無線網路多媒體系統
Wireless Multimedia System

中央大學 吳曉光博士

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

2004 Fall

First Week Agenda

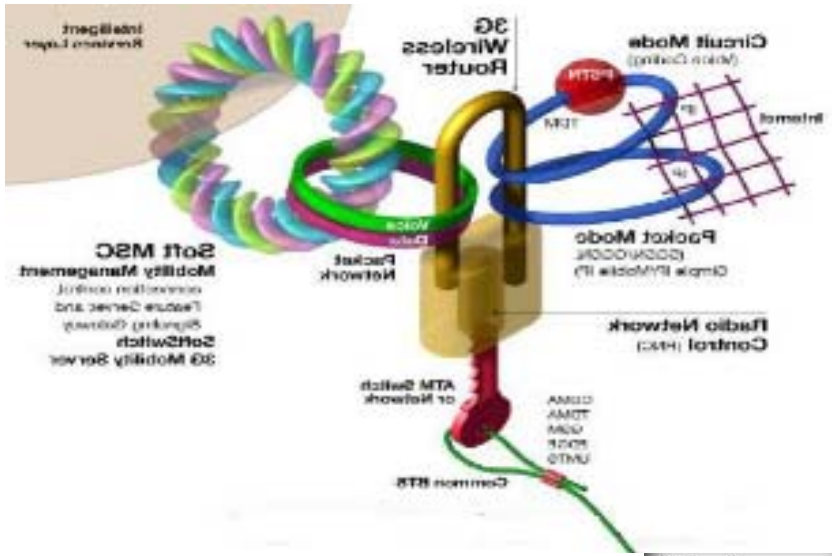
- Course Preview
- Wireless Multimedia/Mobile Computing / Pervasive Computing
- Wireless Mobile Communications
- System Review and Fundamental Problems
- Next Week

Course Preview

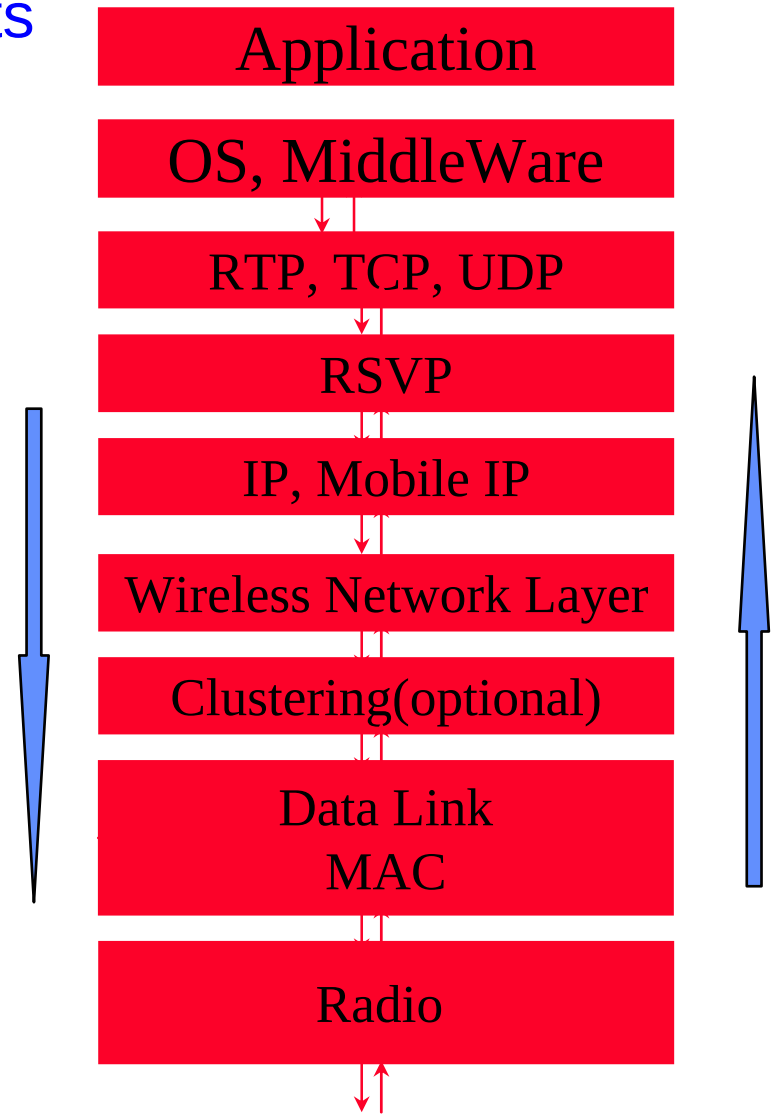
What is Going to Happen in the Course?

Course Contents

- Fundamental Wireless Technology
  - Propagation Model
  - Wireless Medium Access
  - Transport Solutions
  - Ad hoc Wireless System
  - Cellular System
  - Middleware Systems
  - Multimedia System
- Advanced Wireless Technology
  - Multicasting
  - Heterogeneous System
  - Routing Algorithms
  - QoS/ Reliable Transmissions



Roaming Across a variety of heterogeneous network and service environments



Adaptive Algorithm

by QoS Requirement

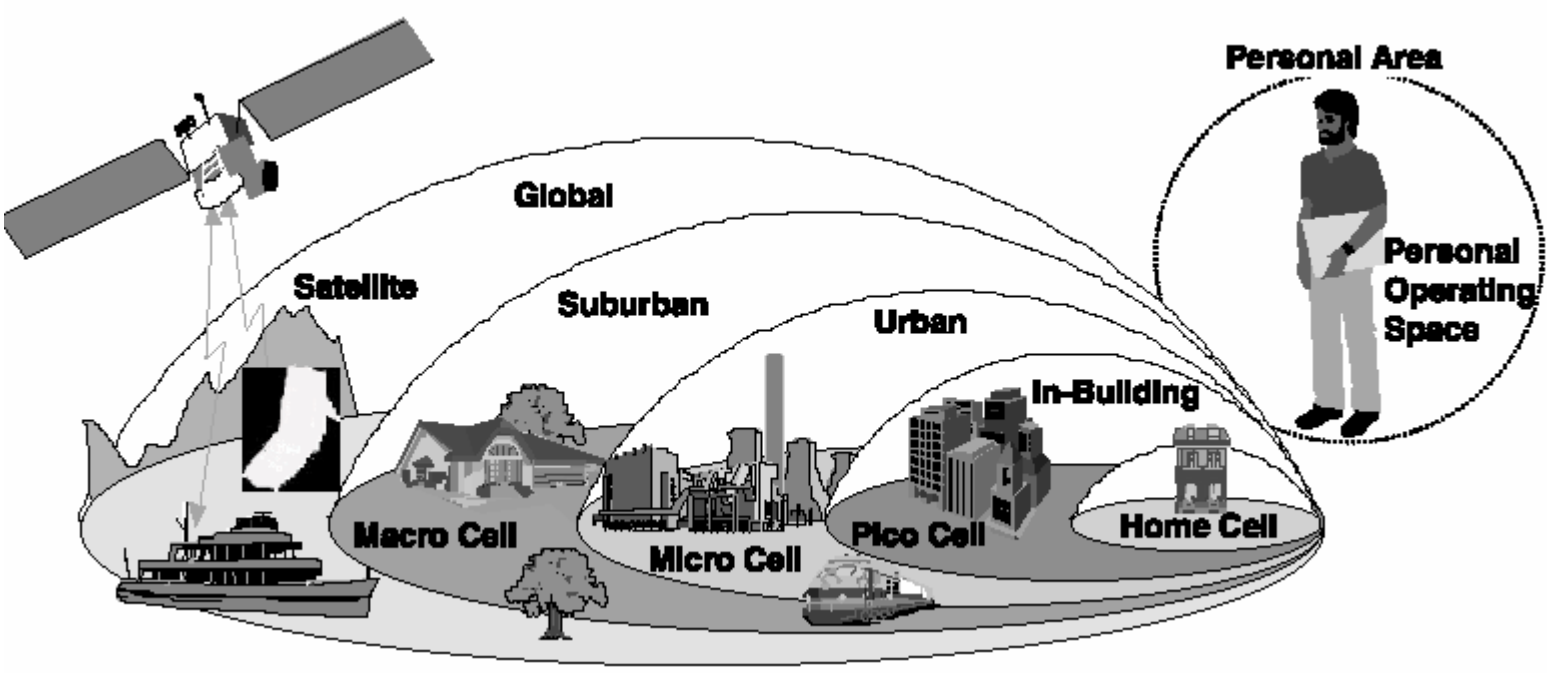
Mobility Unpredictable channel

by QoS Information

New Interests

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

Ubiquitous Services



Adaptive Applications

Varied type of service

Video | Audio | Graph | Text

Adaptive application coding

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

Expectation of the Class

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

Aeronautical Communications

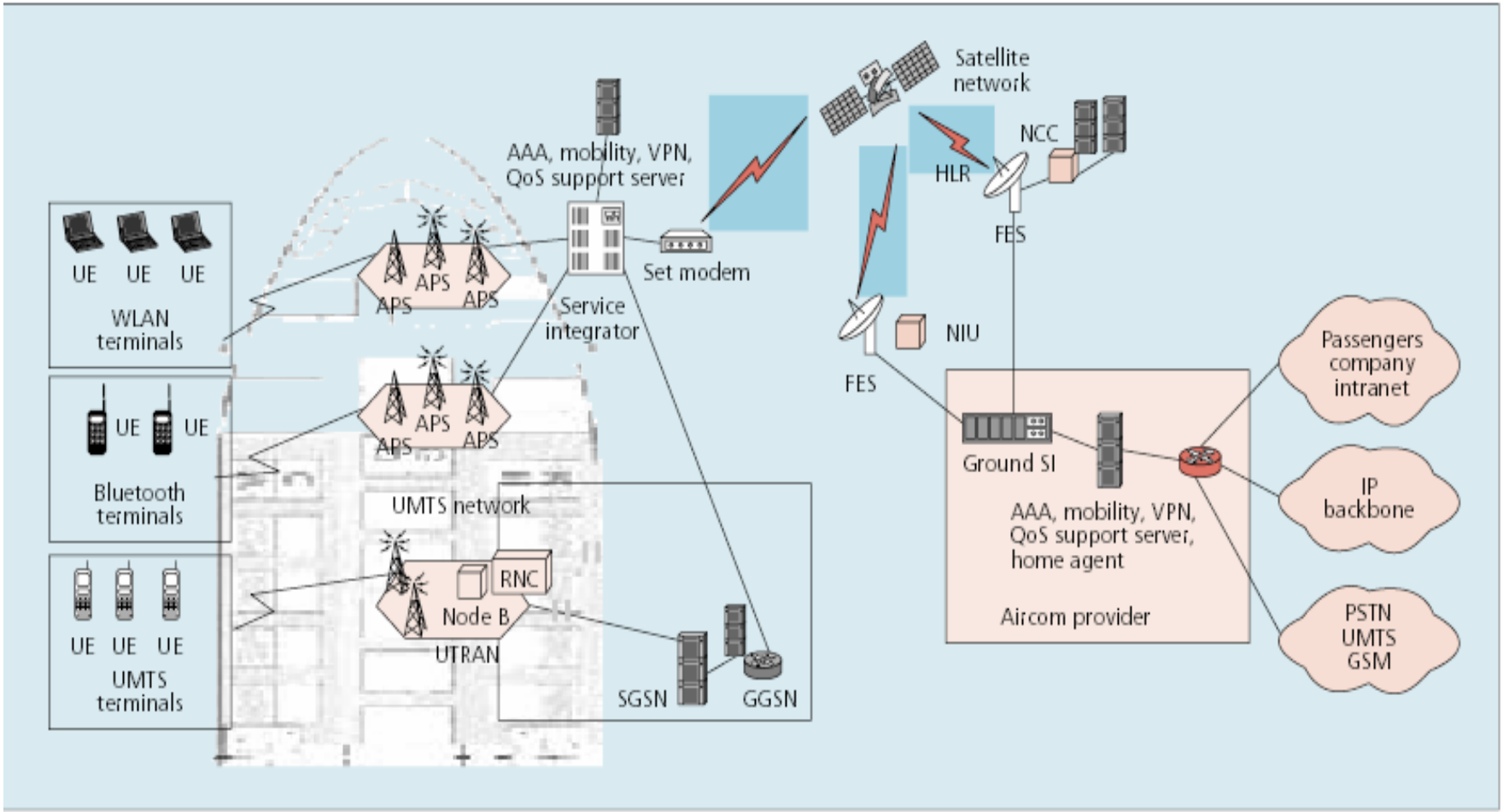


Figure 2. *Aeronautical communications network architecture.*

Situation-Aware Wireless Networks

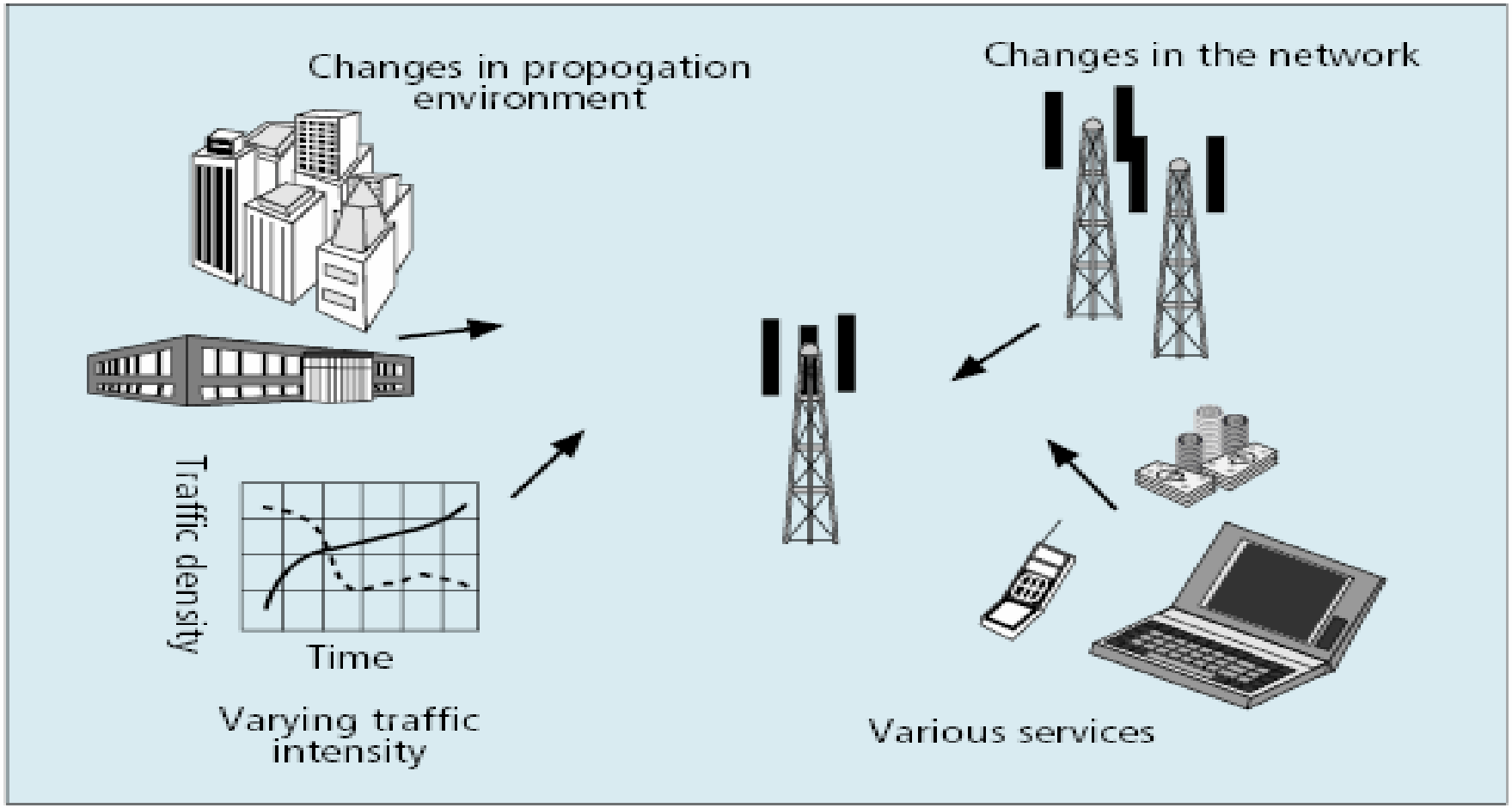


Figure 4. *Situation awareness functionality.*

Network Mobility Management

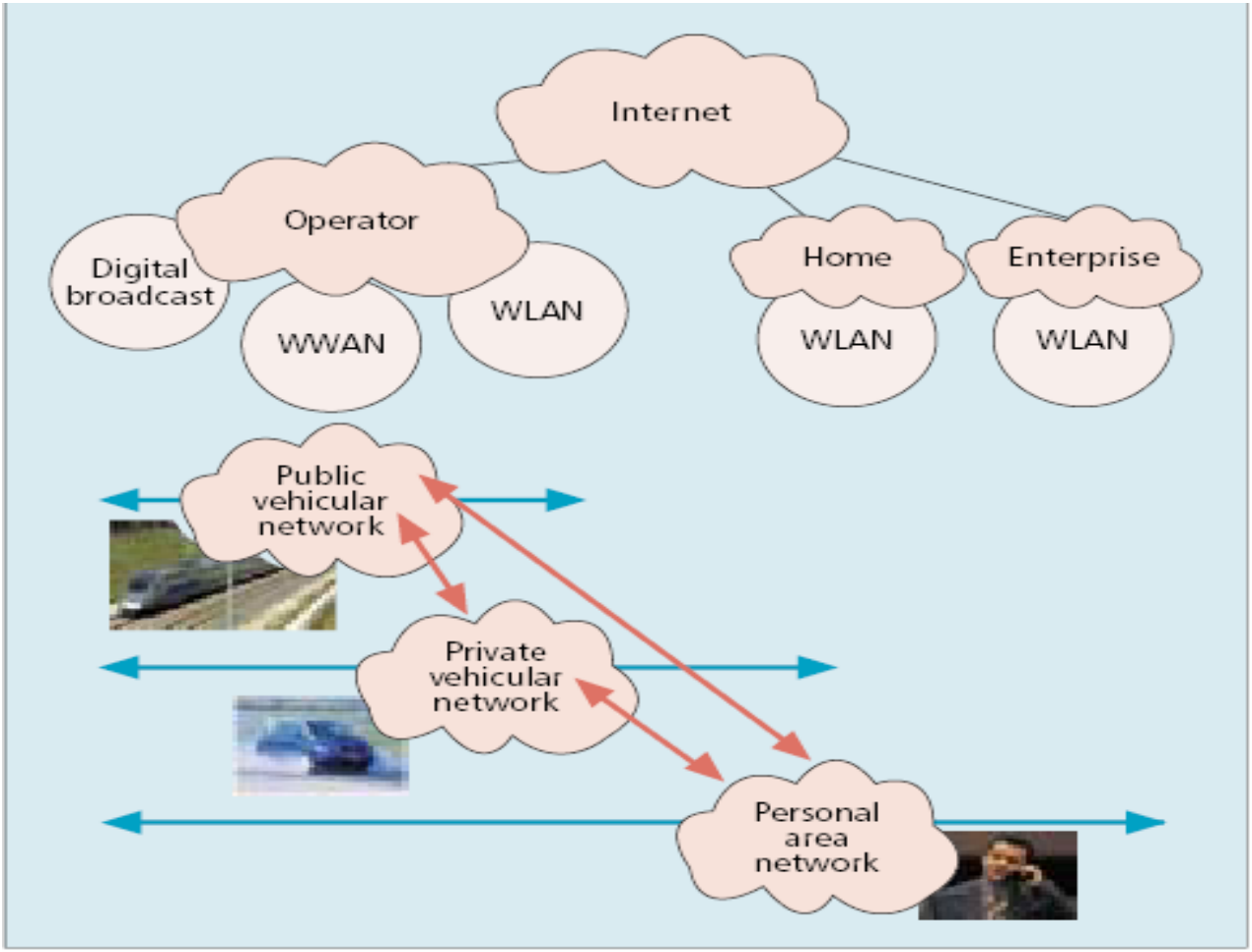
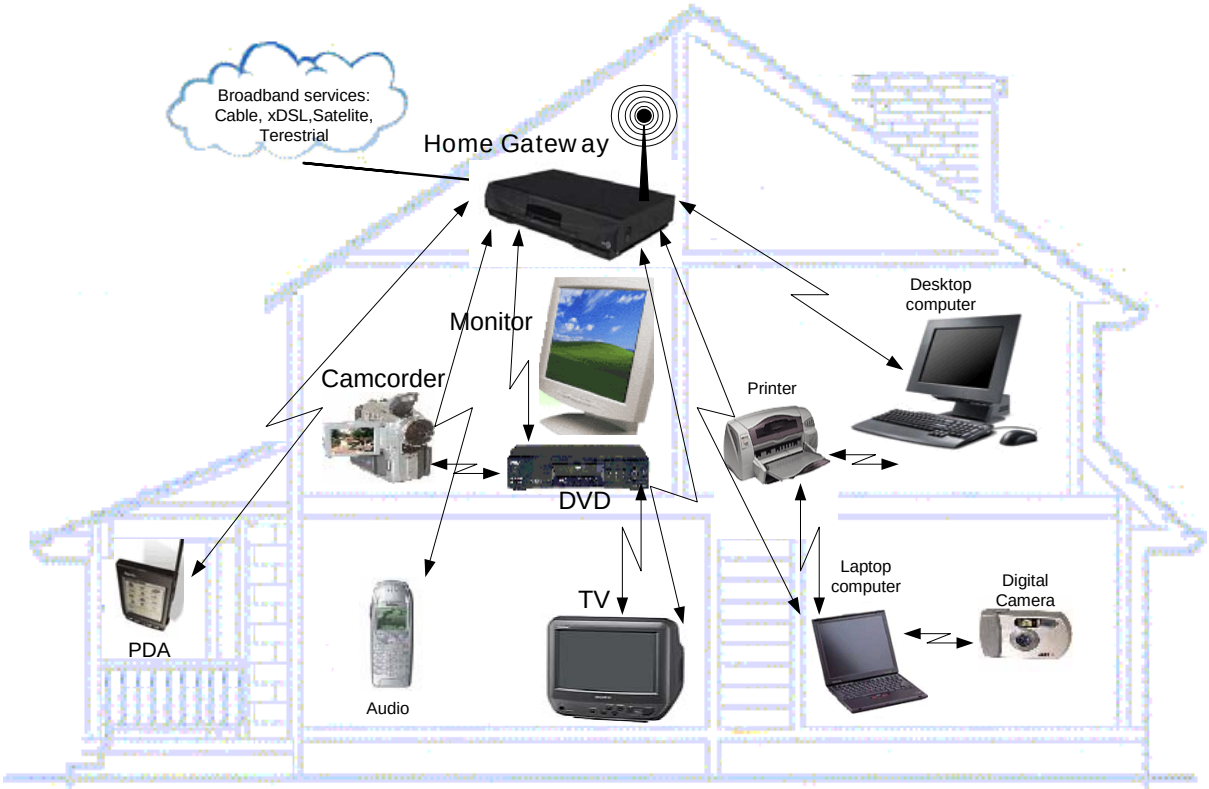


Figure 1. *A mobile network in a B3G system.*

Ultra-Wideband Radio



Course Process

- Wireless Technology Introductions
  - Text Book
  - Wireless Communications and Network (William Stallings 2002)
- 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

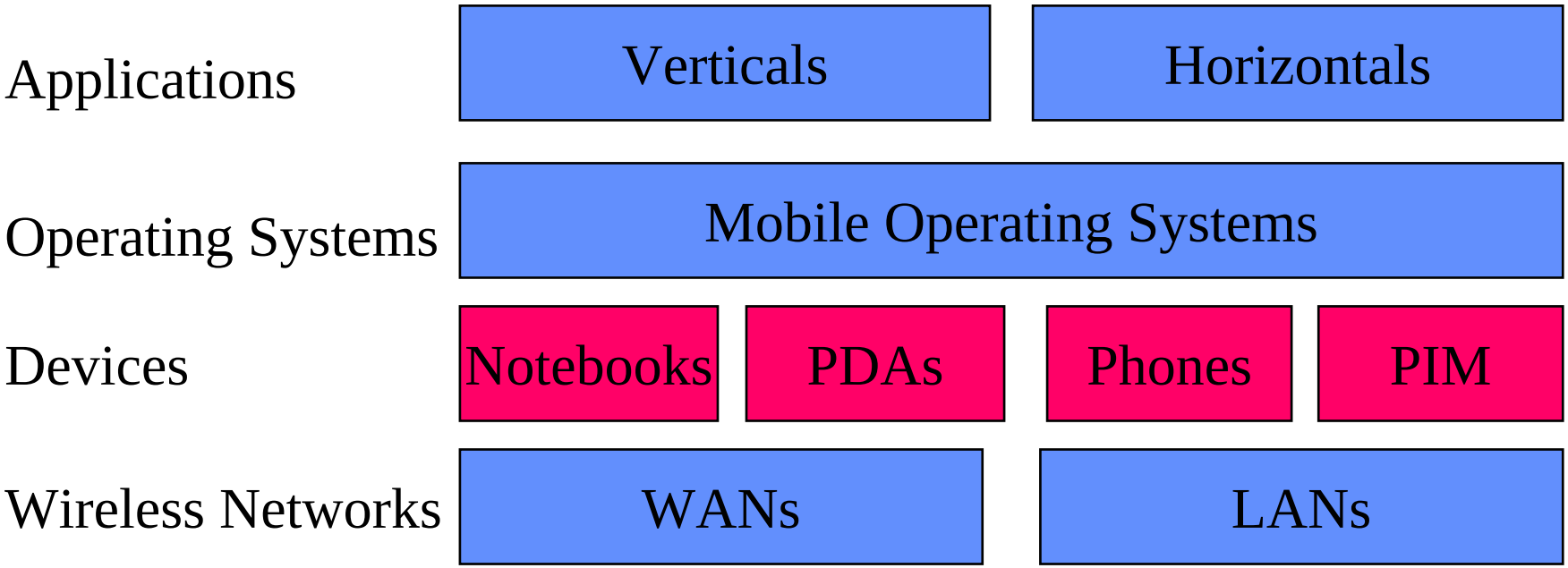
  (S.2001) M. Satyanaraynan, "Pervasive Computing: Vision and Challenges", IEEE Personal Communication Magazine, (August 2001), pp.10-17

