

無線網路多媒體系統 Wireless Multimedia System

Lecture 6: CDMA & 3G Trend

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



Agenda

- ◆ Spread Spectrum (Multipath, interferences from other cells)
- ◆ W-CDMA
- ◆ Evolutions of PCS
- ◆ ALL IP Challenges
 - Mobile IP/Cellular IP
 - QoS Provisions: Integrated Service / DiffServ
- ◆ Next Week (Mobile IP)



Reading

- ◆ [Kohn95]Ryuji Kohno, Reuven Meidan, and Laurence B. Milstein Spread Spectrum Access Methods for Wireless Communications, IEEE Communication Magazine, 1995
- ◆ [Dahlman98]Erick Dahlman, Bjorn Gudmundson, Mat Nilsson and Johan Skold, UMTS/IMT-2000 Based on Wideband CDMA, IEEE Communication Magazine 1998
- ◆ [Ojanpera98] T. Ojanpera, R. Prasad, "An Overview of Third-Generation Wireless Personal Communications: An European Perspective, IEEE Personal Communication Magazine 1998



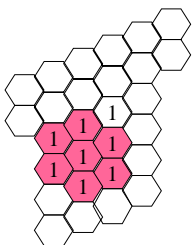
Code Division, Spread Spectrum



What is Going to Happen
in CDMA?



Direct Sequence Cellular



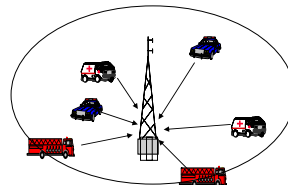
Idealized grid of
Hexagonal cells

- ◆ DS spread spectrum signals are generated by linear modulation with wideband PN sequences which are assigned to individual users
- ◆ Universal Frequency Reuse: One-cell frequency reuse pattern
- ◆ Introduction of a new cell will be less restricted than in the case of either FDMA or TDMA
- ◆ (FDD) Frequency Division Duplex Operation: One frequency band is used for the base-to-mobile (forward or down link), one frequency band is used for the mobile-to-base link (the reverse link or uplink)



Power Control (Reverse Link)

- ◆ Reverse Link: asynchronous, asynchronous CDMA system is vulnerable to the "near-far" problem
- ◆ Power Control: minimize consumption of the transmitted power, fast enough to compensate for Rayleigh fading
- ◆ Capacity is bounded by number of users (MAI Multiple Access interferences)



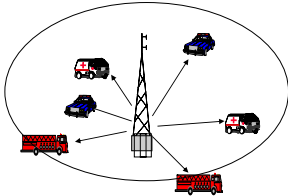
Everybody has a
Code (PN),
asynchronous



Power Control (Forward Link)



- Forward Link: the users can be orthogonalized, (however, the orthogonalization is not preserved between different paths of the multipath propagation, nor is it preserved between the forward links of different cells)
- Power Control: Since the cell's signals can be received at the mobile with equal power, the forward link does not suffer from near-far problem
- Cell boundary



Everybody has a Code (PN) synchronous



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Cellular Capacity



- Capacity of the reverse link (typically asynchronous link)

$$\left(\frac{E_b}{\eta_0}\right)_{eff} = \frac{1}{\frac{\eta_0}{E_b} + \frac{2}{3G}(M-1)(1+K)\alpha}$$

$$M \sim \frac{2}{3} \frac{G}{\left(\frac{E_b}{\eta_0}\right)(1+K)\alpha}$$



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Radio Resource Management



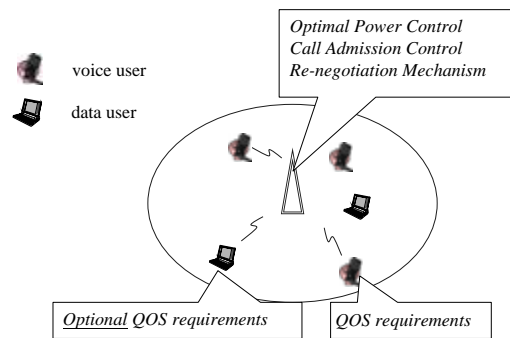
- Power as the common resource makes W-CDMA very flexible
 - Link improvement, less power, more capacity
- Orthogonal variable spreading factor (OVSF) for variable bit rate



