無線網路多媒體系統
Wireless Multimedia System

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2009 Fall

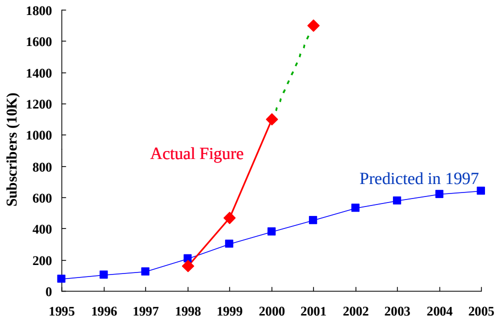
First Week Agenda

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

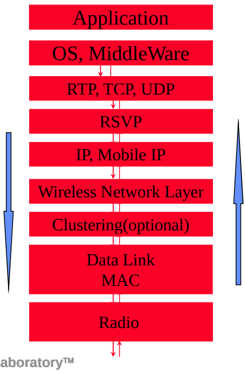
Course Contents

- 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 Mutimedia Transmissions

台灣行動電話發展趨勢圖

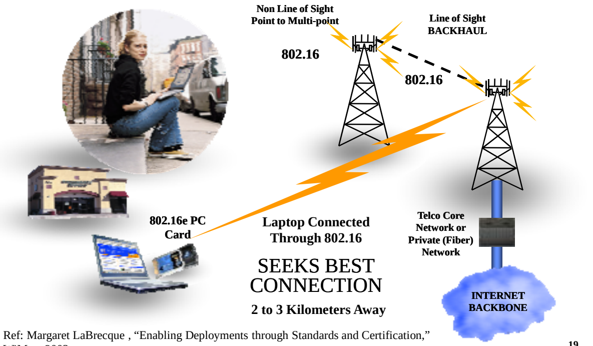


Roaming Across a variety of heterogeneous network and service environments



Application
OS, MiddleWare
RTP, TCP, UDP
RSVP
IP, Mobile IP
Wireless Network Layer
Clustering(optional)
Data Link
MAC
Radio

WiMAX Nomadic and Portable


Non Line of Sight
Point to Multi-point
802.16
Line of Sight
BACKHAUL
802.16
802.16e PC Card
Telco Core Network or Private (Fiber) Network
INTERNET BACKBONE

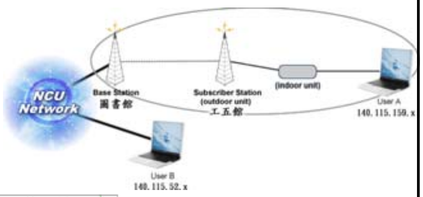
Laptop Connected Through 802.16

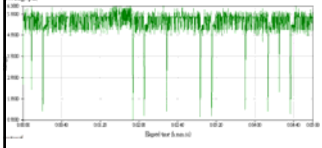
SEEKS BEST CONNECTION

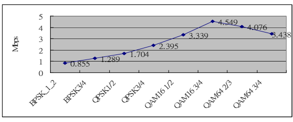
2 to 3 Kilometers Away

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

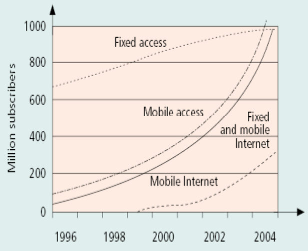
WiMAX 802.16

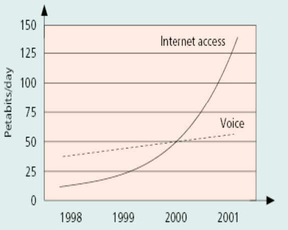

NCU Network
Base Station
圖書館
Subscriber Station
(outdoor unit)
工五館
(indoor unit)
User A
140.115.159.x
User B
140.115.52.x



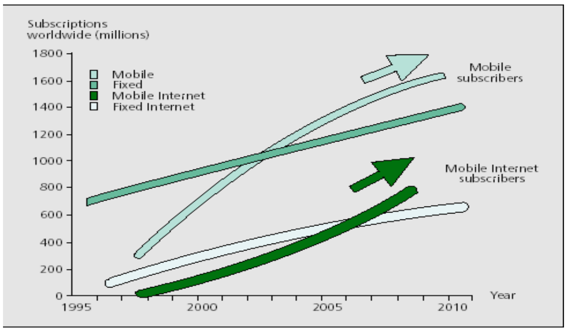


Growth in traffic in different access system and voice and data services



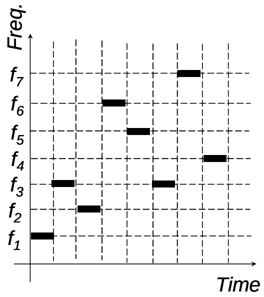


Forecast number of subscribers



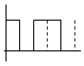
Frequency Hopping Spread Spectrum

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


Freq.
f_7
f_6
f_5
f_4
f_3
f_2
f_1
Time

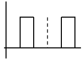
Direct Sequence Spread Spectrum

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



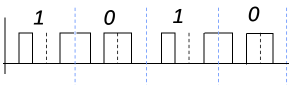
1 0 1 1 0

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

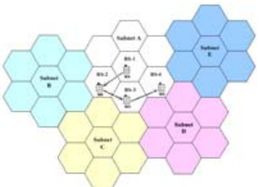


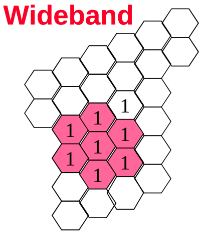
0 1 0 0 1

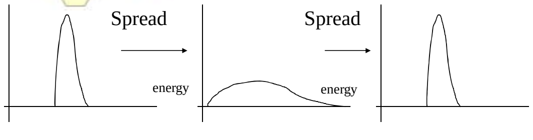
Therefore if data is 1010 it will transmit:

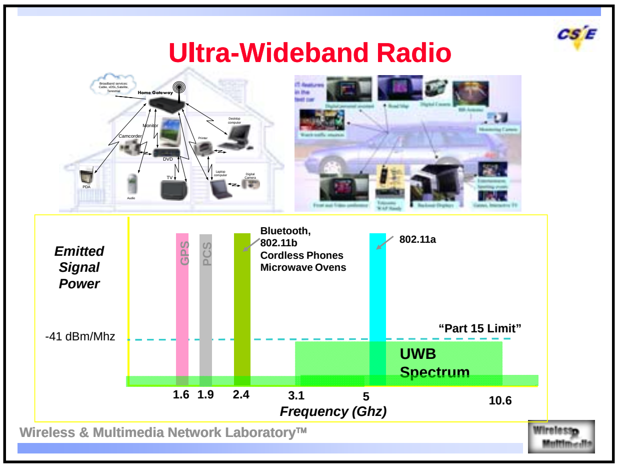


Narrowband vs. Wideband


Subnet A
Subnet B
Subnet C
Subnet D
Subnet E
BS-1
BS-2
BS-3
BS-4




Spread
energy
Bandwidth
Spread
energy
Bandwidth
Bandwidth



Ultra-Wideband Radio

Home Gateway
Emitted Signal Power
GPS
PCS
Bluetooth, 802.11b
Cordless Phones
Microwave Ovens
802.11a
-41 dBm/Mhz
"Part 15 Limit"
UWB Spectrum
1.6
1.9
2.4
3.1
5
10.6
Frequency (Ghz)

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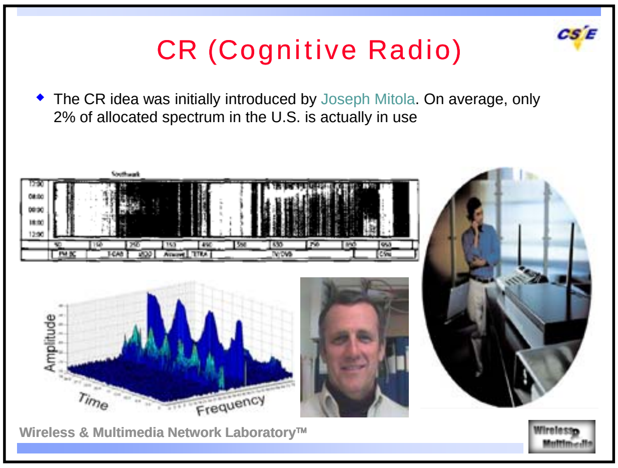
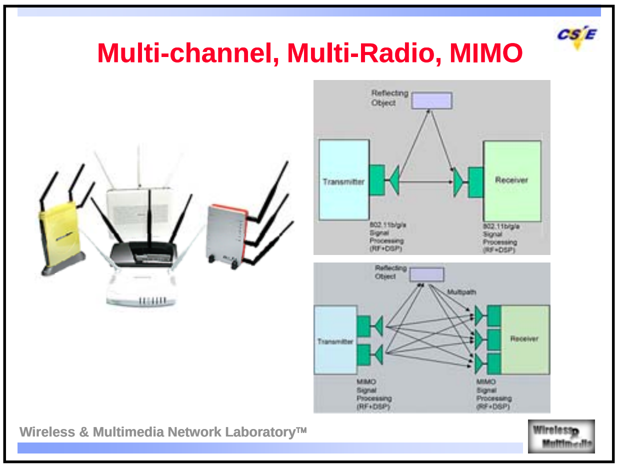


