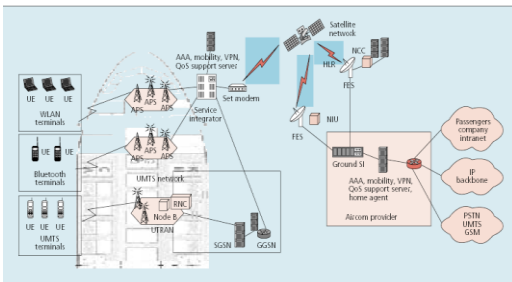
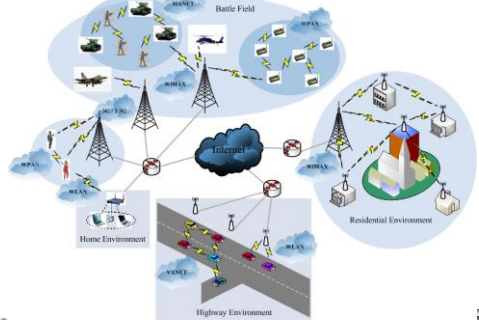


Figure 2. Aeronautical communications network architecture.

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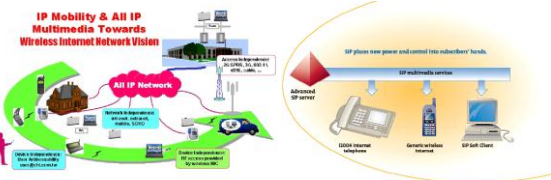
Wireless Applications Scenario



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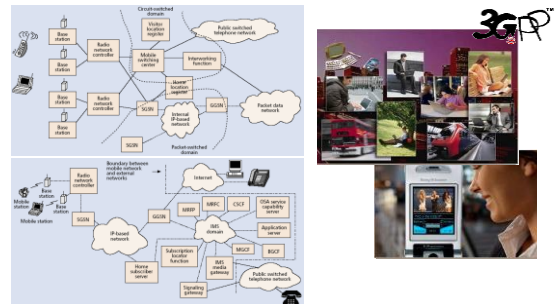
Multimedia over IP



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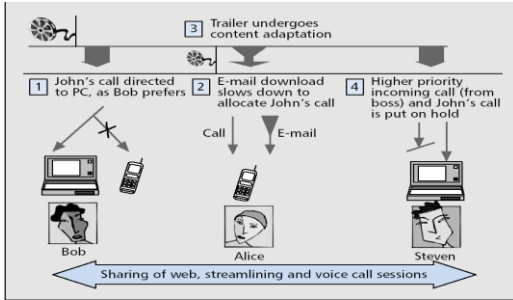
3GPP - Release 5 IMS & HSDPA



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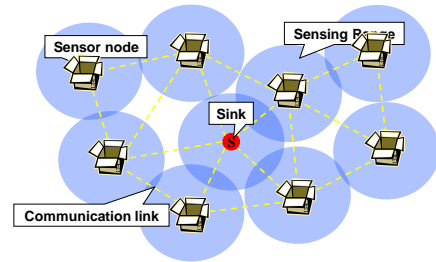
IMS Service Scenario



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Wireless sensor network: data gathering



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Video Transmission in VANET



GPS gets instant video streams from the surveillance cameras at an intersection.

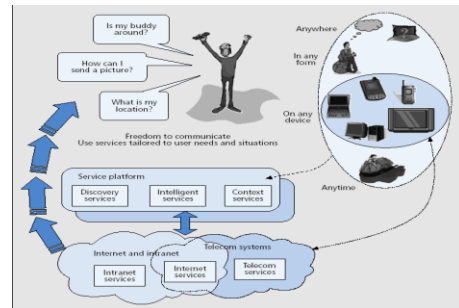
The driver can get a better view of the traffic.



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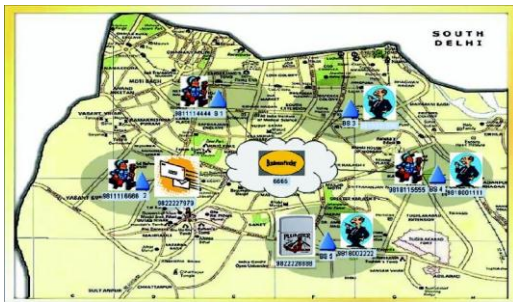
Context Aware Communication



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Business Finder



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Adaptive Applications



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Situation-Aware Wireless Networks

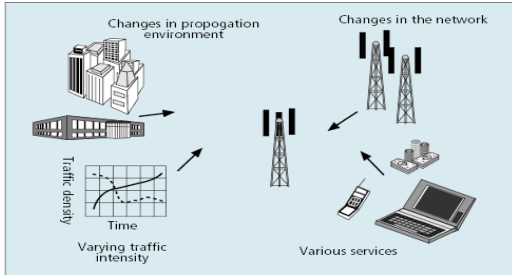


Figure 4. Situation awareness functionality.

