Wireless & Mobile Networks
GL-ISEM

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Welcome to WMN

Course logistics

Office hours: by appointment

I'm very responsive with email

Grading :
Examination: 50%
Project : 50%
Bonus : Class participation: 10% E.g. questions you ask and how much you interact

Topics

- ✓ WLAN: IEEE802.11 …
- ✓ WPAN: IEEE 802.15 …
- ✓ Mobile IP
- ✓ WWAN: GSM, GPRS, EDGE, 3G

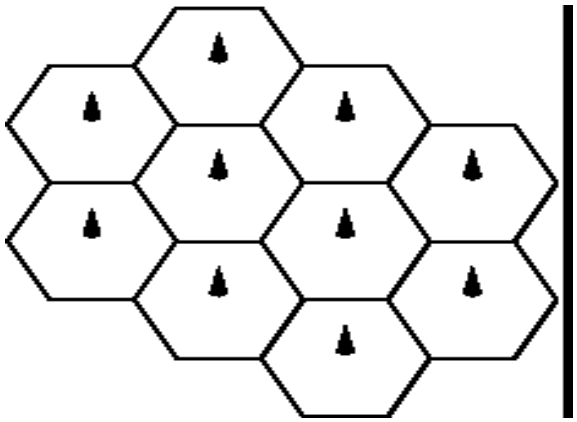
Mobile Networks & Wireless Networks

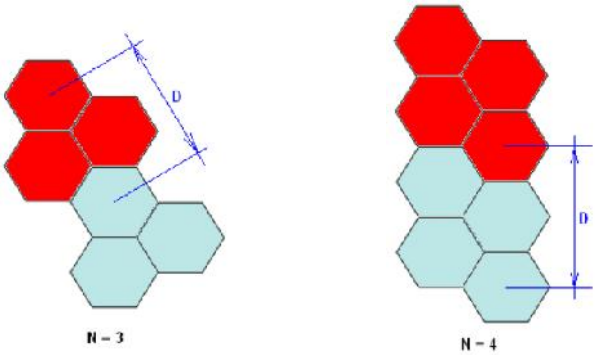
MN	**WN**
An user is defined as mobile user if he is capable to communicate outside of its net of signature conserving same address.	A system is called wireless if the system proposes a service of communication completely independent of sockets..

Examples of Mobile and/or Wireless Networks

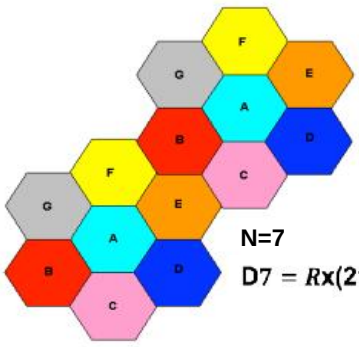
	WN	MN
GSM	✓	✓
UMTS	✓	✓
TCP/IP	x	x
IP Mobile	x	✓
ATM	x	x
DECT	✓	x

Cellular Concept



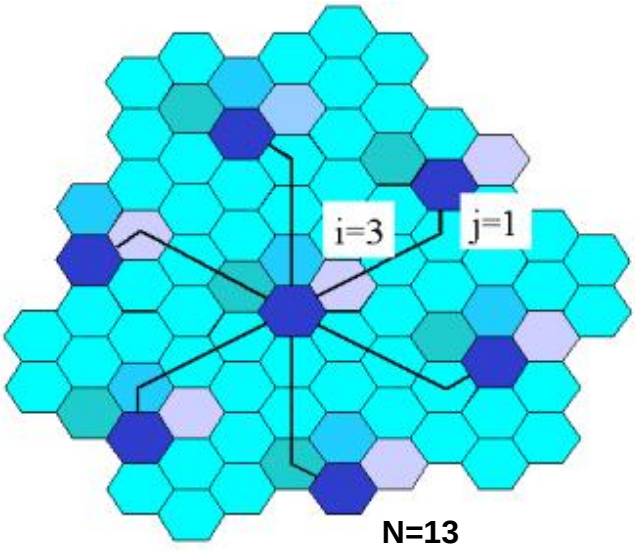


$D_3 = 3R;$
$D_4 = 2R(3)^{1/2}$;



N=7
D7 = Rx(21)$^{1/2}$;