  (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



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)

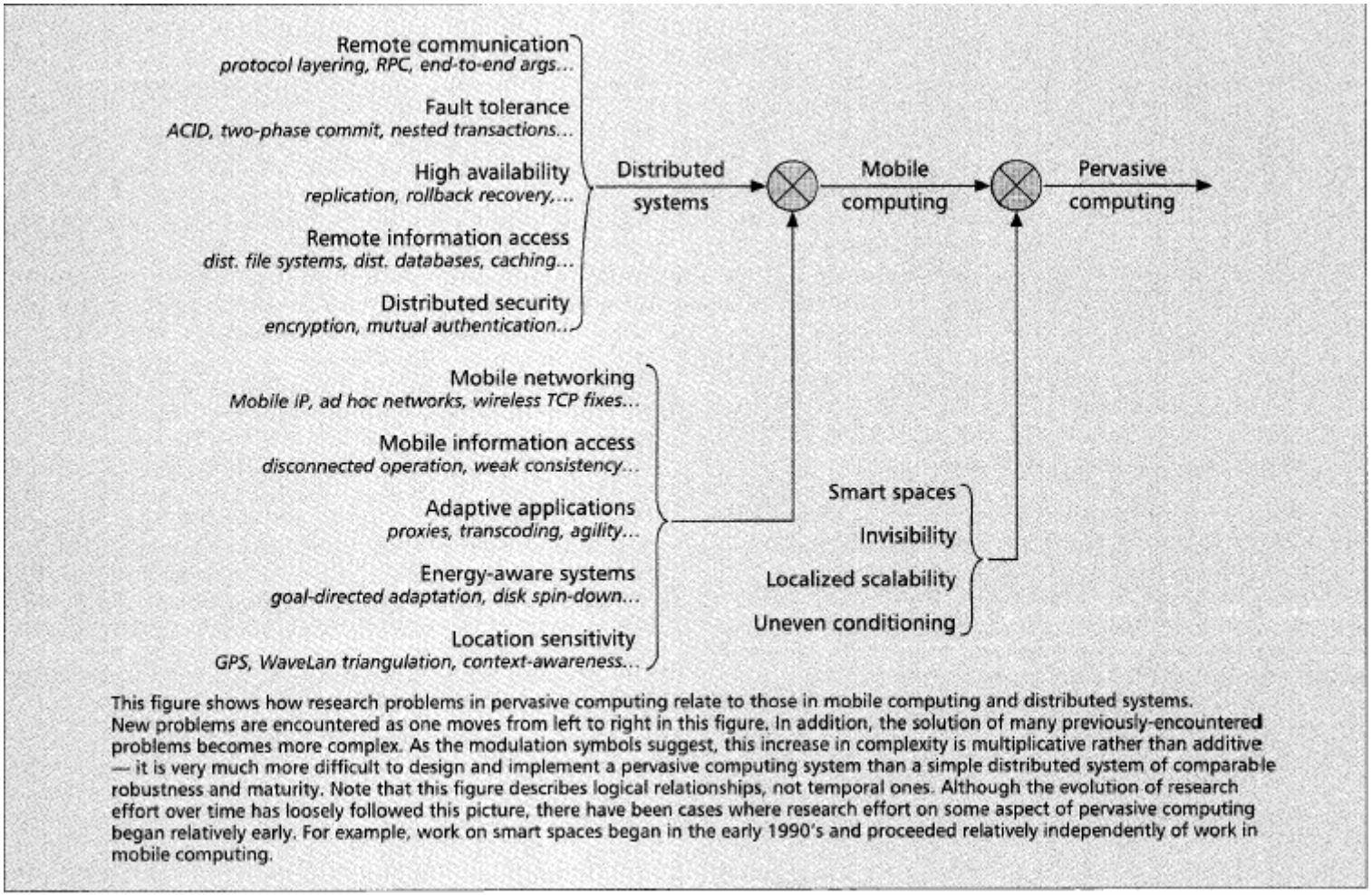
Pervasive Computing

- 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

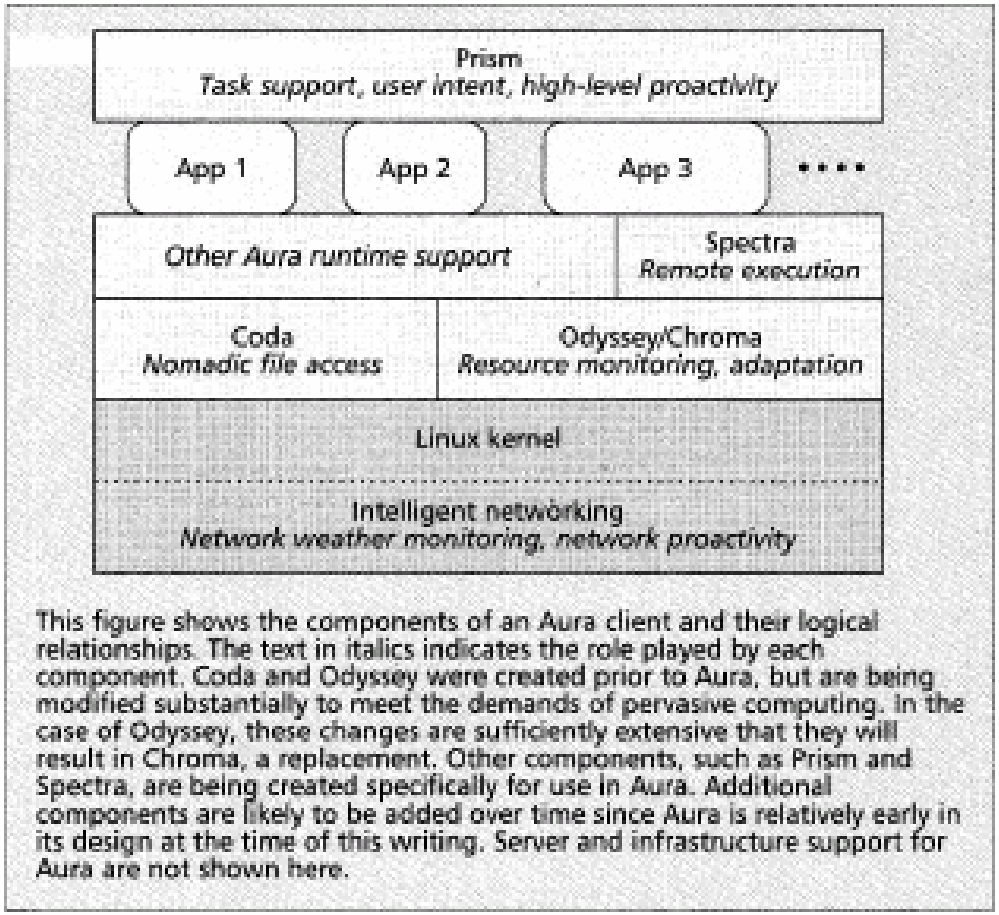
- User Intent
- Cyber Foraging
- Adaptation Strategy
- High-Level Energy Management
- Balancing Pro-activity and Transparency
- Privacy and Trust
- Impact on Layering

Pervasive Computing



■ **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

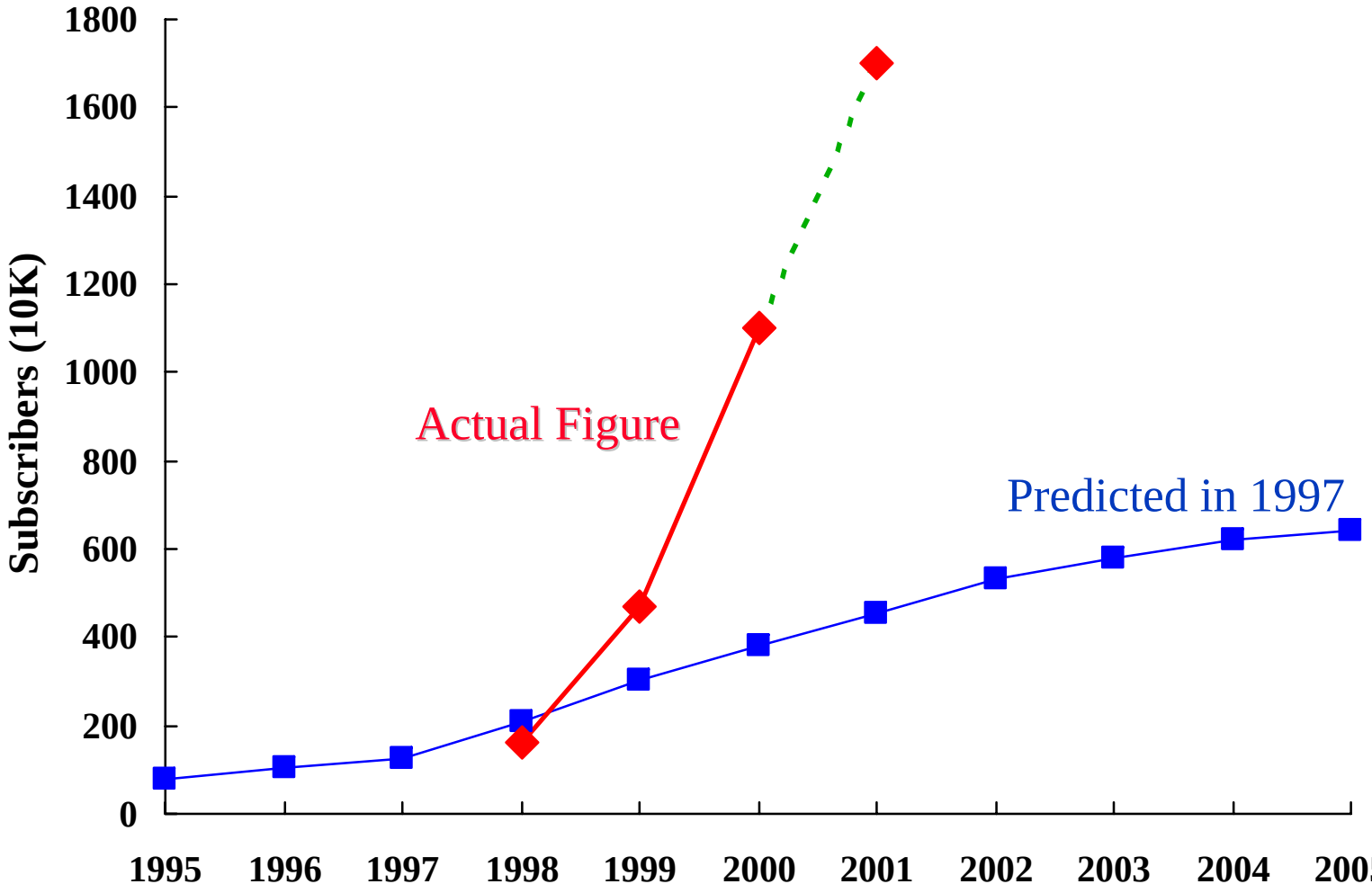
Mobile Communications

Fixed Broadband Wireless Communications

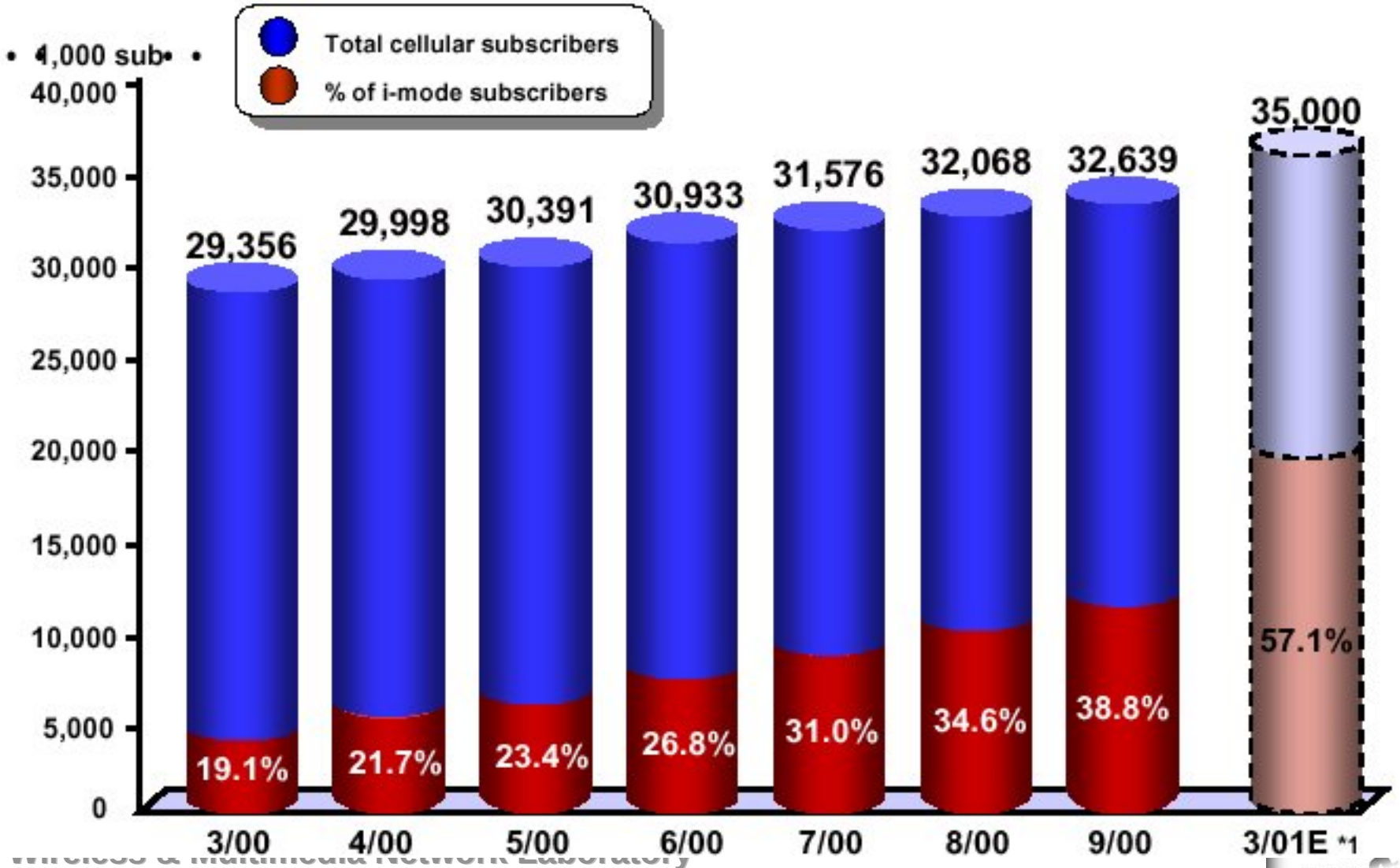
Evolution of Mobile Wireless Systems

- 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

2000 Market Share

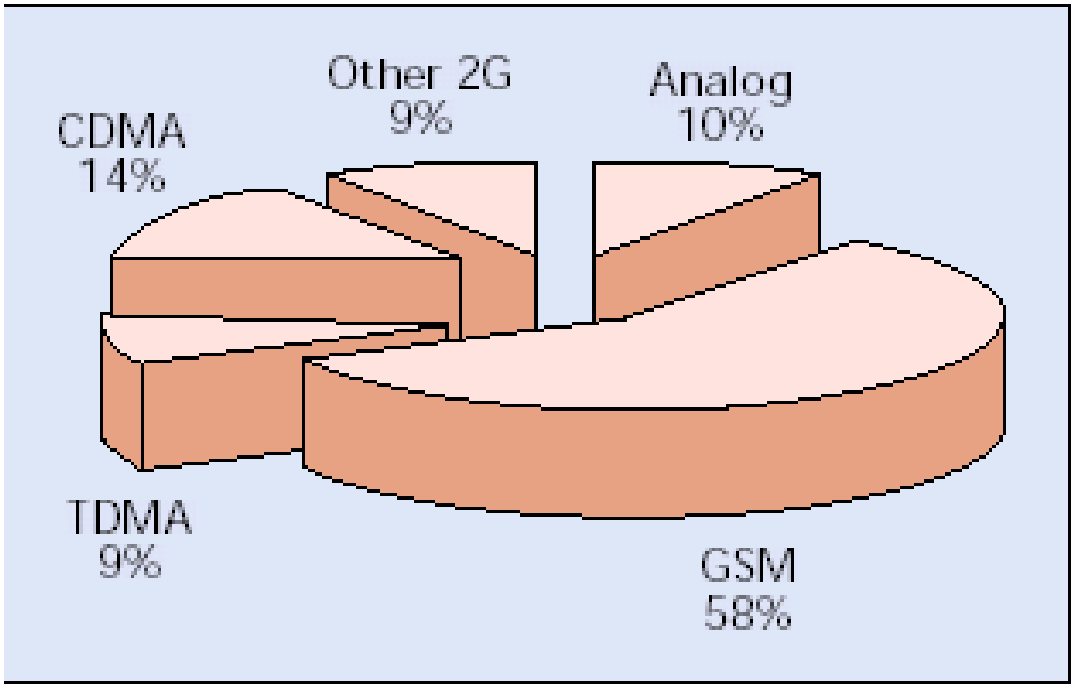


Figure 5. *Estimated market shares of 1G and 2G wireless mobile systems in 2000.*

Mobile Terminal Growth

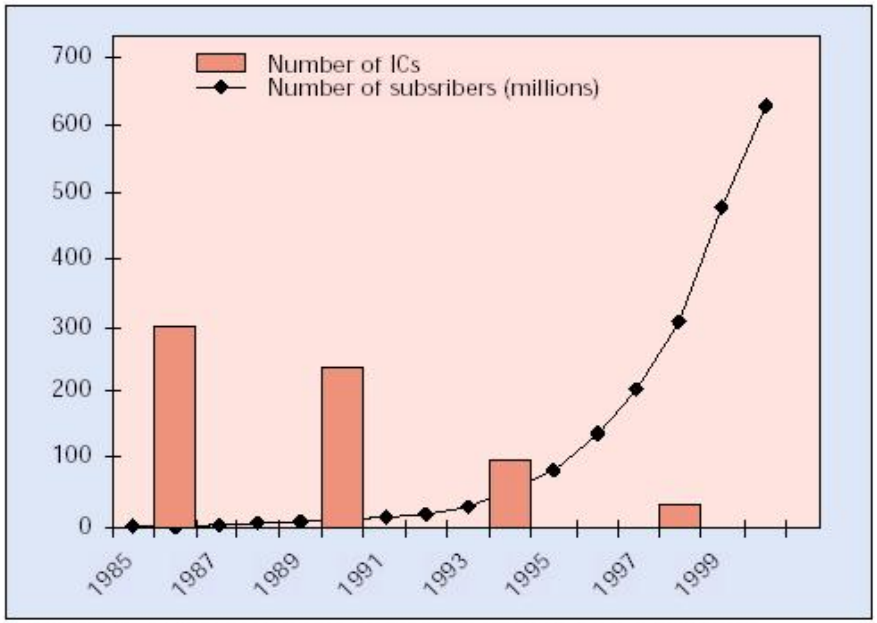


Figure 1. *Subscriber growth and IC reduction in mobile terminals.*

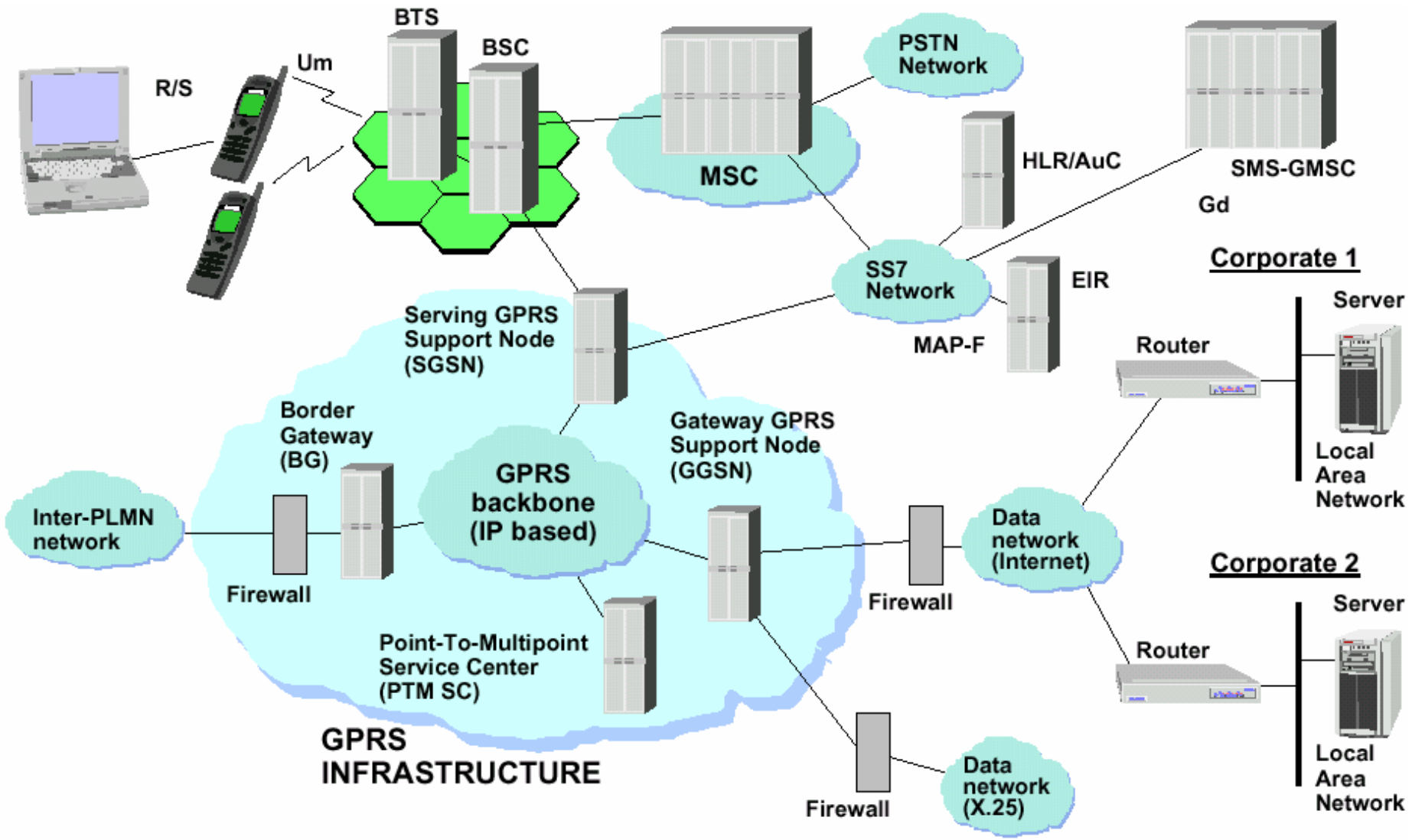
QUALCOMM

> Easy Migration from cdmaOne to 3G

Time to Market

Simple IS-95 to cdma2000 conversion

GPRS Architecture



RS Spectrum Allocation

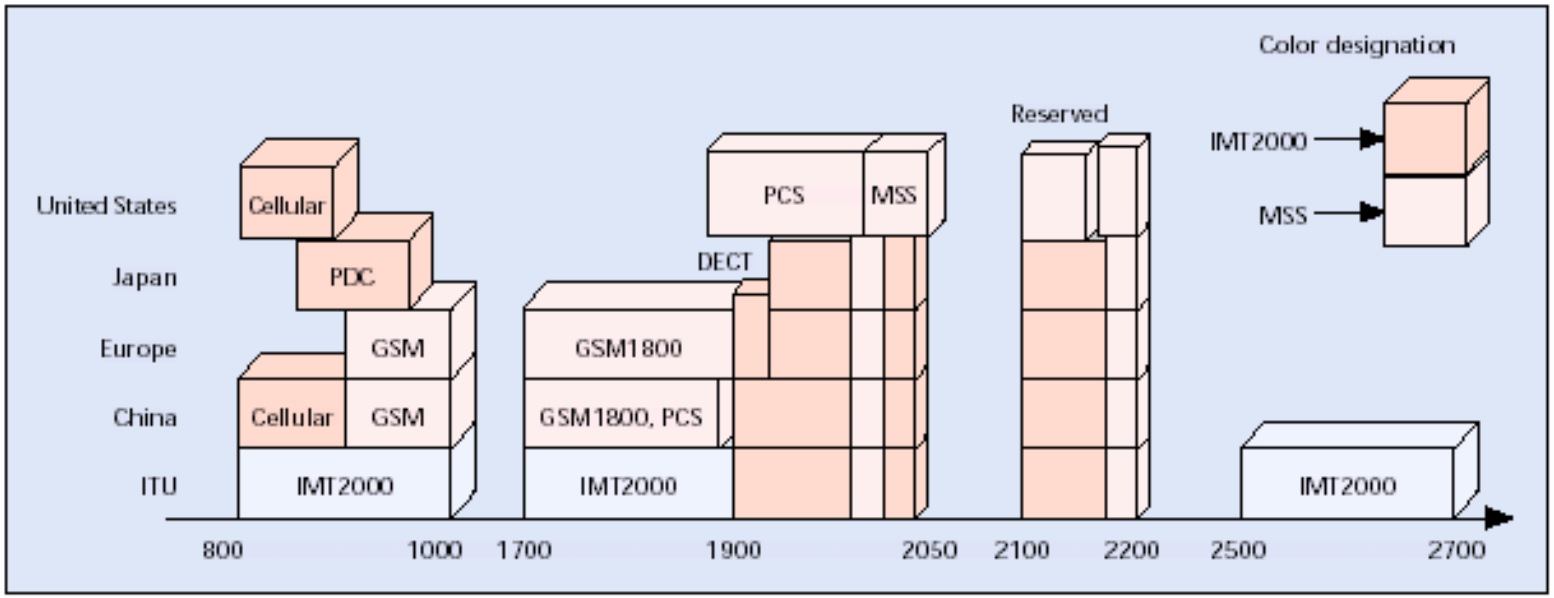
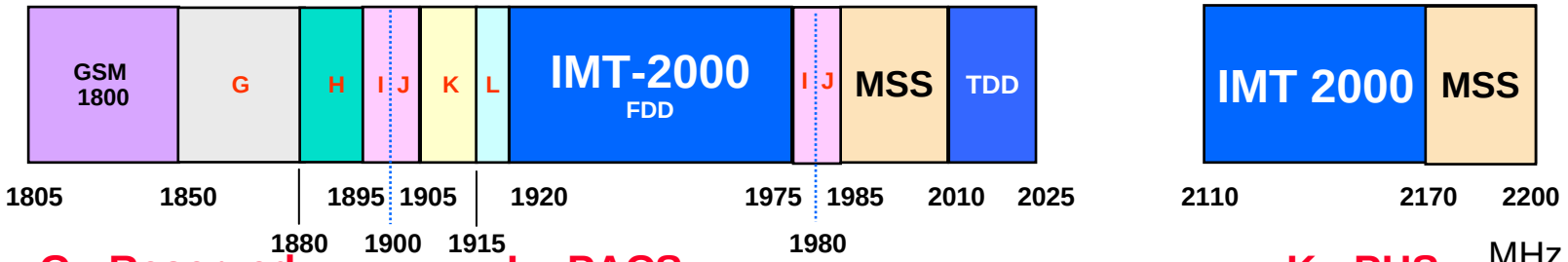