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Network Mobility Management

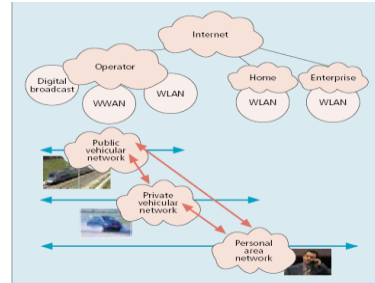


Figure 1. A mobile network in a 3G system.

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IEEE 802.11 WLAN

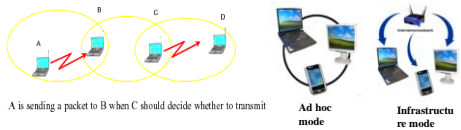
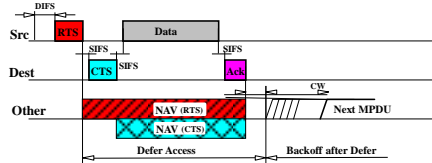


Fig. 1. A is sending a packet to B when C should decide whether to transmit to D.



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802.11 family

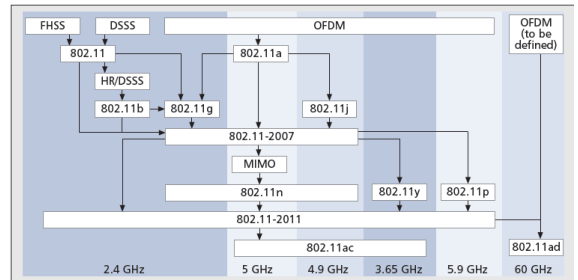
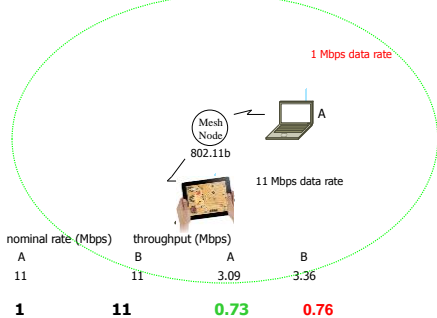


Figure 1. The 802.11 PHY layer amendments and their dependencies.

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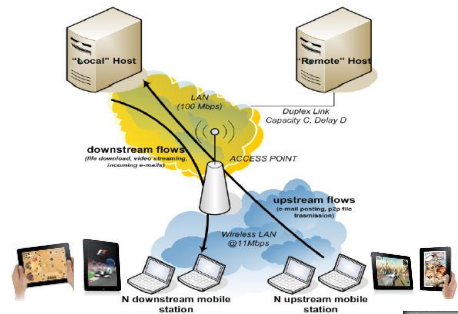
Quiz 0: WLAN Performance Anomaly Problem



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Fairness for upstream and downstream



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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

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Course Process



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

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Mobile Computing



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Mobile phone today =
multipurpose terminal for ...



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Reading list for This Lecture



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

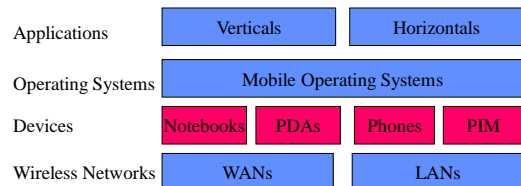
Reference Papers:

- (Heusse 2003) M Heusse, F Rousseau, G Berger-Sabbatel, A Duda – "Performance anomaly of 802.11" IEEE INFOCOM, 2003
- (Guido 2010) Guido R. Hiertz, Dee Denteneer, Lothar Stibor, Yunpeng Zang, Xavier Perez Costa, Bernhard Walke, "The IEEE 802.11 Universe". IEEE Communication Magazine January 2010, pp 62-70.

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Mobile Computing



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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

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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

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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



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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)



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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



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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



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Pervasive Computing

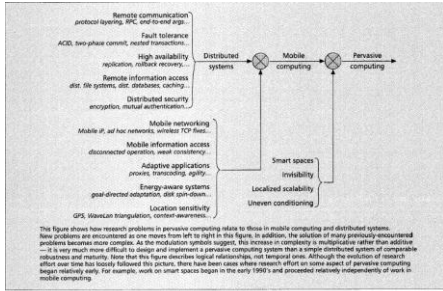
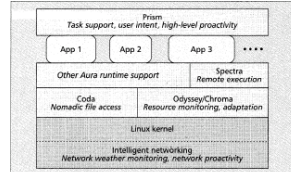


Figure 1. Taxonomy of computer systems research problems in pervasive computing.