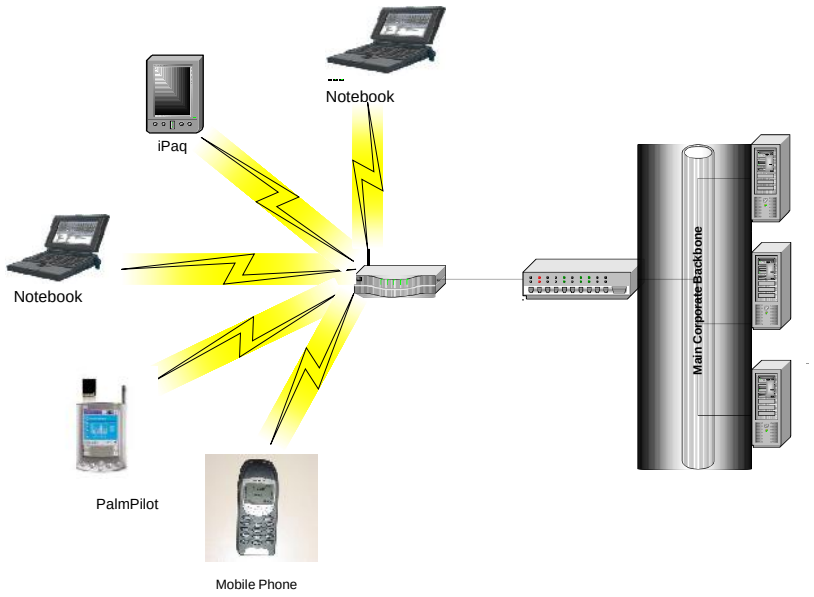
$D_N = R\text{x}(3N)^{1/2}$



WLAN

- 1990 : WLAN project
- IEEE (Institute of Electrical and Electronics Engineers) :
  - IEEE 802.11
  - IEEE 802.15
- Hiperlan (High Performance Local Area Network)
  - HiperLAN

WLAN?



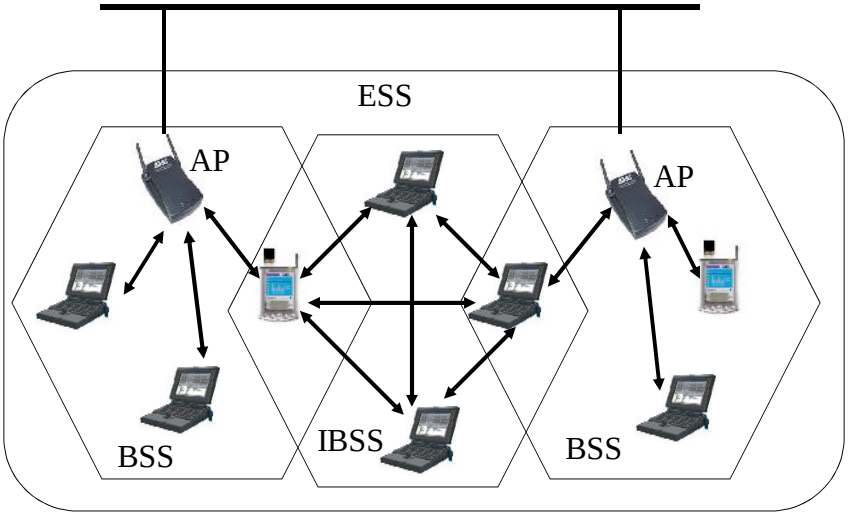
IEEE 802.11

MAC Layer	LLC 802.2			
	802.11f			
	802.11 – 802.11e – 802.11i			
Physical Layer	802.11 DSSS FHSS IR	802.11b	802.11g	802.11a

IEEE 802.11

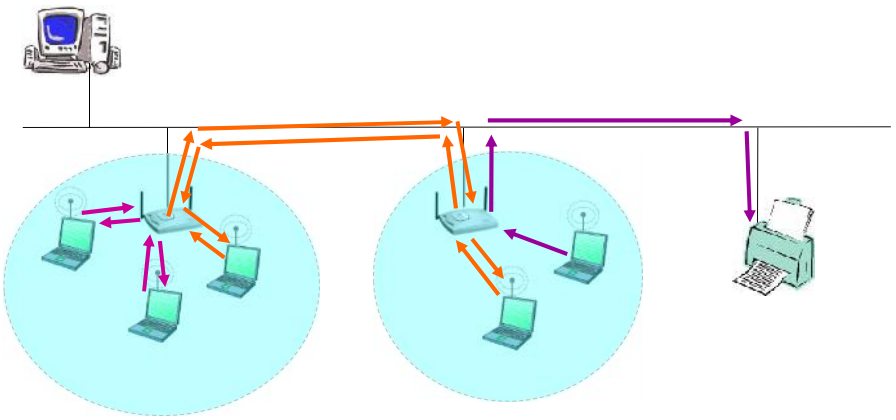
- Frequency : band 2,4 GHz;
- Infrastructue or Ad-hoc
- IEEE 802.11 is Cellular

IEEE 802.11 Architecture

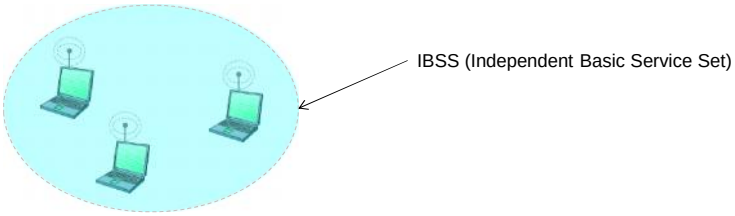


AP: Access point, BSS : Basic Set service, ESS : Extented Set Service, IBSS Independent BSS.