Figure 2. *RF spectrum allocation in major regions.*



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

Wireless Mobile Interface

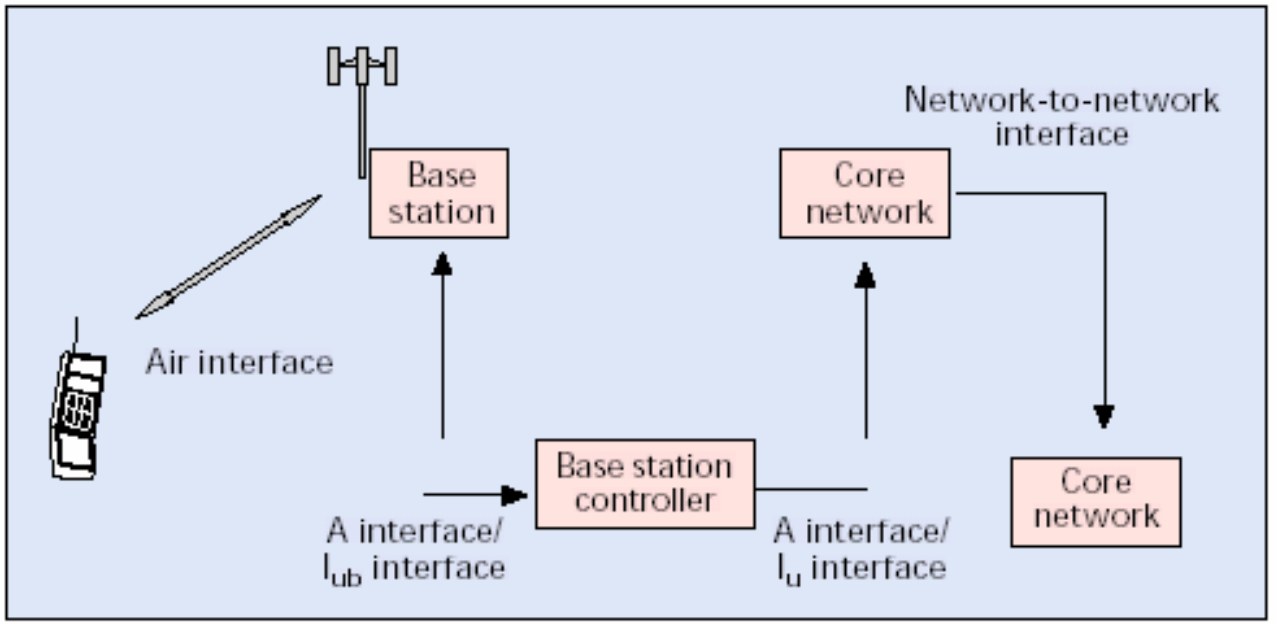
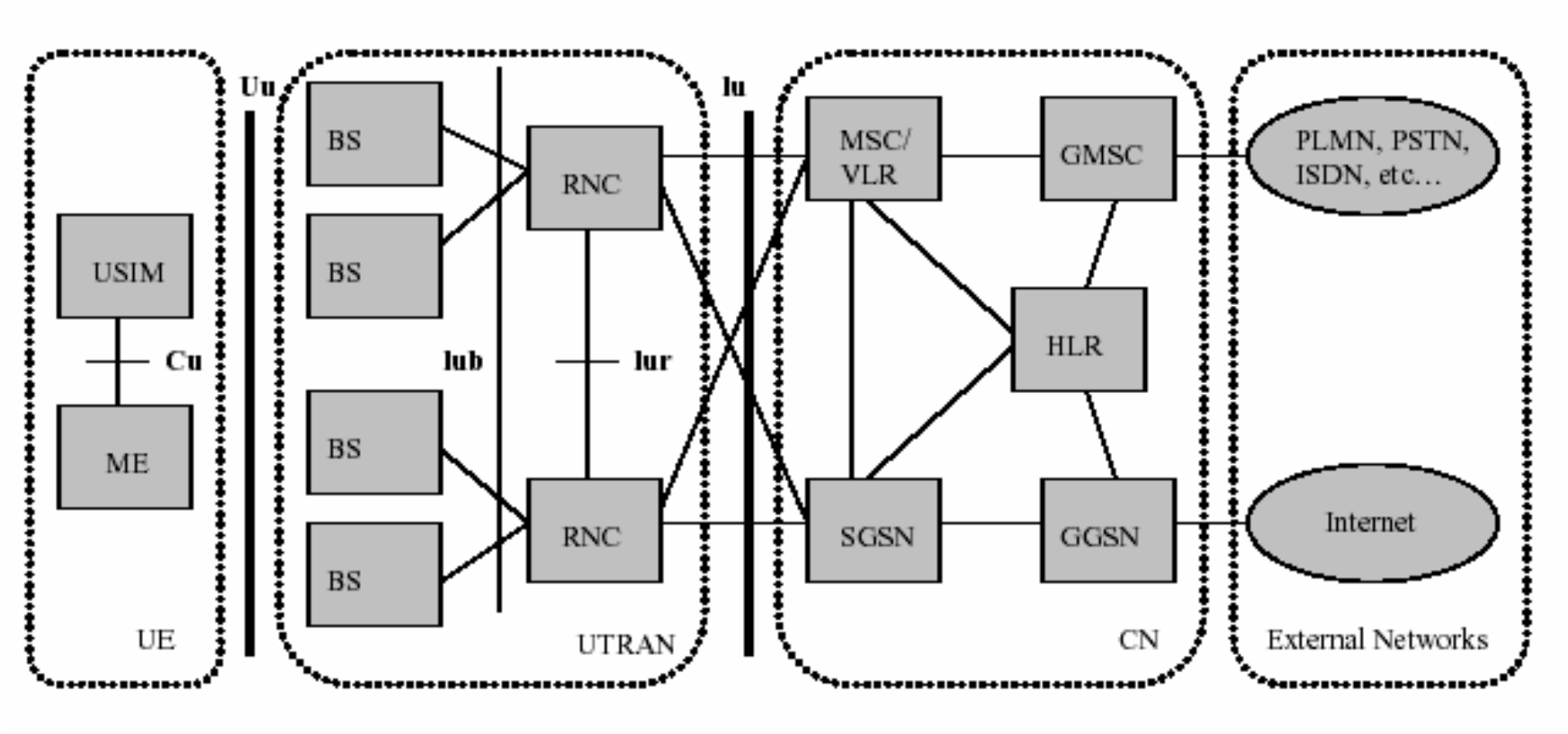
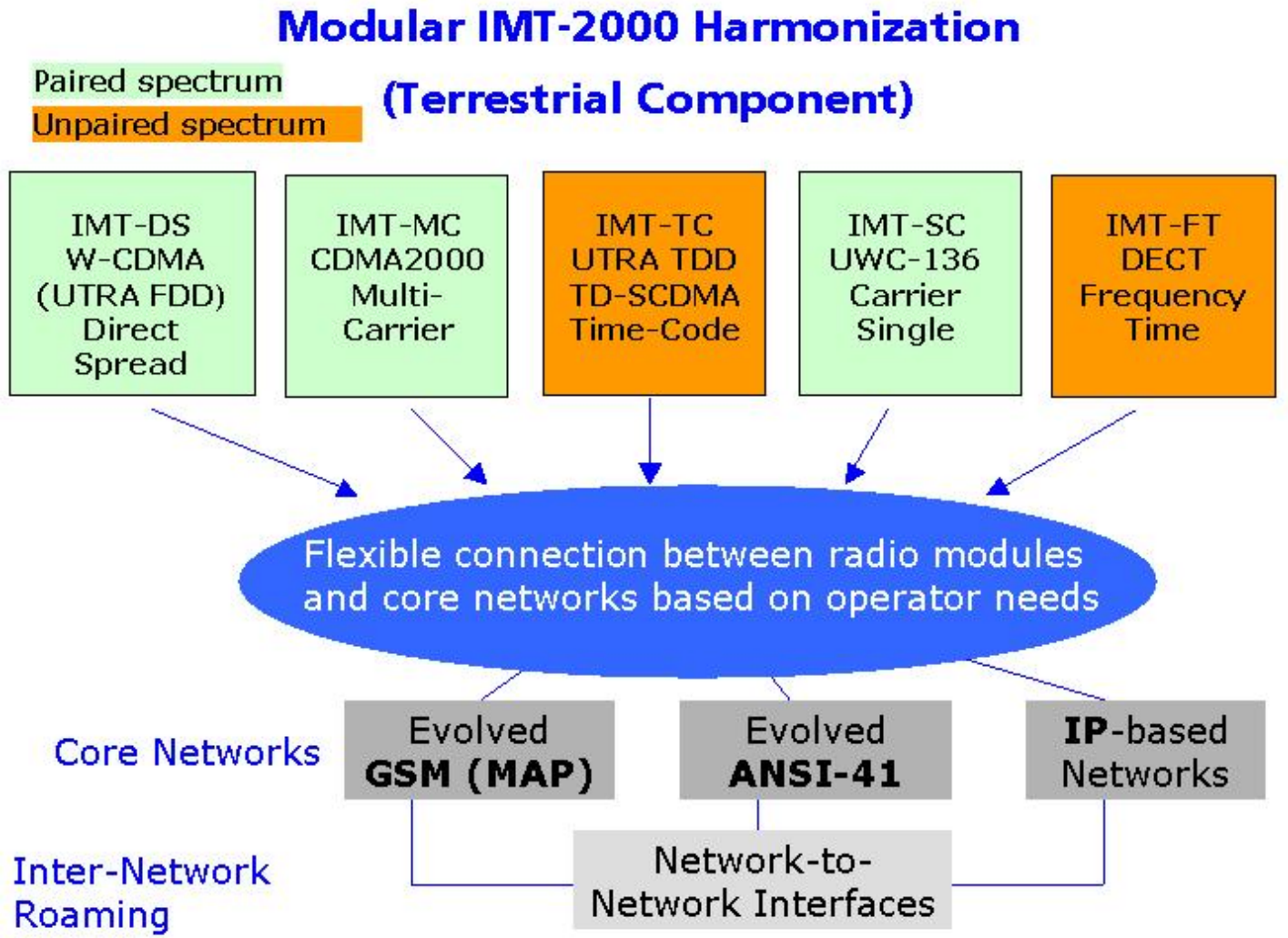