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 Chronos, a replacement. Other components, such as Prim 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

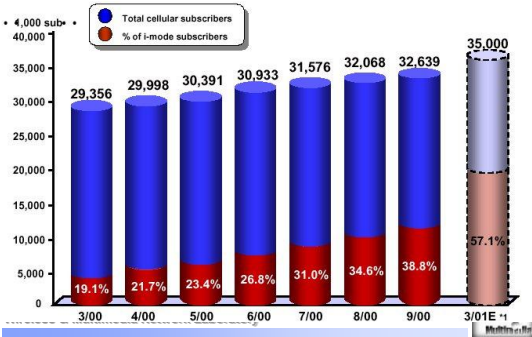


Mobile Communications
Fixed Broadband Wireless Communications

Evolution of Mobile Wireless Systems

- ◆ **First Generation : Analog – Voice (Early 1980s)**
 - Analog modulation
 - Cellular phone (AMPS) with manual roaming
 - Cordless phones
 - Packet radio networks
- ◆ **Second Generation : Digital - Voice & Data (Early 1990s)**
 - WAP (wireless application protocol)
 - 2.5 G GPRS
 - TDMA and narrowband CDMA: EX-GSM, IS-95(cdmaOne)
- ◆ **Third Generation: Digital – Multimedia (Late 1990s)**
 - Unified digital wireless access anytime, anywhere
 - Voice, data, images, video, music, sensor etc.
- ◆ **4G- Life after Third-Generation Mobile Communications**
 - LTE (Long Term Evolution), Wimax

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

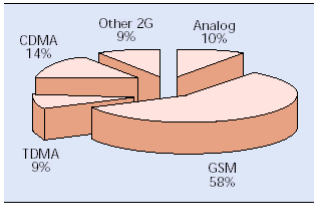


Figure 5. Estimated market shares of 1G and 2G wireless mobile systems in 2000.



Mobile Terminal Growth

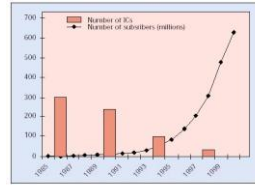
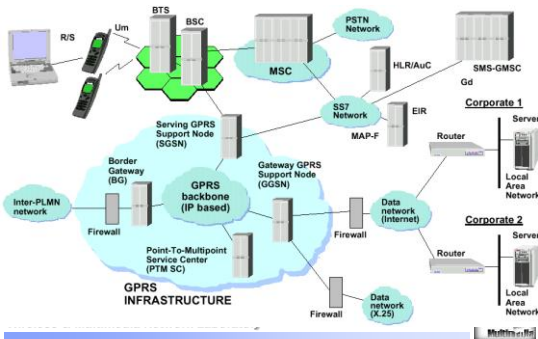


Figure 1. Subscriber growth and IC reduction in mobile terminals.



GPRS Architecture



RS Spectrum Allocation

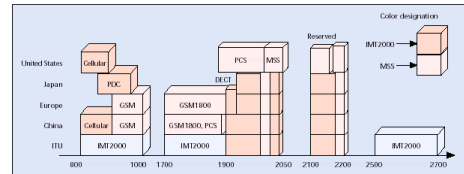
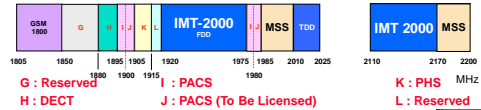


Figure 2. RF spectrum allocation in major regions.



Wireless Mobile Interface

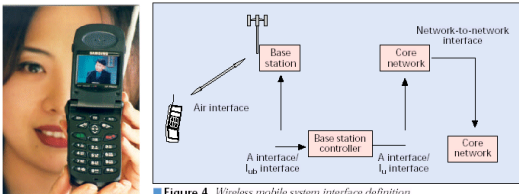
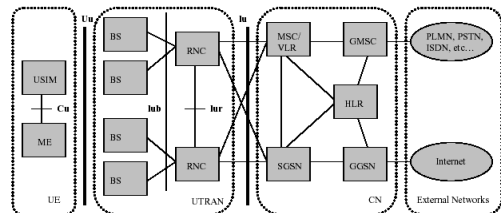


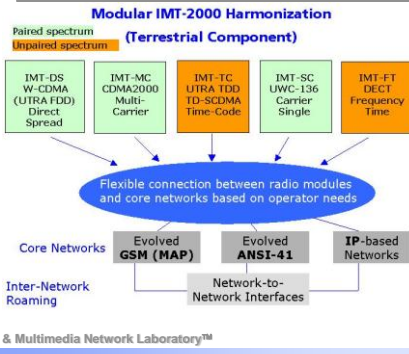
Figure 4. Wireless mobile system interface definition.