infrastructure



ad-hoc

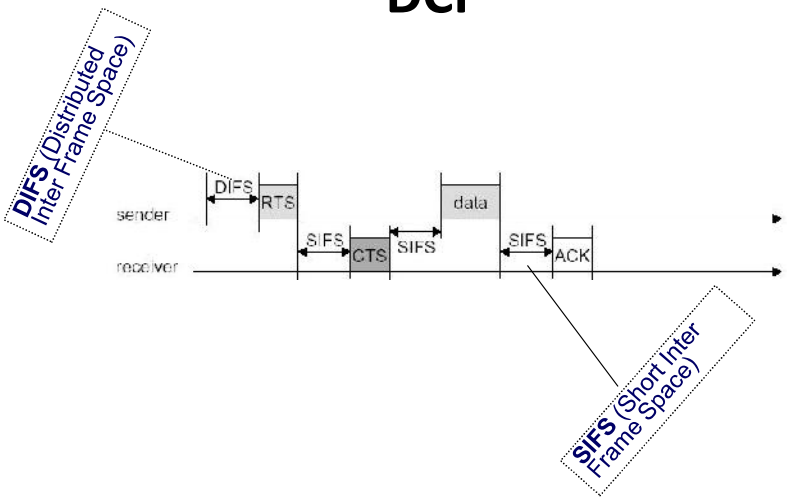


Method Access

MAC layer:

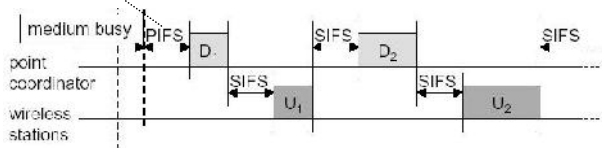
- DCF (Distributed Coordination Function) :
  - based on CSMA/CA
- PCF (Point Coordination Function) :
  - Baseado on *polling*

DCF

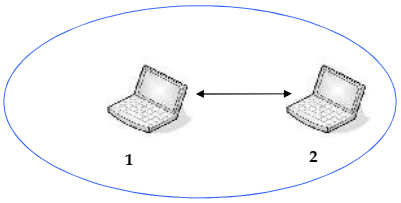


PCF

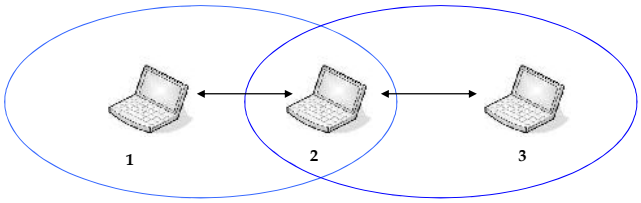
PIFS (Point Coordenation Inter Frame Space)



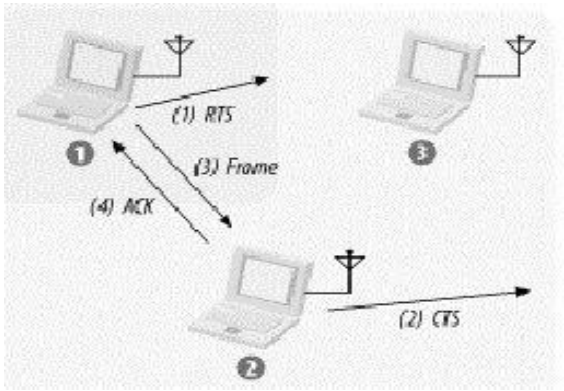
Hidden Node Problem



Hidden Node Problem



RTS/CTS



Bluetooth

King Viking, *Harald Blåtand* (english *Blåtand* = *Bluetooth*).

History

- ✓ 1994 –*Ericsson*
- ✓ 1998 –Bluetooth SIG (*Special Interest Group*):
  - ✓ *Ericsson*
  - ✓ *IBM*
  - ✓ *Intel*
  - ✓ *Nokia*
  - ✓ *Toshiba*

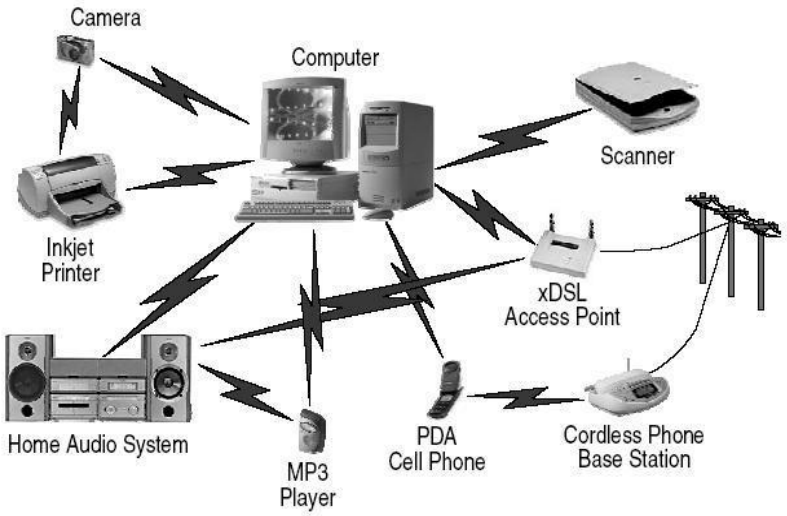
History

- ✓ 1999 –B-SIG : *Microsoft*, *Lucent Motorola* e&*3Com*
- ✓ 1999 – Version1.0
- ✓ 2001 – First devices
- ✓ More than 2500 companies in B-SIG

