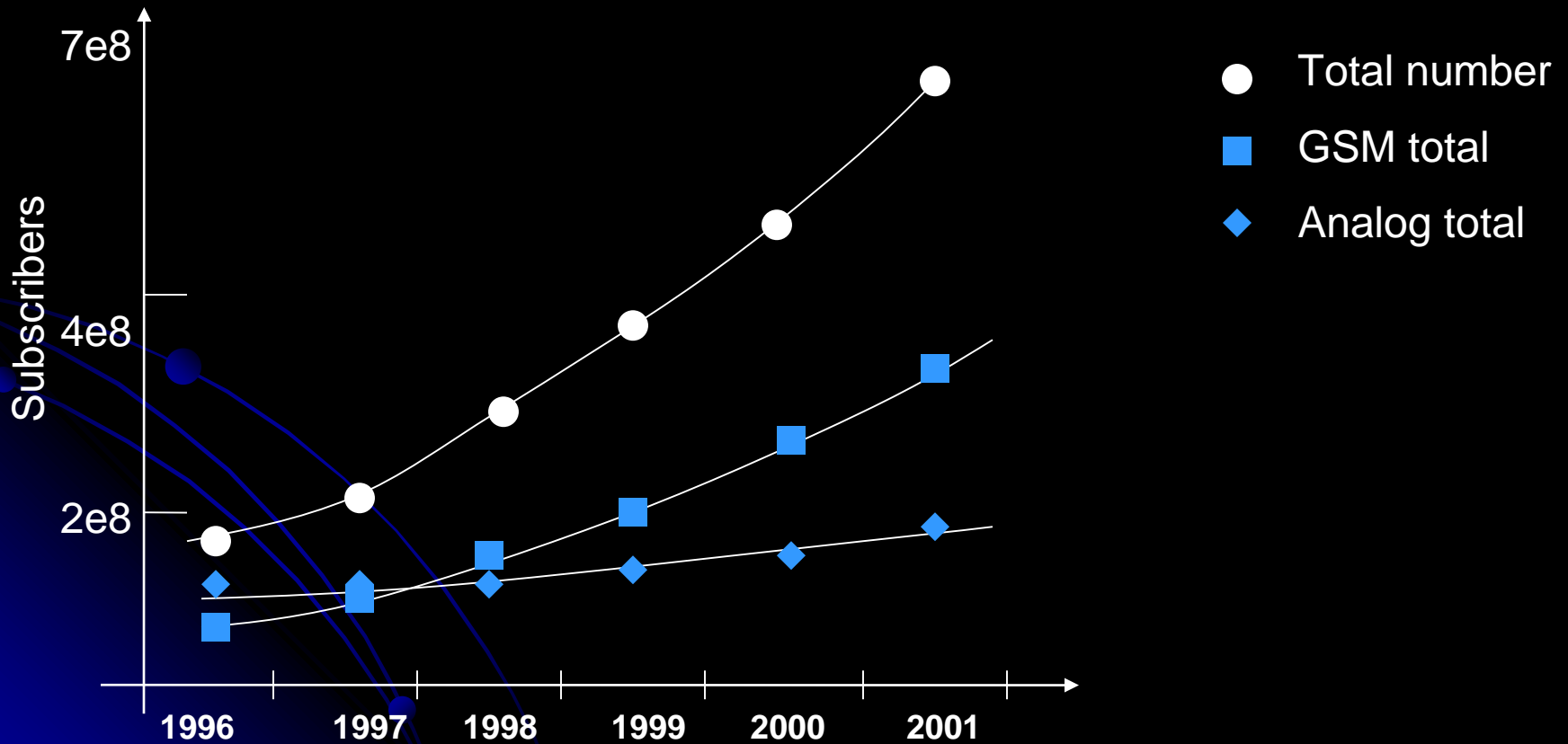


Second Generation Mobile Systems

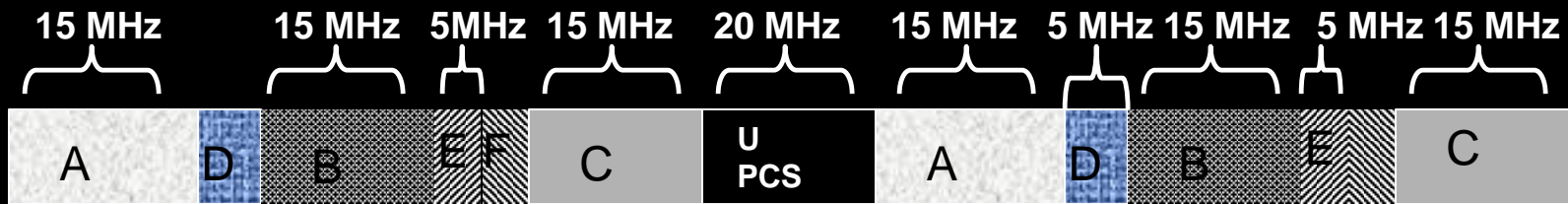
Dr. Tuhina Samanta
Dept of I.T.