CR (Cognitive Radio)

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

Wireless & Multimedia Network Laboratory™



Multi-channel, Multi-Radio, MIMO

Reflecting Object
Transmitter
Receiver
802.11b/g/a Signal Processing (RF+DSP)
802.11b/g/a Signal Processing (RF+DSP)
Reflecting Object
Multipath
Transmitter
Receiver
MIMO Signal Processing (RF+DSP)
MIMO Signal Processing (RF+DSP)

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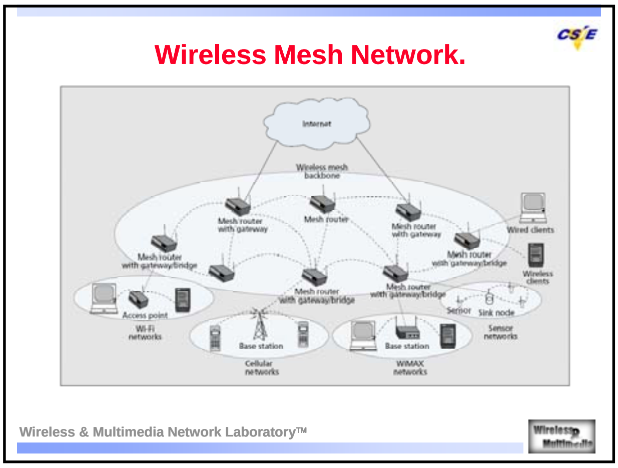

Wireless Mesh Network.

Internet
Wireless mesh backbone
Mesh router with gateway
Mesh router
Mesh router with gateway
Wired clients
Mesh router with gateway/bridge
Mesh router with gateway/bridge
Wireless clients
Mesh router with gateway/bridge
Mesh router with gateway/bridge
Access point
Sensor
Sink node
Wi-Fi networks
Base station
Base station
Sensor networks
Cellular networks
WiMAX networks

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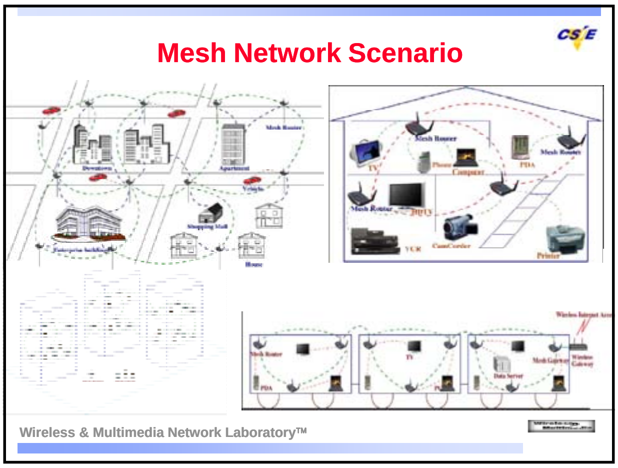
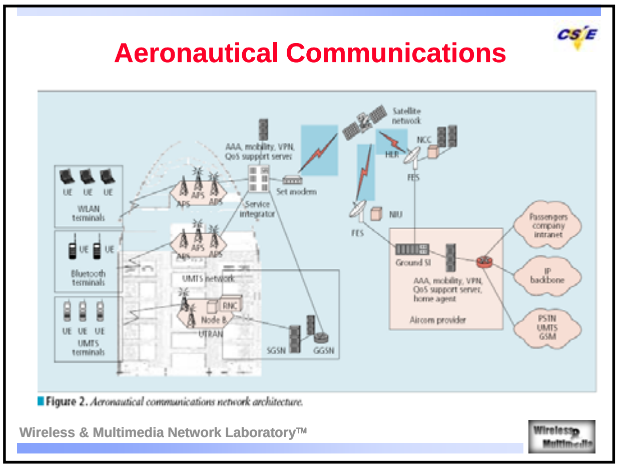


Mesh Network Scenario

Mesh Router
Downtown
Apartment
Vehicle
Shopping Mall
Enterprise building
House
Mesh Router
Phone
Computer
PDA
Mesh Router
Mesh Router
TV
DVD
VCR
CamCorder
Printer
Wireless Internet Access
Mesh Router
Mesh Gateway
Wireless Gateway
PDA
Data Server

Wireless & Multimedia Network Laboratory™



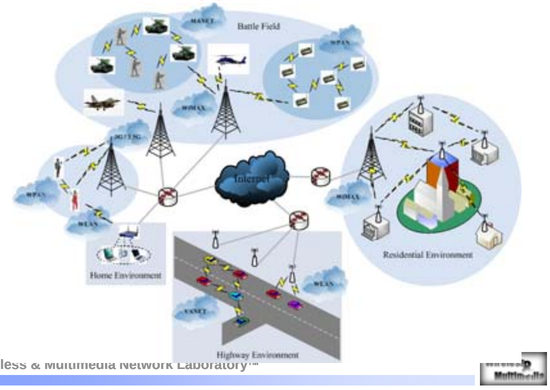
Aeronautical Communications

Satellite network
AAA, mobility, VPN, QoS support server
NCC
HUB
FES
Set modem
APS
APS
APS
Service integrator
UE
UE
UE
WLAN terminals
NIU
FES
UE
UE
Bluetooth terminals
APS
APS
APS
Ground SI
AAA, mobility, VPN, QoS support server, home agent
Passengers company intranet
IP backbone
UMTS network
RNC
Node B
UTRAN
Aircom provider
UE
UE
UE
UMTS terminals
SGSN
GGSN
PSTN UMTS GSM

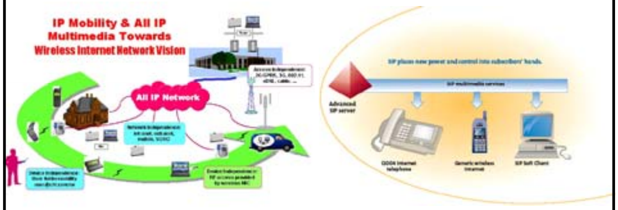
Figure 2. *Aeronautical communications network architecture.*

Wireless & Multimedia Network Laboratory™

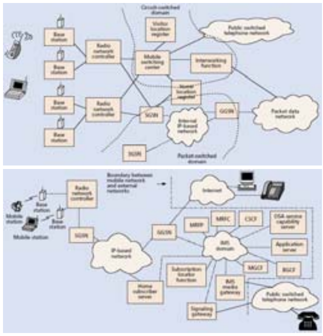
Wireless Applications Scenario


MANET
Battle Field
WPAN
WiMAX
3G/UMTS
Internet
WLAN
Home Environment
Residential Environment
VANET
Highway Environment

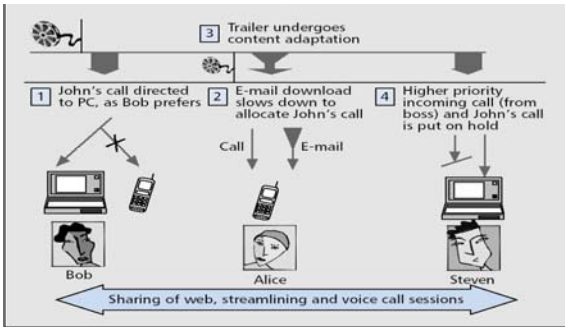
Multimedia over IP


IP Mobility & All IP
Multimedia Towards
Wireless Internet Network Vision
All IP Network
Advanced IP server

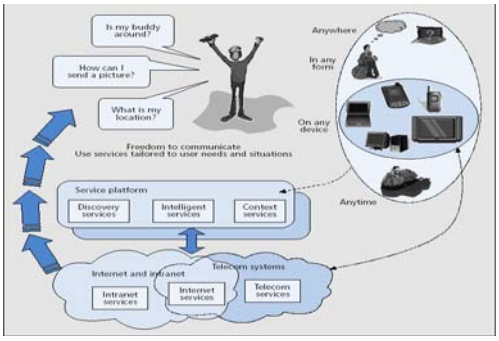
3GPP - Release 5 IMS & HSDPA



IMS Service Scenario


3 Trailer undergoes content adaptation
1 John's call directed to PC, as Bob prefers
2 E-mail download slows down to allocate John's call
4 Higher priority incoming call (from boss) and John's call is put on hold
Call
E-mail
Bob
Alice
Steven
Sharing of web, streamlining and voice call sessions