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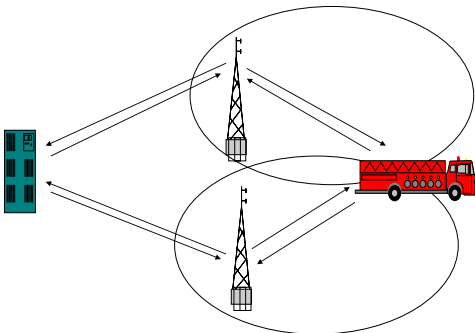
Call Admission Control



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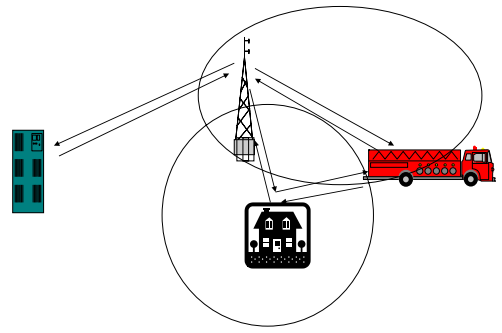
Soft Handovers (Macro Diversity)



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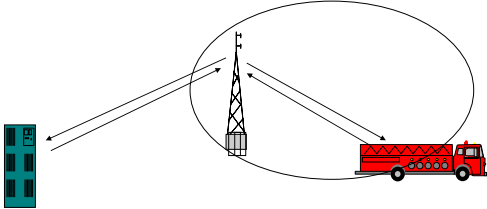
Softer Handovers (Space Diversity)



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Power Control (Open & Close Loop)



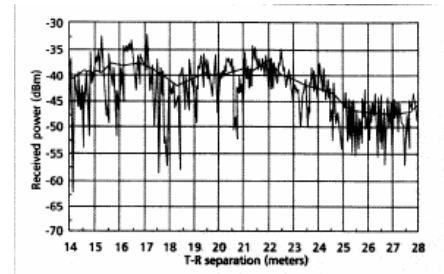
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Close-Loop Power Control



- Compensates a fading channel (1500 times per second)



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UMTS/IMT-2000 Based on Wideband CDMA



What is going to happen for WCDMA

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Application Support in UMTS



- UMTS (Universal Mobile Telecommunication System)
- UTRA (UMTS Terrestrial Radio Access)
- Support:
 - 384 kb/s for wide-area coverage
 - 2 Mb/s for local coverage
- Multimedia Applications Requirements
 - Packet-oriented
 - Variable bit rate
 - Network resources can be available on a shared basis
 - E_b/N_0

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RS Spectrum Allocation

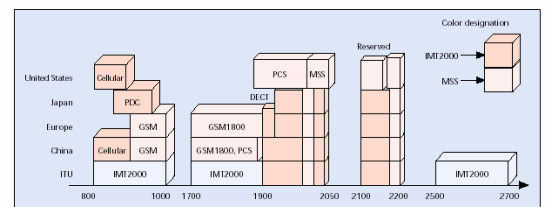
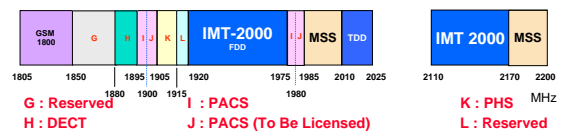
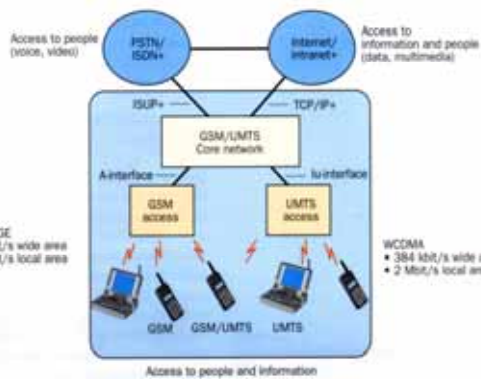


Figure 2. RF spectrum allocation in major regions.