Introduction

- Most popular digital system is GSM (Global System for Mobile Communication), acquiring 40% of the market



Spectrum Space for Second Generation Mobile Systems

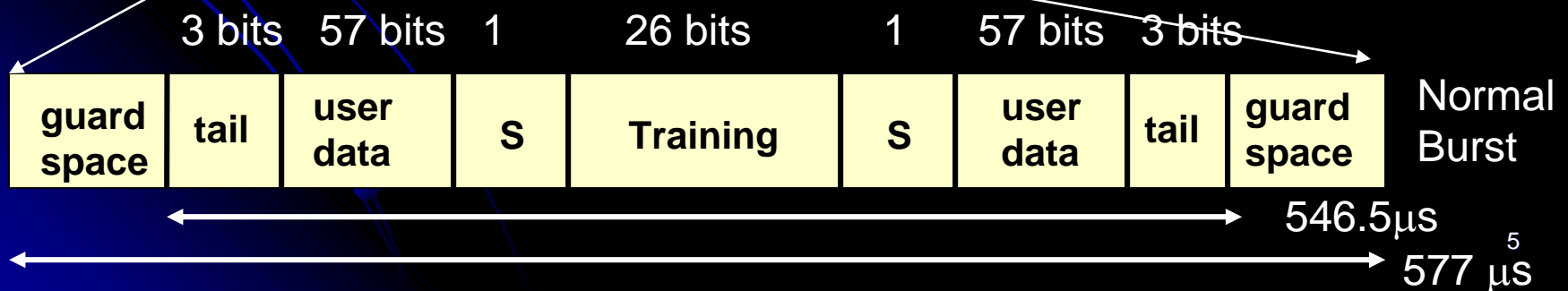
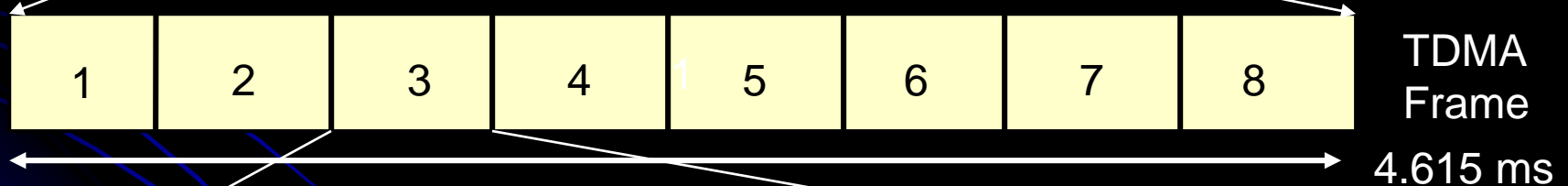
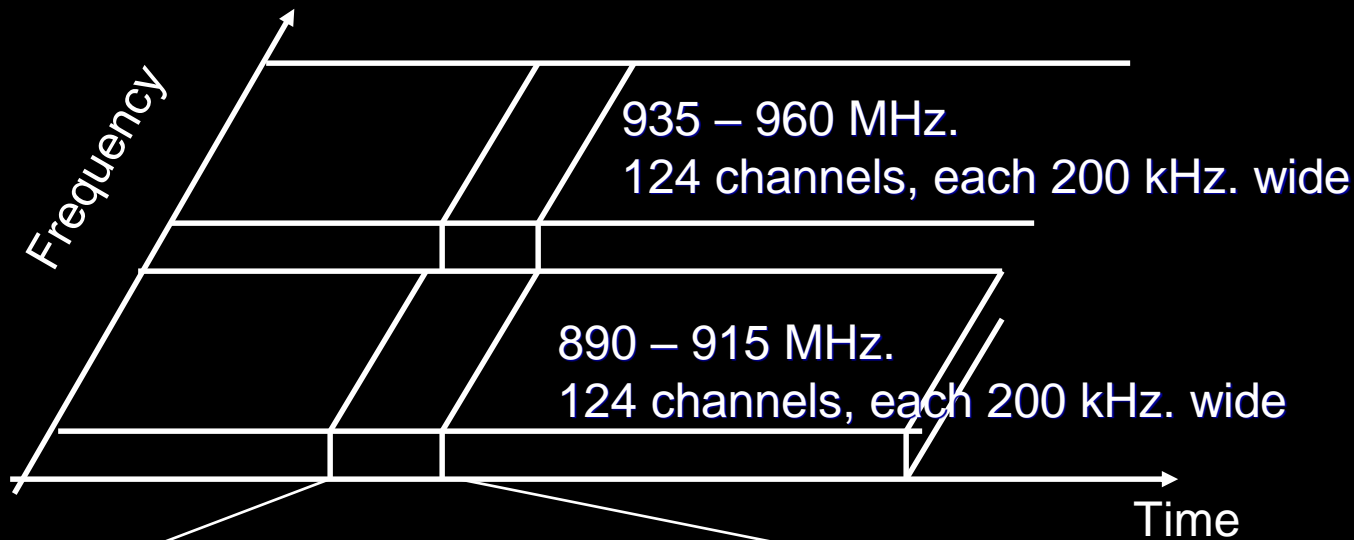