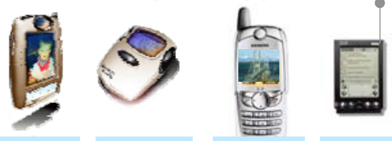
Context Aware Communication


Is my buddy around?
How can I send a picture?
What is my location?
Anywhere
In any form
On any device
Anytime
Freedom to communicate
Use services tailored to user needs and situations
Service platform
Discovery services
Intelligent services
Context services
Internet and intranet
Telecom systems
Intranet services
Internet services
Telecom services

Business Finder

SOUTH DELHI

Adaptive Applications



Varied type of service

Video Audio Graph Text

Adaptive application coding

High ...... **Quality** ...... Low

Situation-Aware Wireless Networks

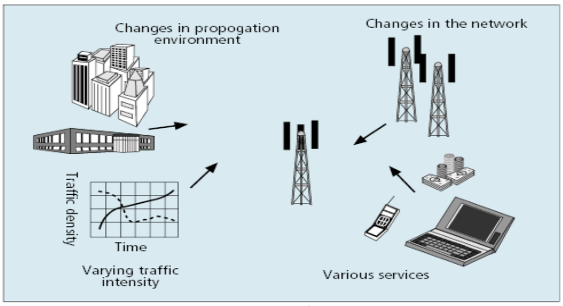

Changes in propogation environment
Changes in the network
Traffic density
Time
Varying traffic intensity
Various services

Figure 4. *Situation awareness functionality.*

Network Mobility Management

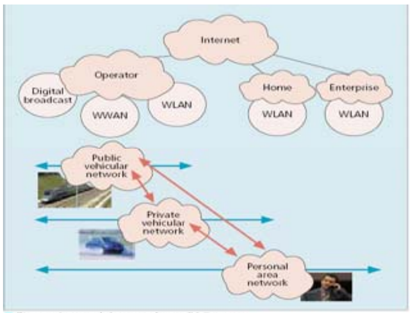
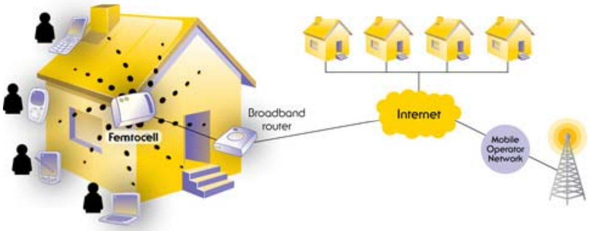
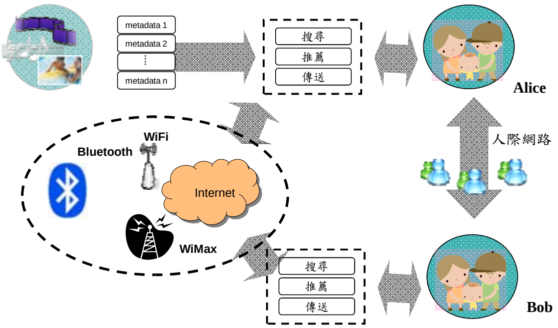

Internet
Operator
Digital broadcast
WWAN
WLAN
Home
Enterprise
WLAN
WLAN
Public vehicular network
Private vehicular network
Personal area network

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

Femtocell


Femtocell
Broadband router
Internet
Mobile Operator Network

異質無線多網多媒體分享與推薦平台場景圖


metadata 1
metadata 2
⋮
metadata n
搜尋
推薦
傳送
Alice
人際網路
WiFi
Bluetooth
Internet
WiMax
搜尋
推薦
傳送
Bob

IEEE 802.11 WLAN

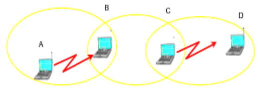
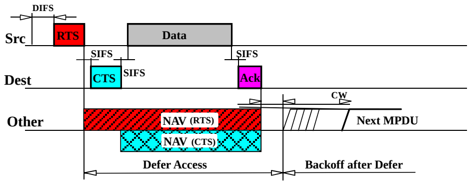


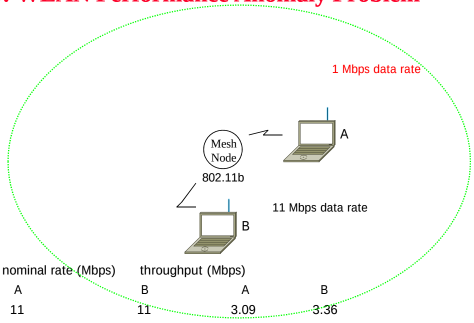
Fig. 1. A is sending a packet to B when C should decide whether to transmit to D.

Ad hoc mode

Infrastructure mode

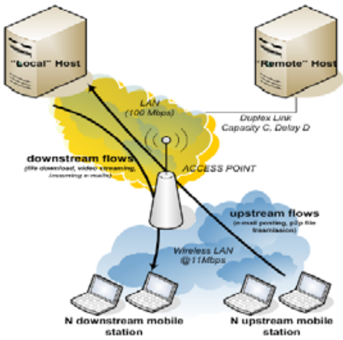

DIFS
Src
RTS
Data
SIFS
SIFS
Dest
CTS
SIFS
Ack
CW
Other
NAV (RTS)
NAV (CTS)
Next MPDU
Defer Access
Backoff after Defer

Quiz 0: WLAN Performance Anomaly Problem


1 Mbps data rate
Mesh Node
802.11b
A
B
11 Mbps data rate

nominal rate (Mbps)		throughput (Mbps)	
A	B	A	B
11	11	3.09	3.36
1	**11**	**0.73**	**0.76**

Fairness for upstream and downstream


"Local" Host
"Remote" Host
LAN
(100 Mbps)
Duplex Link
Capacity C, Delay D
downstream flows
(file download, video streaming, incoming e-mails)
ACCESS POINT
upstream flows
(e-mail posting, p2p file transmission)
Wireless LAN
@11Mbps
N downstream mobile station
N upstream mobile station

Expectation of the Class

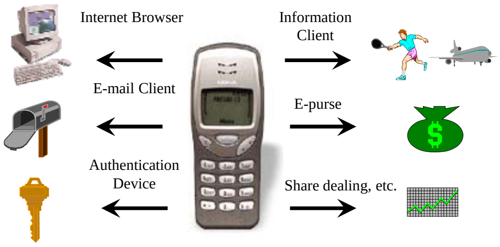
- Basic Understanding of PCS world
- Being able to do the wireless research
- Developing the capability to invent the key wireless applications

Course Process

- Paper reading and your presentations
- Wireless Multimedia Applications Exercises

Mobile Computing

Mobile phone today = multipurpose terminal for ...


Internet Browser
Information Client
E-mail Client
E-purse
Authentication Device
Share dealing, etc.

Reading list for This Lecture

- Required Reading:

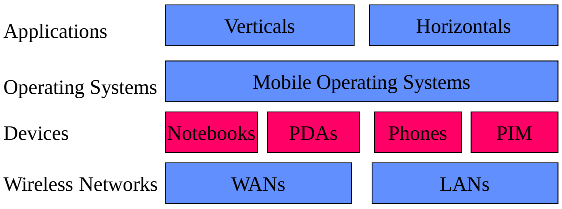
  (S.2001) M. Satyanarayan, “Pervasive Computing: Vision and Challenges”, IEEE Personal Communication Magazine, (August 2001), pp.10-17

  (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. Paulrai, K. V. S. Hari, and R. U. Nabar, “Fixed Broadband Wireless Access: State of the Art, Challegnes, and Future Directions”, IEEE Communication Magazine

Mobile Computing



Applications	Verticals		Horizontals	
Operating Systems	Mobile Operating Systems			
Devices	Notebooks	PDAs	Phones	PIM
Wireless Networks	WANs		LANs	

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

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)

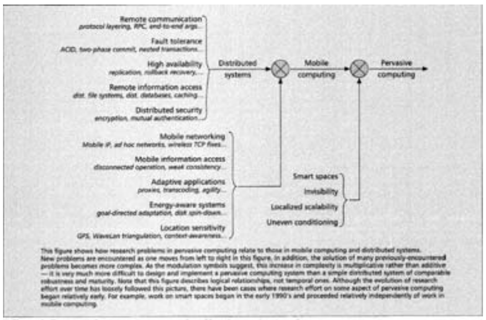
Pervasive Computing

- 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

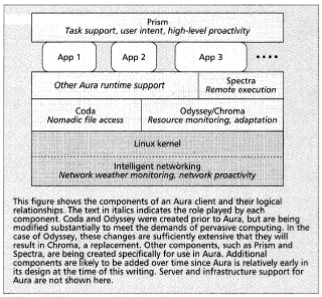
Pervasive Computing


Remote communication
protocol layering, RPC, end-to-end args...
Fault tolerance
ACID, two-phase commit, nested transactions...
High availability
replication, rollback recovery...
Remote information access
dist. file systems, dist. databases, caching...
Distributed security
encryption, mutual authentication...
Distributed systems
Mobile computing
Pervasive computing
Mobile networking
Mobile IP, ad hoc networks, wireless TCP fixes...
Mobile information access
disconnected operation, weak consistency...
Adaptive applications
proxies, transcoding, agility...
Energy-aware systems
goal-directed adaptation, disk spin-down...
Location sensitivity
GPS, WaveLan triangulation, context-awareness...
Smart spaces
Invisibility
Localized scalability
Uneven conditioning

This figure shows how research problems in pervasive computing relate to those in mobile computing and distributed systems. New problems are encountered as one moves from left to right in this figure. In addition, the solution of many previously-encountered problems becomes more complex. As the modulation symbols suggest, this increase in complexity is multiplicative rather than additive — it is very much more difficult to design and implement a pervasive computing system than a simple distributed system of comparable robustness and maturity. Note that this figure describes logical relationships, not temporal ones. Although the evolution of research effort over time has loosely followed this picture, there have been cases where research effort on some aspect of pervasive computing began relatively early. For example, work on smart spaces began in the early 1990's and proceeded relatively independently of work in mobile computing.