Elements of UMTS Architecture



第三代行動電話之技術標準



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	Cdma2000	WCDMA	TD-SCDMA
Multiple access	DS-SSMA/MS-CMA	DS-SSMA	TDMA/DS-SSMA
CLPCF	800 Hz	1600 Hz	200 Hz
PCSS	1 dB (0.5, 0.25 optional)	0.25-1.5 dB	1, 2, 3 dB
Channel coding	Convolutional or turbo coding	Convolutional, RS, or turbo coding	Convolutional or turbo
Spreading code	DL-Walsh, UL-M-ary Walsh mapping	OVSF	OVSF
VSF	4...256	4...256	1...16
Carrier	2 GHz	2 GHz	2 GHz
Modulation	DL: QPSK, UL: BPSK	DL: QPSK, UL: BPSK	QPSK, 8-PSK (at 2 Mb/s)
Bandwidth	1.25*2/3.75*2 MHz	5*2 MHz	1.6 MHz
UL-DL spectrum	Paired	Paired	Unpaired
Chip rate	1.2288/3.6864 Mcchips/s	3.84 Mcchips/s	1.28 Mcchips/s
Frame length	20 ms, 5 ms	10 ms	10 ms
Interleaving periods	5/20/40/80 ms	10/20/40/80 ms	10/20/40/80 ms
Maximum data rate	2.4 Mb/s	2 Mb/s	2 Mb/s
Pilot structure	DL: CCMP, UL: DTMP	DL: DTMP, UL: DTMP	CCMP
Detection	PSBC	PSBC	PSBC
Inter-RS timing	Synchronous	Asynchronous/synchronous	Synchronous

CCMP: common channel multiplexing pilot; DTMP: dedicated time multiplexing pilot; VSF: variable spreading factor; CLPCF: closed power control frequency; PCSS: power control step size; DL: downlink; UL: uplink; PSBC: pilot symbol based coherent; PCBC: pilot based coherent

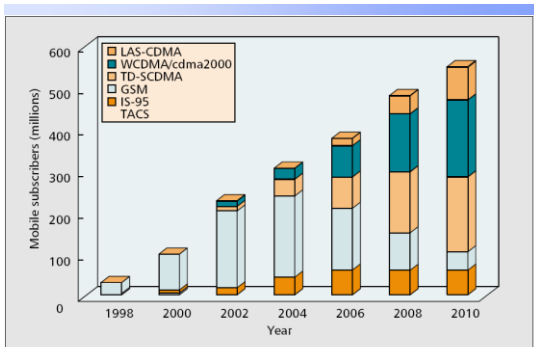
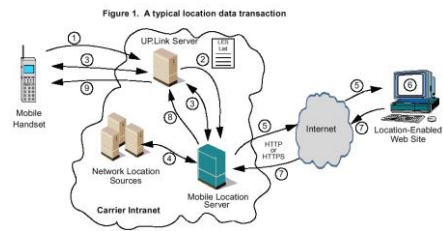


Figure 1. The increasing trend in estimated population of mobile subscribers in China from 1998 to 2010. The total mobile communication related product value is estimated at about US\$ 180-220 billions.

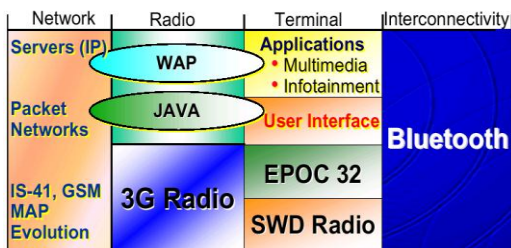
Location-Based Applications



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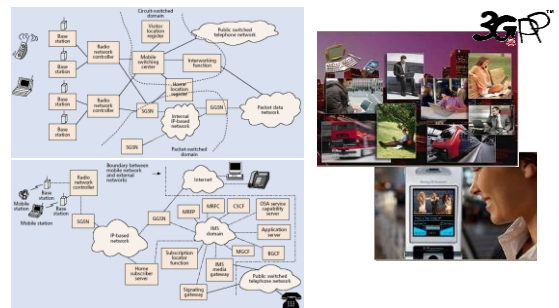
3G-Network integration



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3GPP-Release 5 IMS & HSDPA



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Mobile Broadband System

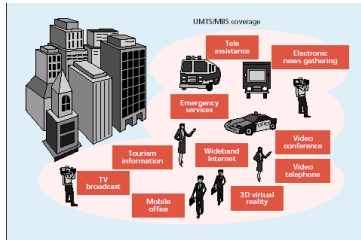


Figure 1. MBS and UMTS coverage and applications.