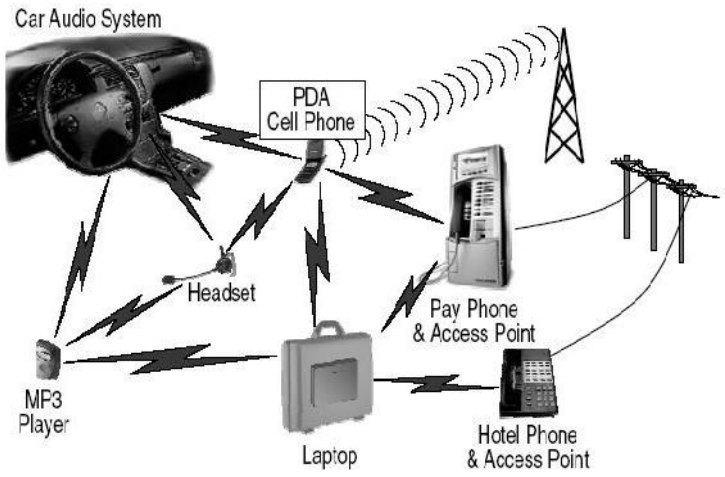
Characteristics

- ✓ WPAN Technology
- ✓ ad-hoc
- ✓ 10m till 100m
- ✓ Low cost
- ✓ 2,4 GHz
- ✓ Max – 1 Mbps
- ✓ Modulation GFSK (Gaussian Frequency Shift Keying)

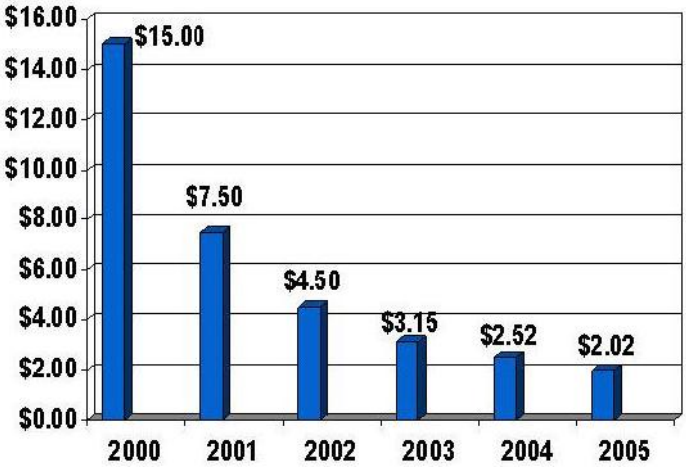
Bluetooth (1)

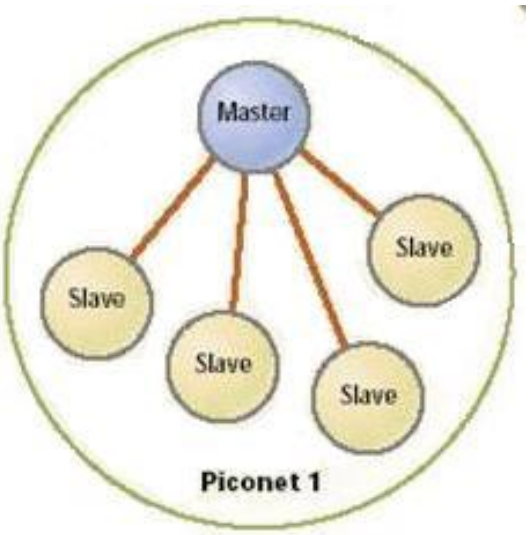


Bluetooth (2)