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Wireless Mobile Interface

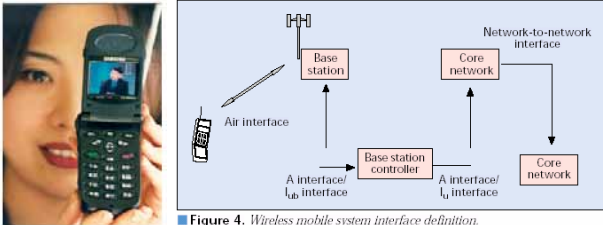
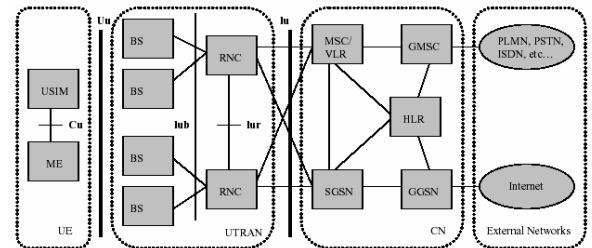
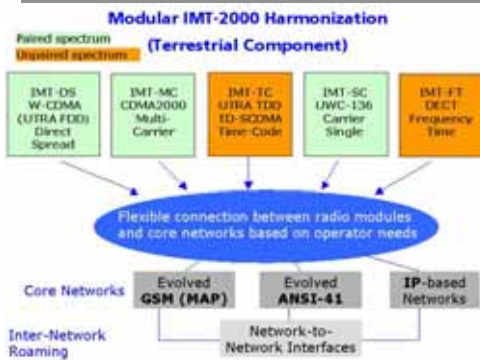


Figure 4. Wireless mobile system interface definition.

Elements of UMTS Architecture



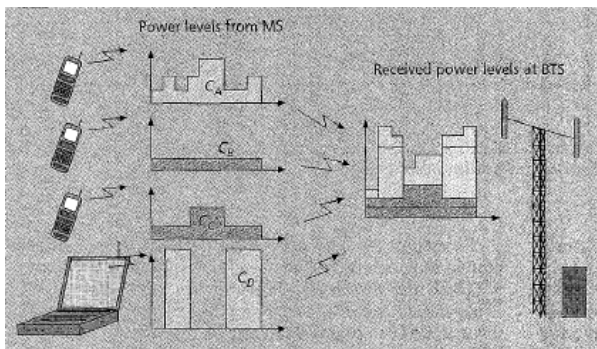
第三代行動電話之技術標準



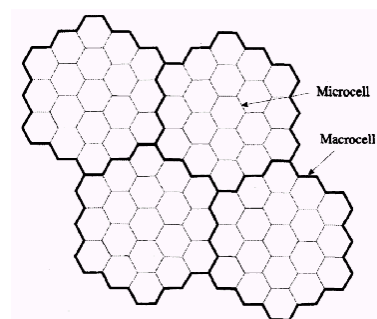
Key W_CDMA Features

- ◆ Performance Improvements
 - Capacity Improvements (3 dB, 384 kb/s, 1.9 Mb/s, 130 users)
 - Coverage and Link Budget Improvements (reuse GSM cell, 144 kb/s)
- ◆ Service Flexibility
 - Support of a wide range of services with maximum rate of 2 Mb/s, the possibility for multiple parallel services on one connection
 - A fast and efficient packet-access scheme
- ◆ Operator Flexibility
 - Support of asynchronous inter-base-station operation
 - Efficient support of different deployment scenarios, HCS, hot-spot
 - Support of evolutionary technologies such as adaptive antenna arrays and multi-user detection
 - A TDD mode designed for efficient operation in uncoordinated environment

