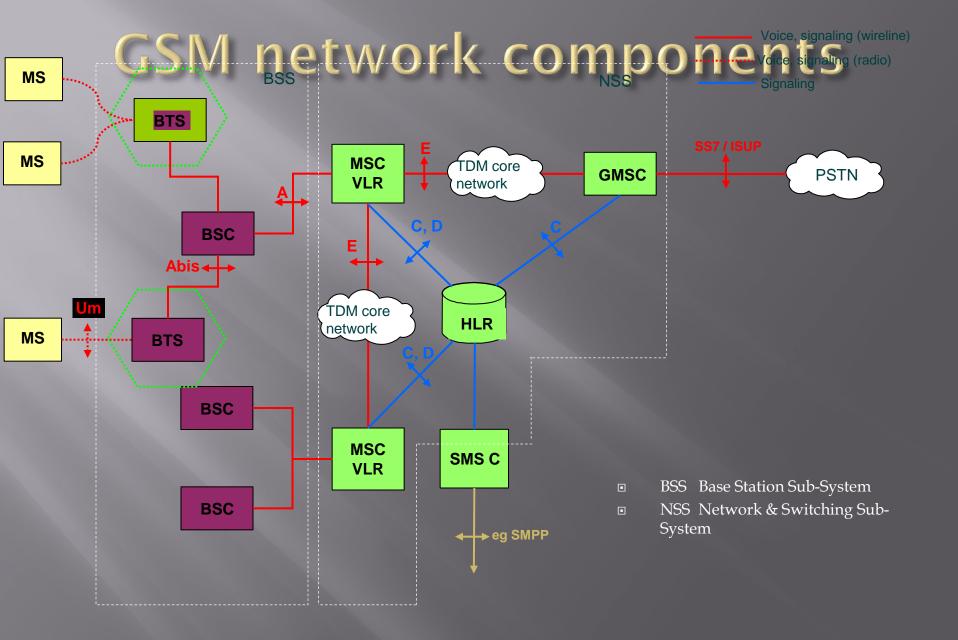
# MOBILE ACCESS NETWORKS GSM, GPRS, EDGE, UMTS