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Mobile System Evolution

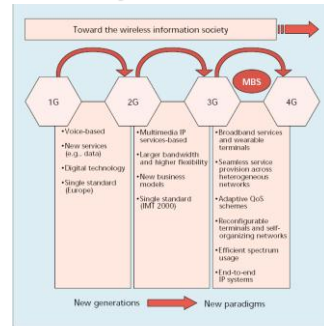
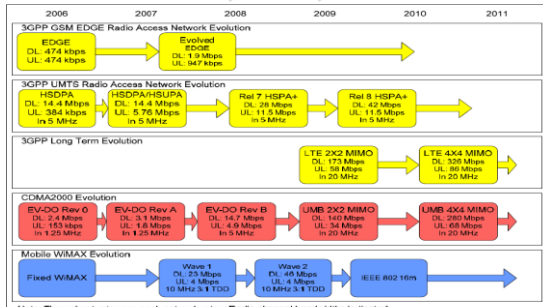


Figure 5. Mobile communication systems evolution.

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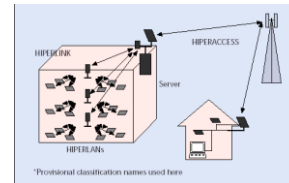


TDMA, CDMA, OFDMA



Note: Throughput rates are peak network rates. Radio channel bandwidths indicated. Dates refer to initial network deployment except 2006 which shows available technologies that year.

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*Provisional classification names used here

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WiMAX Nomadic and Portable



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

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AIRreach™ BROADBAND

National Central University
&
Hughes Network Systems
LMDS Demo Briefing

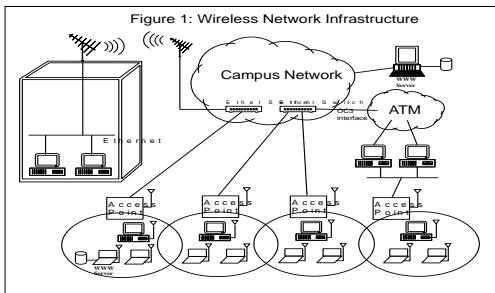
November 1999

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Campus Network

CS/E

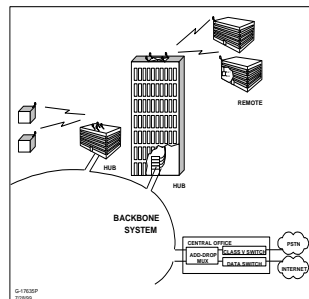


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LMDS NCU Test-bench

CS/E

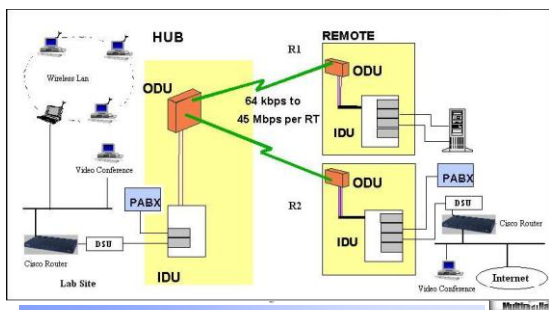


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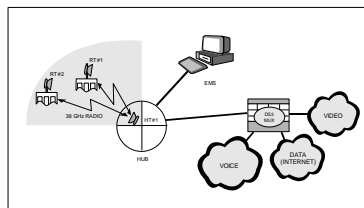
Architecture of the Demo

CS/E



National Central University Demo Layout

CS/E

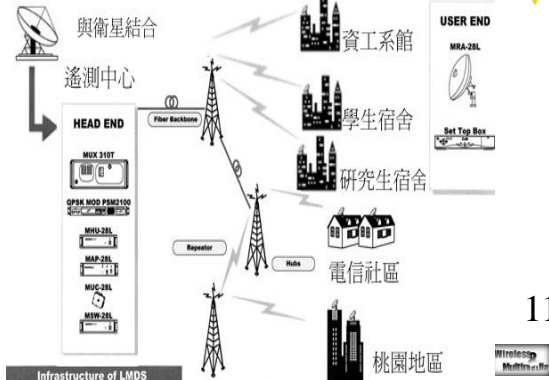


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Step.1 LMDS Architecture

CS/E

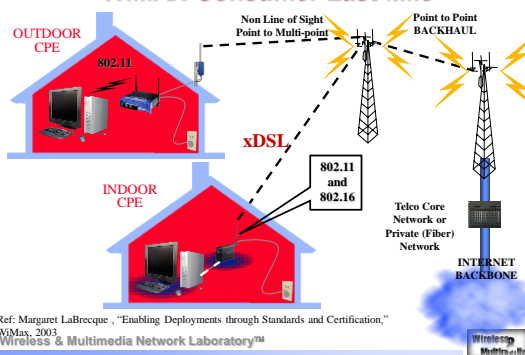


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Wireless
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WiMAX Consumer Last Mile