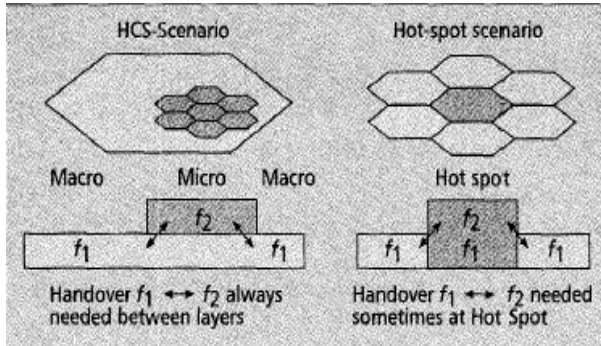
Multiplexing variable bit rate users



An example of two-tier cellular system



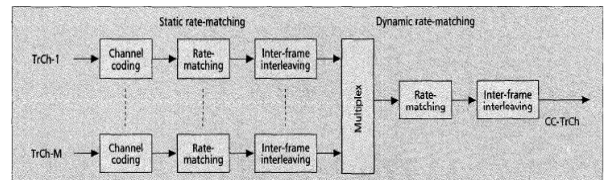
Handoff



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Transport of the channel



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Evolutions of PCS

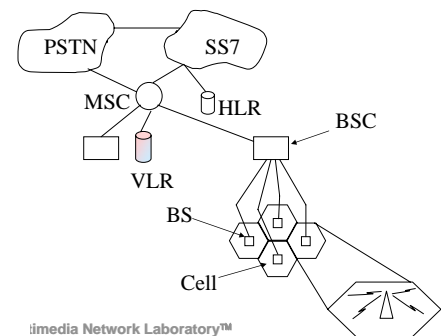


PCS Requirements

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PCS network architecture



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Location Update Procedure

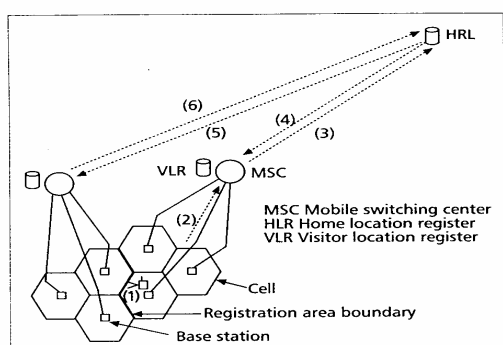
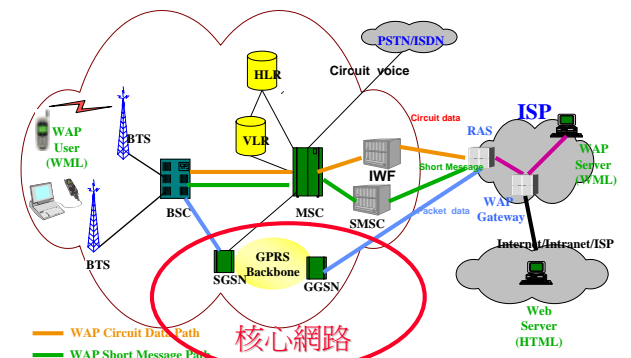


Figure 3. Location registration procedures.



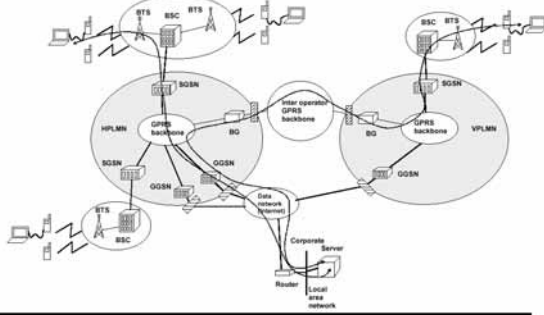
GPRS



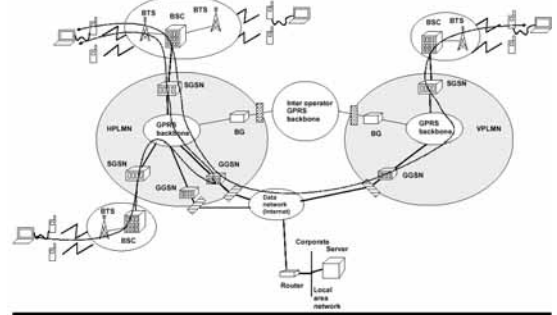
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Data transfer MS-fixed