Figure 4. *Wireless mobile system interface definition.*

Elements of UMTS Architecture

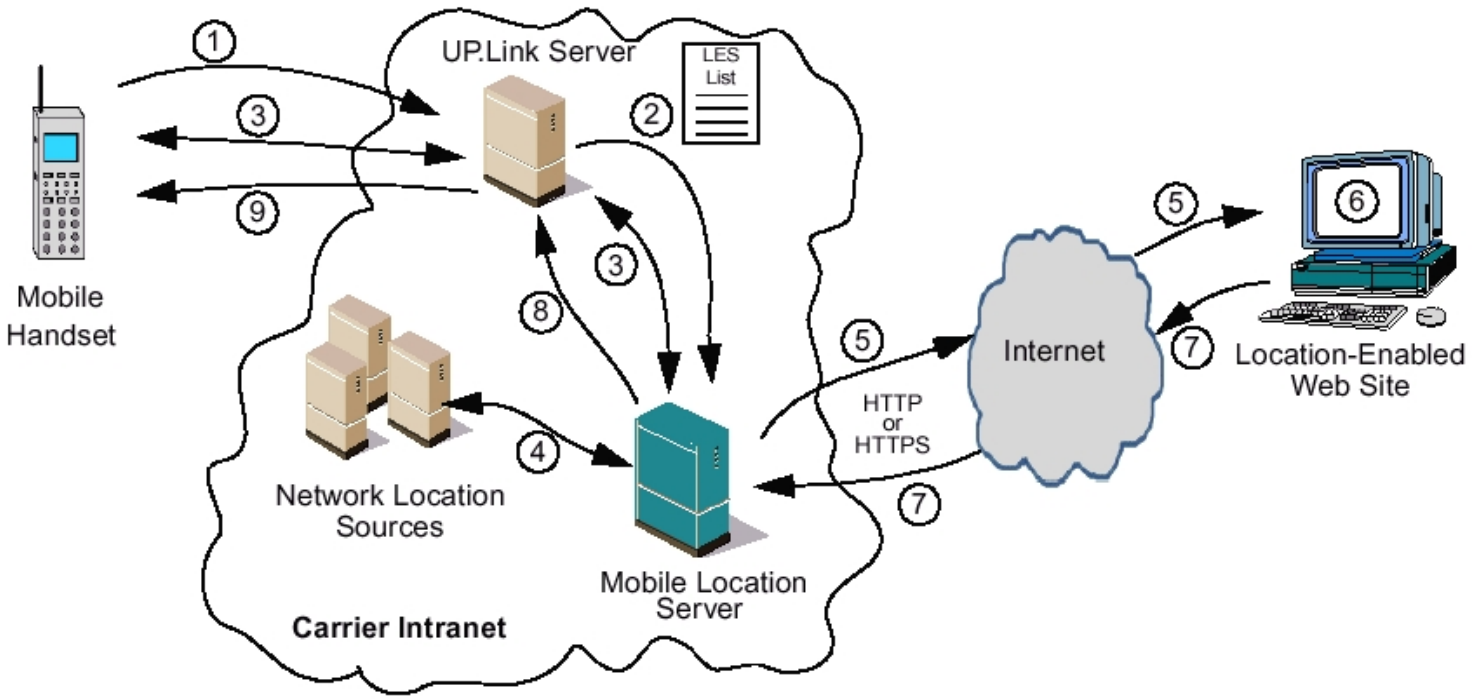


第三代行動電話之技術標準

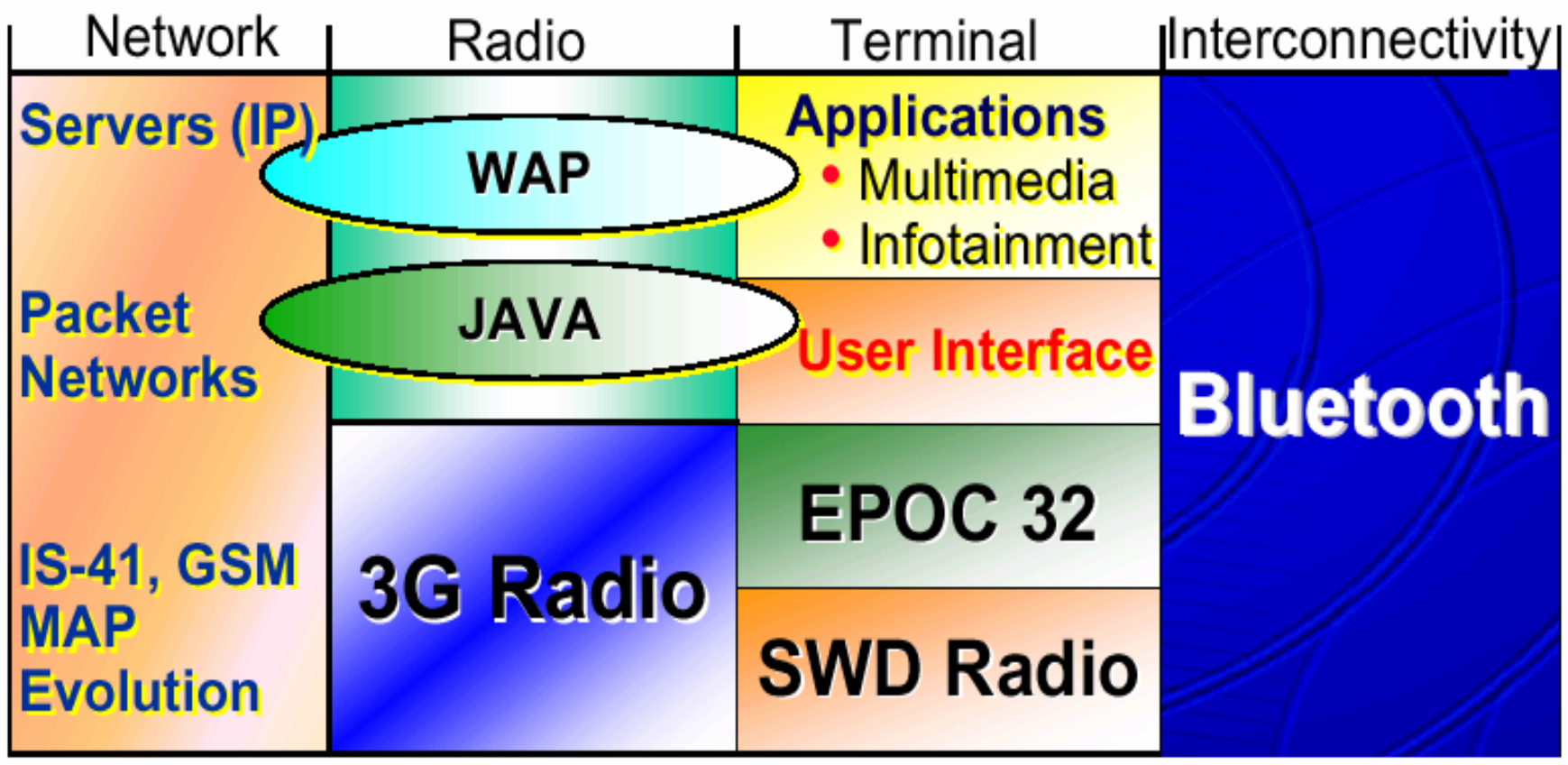


Location-Based Applications

Figure 1. A typical location data transaction



3G-Network integration



Mobile Broadband System

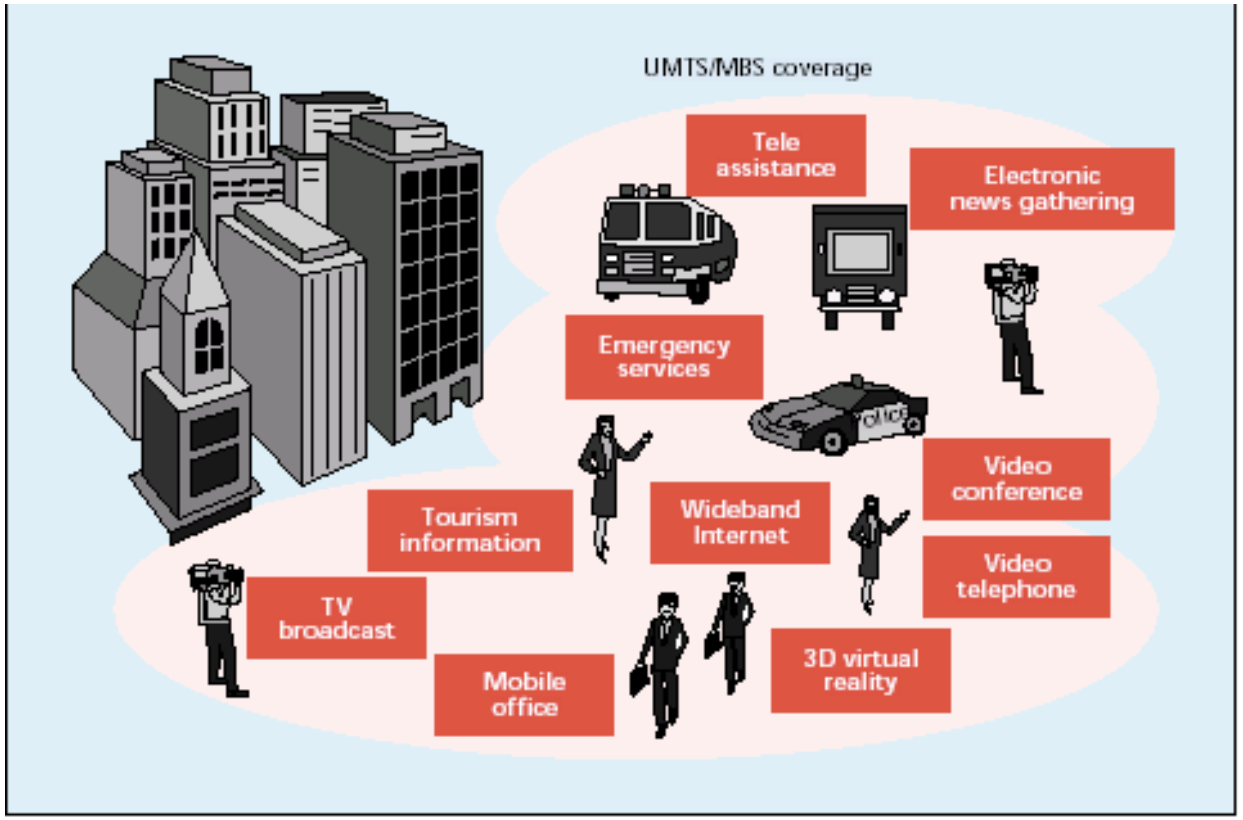


Figure 1. *MBS and UMTS coverage and applications.*

Mobile System Evolution

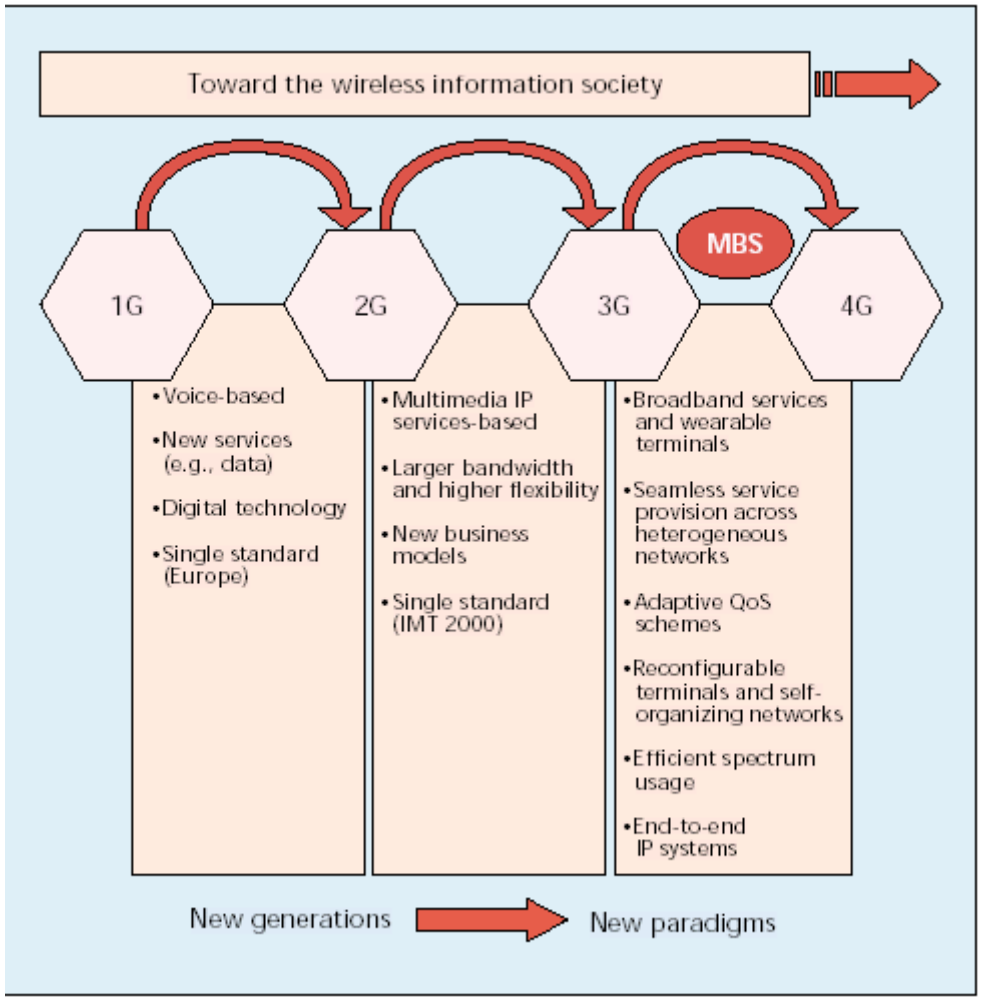
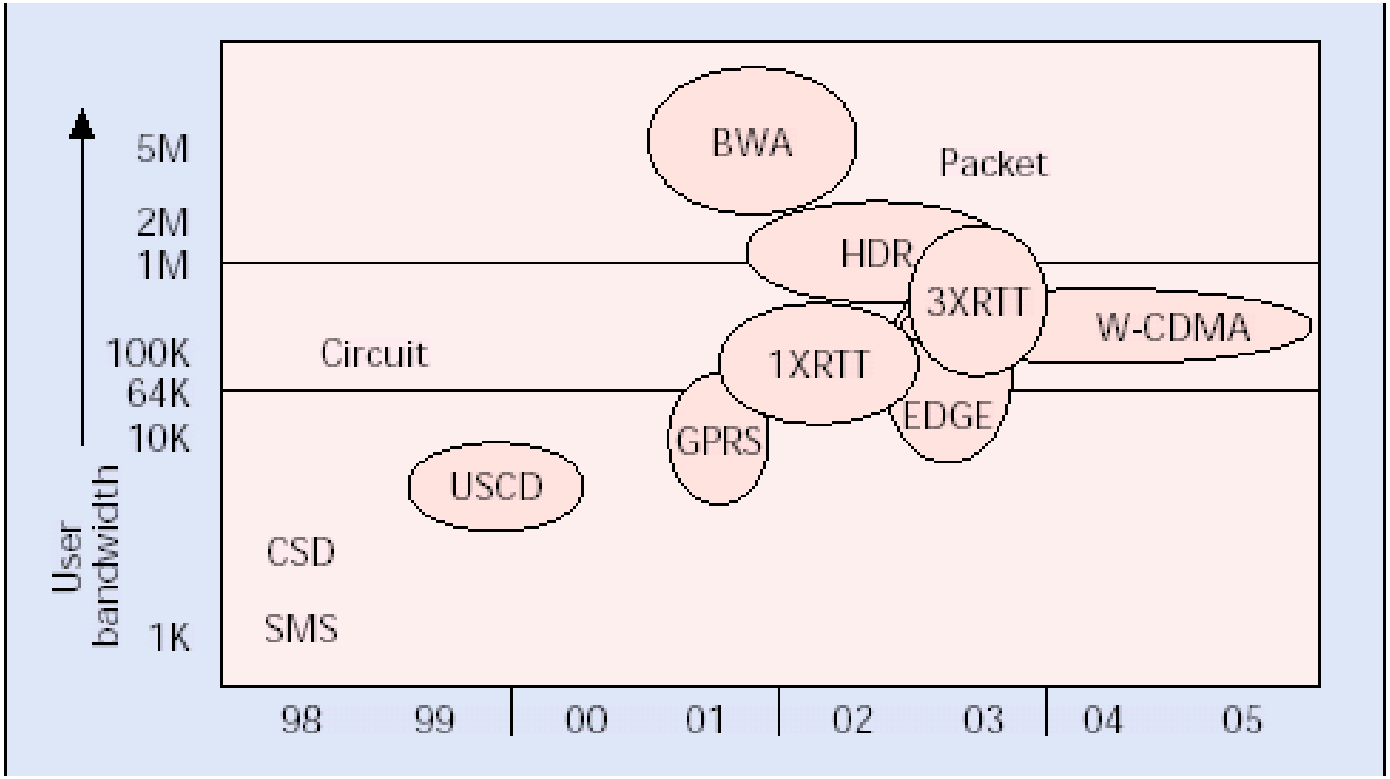


Figure 5. *Mobile communication systems evolution.*


5M
2M
1M
100K
64K
10K
1K
User bandwidth
BWA
Packet
HDR
3XRTT
W-CDMA
Circuit
1XRTT
EDGE
GPRS
USCD
CSD
SMS
98
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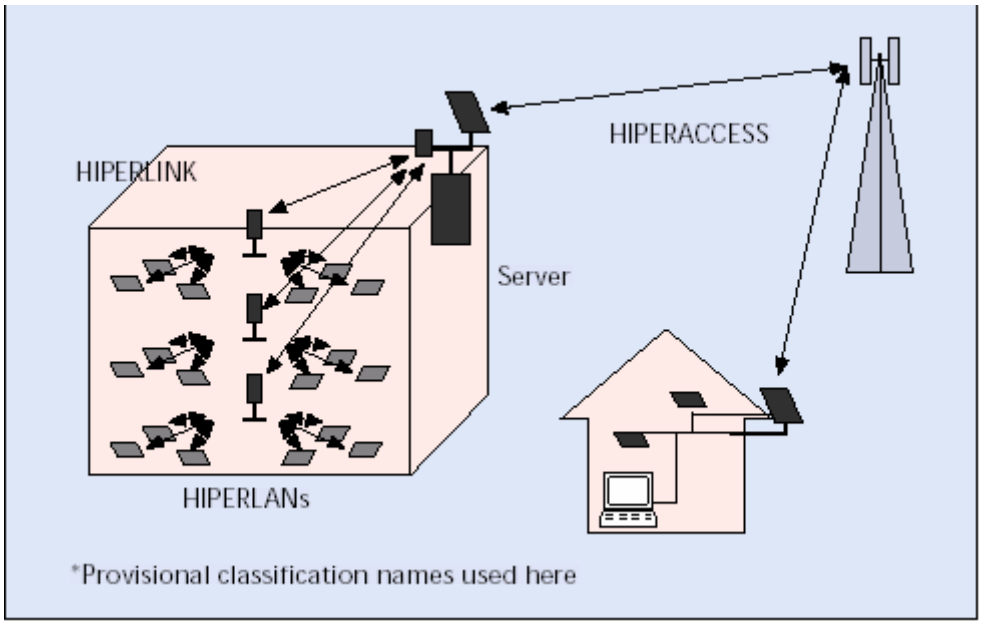

HIPERACCESS
HIPERLINK
Server
HIPERLANs
*Provisional classification names used here

WiMAX Nomadic and Portable

Non Line of Sight
Point to Multi-point

802.16

Line of Sight
BACKHAUL

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

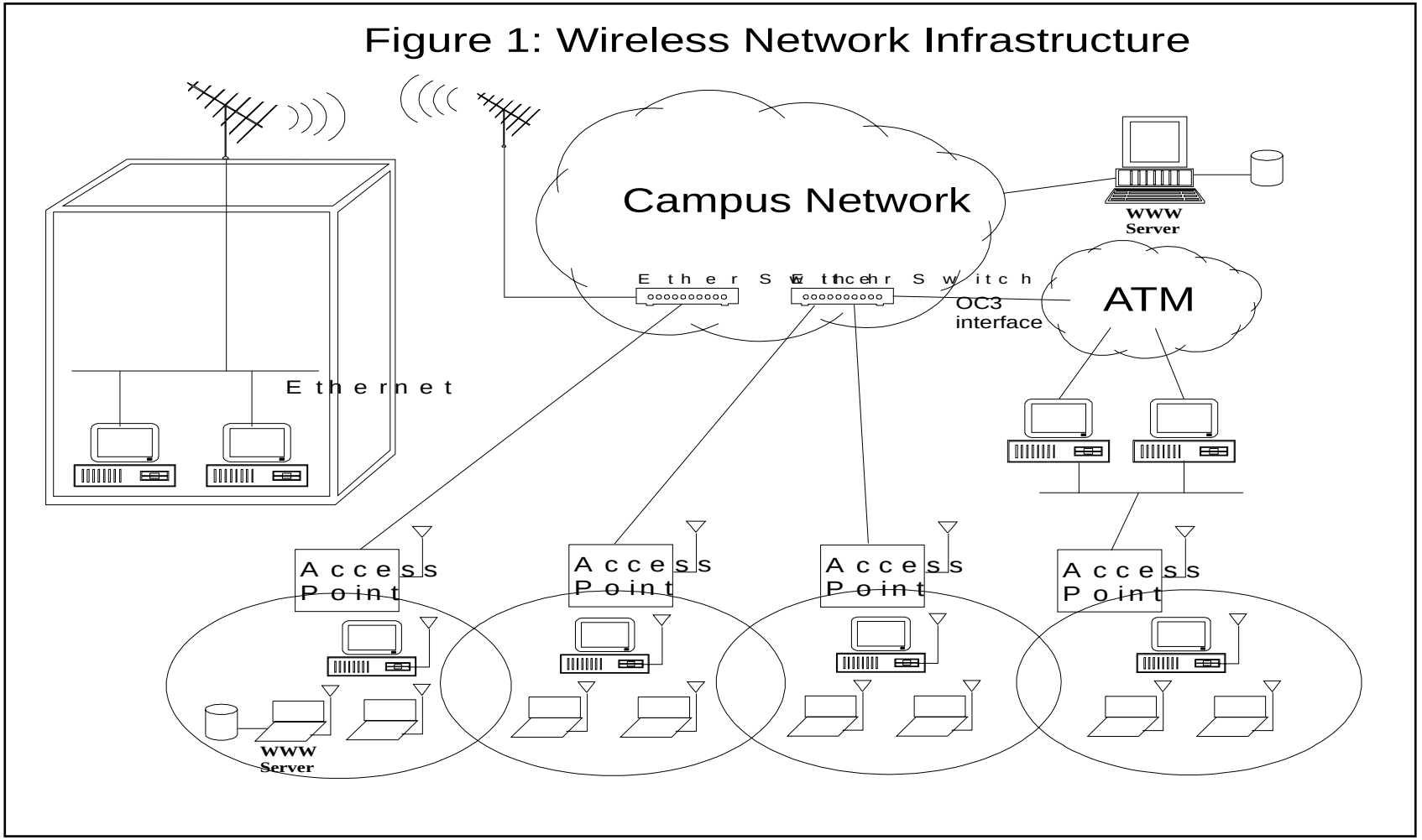
INTERNET
BACKBONE

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

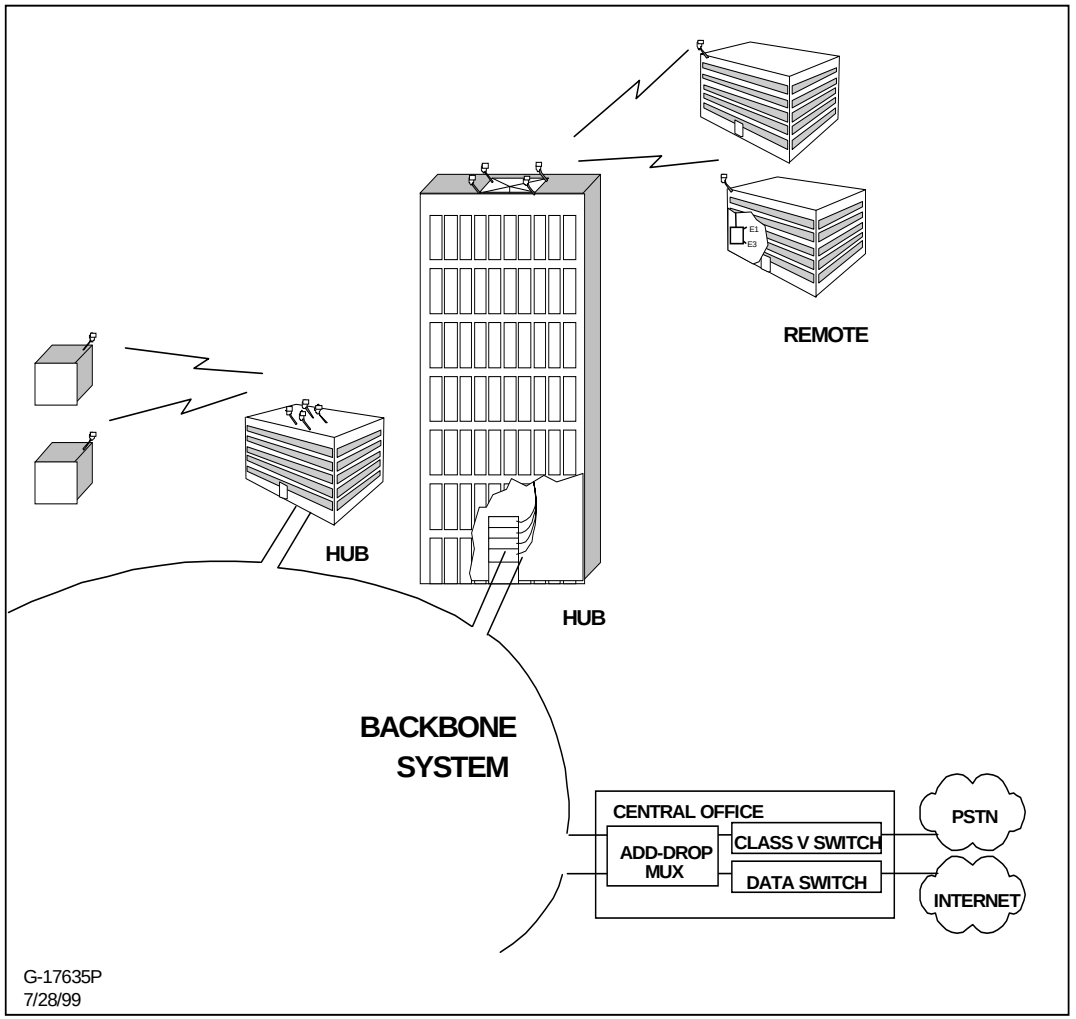
National Central University
&
Hughes Network Systems
LMDS Demo Briefing