- GSM
- GPRS
- EDGE
- UMTS

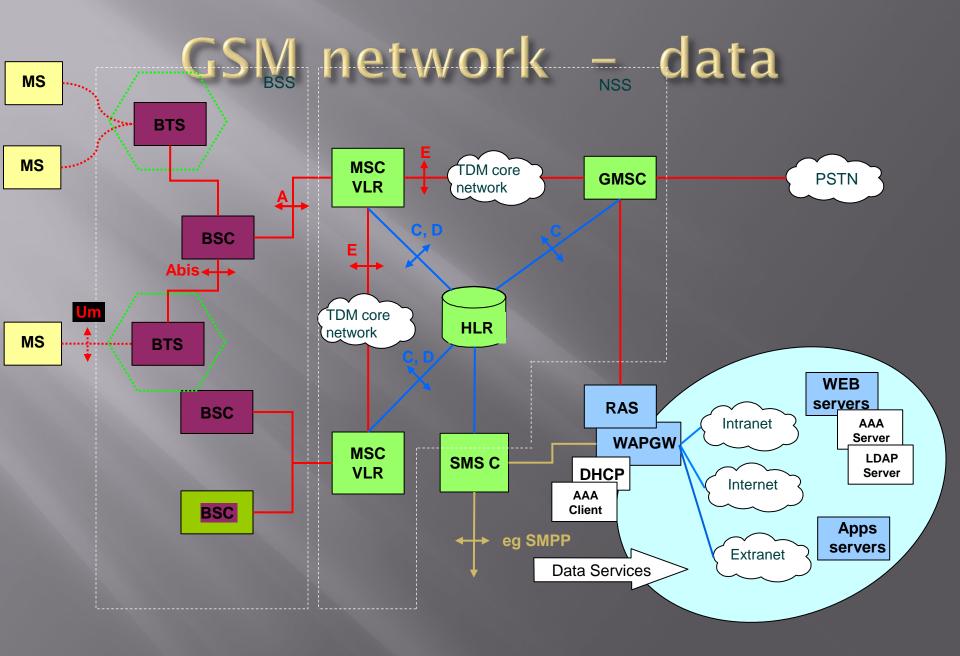
## GSM Overview & History

- Global System for Mobile Communications
- Cellular digital communication system, 900 Mhz frequency range
  - Initiated by the CEPT (1982)
  - Replacement of early analog cellular systems: NMT, TACS, AMPS, ...
  - Agreement (MoU) between Operators about tariffs, numbering plans,... (1987)
  - Start of operations in 1991. The first GSM network was launched in 1991 by <u>Radiolinja</u> in <u>Finland</u> with joint technical infrastructure maintenance from <u>Ericsson</u>
- Basic service: interactive voice communications between mobile, wireless handsets (Mobile Station, MS), and between MS and wire-line phones









#### GSM - Subscriber Identification

International Mobile Subscriber Identity

- Uniquely identifies the mobile subscriber
- Stored in the Subscriber Identity Module (SIM)
- IMSI = MCC + MNC + MSIN
  - MCC Mobile Country Code (3 digits)
  - MNC Mobile Network Code (2 digits)
  - MSIN Mobile Subscriber Identification Number (10 digits or less)

#### MSISDN

Mobile Station ISDN number

- Directory Number, used to call the MS part of ITU Recommendation E.164
- Stored in the HLR
- MSISDN = CC + NDC + Subscriber Number
  - CC Country Code
  - NDC National Destination Code (Mobile Network Operator)

#### IMEI

International Mobile Equipment Identifier

- Assigned to the MS (not to the SIM)
- IMEI = TAC + FAC +MS Serial Number
  - TAC Type Approval Code
  - FAC Final Assembly Code

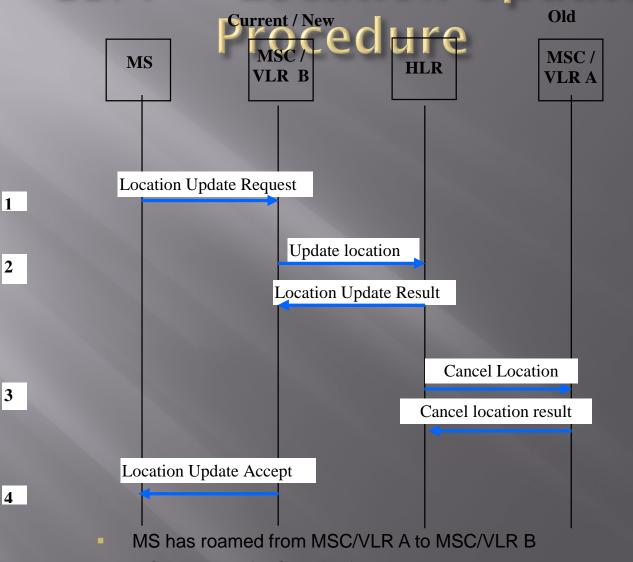
#### MSRN

Mobile Station Roaming Number - temporary

Assigned by the serving MSC/VLR to a roaming subscriber, during the call set up phase (incoming call).