Data transfer MS-MS



Coming Challenges for IP

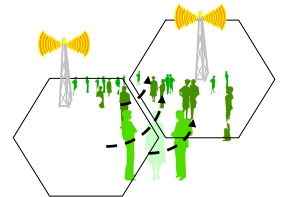


Location Managements~ handoff, roaming
QoS Transport~ Backbone delivery

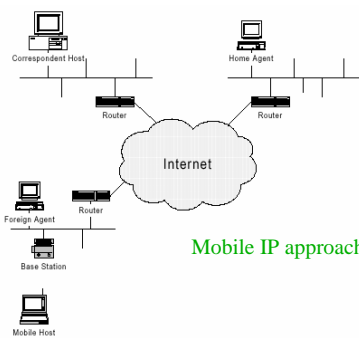
Mobility

- ♦ User mobility
 - Micro
 - Macro
- ♦ IP mobility support
 - Mobile IP
 - Cellular IP
 - HAWAII

- Handoff issue
- Location management
- Paging

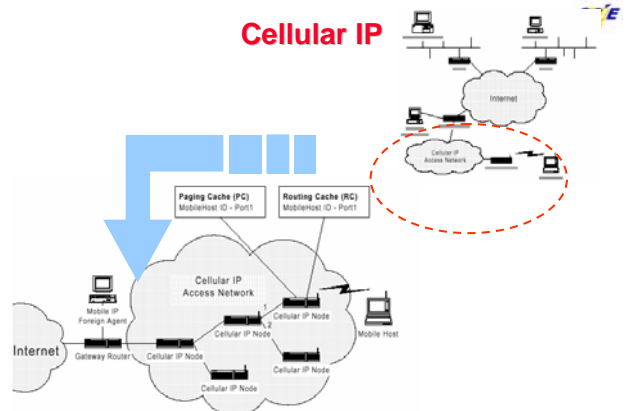


Nomadic wireless access

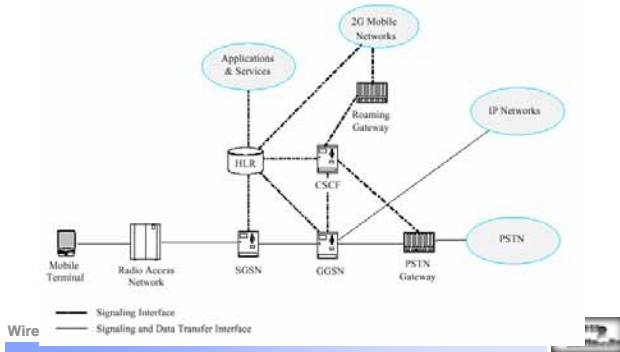


Mobile IP approach

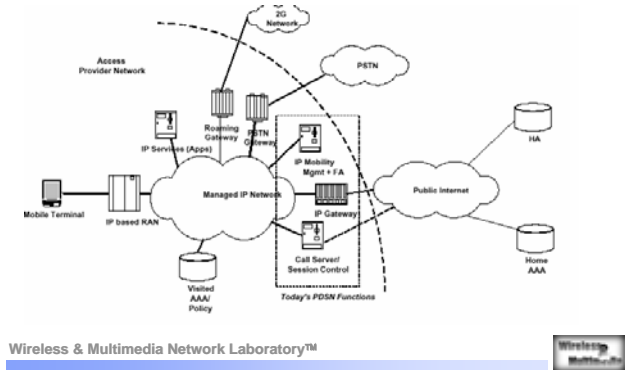
Cellular IP



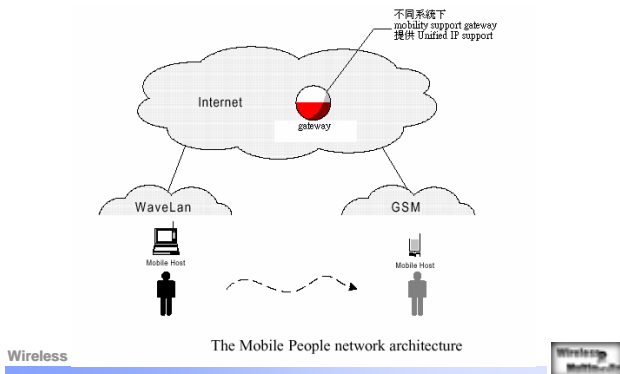
3GPP IP reference architecture