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

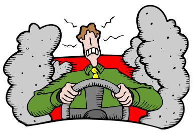
Aura Client


Prism
Task support, user intent, high-level proactivity
App 1
App 2
App 3
• • • •
Other Aura runtime support
Spectra
Remote execution
Coda
Nomadic file access
Odyssey/Chroma
Resource monitoring, adaptation
Linux kernel
Intelligent networking
Network weather monitoring, network proactivity

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



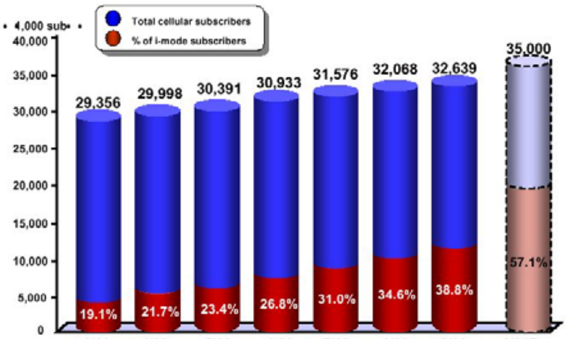
Mobile Communications

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

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

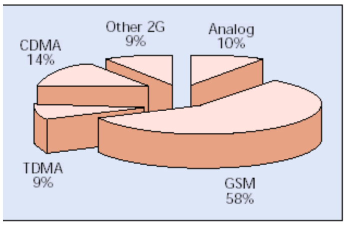


Figure 5. *Estimated market shares of 1G and 2G wireless mobile systems in 2000.*

Mobile Terminal Growth

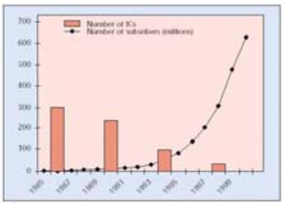
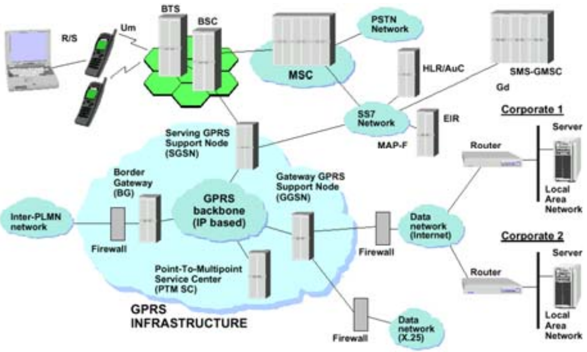


Figure 1. *Subscriber growth and IC reduction in mobile terminals.*

Time to Market
Easy Migration from cdmaOne to 3G
Simple IS-95 to cdma2000 conversion

GPRS Architecture


R/S
Um
BTS
BSC
MSC
PSTN Network
HLR/AuC
SMS-GMSC
Gd
SS7 Network
EIR
MAP-F
Corporate 1
Server
Router
Local Area Network
Serving GPRS Support Node (SGSN)
Border Gateway (BG)
Gateway GPRS Support Node (GGSN)
Inter-PLMN network
GPRS backbone (IP based)
Firewall
Data network (Internet)
Firewall
Corporate 2
Server
Router
Point-To-Multipoint Service Center (PTM SC)
GPRS INFRASTRUCTURE
Firewall
Data network (X.25)
Local Area Network

RS Spectrum Allocation

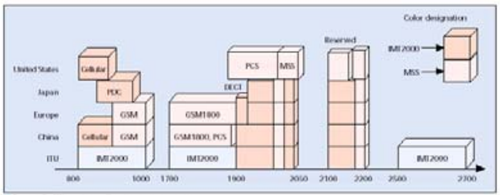
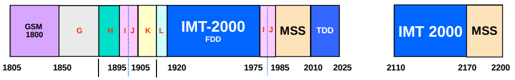

Color designation
IMT 2000
MSS
Reserved
United States
Japan
Europe
China
ITU
Cellular
PDC
GSM
Cellular
GSM
IMT 2000
GSM1800
GSM1800, PCS
IMT2000
PCS
MSS
DECT
IMT2000
800
1000
1700
1900
2050
2100
2200
2500
2700

Figure 2. *RF spectrum allocation in major regions.*


GSM 1800
G
H
I
J
K
L
IMT-2000
FDD
I
J
MSS
TDD
IMT 2000
MSS
1805
1850
1880
1895
1900
1905
1915
1920
1975
1980
1985
2010
2025
2110
2170
2200
MHz

G : Reserved
H : DECT
I : PACS
J : PACS (To Be Licensed)
K : PHS
L : Reserved

Wireless Mobile Interface

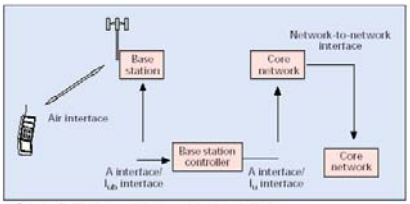
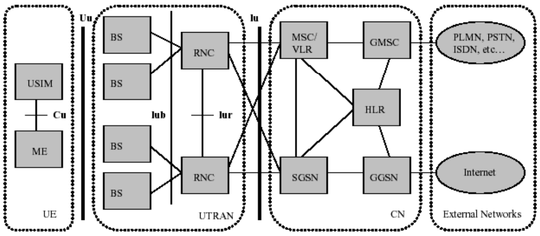
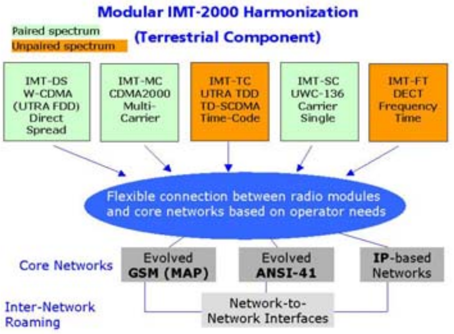

Network-to-network interface
Base station
Core network
Air interface
Base station controller
A interface/
I_{ub} interface
A interface/
I_u interface
Core network

Figure 4. *Wireless mobile system interface definition.*

Elements of UMTS Architecture


Uu
Iu
BS
BS
BS
BS
RNC
RNC
USIM
Cu
ME
UE
Iub
Iur
UTRAN
MSC/
VLR
GMSC
HLR
SGSN
GGSN
CN
PLMN, PSTN,
ISDN, etc…
Internet
External Networks

第三代行動電話之技術標準



Modular IMT-2000 Harmonization

(Terrestrial Component)

Paired spectrum
Unpaired spectrum

IMT-DS
W-CDMA
(UTRA FDD)
Direct
Spread

IMT-MC
CDMA2000
Multi-
Carrier

IMT-TC
UTRA TDD
TD-SCDMA
Time-Code

IMT-SC
UWC-136
Carrier
Single

IMT-FT
DECT
Frequency
Time

Flexible connection between radio modules and core networks based on operator needs

Core Networks

Evolved
GSM (MAP)

Evolved
ANSI-41

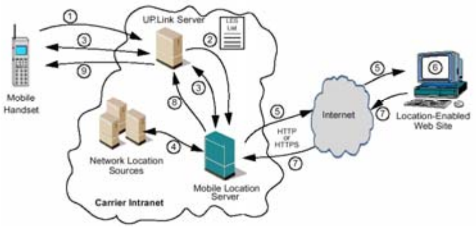
IP-based
Networks

Inter-Network
Roaming

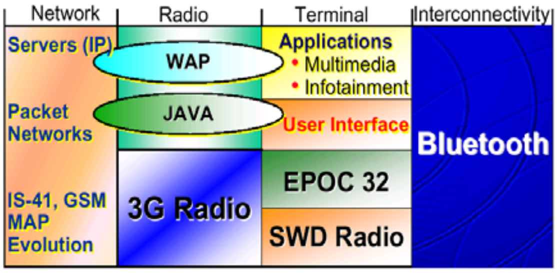
Network-to-
Network Interfaces

Location-Based Applications

Figure 1. A typical location data transaction


①
③
⑨
UP.Link Server
②
LES
List
③
⑧
Mobile
Handset
Network Location
Sources
④
Mobile Location
Server
Carrier Intranet
⑤
HTTP
or
HTTPS
⑦
Internet
⑤
⑥
⑦
Location-Enabled
Web Site