November 1999

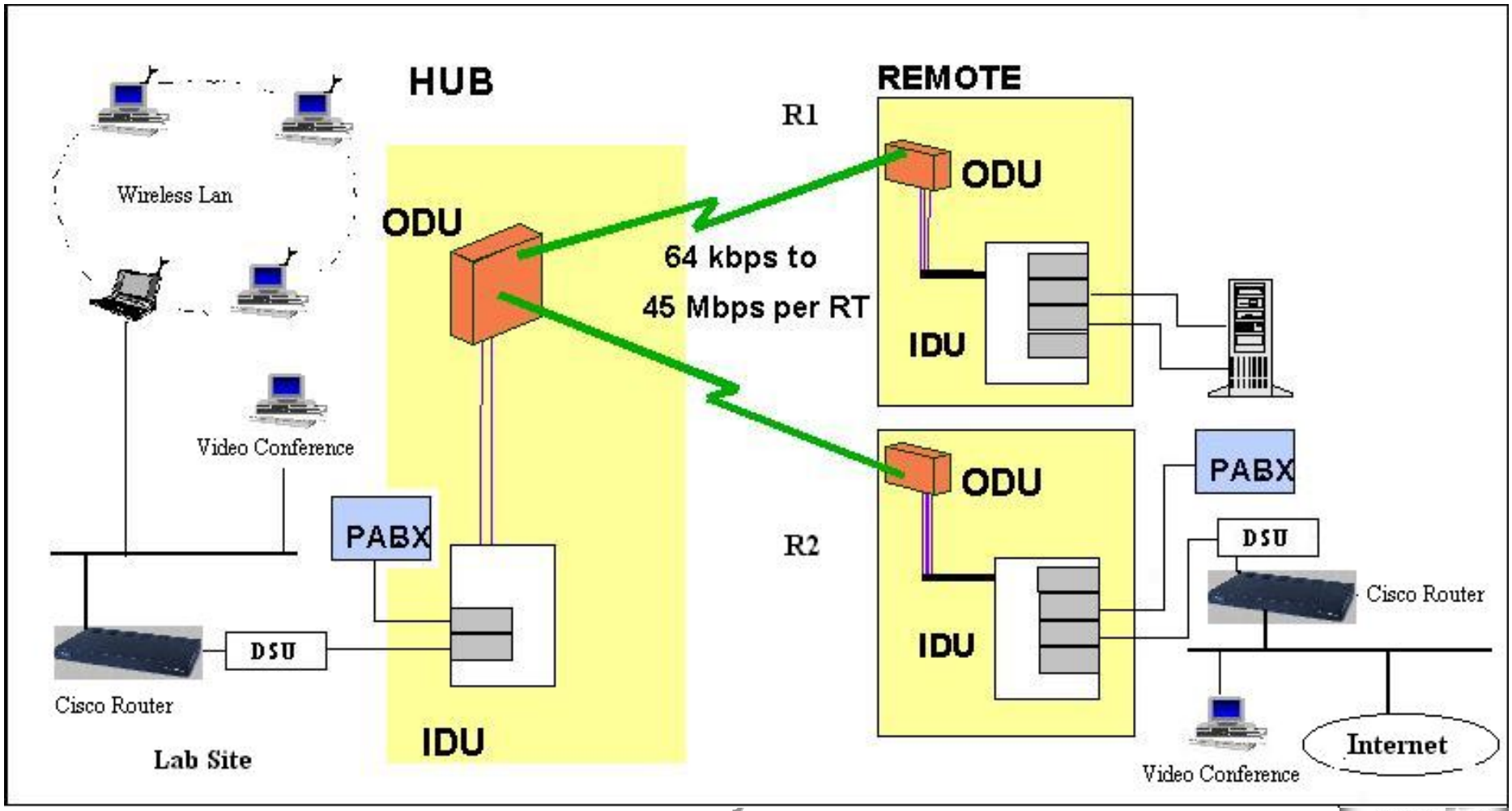
Campus Network



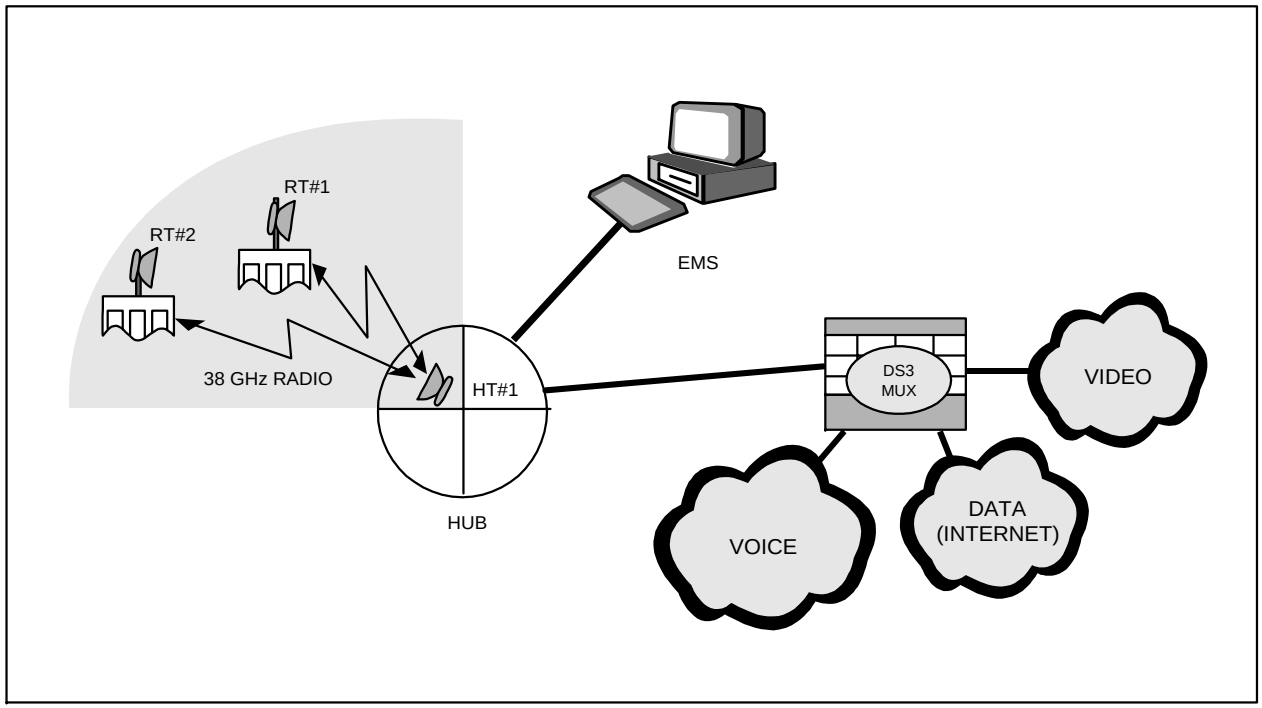
LMDS NCU Test-bench



Architecture of the Demo

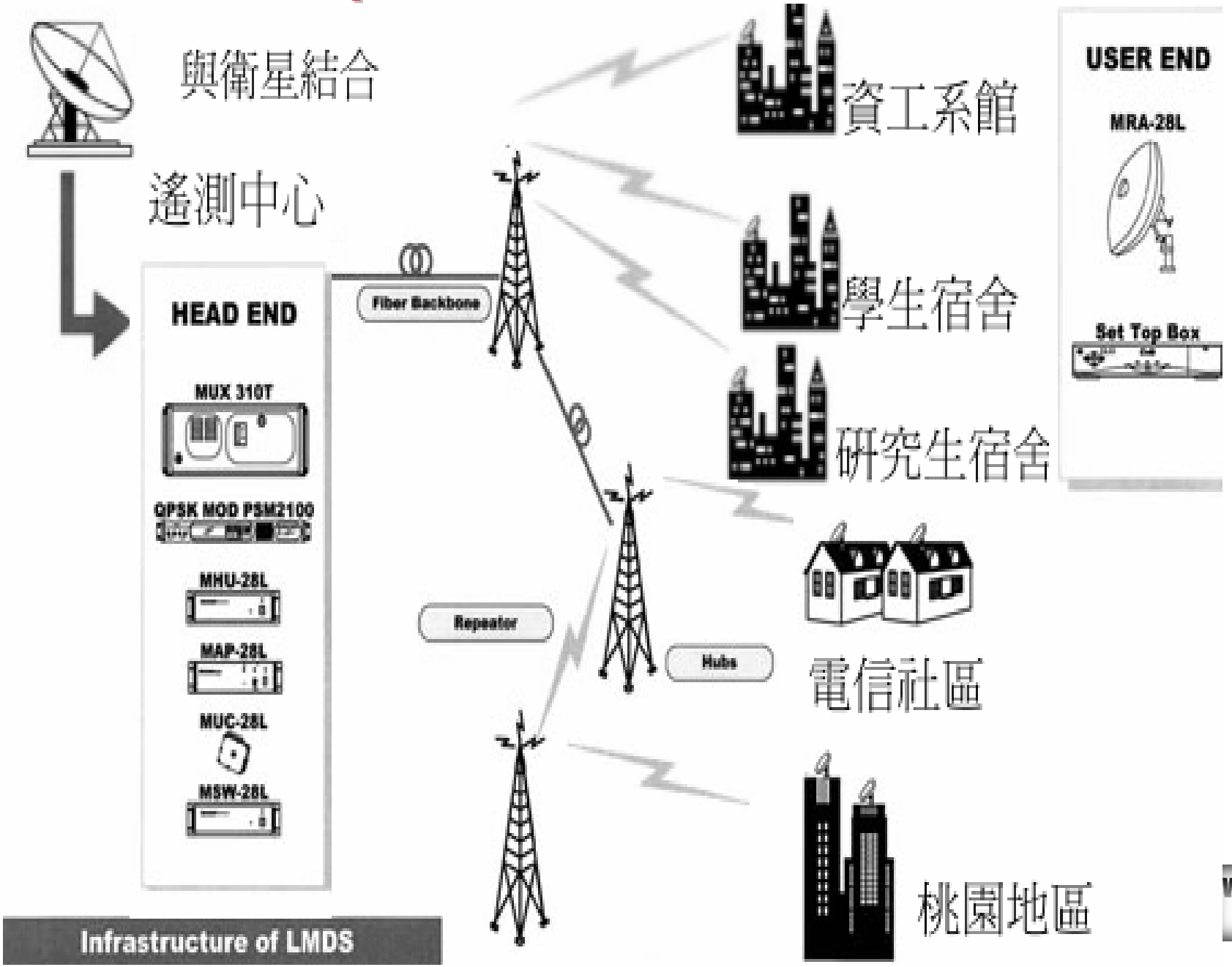


National Central University Demo Layout



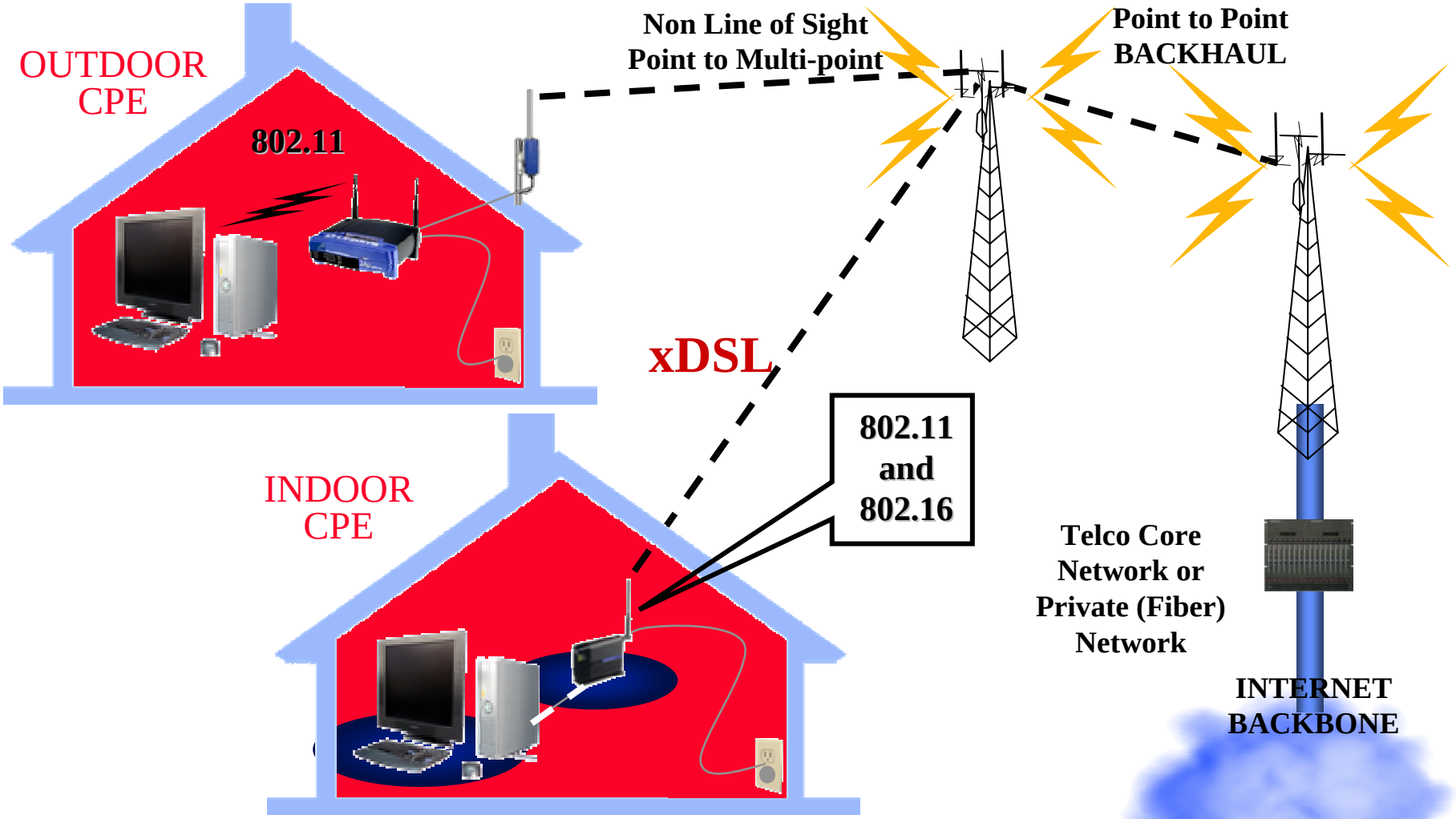
G-17833P 8/19/99

Step.1 LMDS Architecture



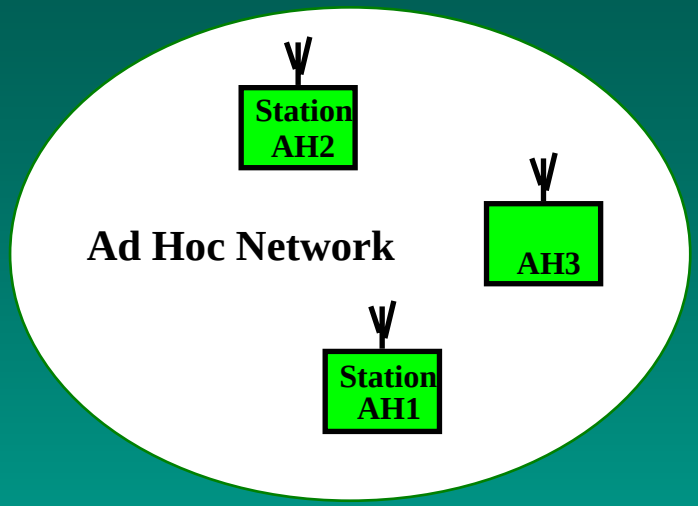
Infrastructure of LMDS

WiMAX Consumer Last Mile



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

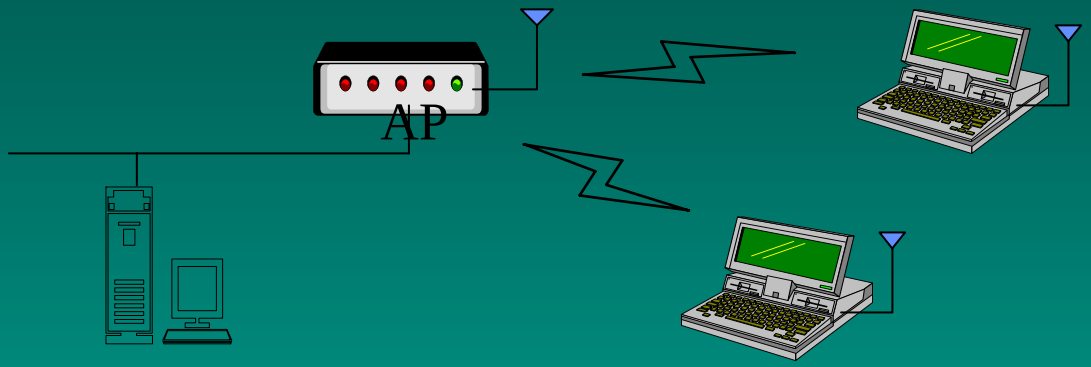
IEEE 802.11 Configurations - Independent



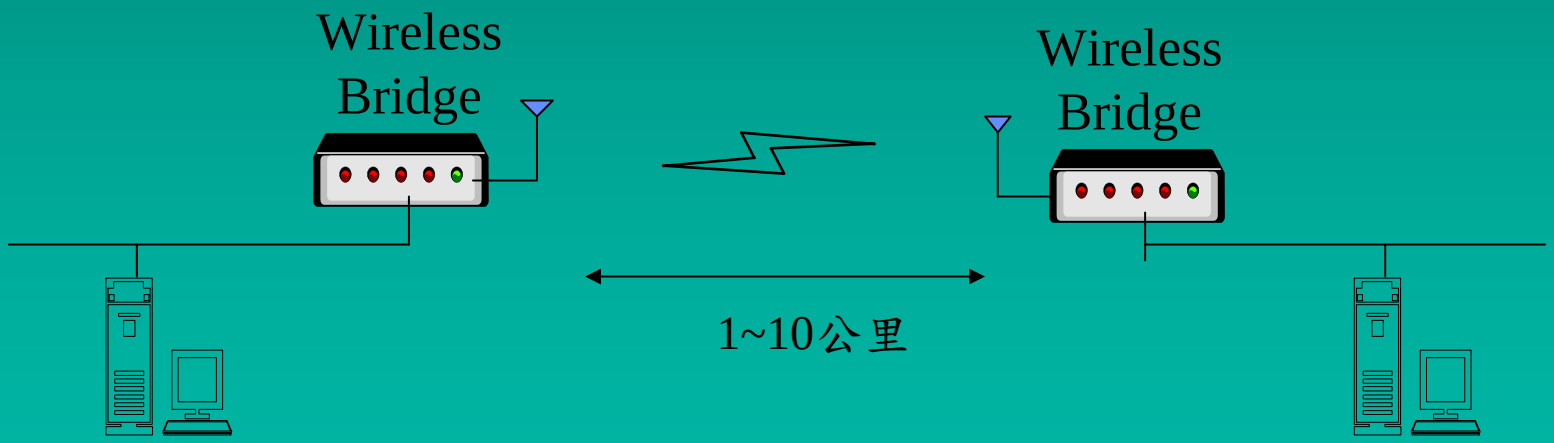
- Independent
  - one Basic Service Set - BSS
  - Ad Hoc network
  - direct communication
  - limited coverage area

Topology of a Wireless LAN

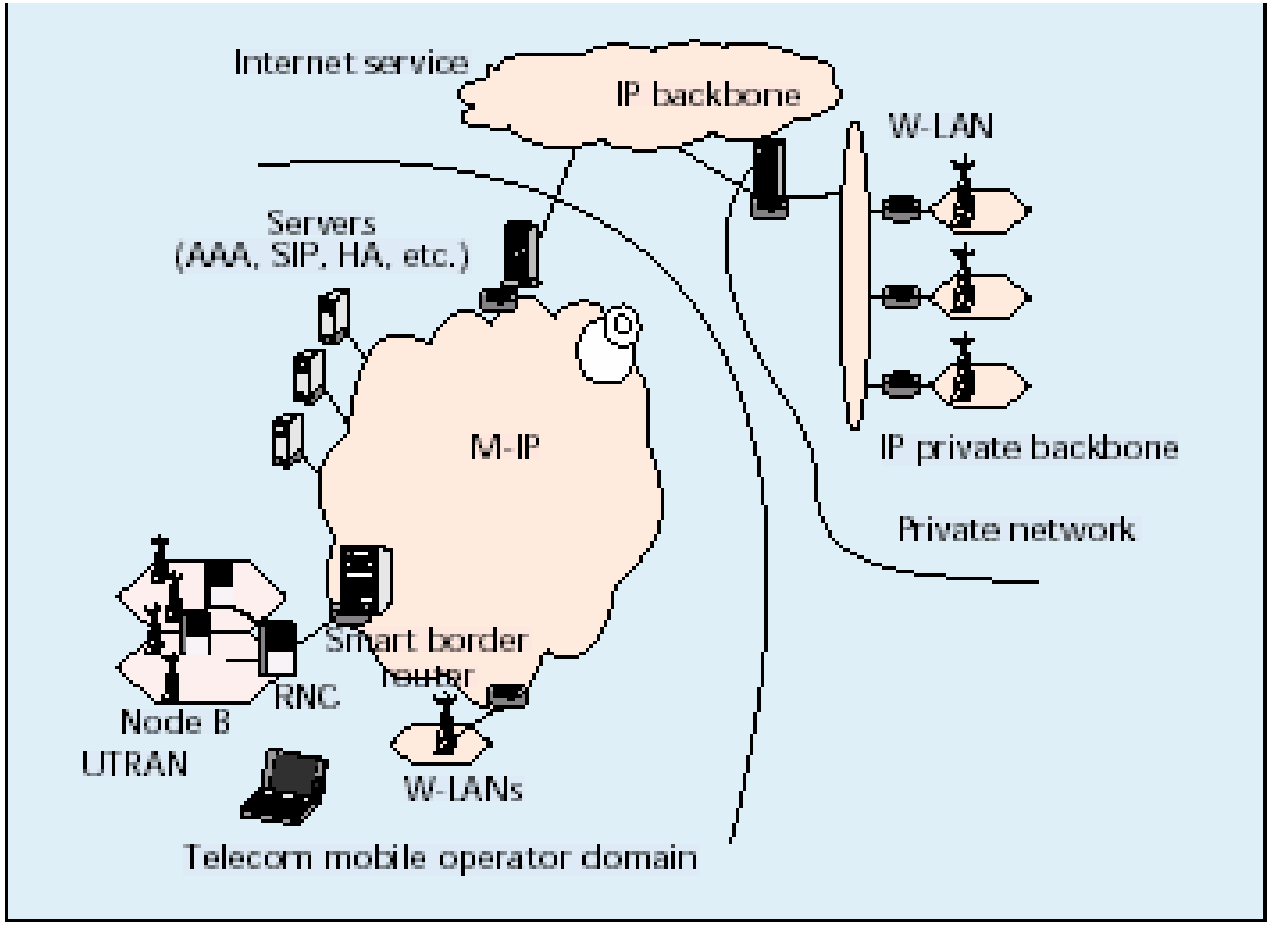
- 進接(Access)應用: 使用者與網路的連接



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

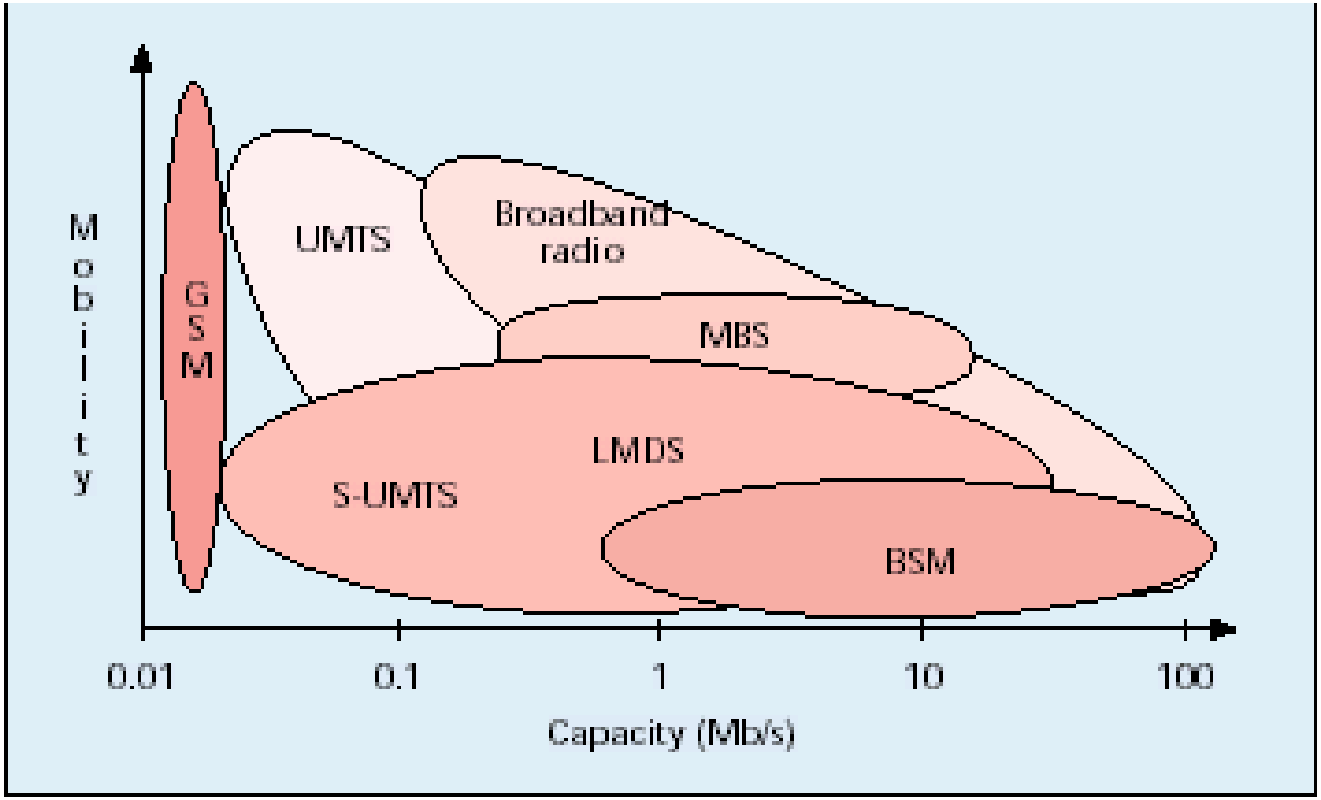


IP integration

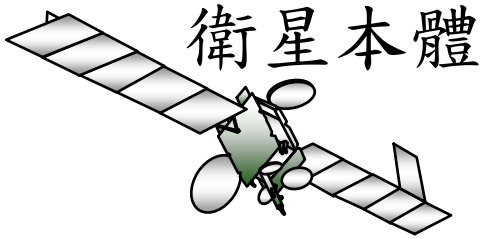


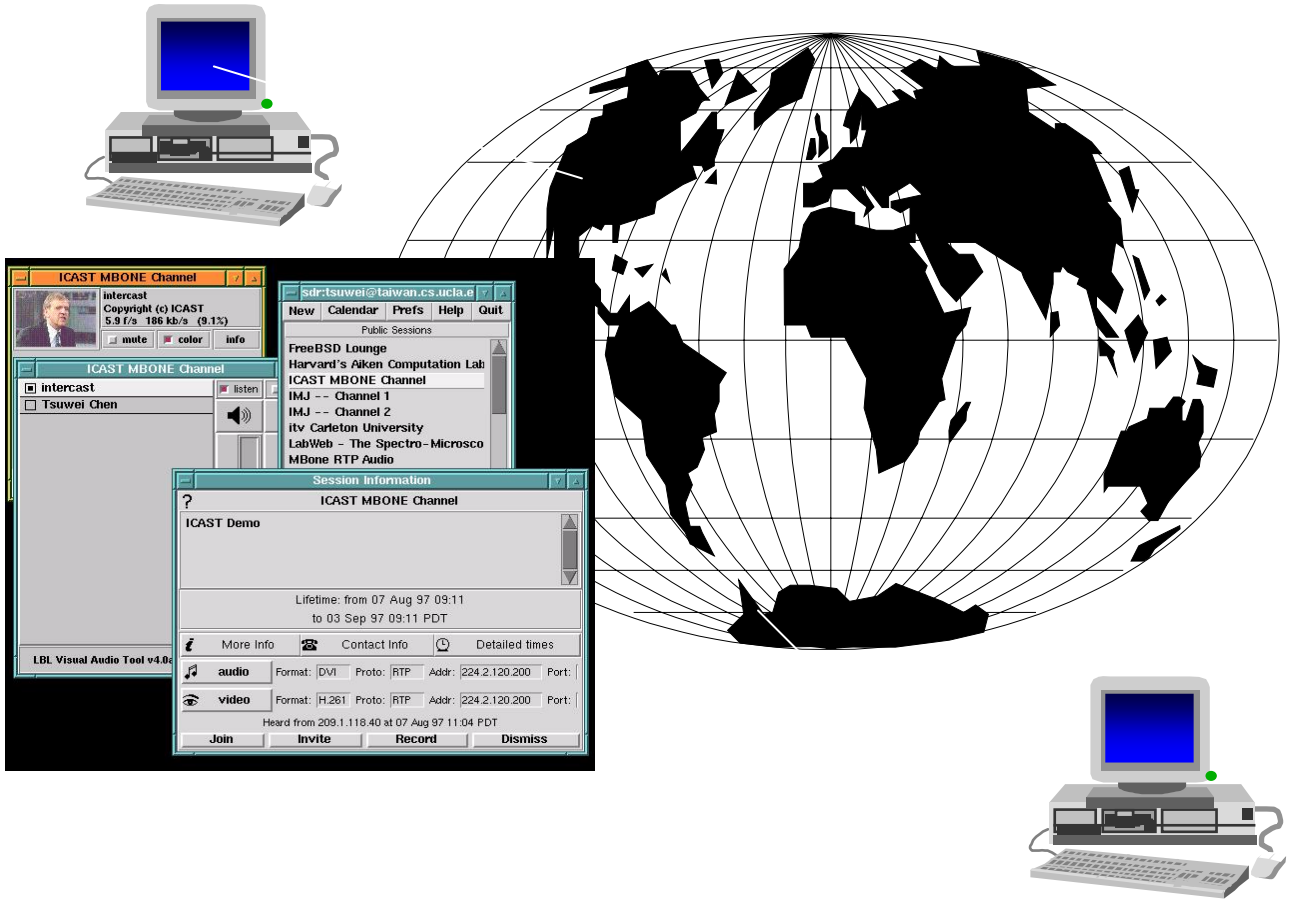
WiMedia Solutions – Simple Usage

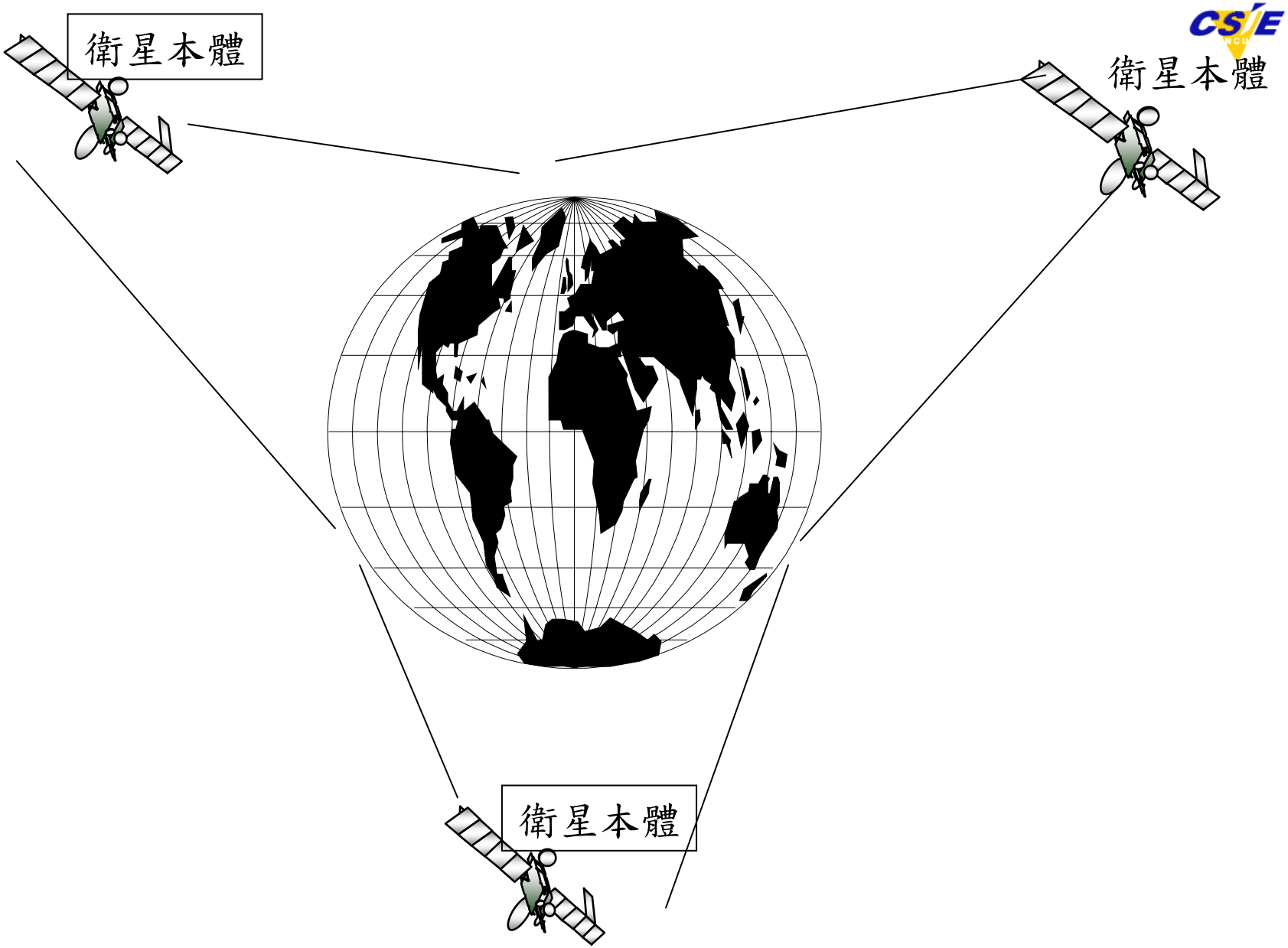
Capacity and Mobility



地球村的建立


衛星本體


ICAST MBONE Channel
intercast
Copyright (c) ICAST
5.9 f/s 186 kb/s (9.1%)
mute
color
info
ICAST MBONE Channel
intercast
Tsuwei Chen
listen
LBL Visual Audio Tool v4.0a
sdr:tsuwei@taiwan.cs.ucla.e
New
Calendar
Prefs
Help
Quit
Public Sessions
FreeBSD Lounge
Harvard's Aiken Computation Lab
ICAST MBONE Channel
IMJ -- Channel 1
IMJ -- Channel 2
itv Carleton University
LabWeb - The Spectro-Microsco
MBone RTP Audio
Session Information
ICAST MBONE Channel
ICAST Demo
Lifetime: from 07 Aug 97 09:11
to 03 Sep 97 09:11 PDT
More Info
Contact Info
Detailed times
audio
Format: DVI Proto: RTP Addr: 224.2.120.200 Port:
video
Format: H.261 Proto: RTP Addr: 224.2.120.200 Port:
Heard from 209.1.118.40 at 07 Aug 97 11:04 PDT
Join
Invite
Record
Dismiss