CS/E

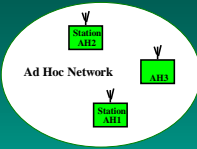


Ref: Margaret LaBrecque, "Enabling Deployments through Standards and Certification," WiMax, 2003

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IEEE 802.11 Configurations - Independent

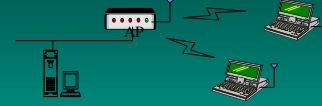


- Independent
 - one Basic Service Set - BSS
 - Ad Hoc network
 - direct communication
 - limited coverage area

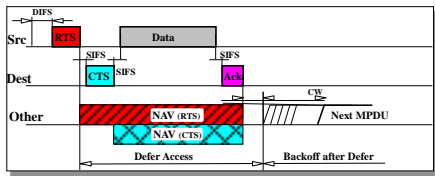
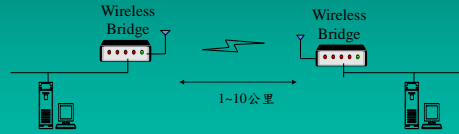
Topology of a Wireless LAN



- 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。



- Duration field in RTS and CTS frames distribute Medium Reservation information which is stored in a Network Allocation Vector (NAV).
- Defer on either NAV or "CCA" indicating Medium Busy.
- Use of RTS / CTS is optional but must be implemented.

Node Contention & Rate Adaptation

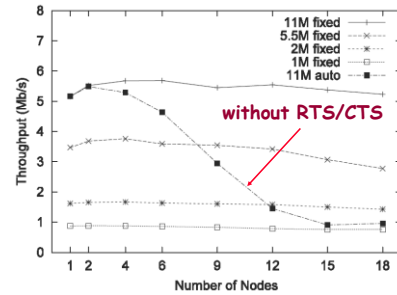
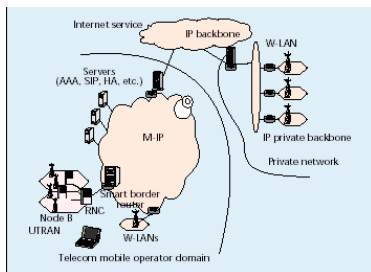


Fig. 7 Throughputs with node contentions.

[Choi, ACM SIGMETRICS'05]

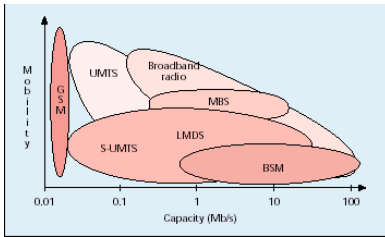
IP integration



WiMedia Solutions – Simple Usage



Capacity and Mobility



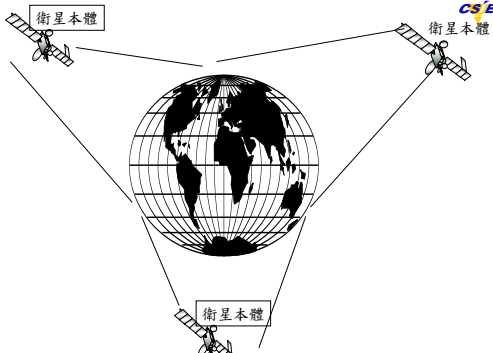
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地球村的建立



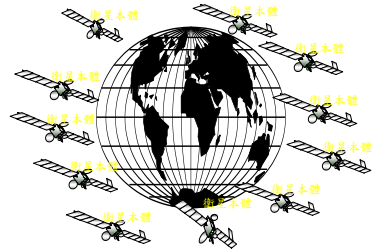
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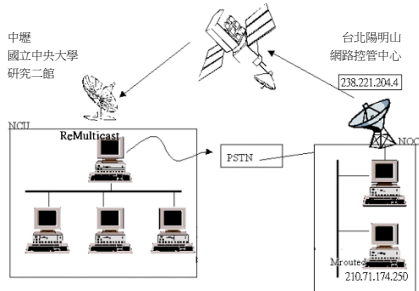
Sky of Satellites