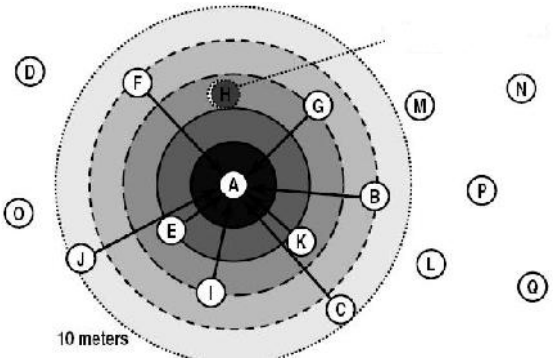


Cost USA

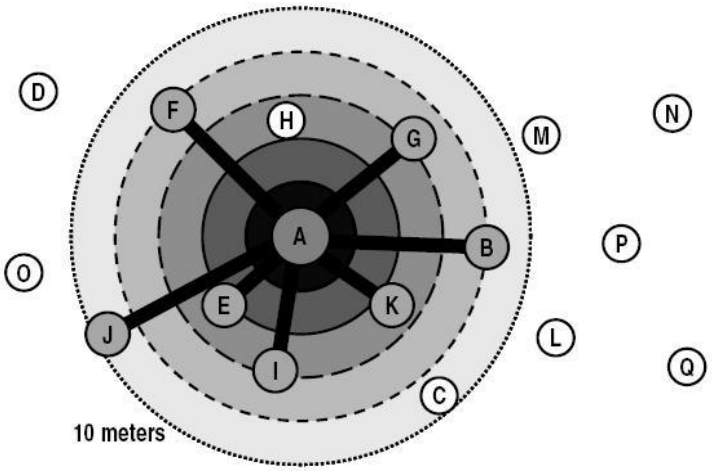



Master
Slave
Slave
Slave
Slave
Piconet 1

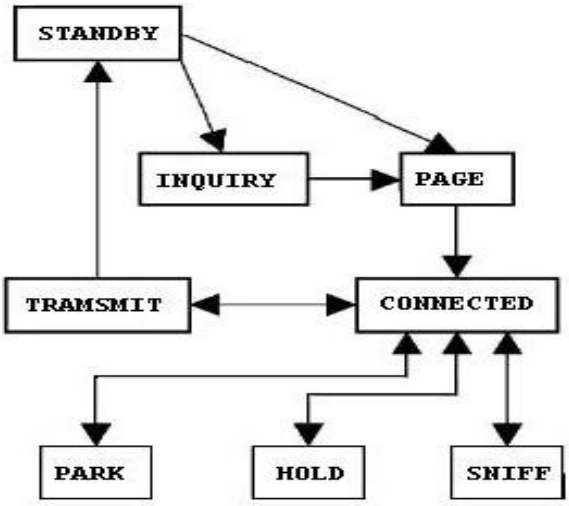
Inquiry


D
F
H
G
M
N
A
B
P
O
E
K
J
L
I
C
Q
10 meters

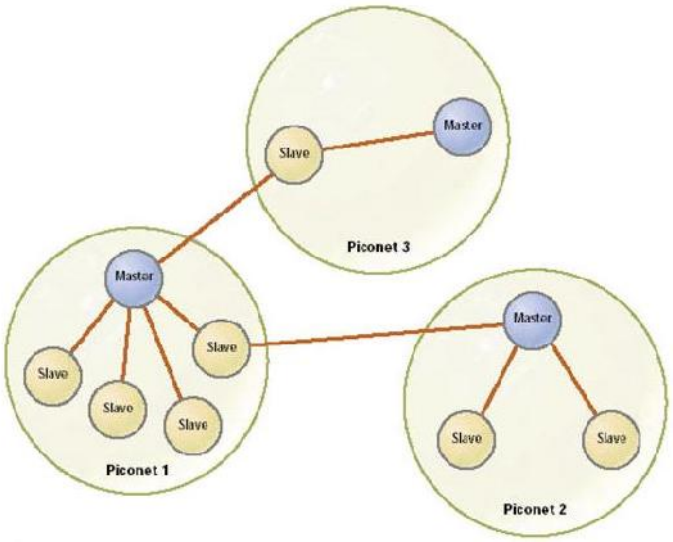
Paging



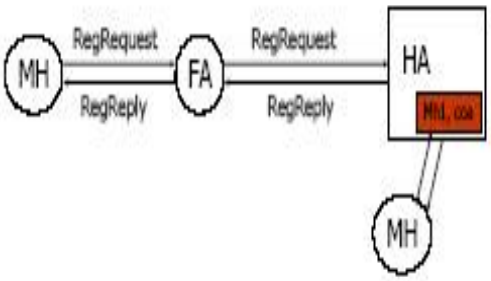
States

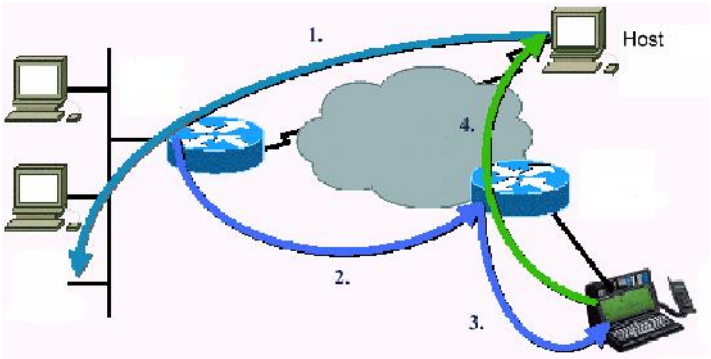


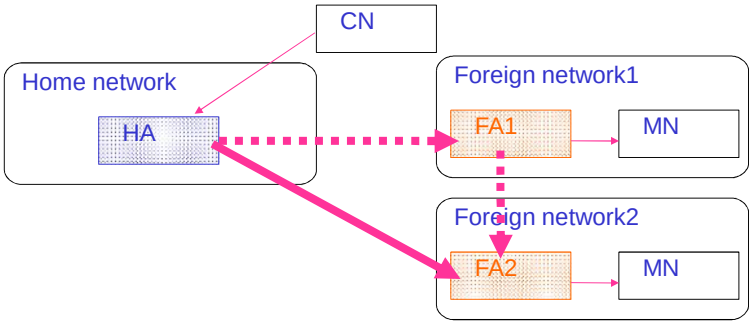
Scatternet



Mobile IP

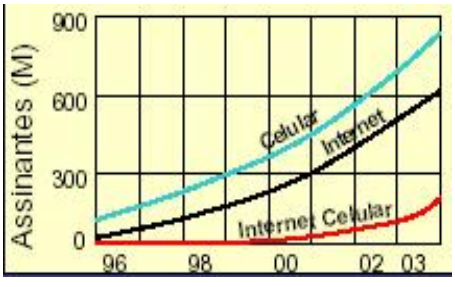

MH
RegRequest
RegReply
FA
RegRequest
RegReply
HA
Mid. cos
MH


1.
Host
4.
2.
3.



GSM++ Technologies

- GSM
- HSCSD
- GPRS
- EDGE



Web site Ericsson

GSM - HSCSD – GPRS - EDGE

- **GSM** - **G**lobal **S**ystem for **M**obile communications
- **HSCSD** - **H**igh **S**peed **C**ircuit **S**witched **D**ata
- **GPRS** - **G**eneral **P**acket **R**adio **S**ervice
- **EDGE** = **E**nhanced **D**ata rates for **G**SM **E**volution

GSM

- 1979: reservation of the band of the 900 MHz for mobile communications in Europe (IUT);
- 1980: creation of GSM (Groupe Spécial Mobile) working group
- 1992: real commercialization of first systems GSM

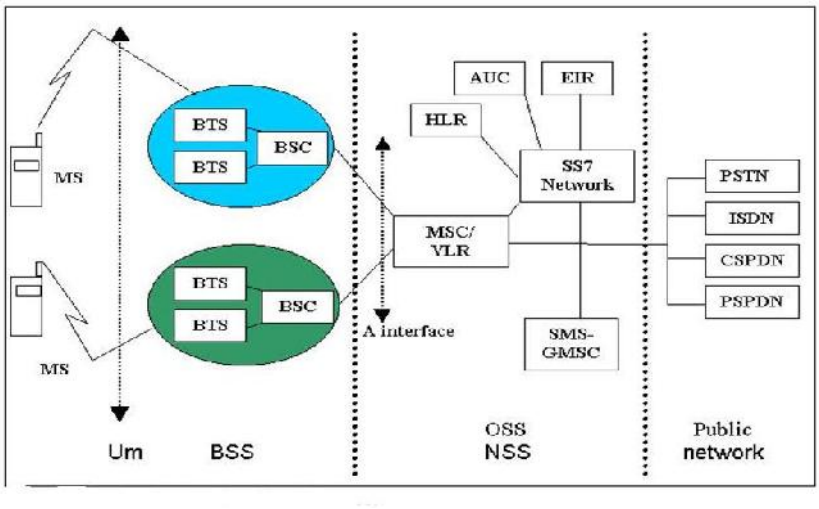
Since, the GSM communications left its French acronym for the one of Global System for Mobile communications and supplanted the analogical systems.

frequency:

- band 890-915 Mhz for the uplink (TM for BTS)

- band 935-960 Mhz for the downlink (BTS for TM)

General Architecture



BSS : Base Station Subsystem

- MS (Mobile Station) : visible part of the system mobile radio.

- BTS (Base Transceiver Station) : points of access net GSM. The BTSs are materialized under the form of antennas on the the buildings in the city or on the edge of the road.

- BSC (Base Station Controller) : a BSC generates the canals radios and the BTS applies the decisions taken by the BSC (as the control of admission of the calls and the management of handovers).

NSS : Network SubSystem

- MSC (Mobile-services Switching Center) : The MSC is a numerical switch that manages all the communications under its covering area;
- HLR (Home Location Register) : database of nominal localization in which the relative information to the subscribers of a mobile net are stored;
- VLR (Visitor Location Register) : database of Local localization in which the relative information to the users of a specific region are stored .

GSM Services

- Voice
- Data
- Short Message Services (SMS)
- Sec.
- QoS!!!