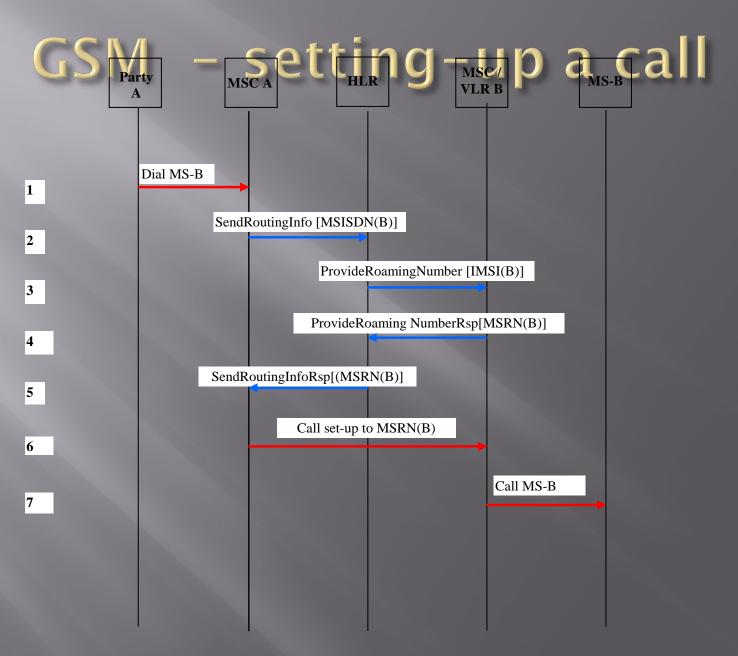


#### GSM - Location Update



MS power-on (IMSI Attach) in location area B





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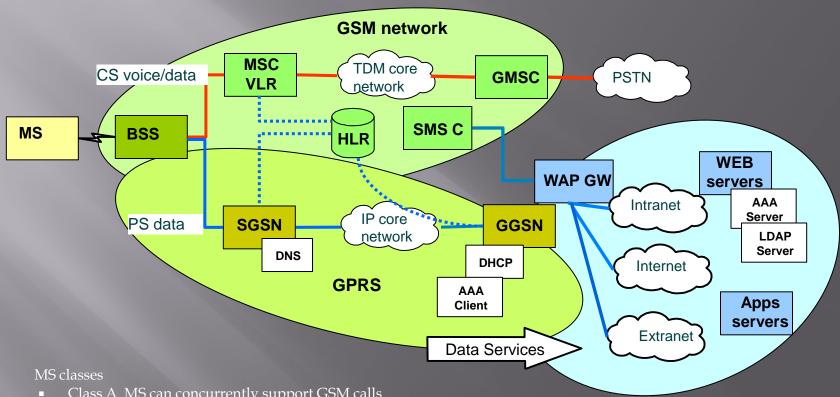
## GPRS History & Overview

- General Packet Radio Services
- Targeted to mobile data users internet access
  - 2001 400 M Internet users, 700 M Wireless Users (500 M GSM Users)
  - 2005 1B+ Internet Users (+100 M / Year), 1B Wireless Users
  - GPRS to meet the growing demand for wireless packet data sevicesTransfer of standardization work from CEPT to ETSI (1988)
- ETSI Specifications
- Introduced in ETSI Rel'97, opened circa 2000
- GPRS is an overlay packet data network
  - added at marginal cost to a GSM network
- Basic service: IP data traffic
  - Architecture accommodate other protocols such X.25

#### **GPRS** Radio Interface

- Same as GSM
- No change in the radio network, same BTS
- BSC SW upgrade
- Maximum link speed
  - Theoretical: 115 Kbps using 8 TDMA time slots
  - Practical: 30 Kbps

## GPRS Architecture - Packet Switched Data



- - Class A MS can concurrently support GSM calls and GPRS data packets
  - Class B MS can support GSM calls and GPRS data packets, not at the same time
  - Class C MS can support GSM calls or GPRS data packets (manual configuration)

- Serving GPRS Support Node SGSN
- GGSN Gateway GPRS Support Node

- GSM
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#### **EDGE Overview**