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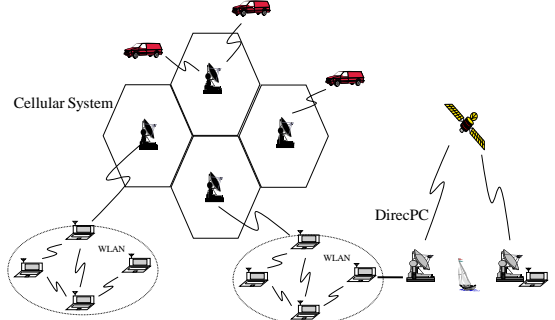
DirecPC Satellite Experiments



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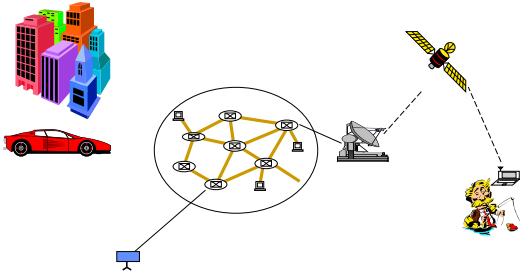
Ubiquitous Access



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"Anytime Anywhere" Information System



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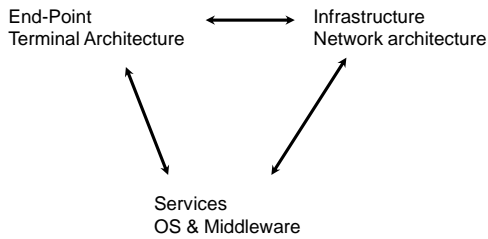
Fundamental Issues



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Three System Components



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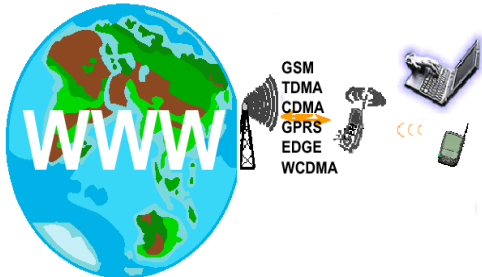
Personal area network



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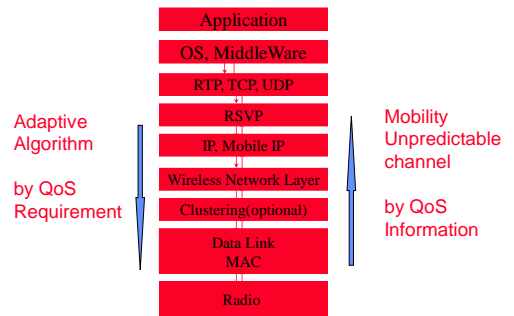
Connect devices to internet on the mobile infrastructure world wide



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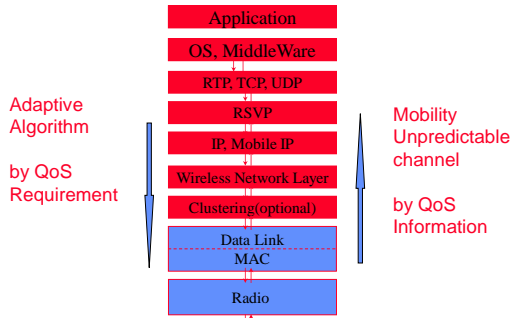
QoS and Multimedia Traffic Support



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QoS and Multimedia Traffic Support



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Channel Propagation and Fading

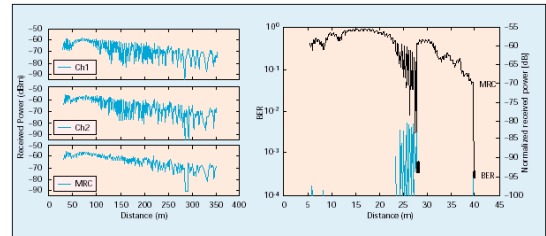
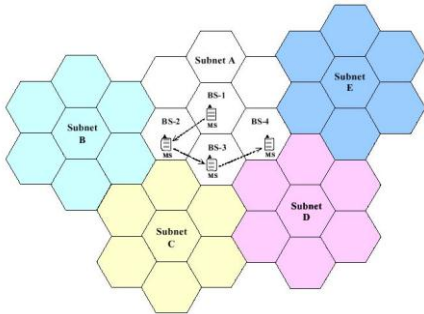


Figure 4. Received power as a function of distance: in a street (left), in a pavilion (right), BER and handover (right).