HSCSD & GPRS vs GSM

Multislot

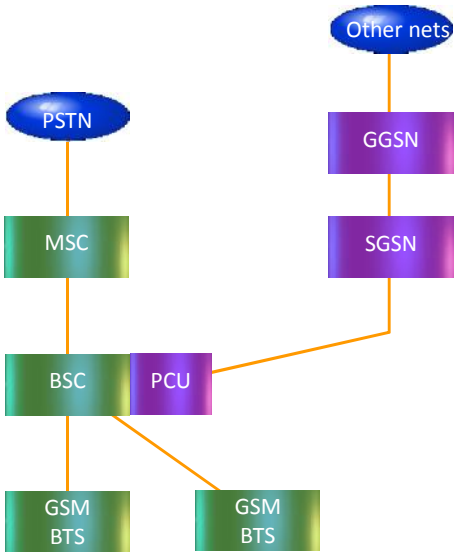
HSCSD e GPRS

Uni-timeslot

GSM

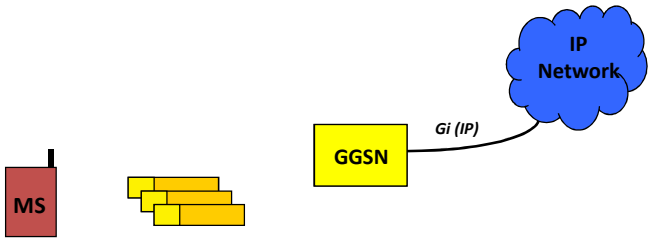
GSM + GPRS

1. BSS : software upgrade
   hardware upgrade
2. New components
   (SGSN – GGSN)



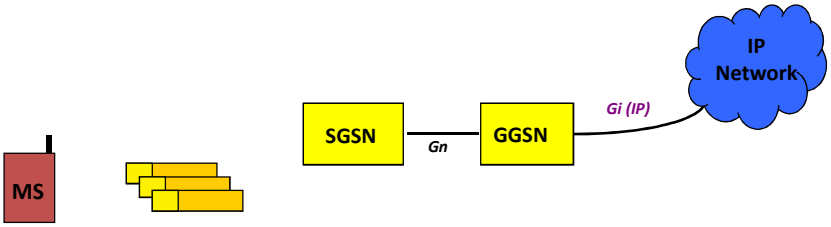
Gateway GPRS Support Node GGSN

- Interface for external Nets
- Like traditional Gateway
- Routing
- …



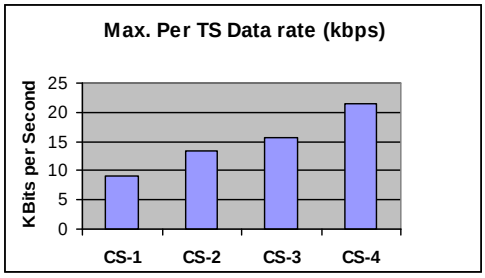
Serving GPRS Support Node - SGSN

- In same level like MSC
- Packets transfer between MS & GGSN.
- …

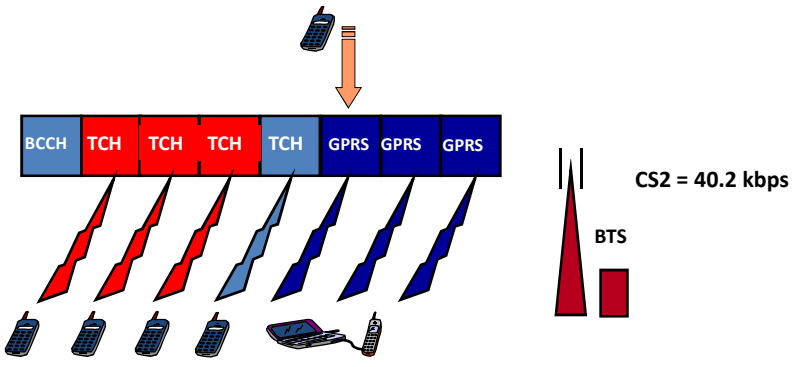


Coding Scheme

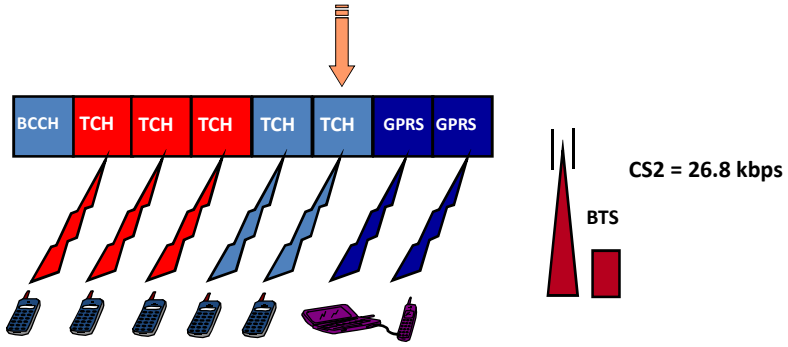
Coding Scheme	Coded bits	Punctured bits	Data Rate (kbps)	Multiple Slot Max. Data Rate (kbps)
CS-1	456	0	9,05	72,4
CS-2	588	132	13,4	107,2
CS-3	676	220	15,6	124,8
CS-4	456	0	21,4	171,2