衛星本體
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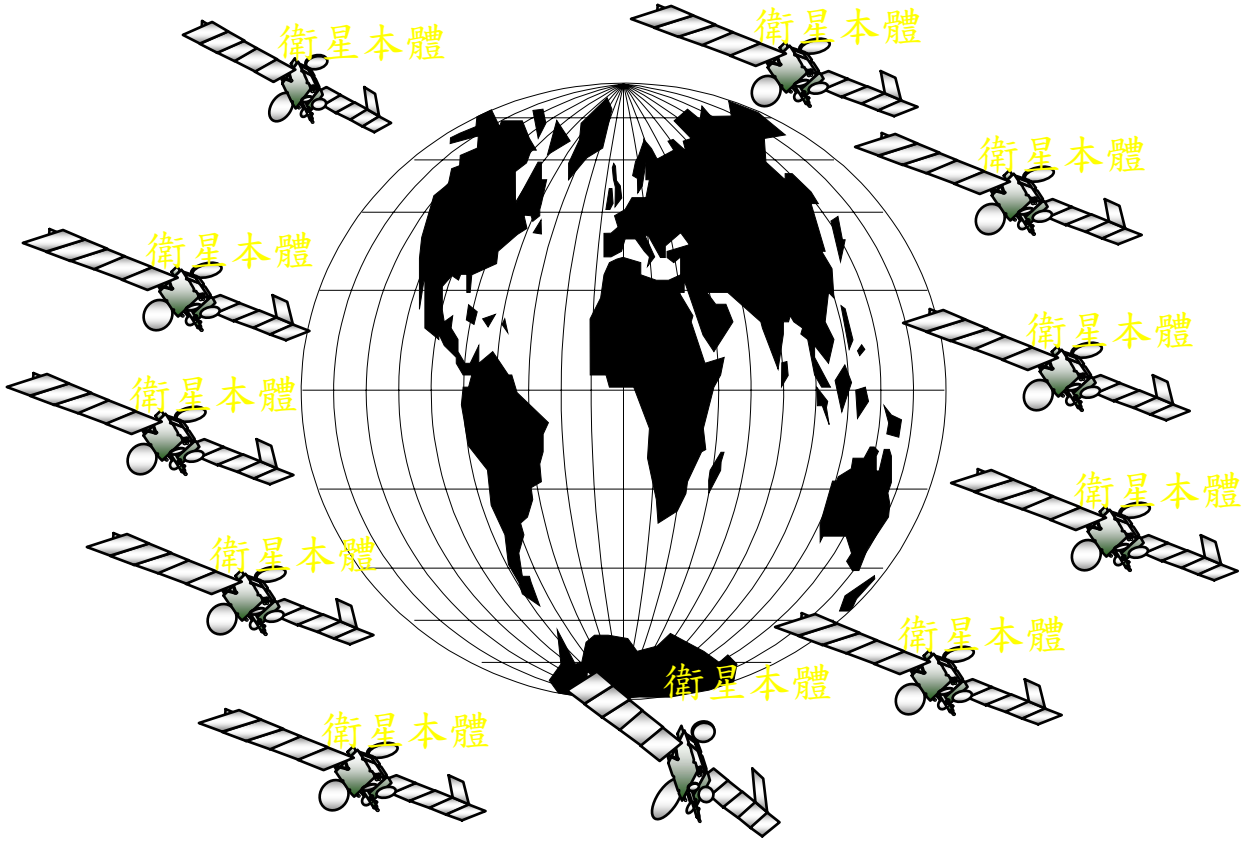
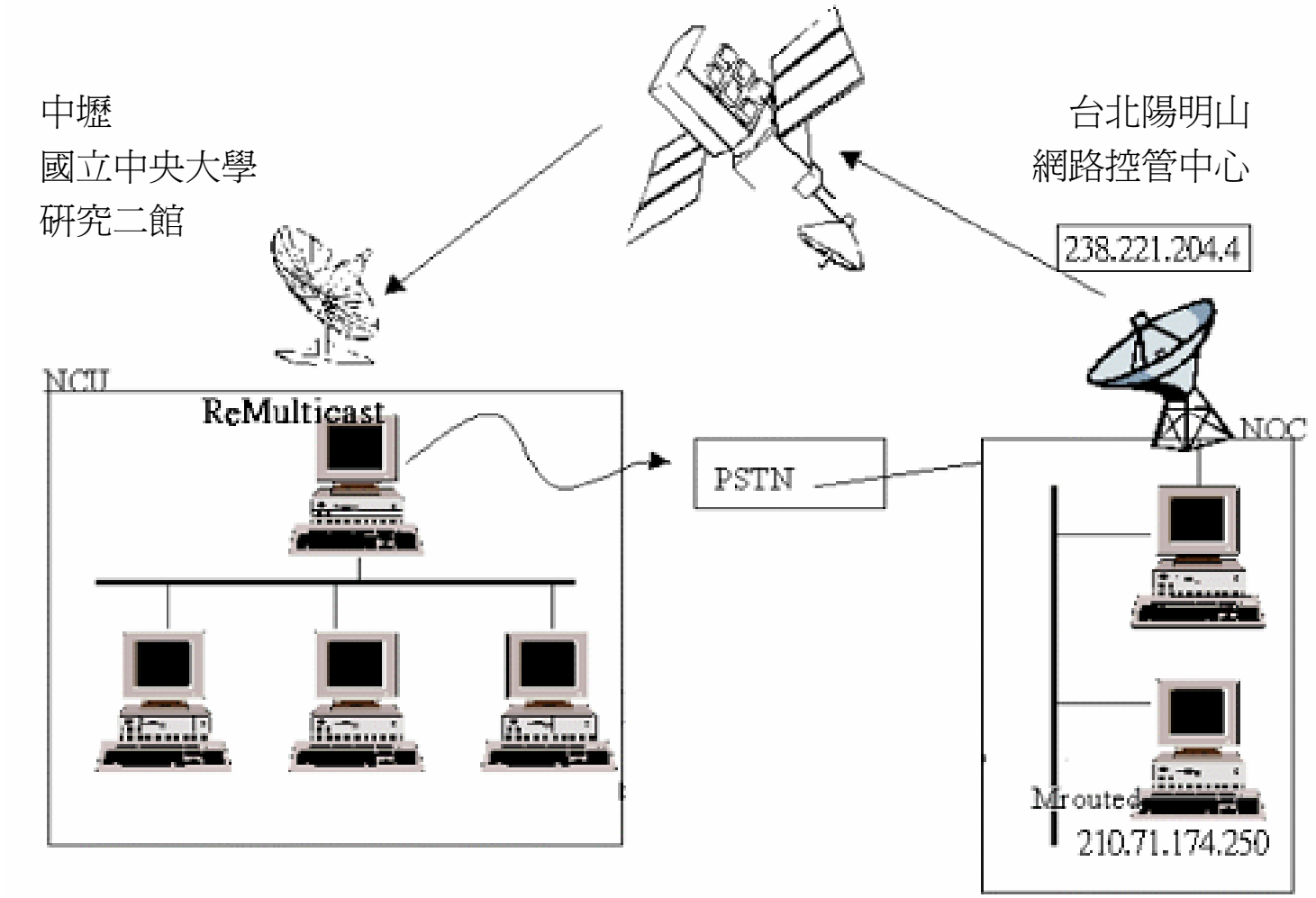
衛星本體