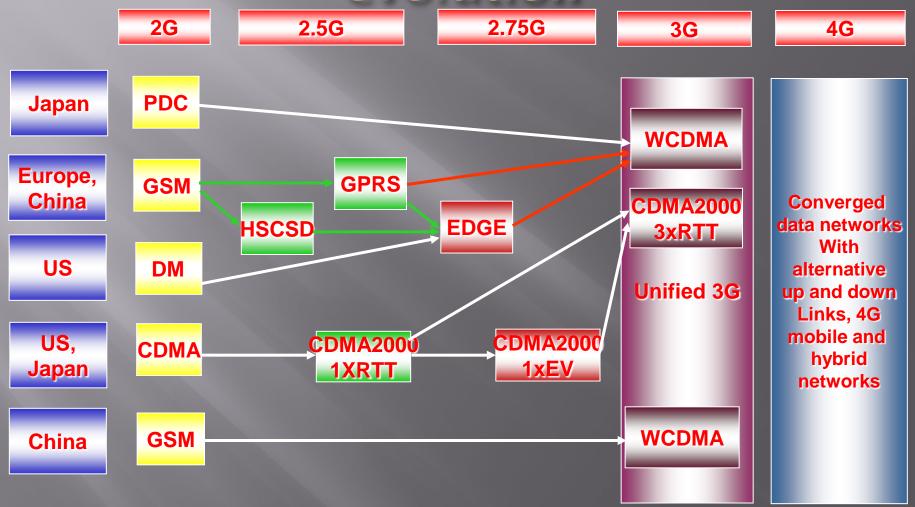
- Enhanced Data Rates for Global Evolution
- Objective: provide higher data rates to GPRS users
  - GPRS Data Rate \* 3 on a TDMA Time-slot
- Maximum Link speed
  - Theoretical 473 Kbps (59 Kbps \* 8 TDMA time-slots)
  - Practical around 100 Kbps
- □ Introduced in ETSI Rel'99, opened circa 2001
- Radio interface
  - Same radio frequencies as GSM / GPRS, same technology (FDMA, TDMA)
  - Data rate increase obtained by change of modulation
    - GSM/GPRS: GMSK, 1 bit / symbol
    - EDGE: 8-PSK, 3 bits / symbol
- Same network architecture as GSM/GPRS:
  - SGSN, GGSN,...

- GSM
- GPRS
- EDGE
- UMTS

#### **UMTS** Overview

- 3G architecture defines 2 groups of network elements, with distinct functions and independent evolution:
  - The Core Network (eg IMS)
  - The Access Network UMTS Terrestrial Radio Access Network (UTRAN)
- UTRAN main characteristics
  - Target data rates of 144 kbps, 384 kbps, or 2.048 kpbs depending upon cell size and mobility requirements
  - Frequency spectrum 1885-2025 MHz, 2110-2200 MHz
    - Different from GSM / GPRS / EDGE
  - Access Wideband Code Division Multiple Access (WCDMA)
    - Different from GSM / GPRS / EDGE

## Access Network - Summary of evolution



#### GSM

- It is the dominant technology used around the globe.
- It uses "narrowband" TDMA in which the frequency band is divided into multiple channels which are then stacked together into a single stream
- A single radio channel is divided into 8 timeslots per channel and then each user is allocated one timeslot.
- TDMA allows several callers to share the same channel at the same time.

#### CDMA

- It allows several transmitters to send information simultaneously over a single communication channel.
- This allows several users to share a bandwidth of frequencies which is called multiplexing.
- CDMA offers more efficient use of an analog transmission because it allows greater frequency reuse, as well as increasing battery life, improving the rate of dropped calls, and offering far greater security than GSM/TDMA.

#### GSM VS CDMA

Feature	GSM	CDMA
Technology	TDMA	CDMA
Year of First Use	1,991	2,000
Worldwide market share	80%	12%
Roaming	Worldwide, 200+ countries	Limited
Signal quality/coverage area	Signal quality-Good coverage indoors on 850/900 MHz. Repeaters possible. 35 km coverage	Unlimited cell size, low transmitter power permits large cells
Frequency utilization/Call density	0.2 MHz = 8 timeslots.  Each timeslot can hold up to 2 calls through interleaving.	5 MHz = 2 Mbit/s. Each call uses 1.8-12 kbit/s depending on chosen quality and audio complexity.
Battery life	Very good due to simple protocol, good coverage and mature, powerefficient chipsets.	Lower due to high demands of CDMA power control and young chipsets.