3G-Network integration



Network

Radio

Terminal

Interconnectivity

Servers (IP)

WAP

Applications
- Multimedia
- Infotainment

Packet
Networks

JAVA

User Interface

Bluetooth

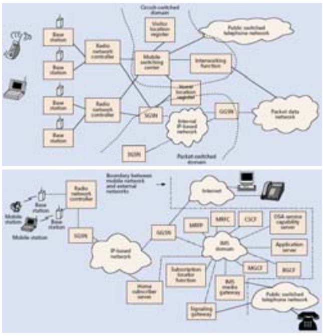
IS-41, GSM
MAP
Evolution

3G Radio

EPOC 32

SWD Radio

3GPP-Release 5
IMS & HSDPA



Mobile Broadband System

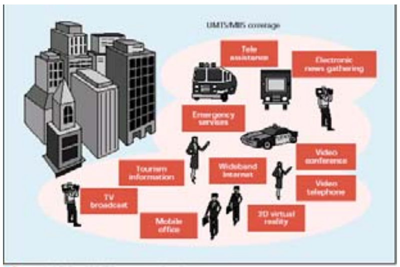

UMTS/MBS coverage
Tele assistance
Electronic news gathering
Emergency services
Tourism information
Wideband Internet
Video conference
Video telephone
TV broadcast
Mobile office
3D virtual reality

Figure 1. *MBS and UMTS coverage and applications.*

Mobile System Evolution

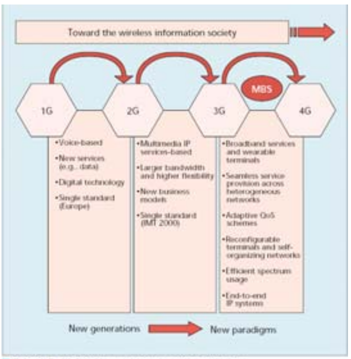
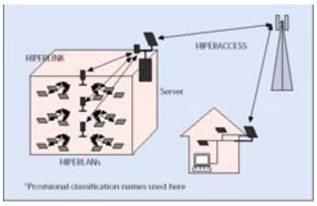
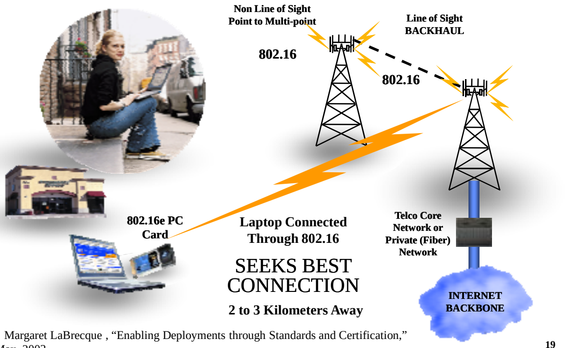

Toward the wireless information society
1G
2G
3G
MBS
4G
•Voice-based
•New services (e.g., data)
•Digital technology
•Single standard (Europe)
•Multimedia IP services-based
•Larger bandwidth and higher flexibility
•New business models
•Single standard (IMT 2000)
•Broadband services and wearable terminals
•Seamless service provision across heterogeneous networks
•Adaptive QoS schemes
•Reconfigurable terminals and self-organizing networks
•Efficient spectrum usage
•End-to-end IP systems
New generations
New paradigms

Figure 5. *Mobile communication systems evolution.*


HIPERLINK
HIPERACCESS
Server
HIPERLANs
*Provisional classification names used here

WiMAX Nomadic and Portable


Non Line of Sight
Point to Multi-point
Line of Sight
BACKHAUL
802.16
802.16
802.16e PC Card
Laptop Connected Through 802.16
Telco Core Network or Private (Fiber) Network
SEEKS BEST CONNECTION
2 to 3 Kilometers Away
INTERNET BACKBONE

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

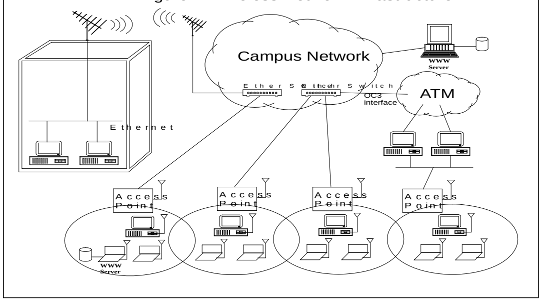
AIReach™
BROADBAND

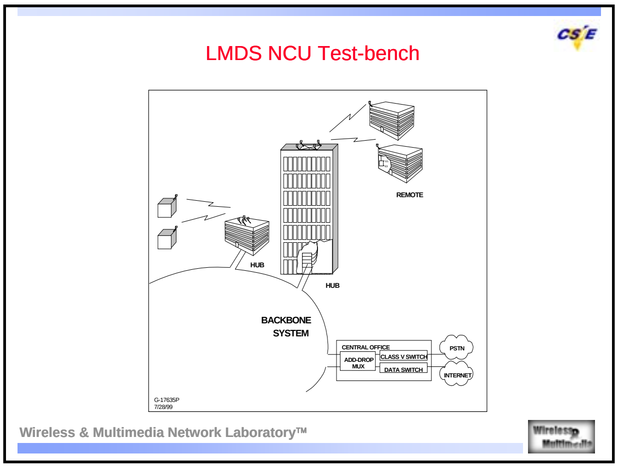
National Central University
&
Hughes Network Systems
LMDS Demo Briefing

November 1999

Campus Network

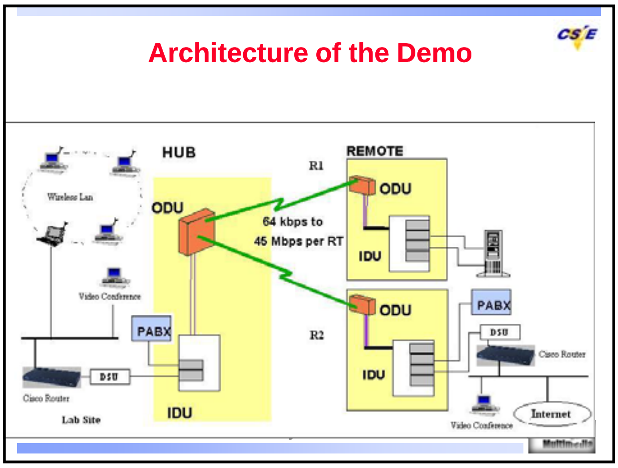
Figure 1: Wireless Network Infrastructure


Campus Network
WWW Server
Ether Switch
Ether Switch
OC3 interface
ATM
Ethernet
Access Point
Access Point
Access Point
Access Point
WWW Server



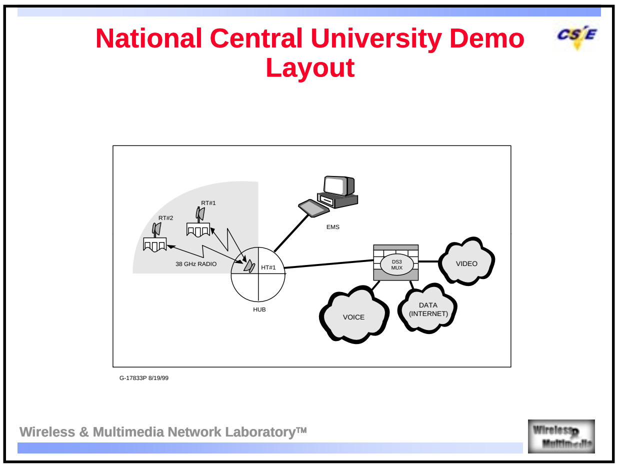
LMDS NCU Test-bench

REMOTE
HUB
HUB
BACKBONE SYSTEM
CENTRAL OFFICE
ADD-DROP MUX
CLASS V SWITCH
DATA SWITCH
PSTN
INTERNET
G-17635P
7/28/99



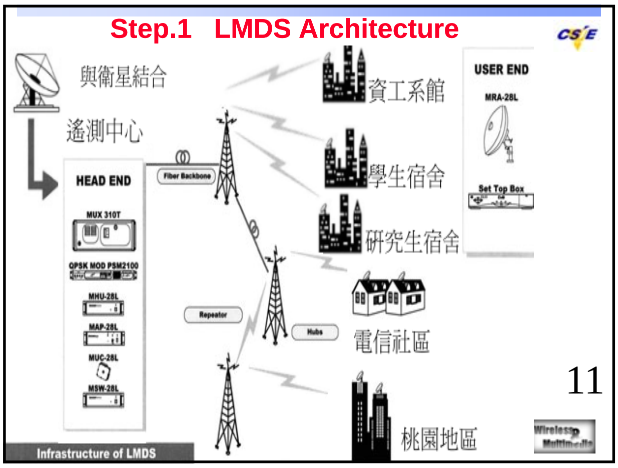
Architecture of the Demo

HUB
REMOTE
R1
R2
Wireless Lan
ODU
64 kbps to
45 Mbps per RT
ODU
IDU
ODU
IDU
PABX
PABX
DSU
DSU
Video Conference
Cisco Router
Cisco Router
Lab Site
IDU
Internet
Video Conference