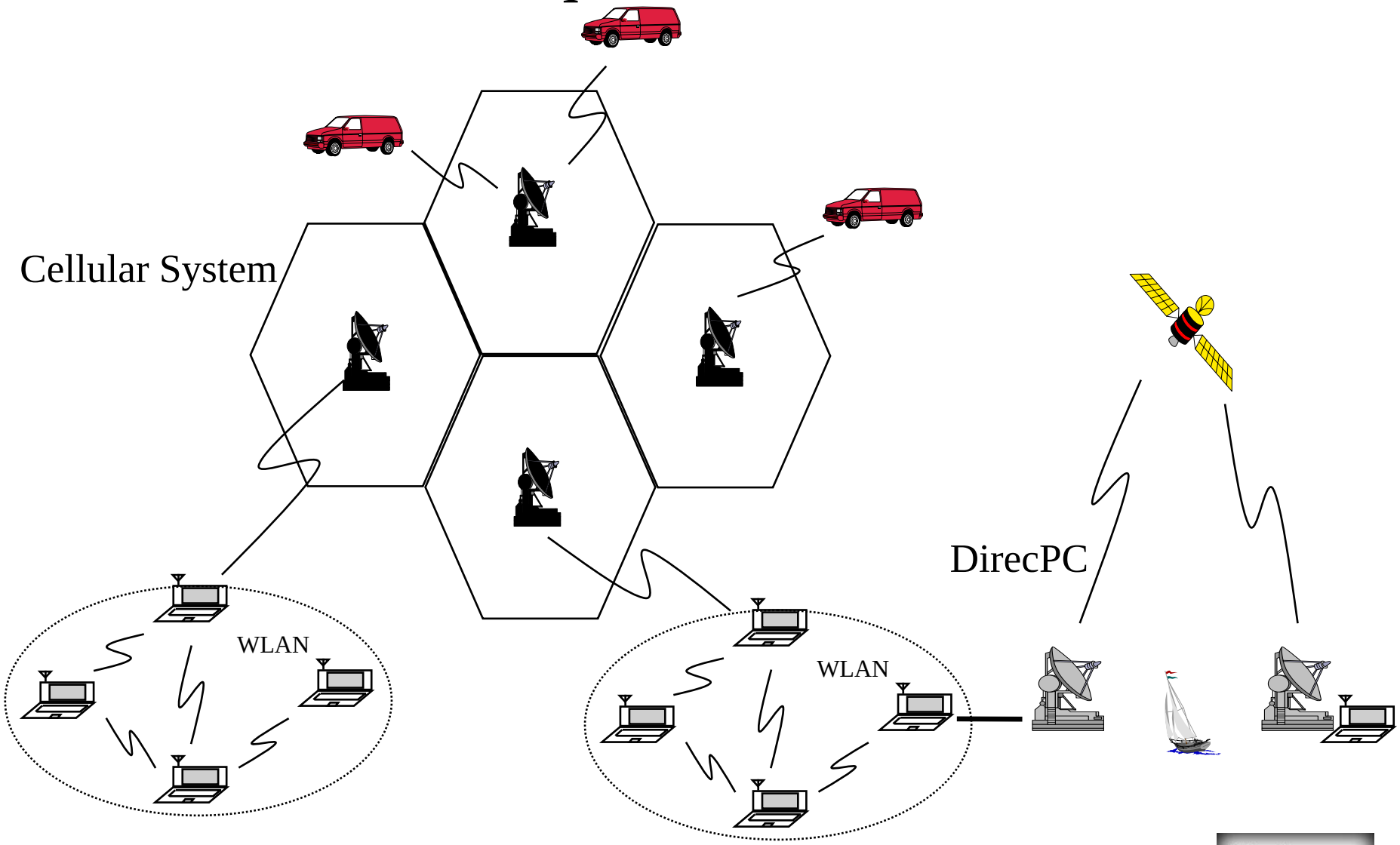
Sky of Satellites



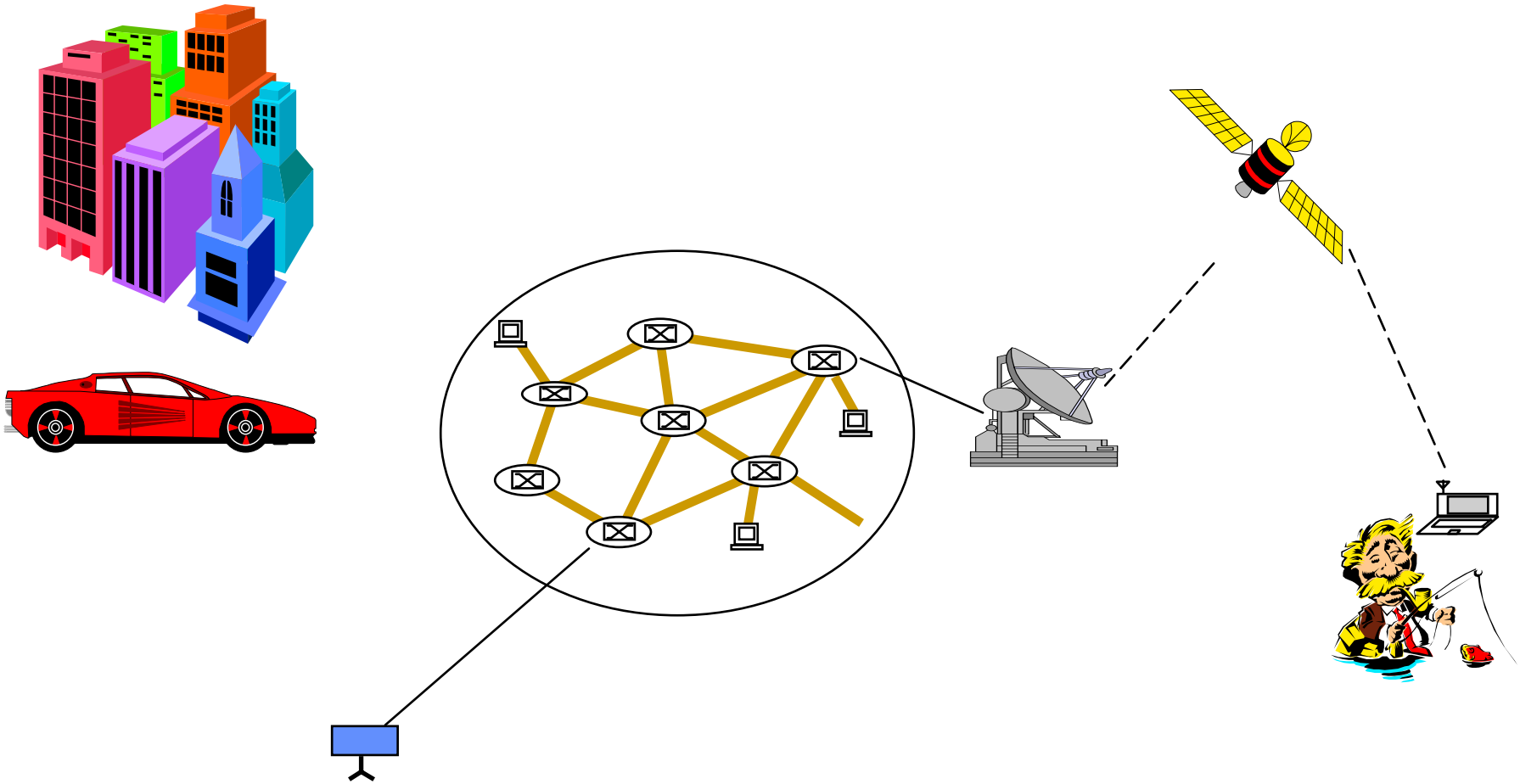
DirecPC Satellite Experiments



Ubiquitous Access

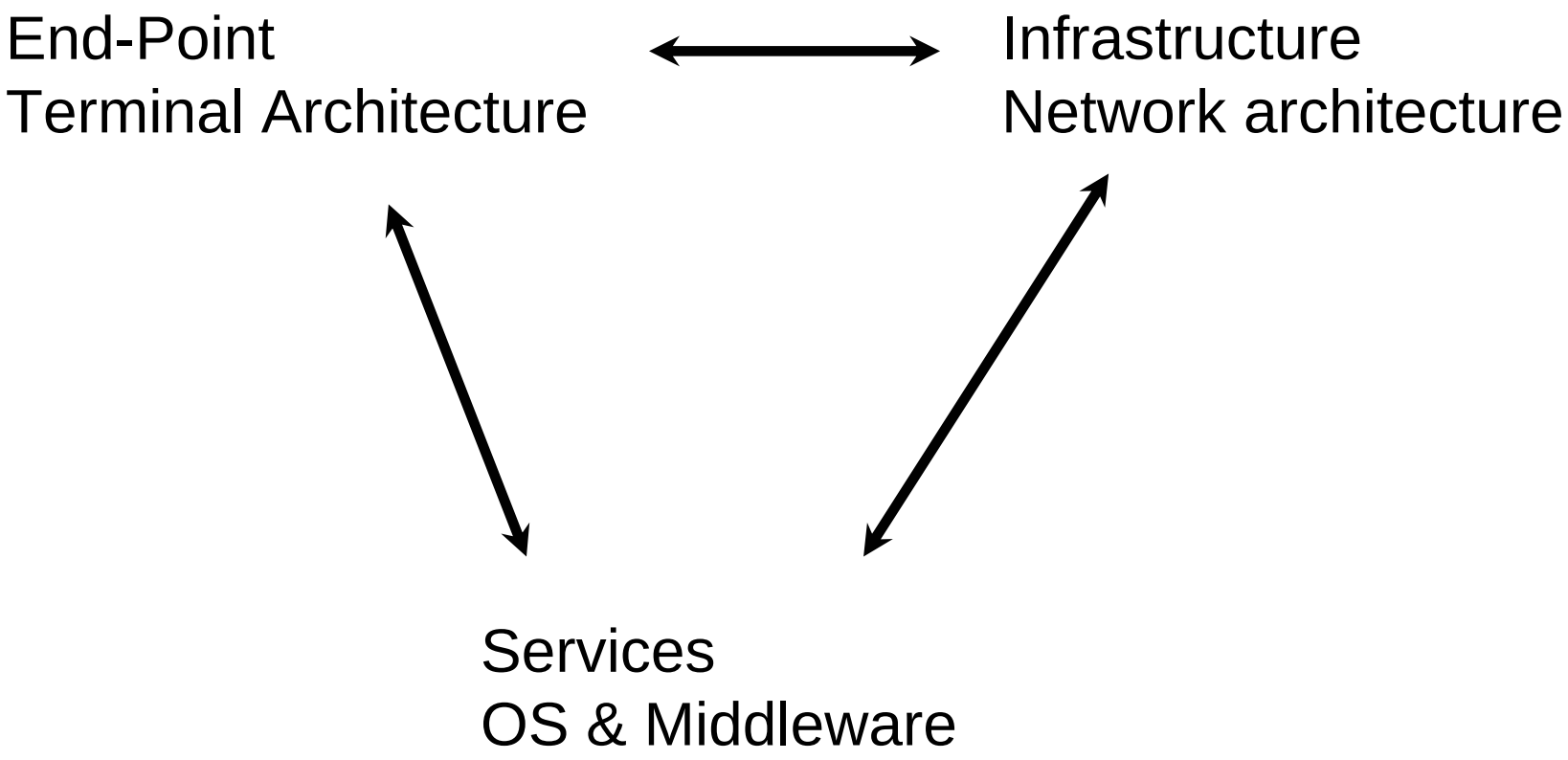


“Anytime Anywhere ” Information System

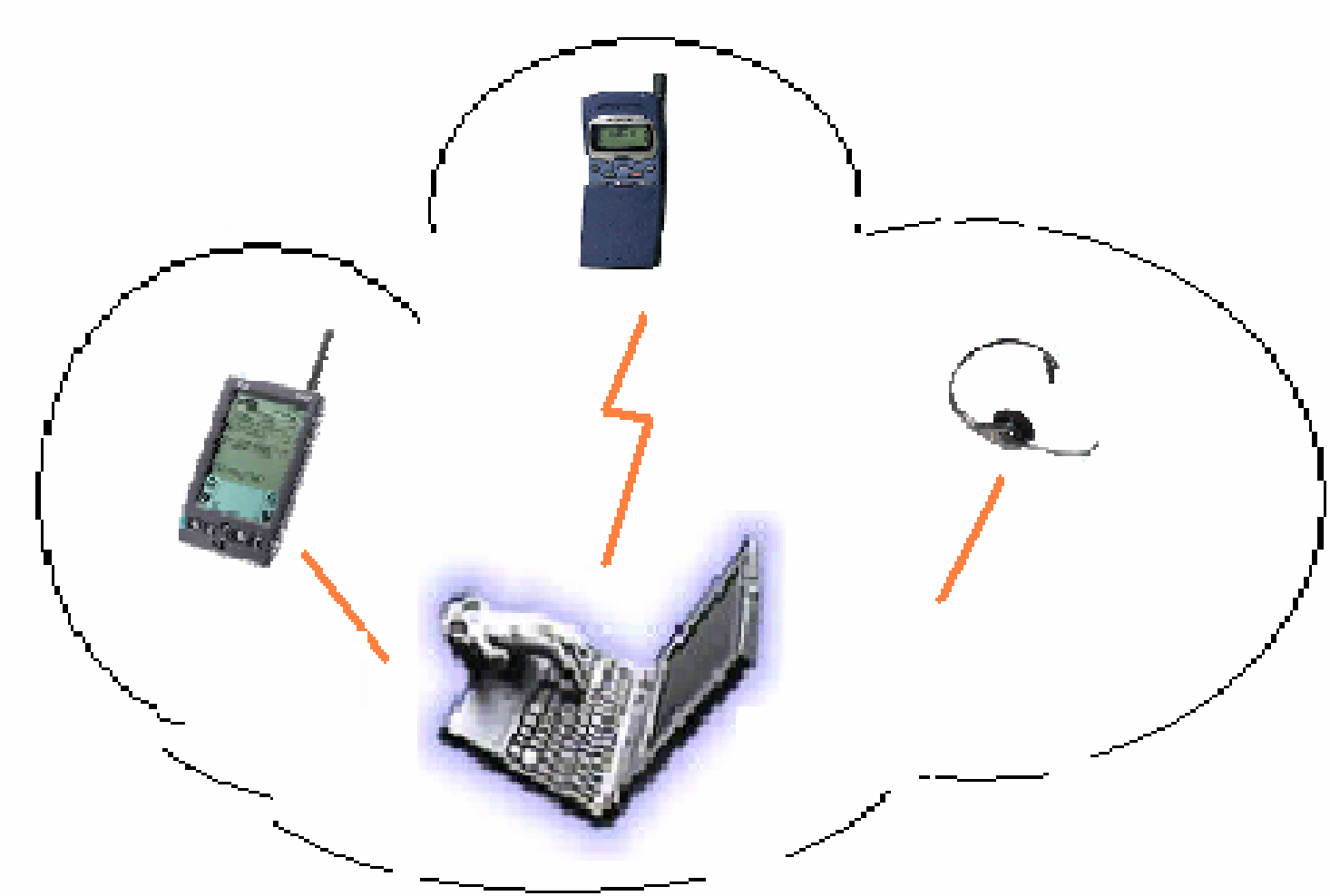


Fundamental Issues

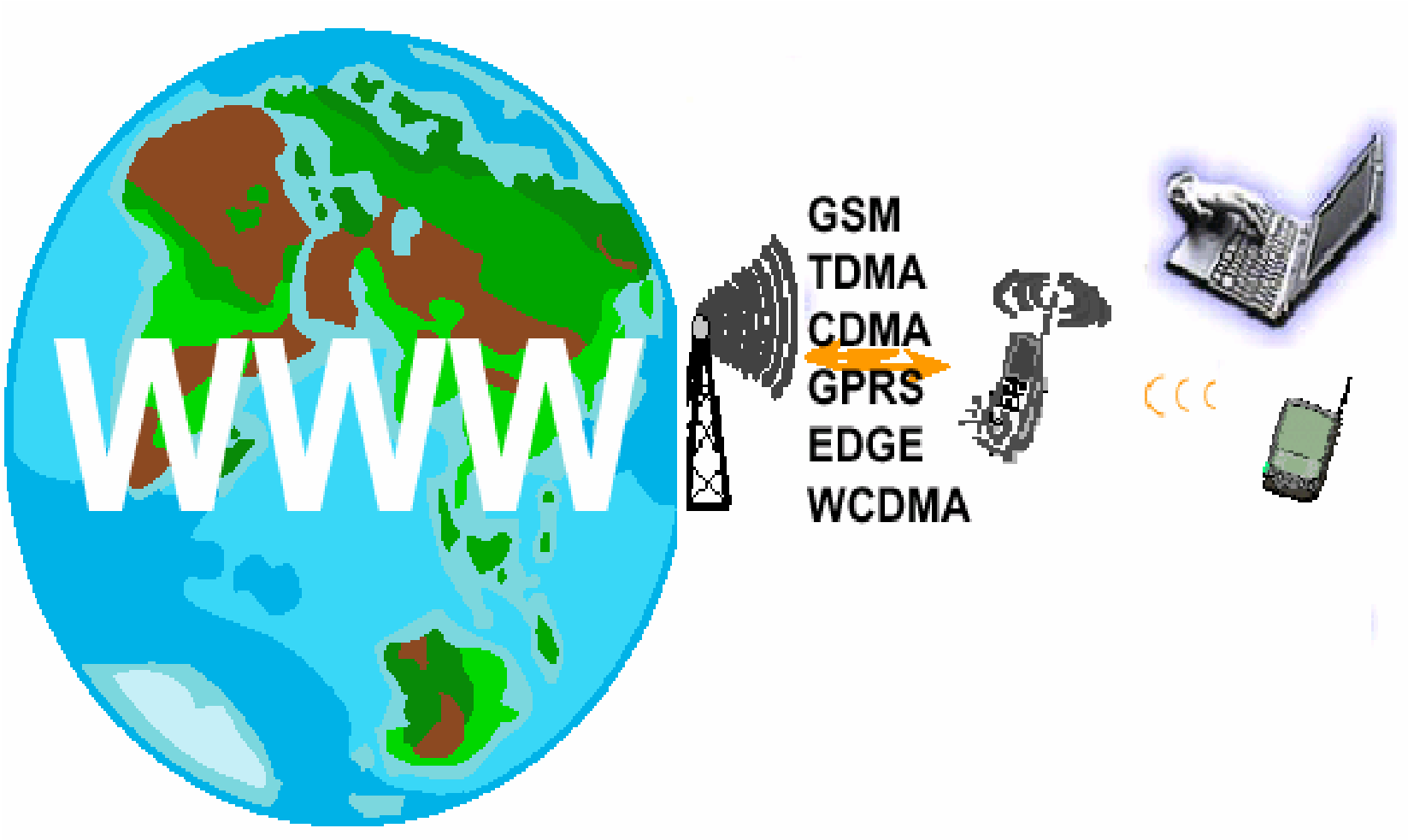
Three System Components



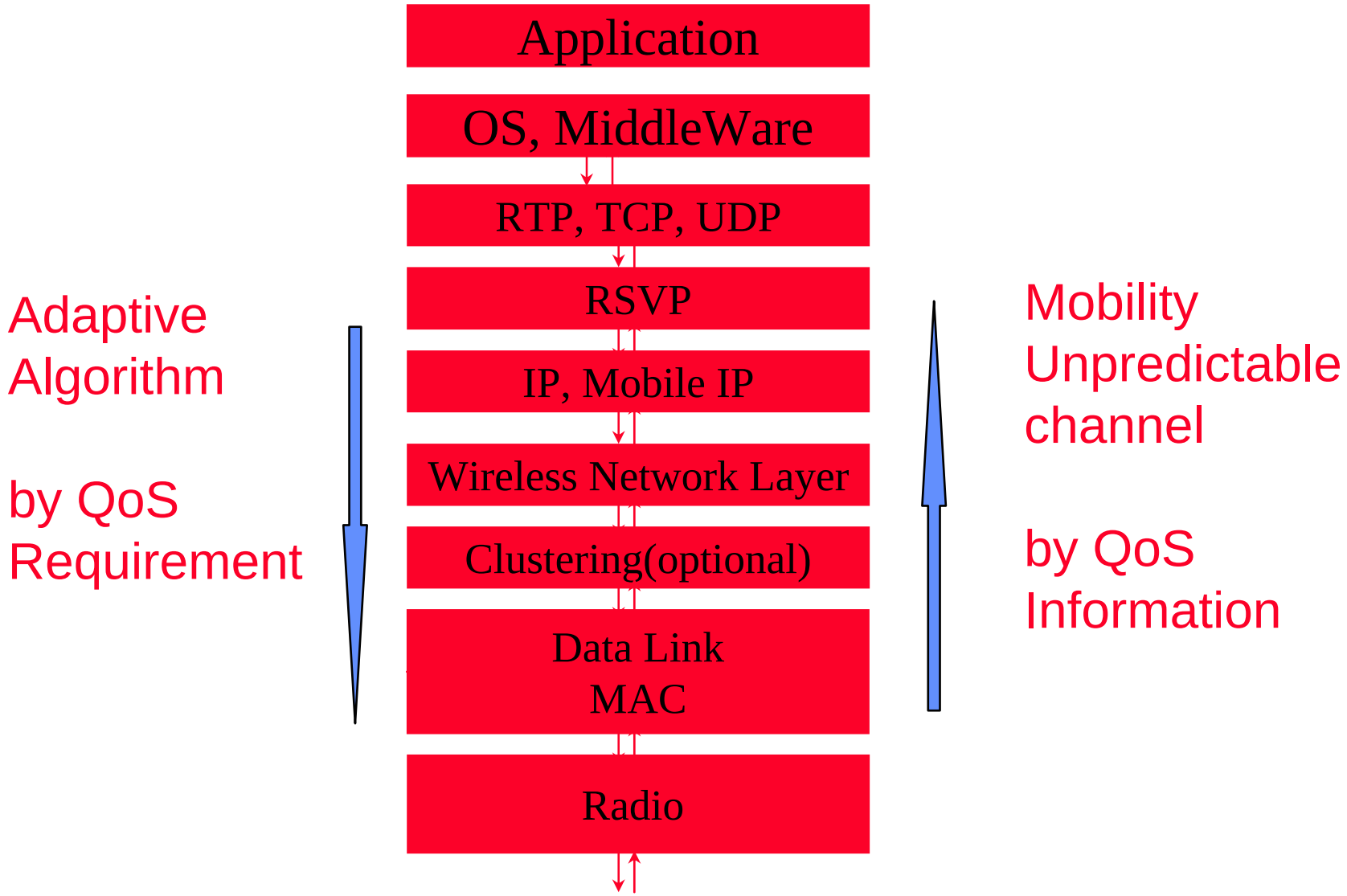
Personal area network



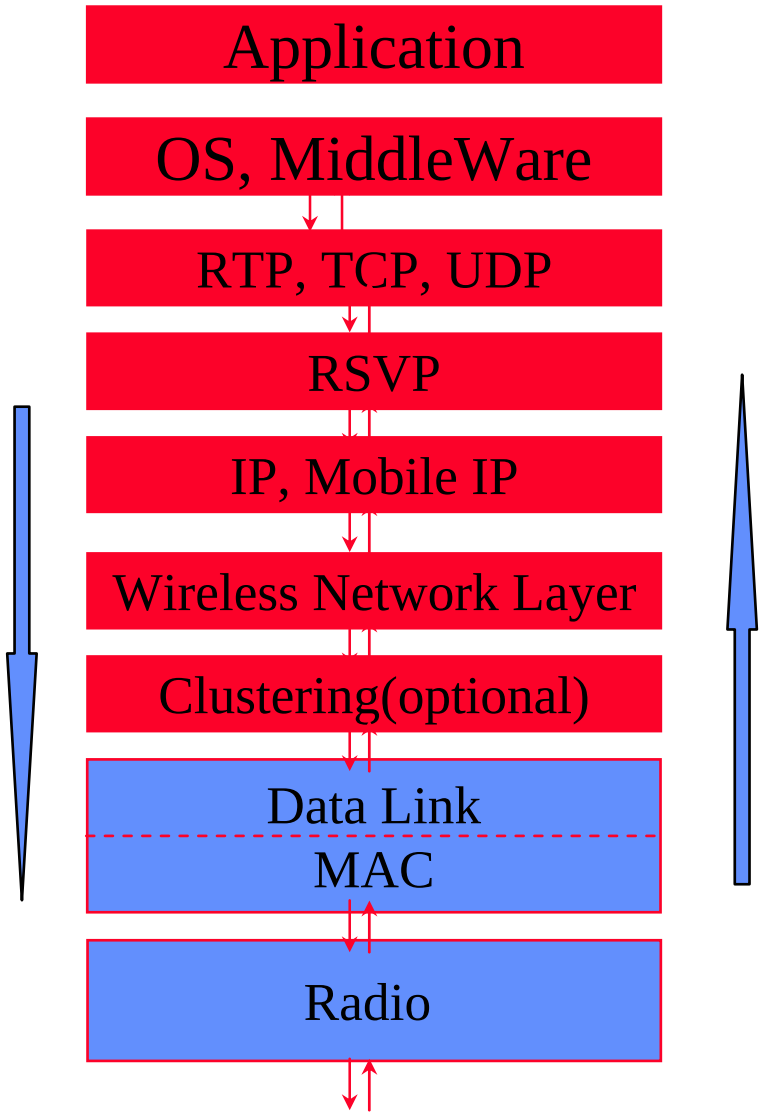
Connect devices to internet on the mobile infrastructure world wide



QoS and Multimedia Traffic Support



QoS and Multimedia Traffic Support



Adaptive Algorithm

by QoS Requirement

Mobility Unpredictable channel

by QoS Information

Channel Propagation and Fading

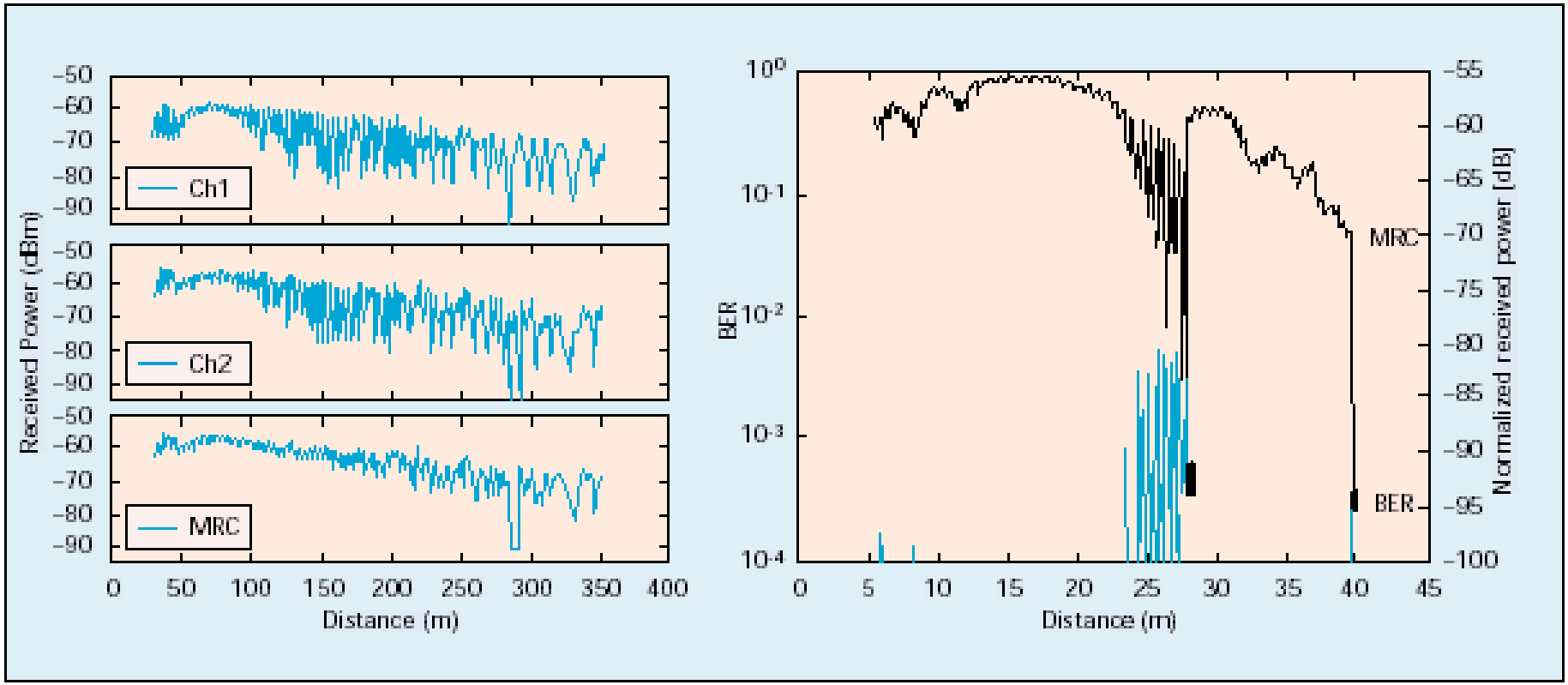
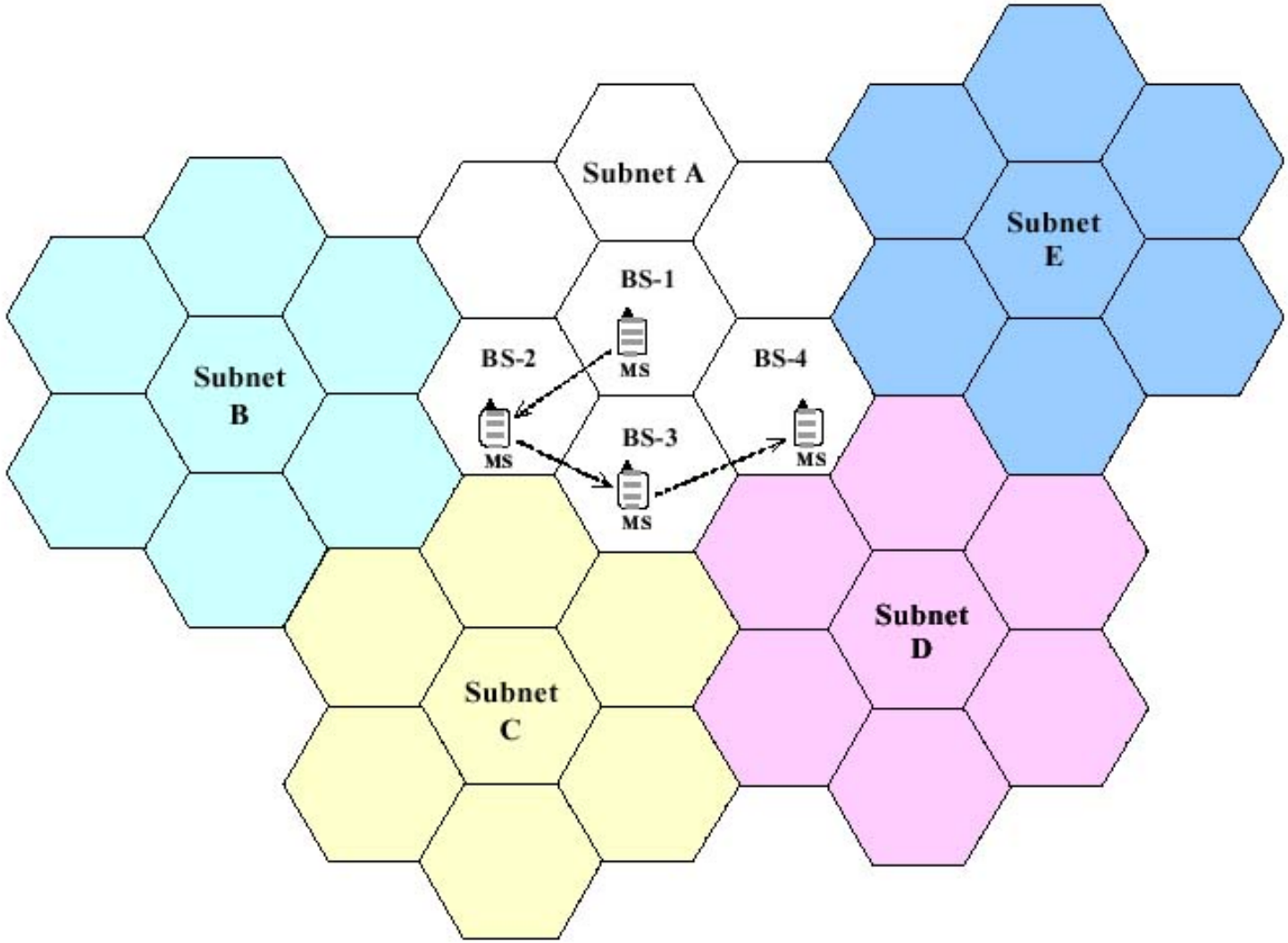


Figure 4. *Received power as a function of distance: in a street (left), in a pavilion (right); BER and handover (right).*

Intra-Domain Handoff

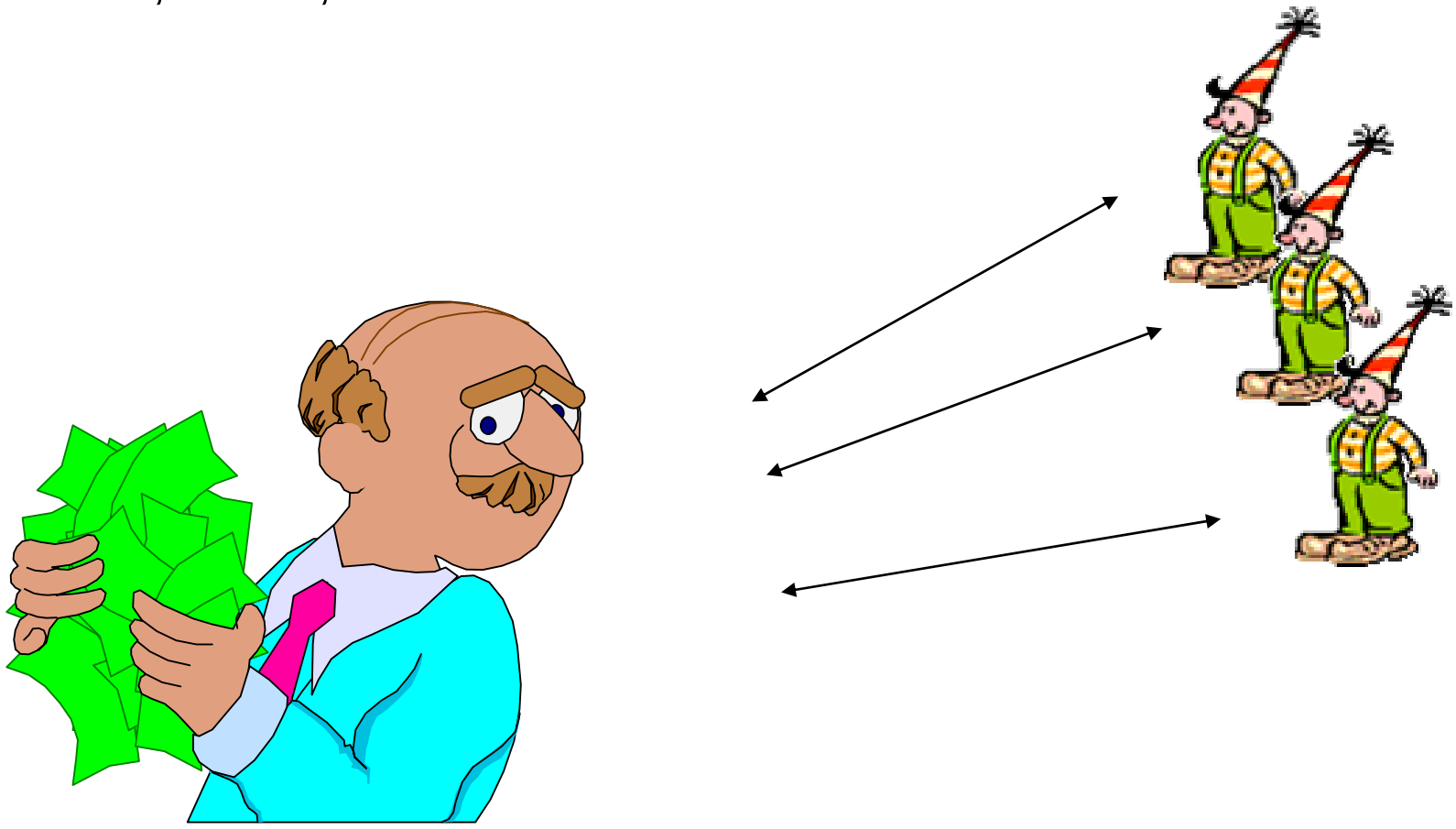


Resource Sharing

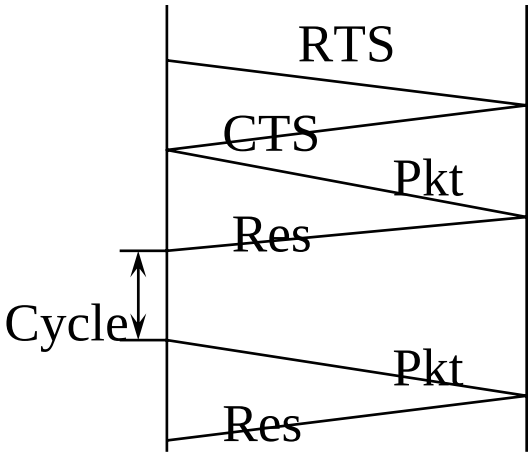
- Reservation Approaches
  - Centralized Control
  - token (round robin)
- Collision Approaches
  - fight for resource
  - distributed control

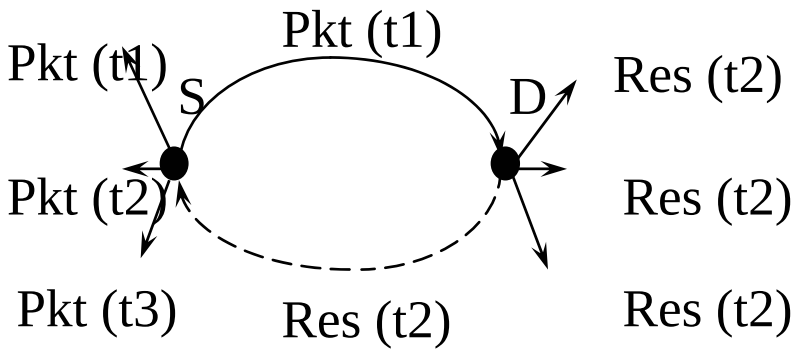
Through A Centralized Control

- TDMA, FDMA, CDMA

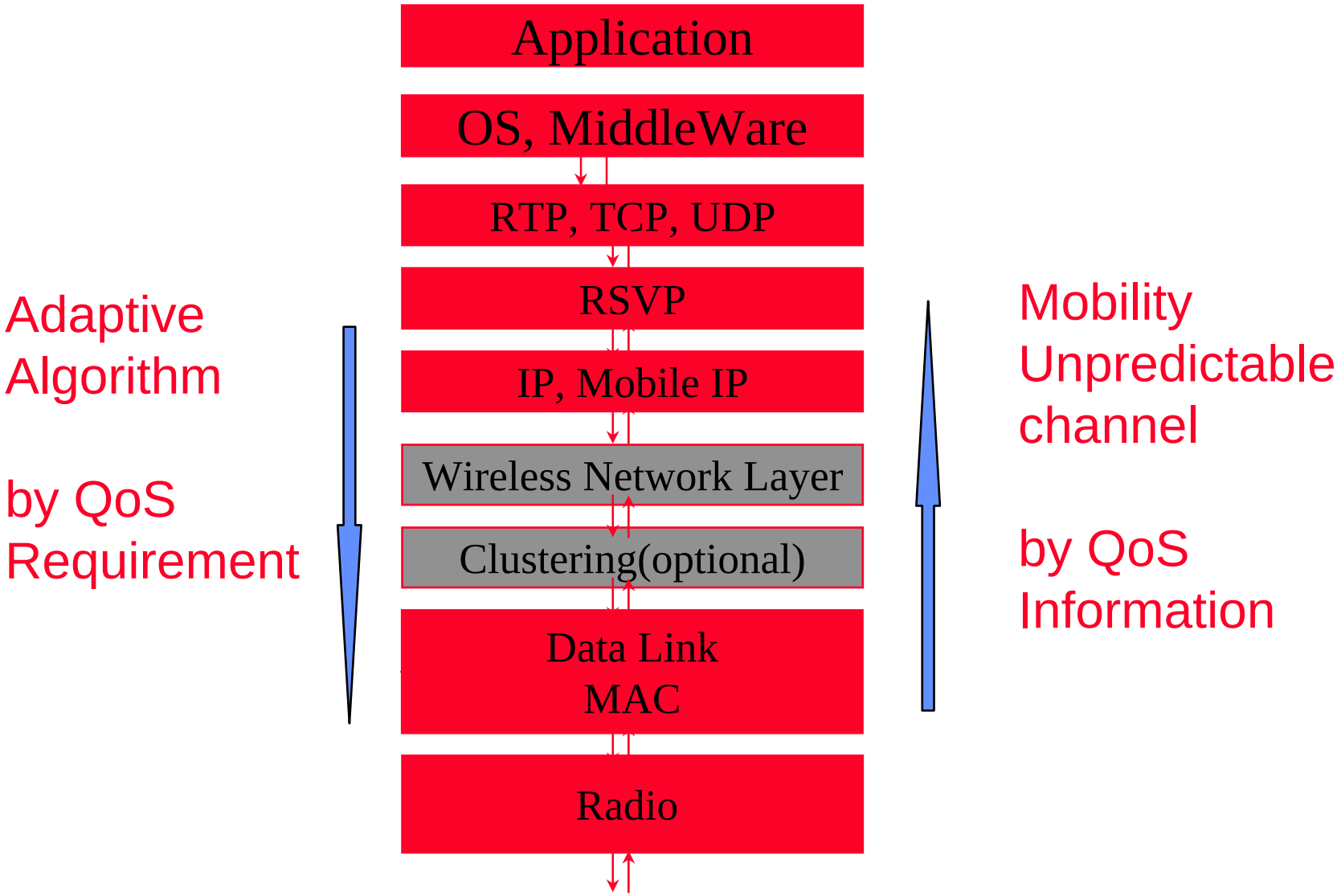


MACA/PR

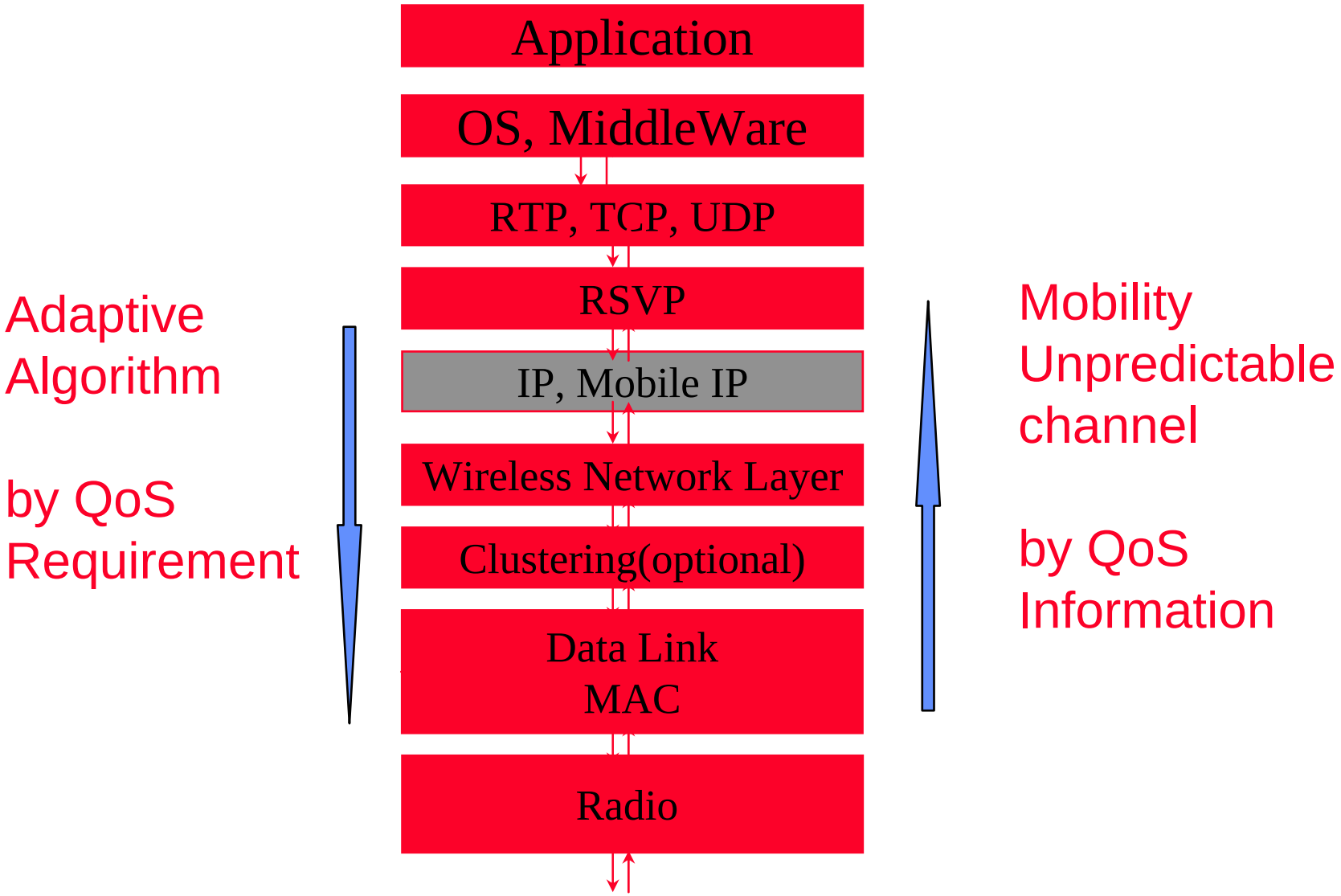

RTS
CTS
Pkt
Res
Cycle
Pkt
Res


Pkt (t1)
Pkt (t1)
S
D
Res (t2)
Pkt (t2)
Res (t2)
Pkt (t3)
Res (t2)
Res (t2)