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Intra-Domain Handoff



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Resource Sharing

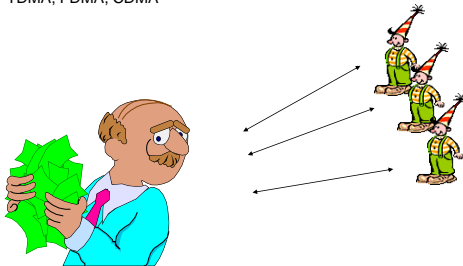
- ◆ Reservation Approaches
 - Centralized Control
 - token (round robin)
- ◆ Collision Approaches
 - fight for resource
 - distributed control

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Through A Centralized Control

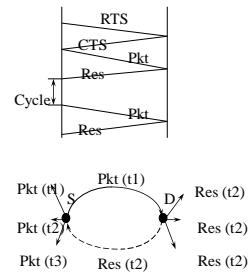
- ◆ TDMA, FDMA, CDMA



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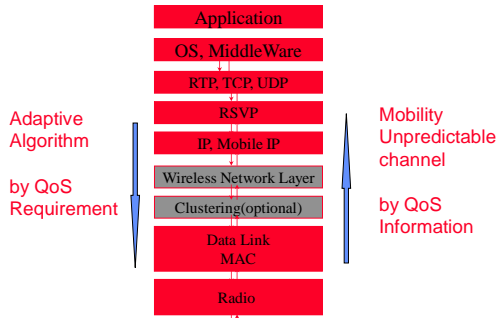
MACA/PR



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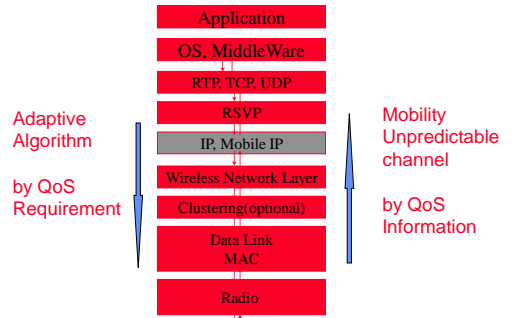
QoS and Multimedia Traffic Support



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QoS and Multimedia Traffic Support



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Internetworking, IP, Mobile



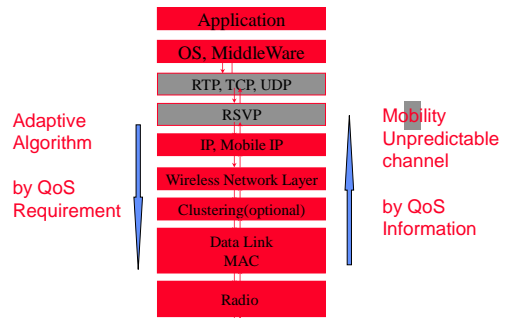
- ◆ Internetworking
 - roaming through different networks
 - supporting IP format
 - supporting IP portability



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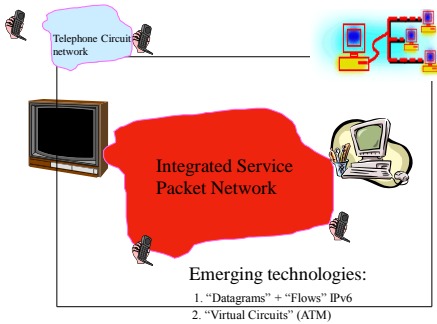
QoS and Multimedia Traffic Support



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What problem does Multimedia Bring?

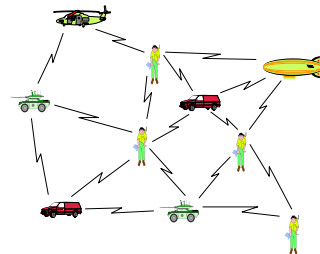


5

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Ad Hoc Wireless Network



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Tight and Loose Internetworking

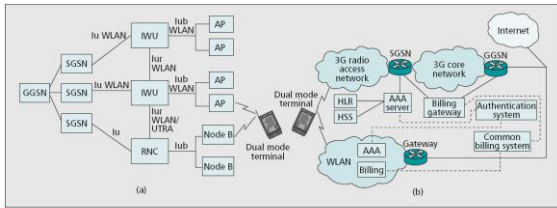


Figure 1. a) Tight and b) loose interworking architecture of 3G/WLAN networks.



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 Information 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

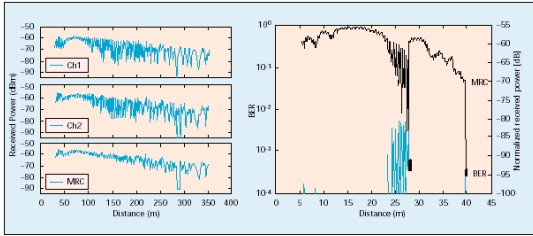


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