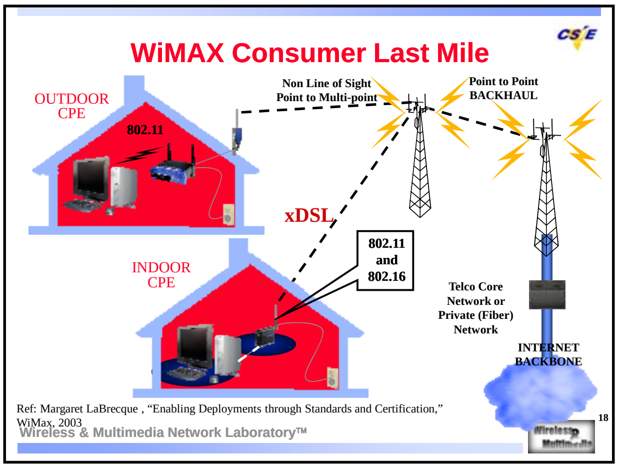
National Central University Demo Layout

RT#1
RT#2
38 GHz RADIO
HT#1
HUB
EMS
DS3 MUX
VIDEO
VOICE
DATA (INTERNET)
G-17833P 8/19/99



Step.1 LMDS Architecture

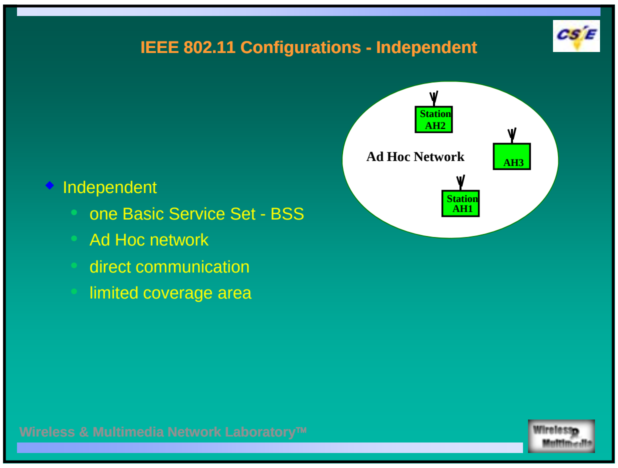
與衛星結合
遙測中心
HEAD END
MUX 310T
QPSK MOD PSM2100
MHU-28L
MAP-28L
MUC-28L
MSW-28L
Fiber Backbone
Repeater
Hubs
資工系館
學生宿舍
研究生宿舍
電信社區
桃園地區
USER END
MRA-28L
Set Top Box
Infrastructure of LMDS
11



WiMAX Consumer Last Mile

OUTDOOR CPE
802.11
Non Line of Sight
Point to Multi-point
Point to Point
BACKHAUL
xDSL
802.11 and 802.16
INDOOR CPE
Telco Core Network or Private (Fiber) Network
INTERNET BACKBONE
18

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



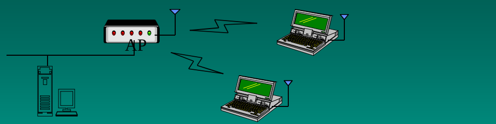
IEEE 802.11 Configurations - Independent

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

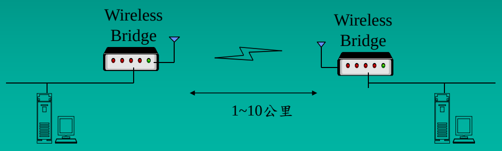
Ad Hoc Network
Station AH2
AH3
Station AH1

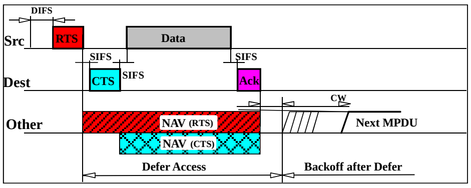
Topology of a Wireless LAN

- 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.


Wireless
Bridge
Wireless
Bridge
1~10公里


DIFS
Src
RTS
Data
SIFS
SIFS
SIFS
Dest
CTS
Ack
CW
Other
NAV (RTS)
NAV (CTS)
Next MPDU
Defer Access
Backoff after Defer

- ***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

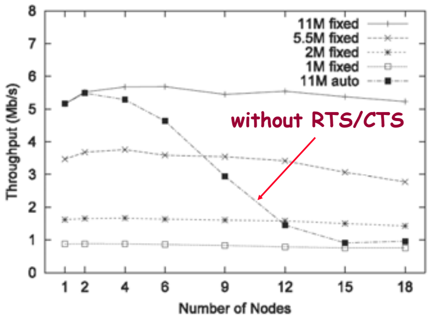
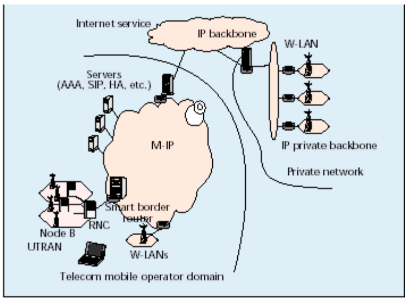


Fig. 7 Throughputs with node contentions.

[Choi, *ACM SIGMETRICS'05*]

IP integration

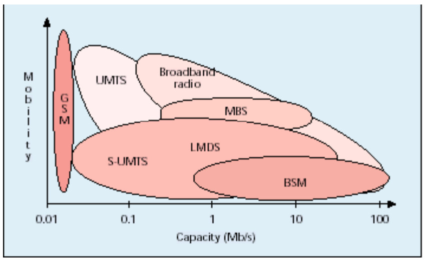

Internet service
IP backbone
W-LAN
Servers
(AAA, SIP, HA, etc.)
M-IP
IP private backbone
Private network
Smart border
router
RNC
Node B
UTRAN
W-LANs
Telecom mobile operator domain

WiMedia Solutions – Simple Usage

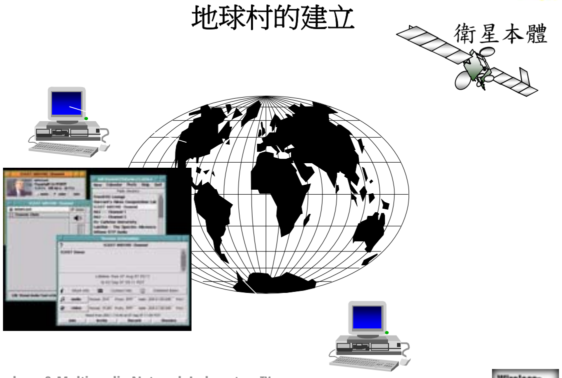
Video Stream (e.g., MPEG2)

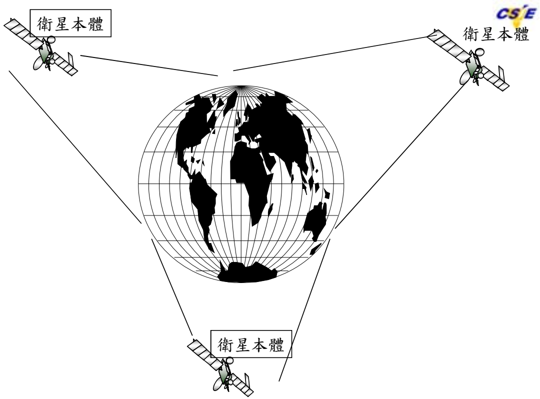
Discovery, Channel Management
and other Control Signaling