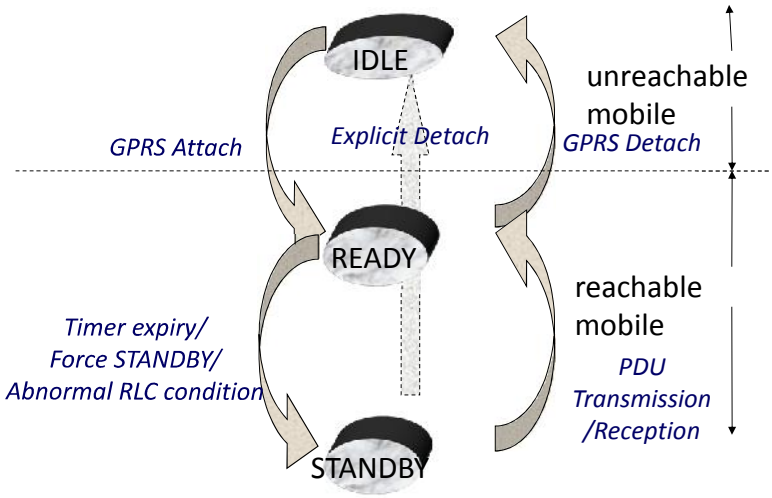
Timeslot sharing



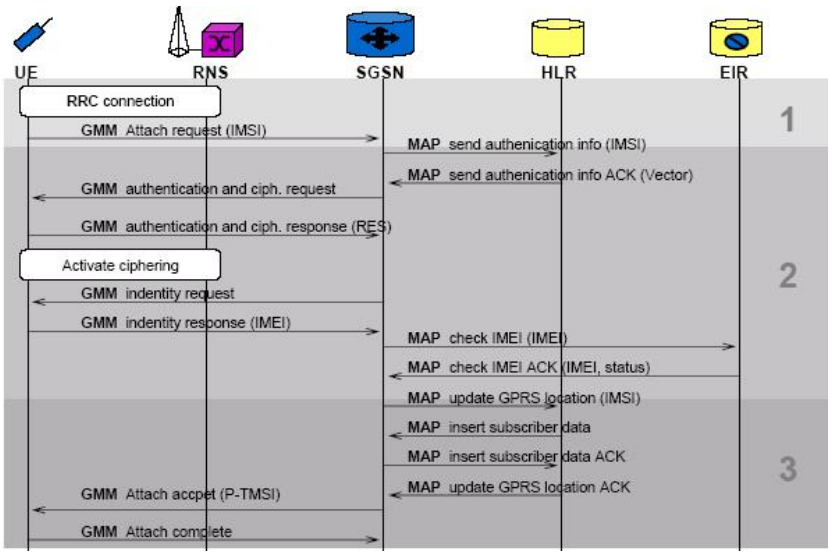
Timeslot sharing



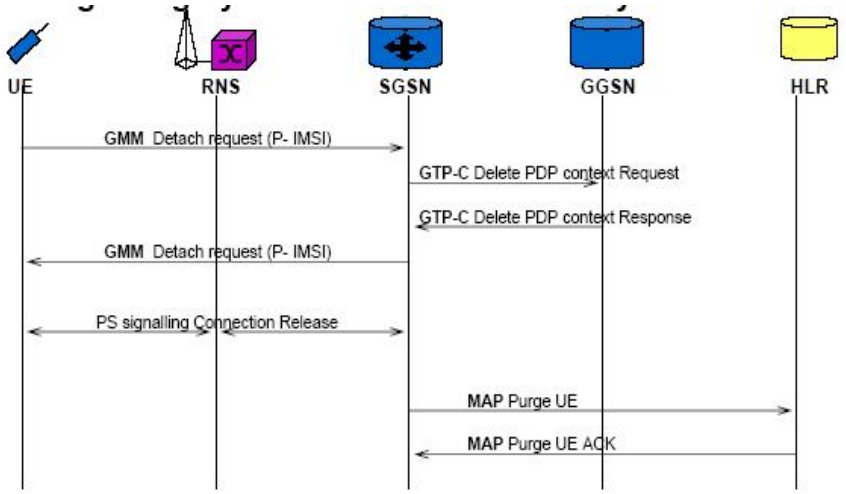
MS States



Attach



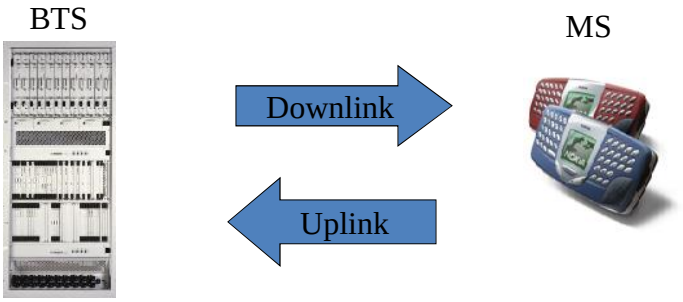
Detach



EDGE

- **EDGE** = **E**nhanced **D**ata rates for **G**SM **E**volution

EDGE Classes



Classe	Downlink	Uplink
A	8PSK	GMSK
B	8PSK	8PSK

EDGE Coding Schemes

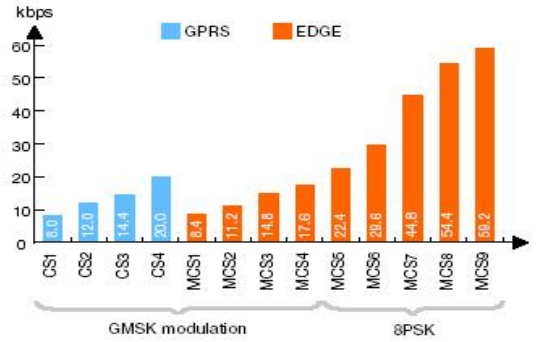


Figure 4. Coding schemes for GPRS and EGPRS (user data rate). (Key: 8PSK, 8-phase shift keying; CS, Coding scheme; EGPRS, Enhanced GPRS; GMSK, Gaussian minimum shift keying; MCS, Modulation coding scheme)

EDGE Impact

- Hardware upgrade in BSS
- Software upgrade for BS and BSC
- New Terminals
  - Terminal : 8PSK uplink e downlink
  - Terminal : GMSK uplink e 8PSK downlink

GSM + GPRS + EDGE