QoS and Multimedia Traffic Support



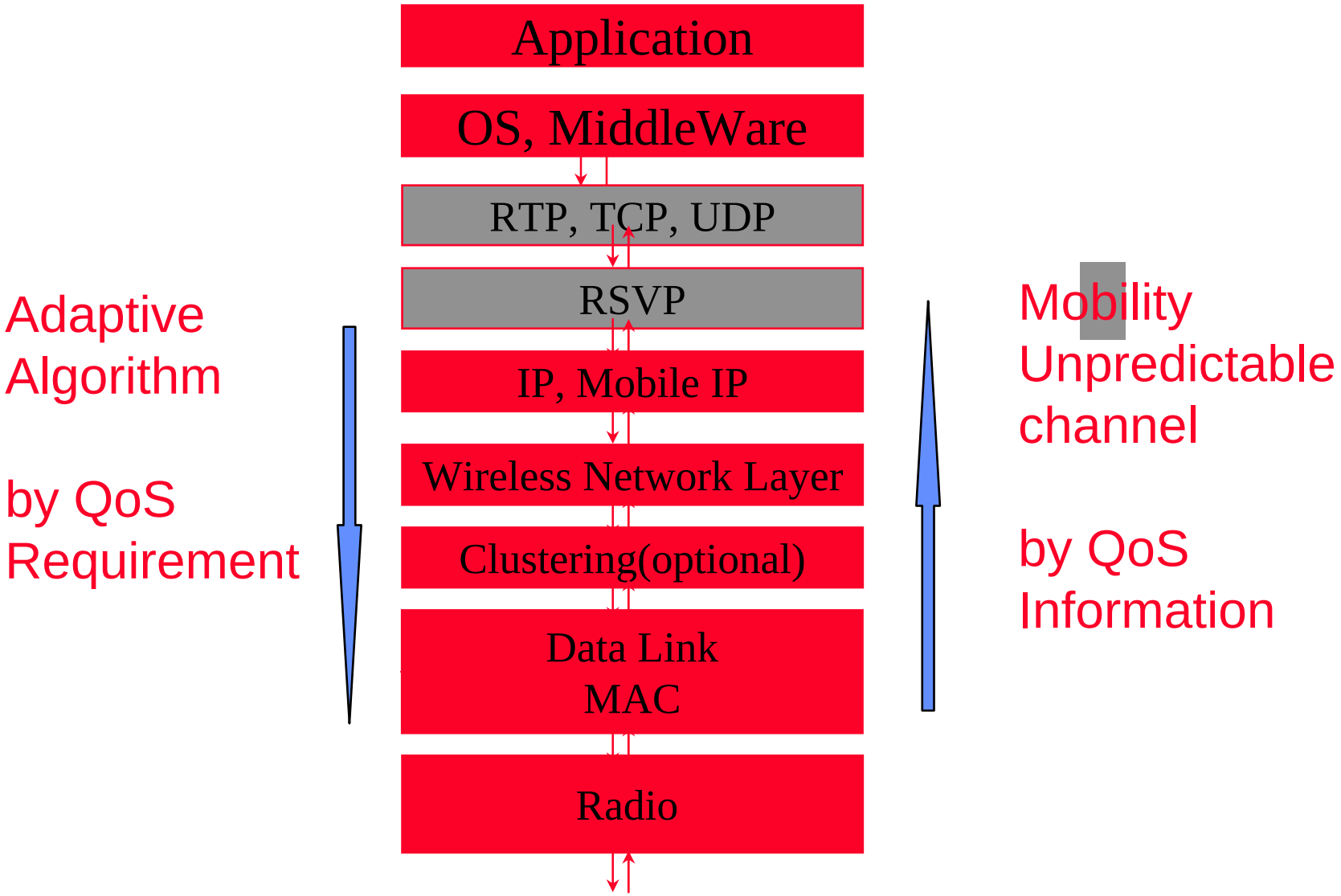
QoS and Multimedia Traffic Support



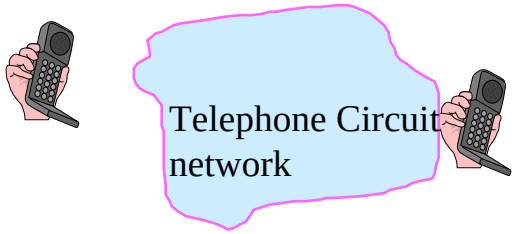
Internetworking, IP, Mobile

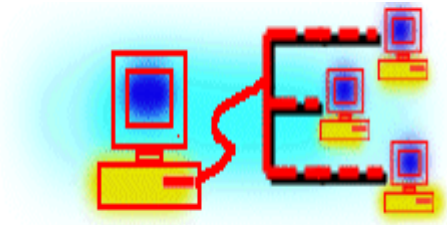
- Internetworking
  - roaming through different networks
  - supporting IP format
  - supporting IP portability

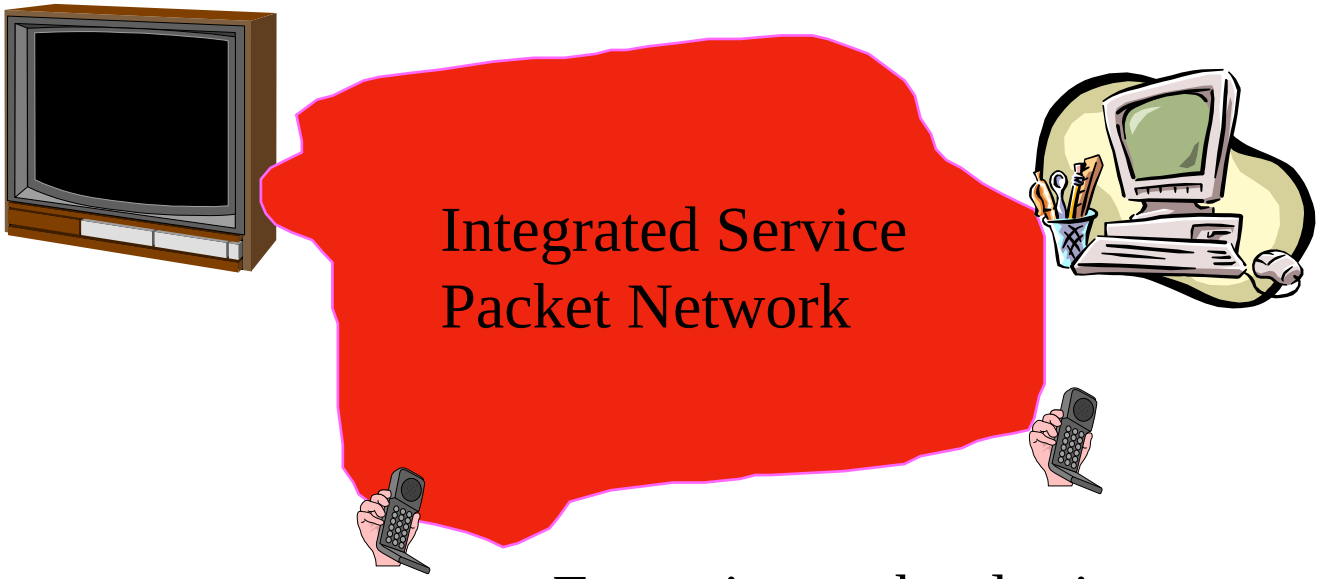
QoS and Multimedia Traffic Support



What problem does Multimedia Bring?







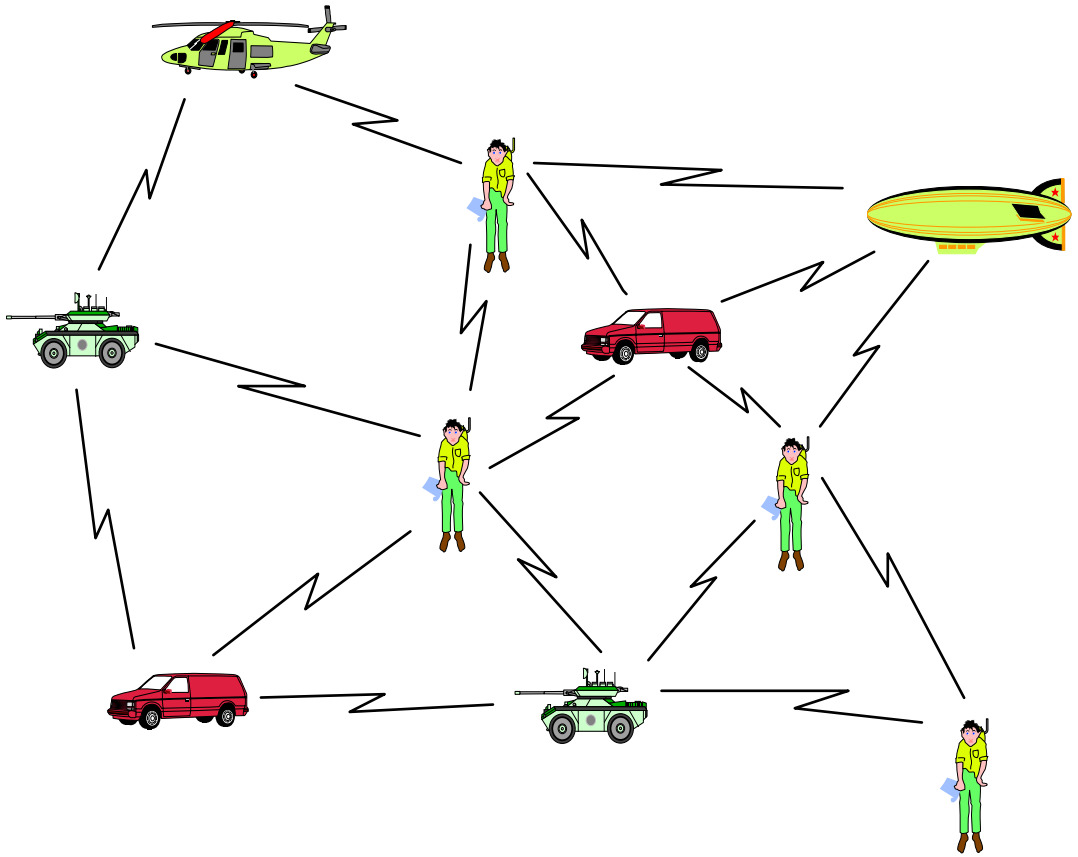
Emerging technologies:

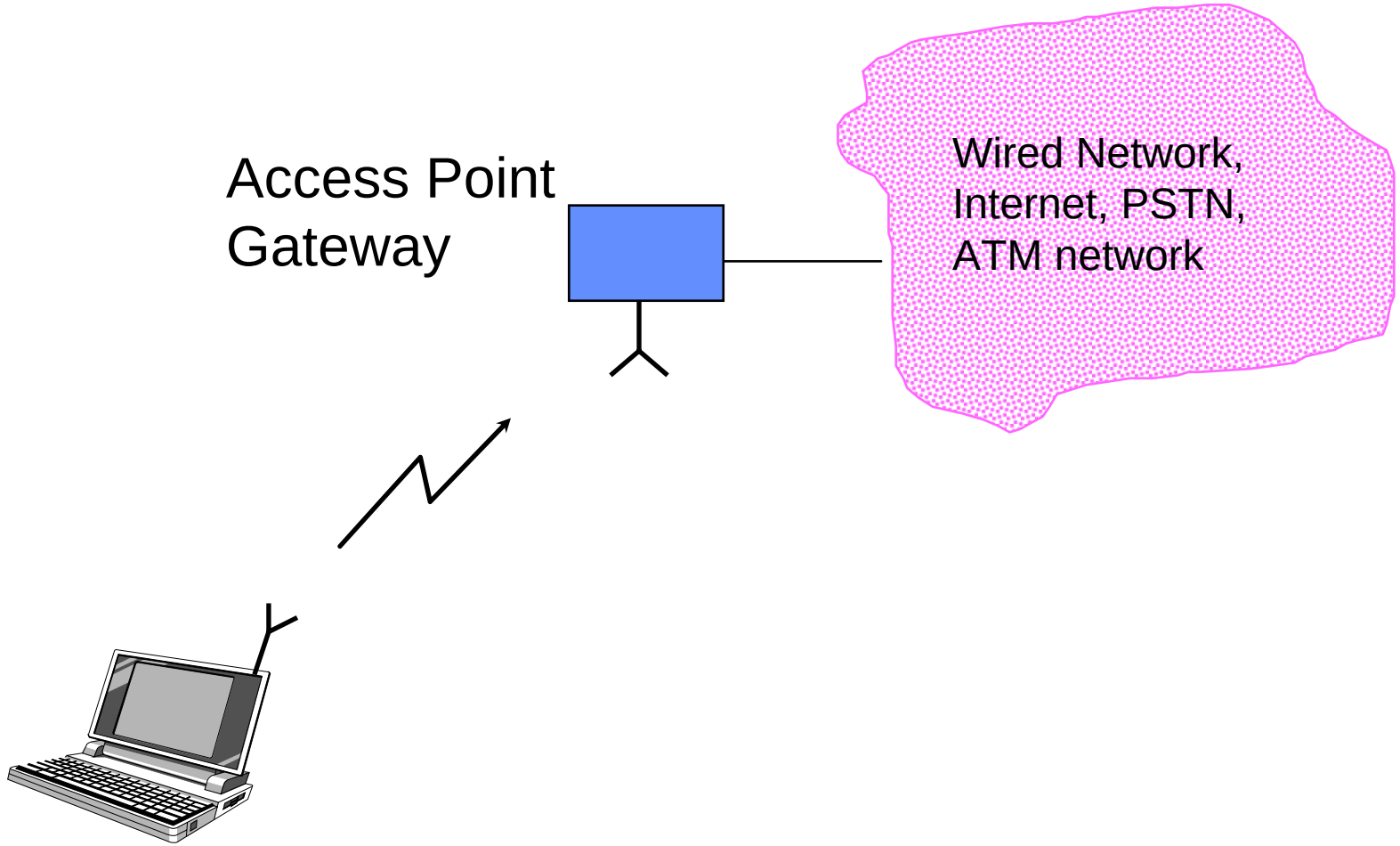
1. “Datagrams” + “Flows” IPv6
2. “Virtual Circuits” (ATM)

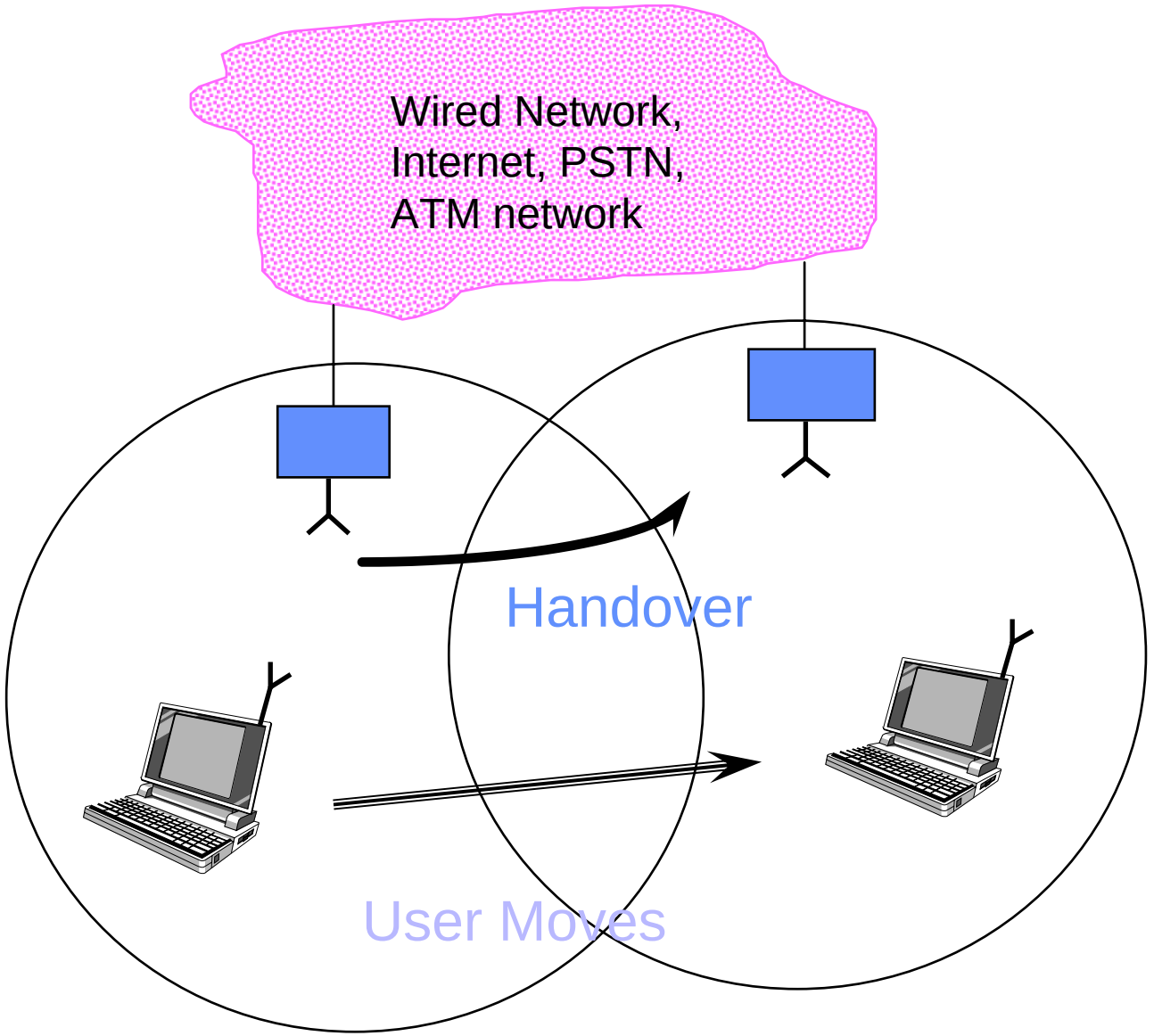
System Configurations

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

Ad Hoc Wireless Network

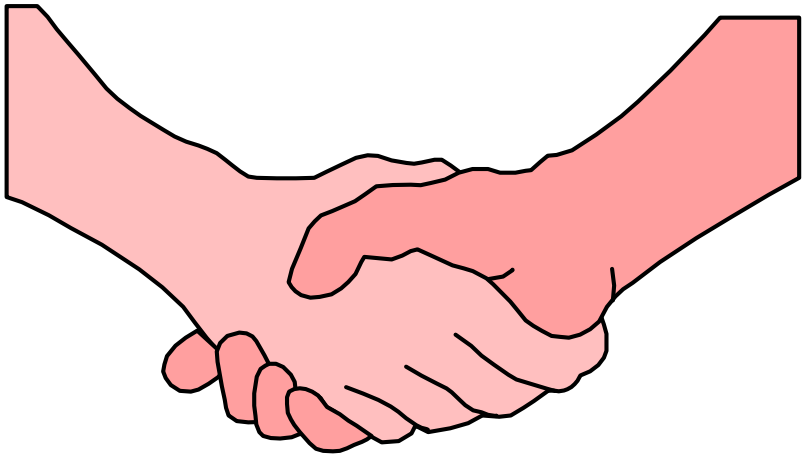



Access Point
Gateway
Wired Network,
Internet, PSTN,
ATM network


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

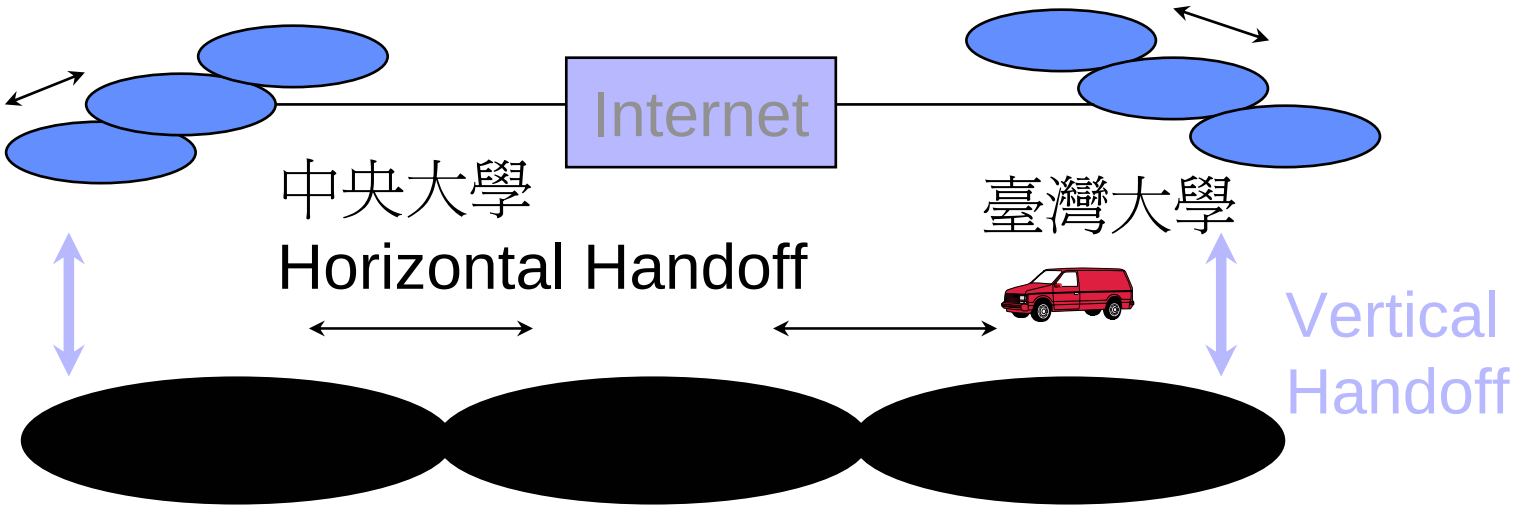
Typical Cellular Call

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



Wireless Comm: Heterogeneity & Security

- Heterogeneous networks



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

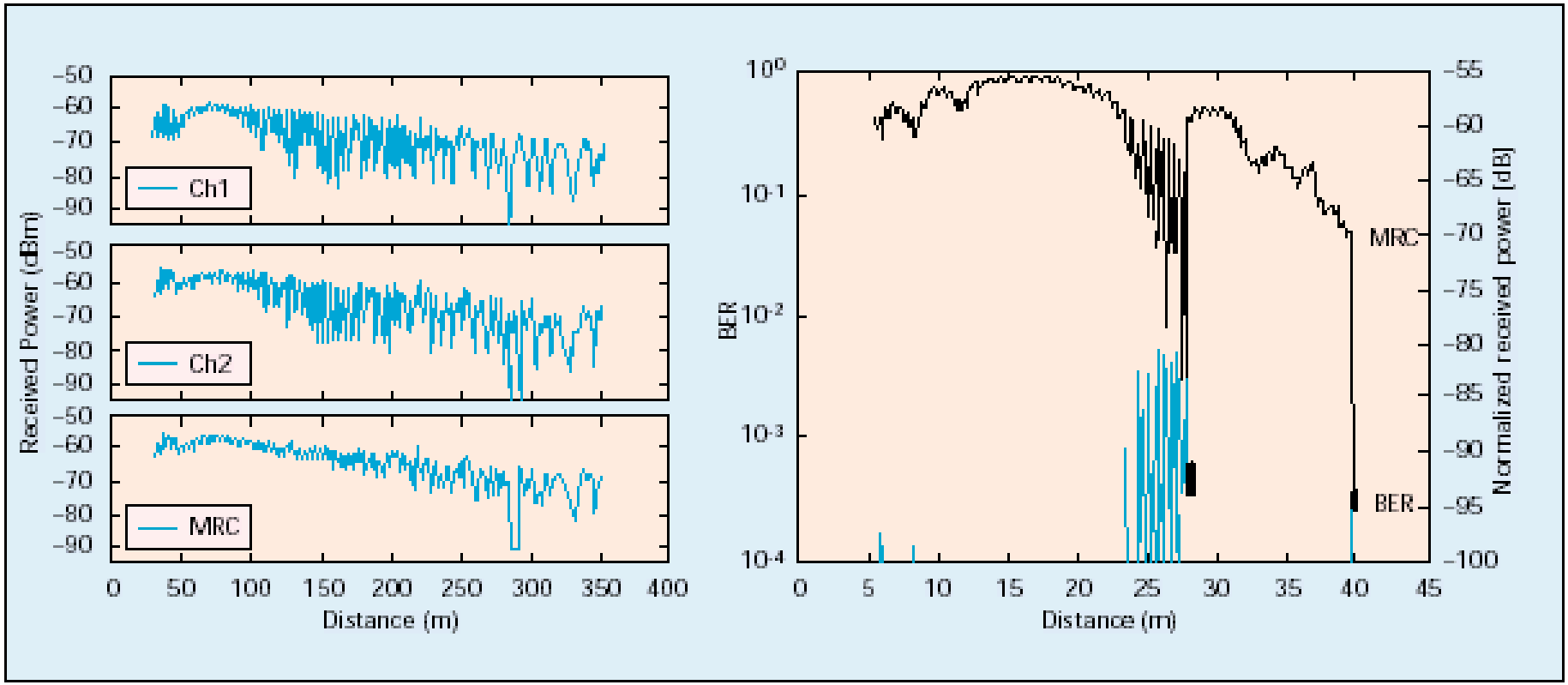
Portability

- 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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