Capacity and Mobility

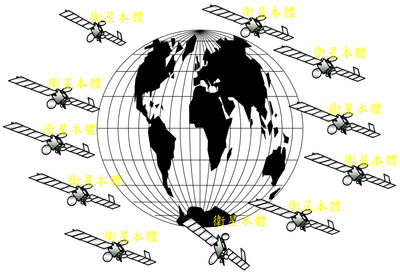


地球村的建立

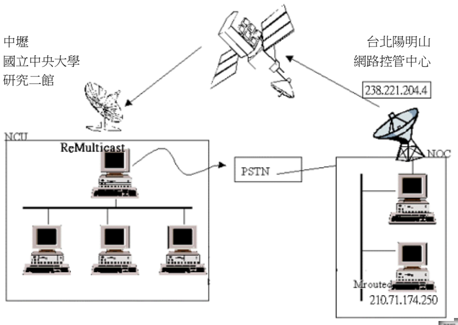



衛星本體
衛星本體
衛星本體

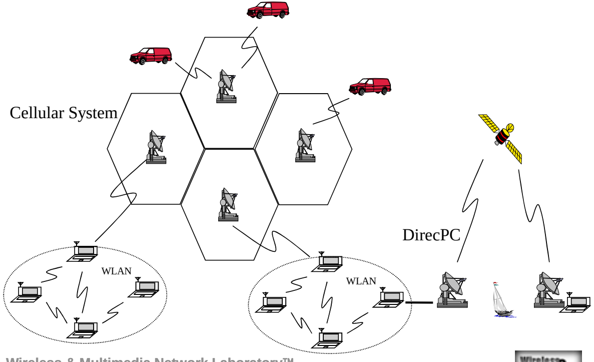
Sky of Satellites



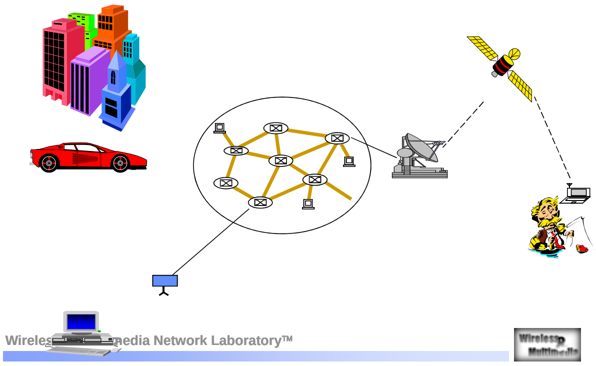
DirecPC Satellite Experiments


中壢
國立中央大學
研究二館
台北陽明山
網路控管中心
238.221.204.4
NCU
ReMulticast
PSTN
NOC
Mrouted
210.71.174.250

Ubiquitous Access

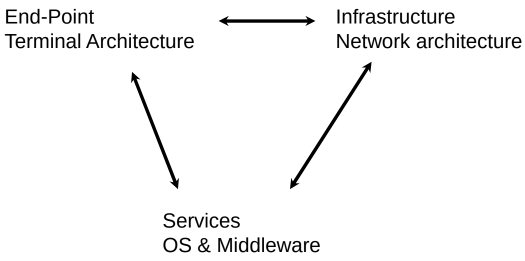

Cellular System
WLAN
WLAN
DirecPC

“Anytime Anywhere ” Information System



Fundamental Issues

Three System Components

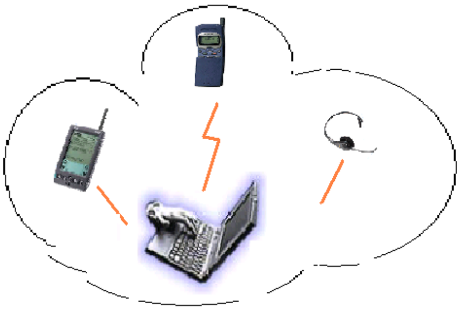


End-Point
Terminal Architecture

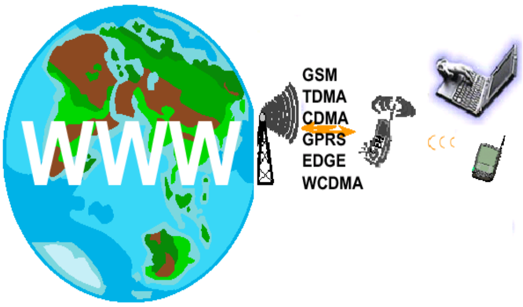
Infrastructure
Network architecture

Services
OS & Middleware

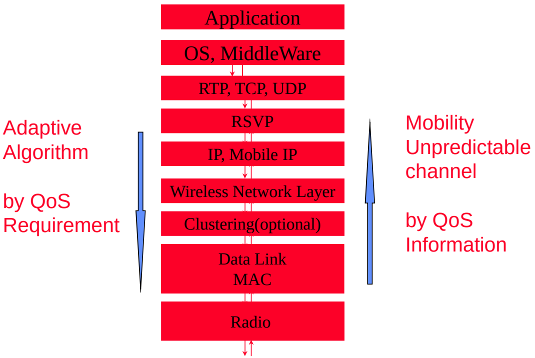
Personal area network



Connect devices to internet on the mobile infrastructure world wide



QoS and Multimedia Traffic Support



Application
OS, MiddleWare
RTP, TCP, UDP
RSVP
IP, Mobile IP
Wireless Network Layer
Clustering(optional)
Data Link
MAC
Radio

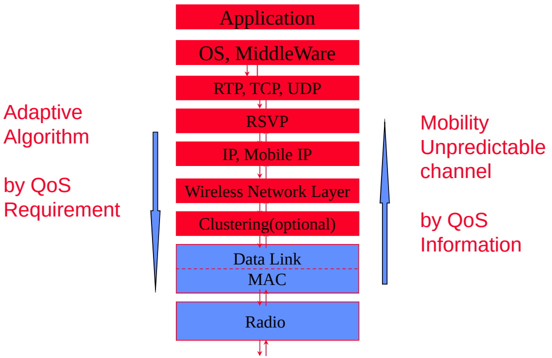
Adaptive
Algorithm

by QoS
Requirement

Mobility
Unpredictable
channel

by QoS
Information

QoS and Multimedia Traffic Support



Application
OS, MiddleWare
RTP, TCP, UDP
RSVP
IP, Mobile IP
Wireless Network Layer
Clustering(optional)
Data Link
MAC
Radio

Adaptive
Algorithm

by QoS
Requirement

Mobility
Unpredictable
channel

by QoS
Information

Channel Propagation and Fading

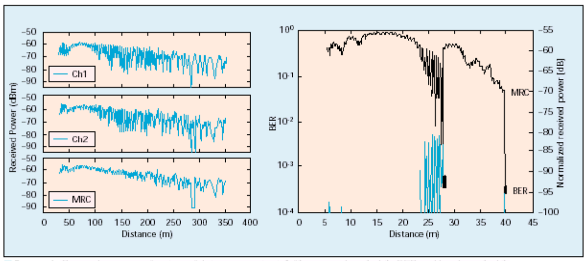
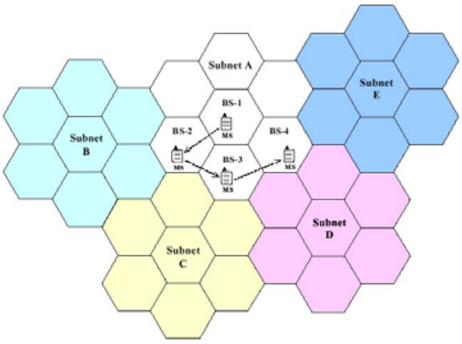


Figure 4. *Received power as a function of distance: in a street (left), in a pavilion (right); BER and handover (right).*

Intra-Domain Handoff

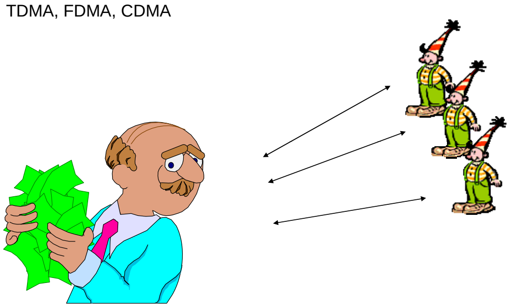

Subnet A
BS-1
MS
BS-2
MS
BS-3
MS
BS-4
MS
Subnet B
Subnet C
Subnet D
Subnet E

Resource Sharing

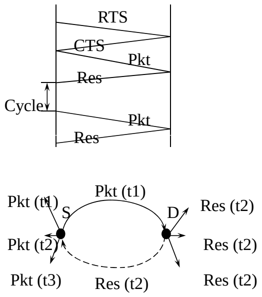
- Reservation Approaches
  - Centralized Control
  - token (round robin)
- Collision Approaches
  - fight for resource
  - distributed control

Through A Centralized Control

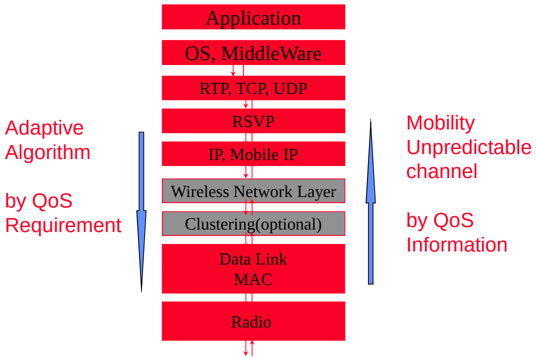
- TDMA, FDMA, CDMA



MACA/PR


RTS
CTS
Pkt
Res
Cycle
Pkt
Res
Pkt (t1)
Pkt (t1)
S
D
Res (t2)
Pkt (t2)
Res (t2)
Pkt (t3)
Res (t2)
Res (t2)

QoS and Multimedia Traffic Support



Application

OS, MiddleWare

RTP, TCP, UDP

RSVP

IP, Mobile IP

Wireless Network Layer

Clustering(optional)