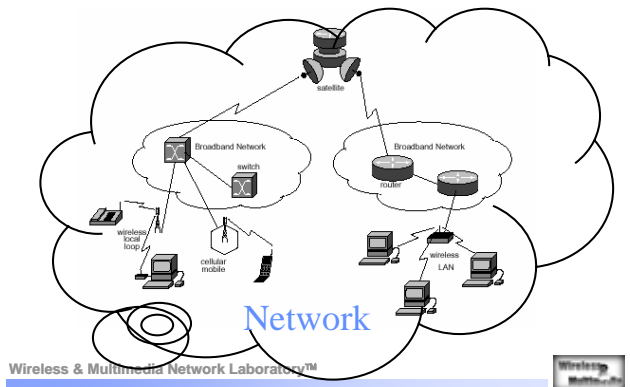
3GPP2 IP reference architecture



Heterogeneous access network



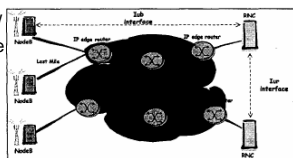
Heterogeneous End System



Last Mile QoS Issues



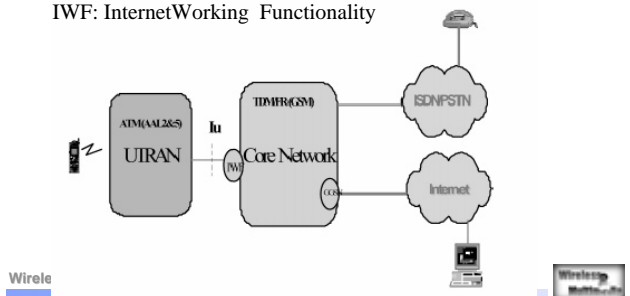
- Last mile connect NodeB and RAN. It is usually low bandwidth links.
- limit the transmission time for a packet.
- Three choices
 - Fragmentation on a layer below
 - Fragmentation on a layer above
 - Fragmentation in IP Layer



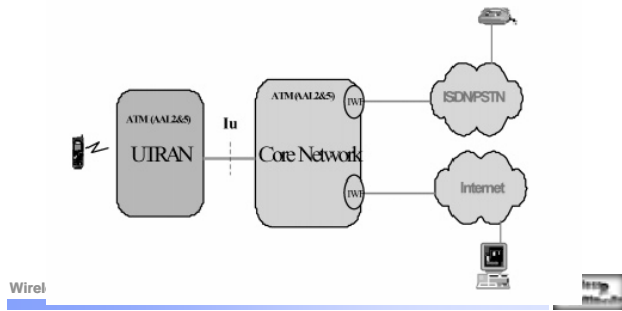
Option1



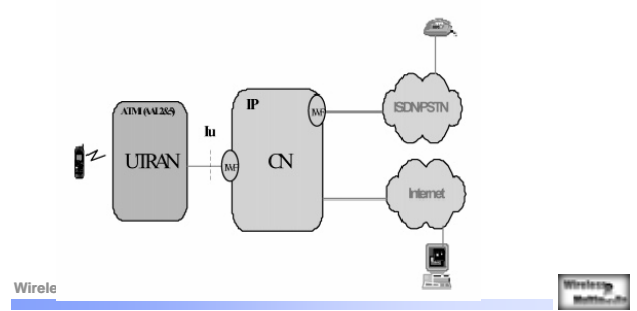
IWF: InternetWorking Functionality



Option 2



Option 3



Option 4