Data Link
MAC

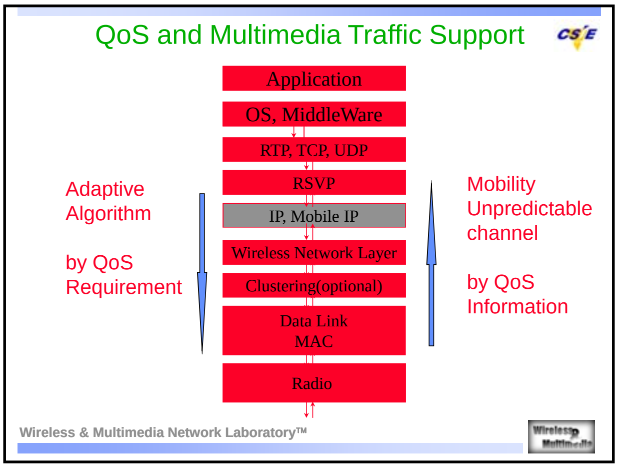
Radio

Adaptive
Algorithm

by QoS
Requirement

Mobility
Unpredictable
channel

by QoS
Information



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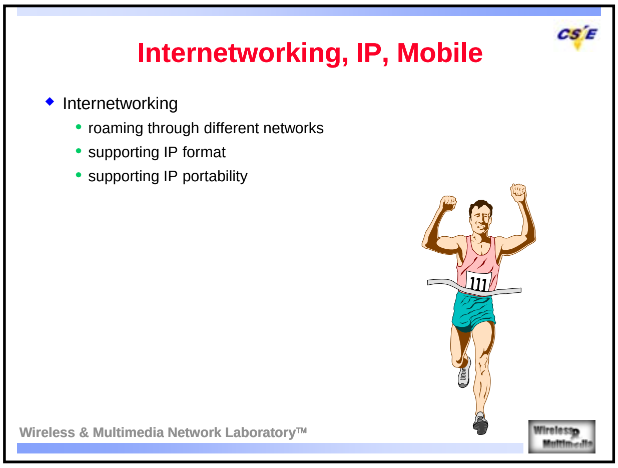
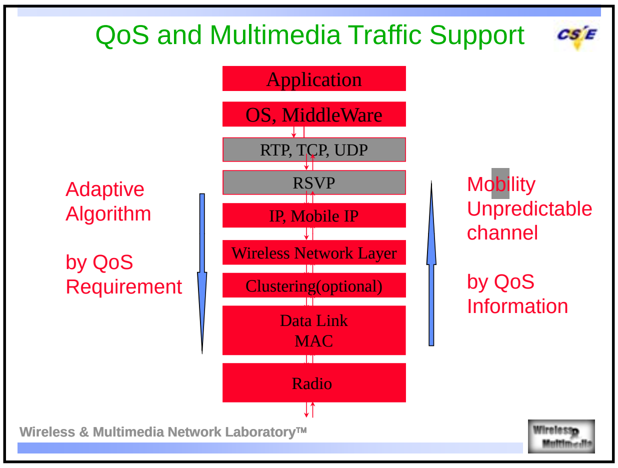
Wireless & Multimedia Network Laboratory™



Internetworking, IP, Mobile

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

Wireless & Multimedia Network Laboratory™



QoS and Multimedia Traffic Support

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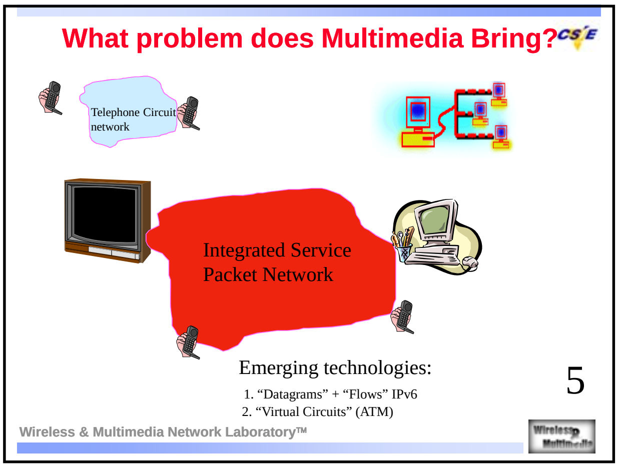


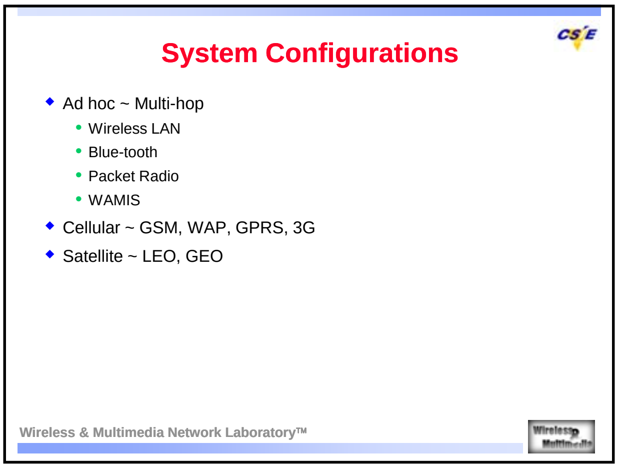
What problem does Multimedia Bring?

Emerging technologies:

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

5

Wireless & Multimedia Network Laboratory™



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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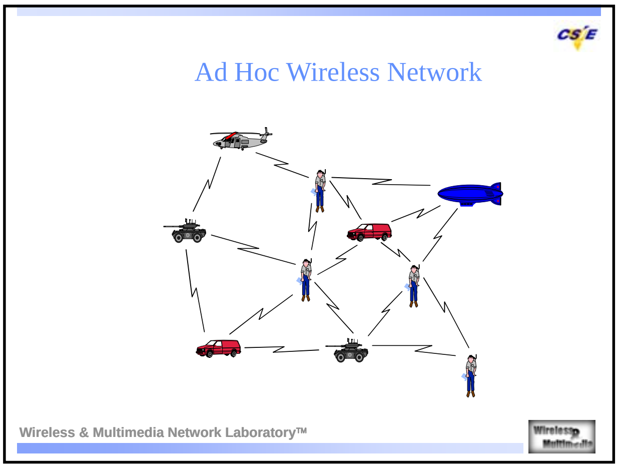

Ad Hoc Wireless Network

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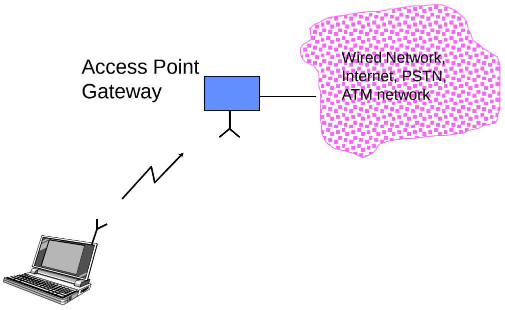
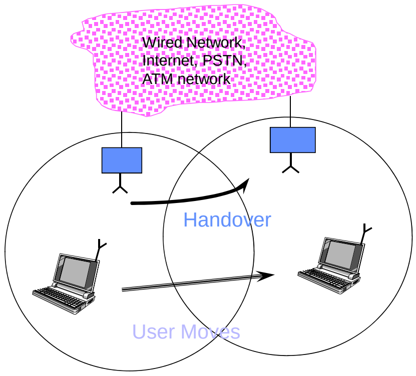
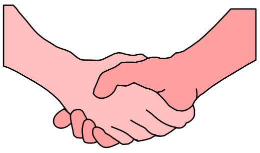

Access Point
Gateway
Wired Network,
Internet, PSTN,
ATM network


Wired Network,
Internet, PSTN,
ATM network
Handover
User Moves

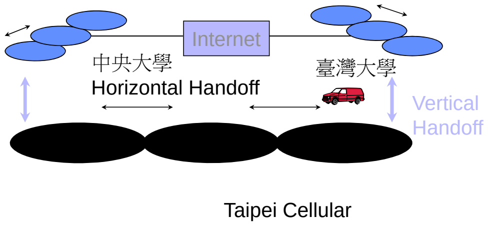
Typical Cellular Call

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



Wireless Comm: Heterogeneity & Security

- Heterogeneous networks


Internet
中央大學
臺灣大學
Horizontal Handoff
Vertical
Handoff
Taipei Cellular

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

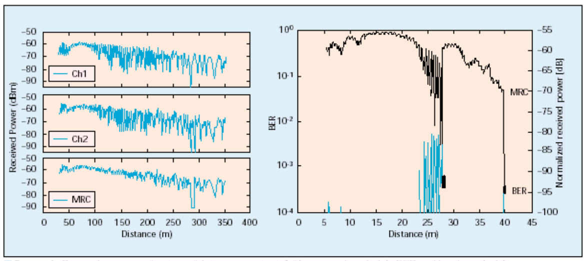
Portability

- 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



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