- A, B → Major trading areas
- C, D, E, F → Basic trading areas
- U PCS → Unlicensed PCS nationwide

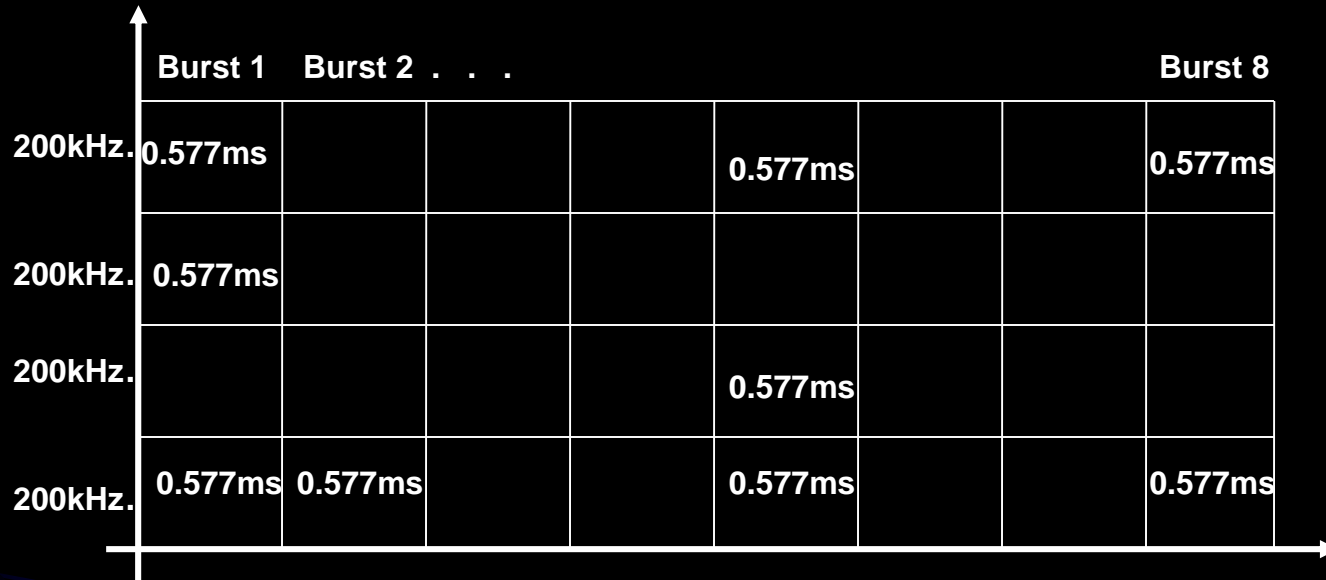
GSM

	Downlink (BS-MS)	Uplink (MS-BS)
<i>GSM 900 MHz.</i>	890 – 915 MHz.	935 – 960 MHz.
<i>GSM 1800 MHz.</i>	1710 – 1785 MHz.	1805 – 1880 MHz.

GSM-TDMA Frames and Slots

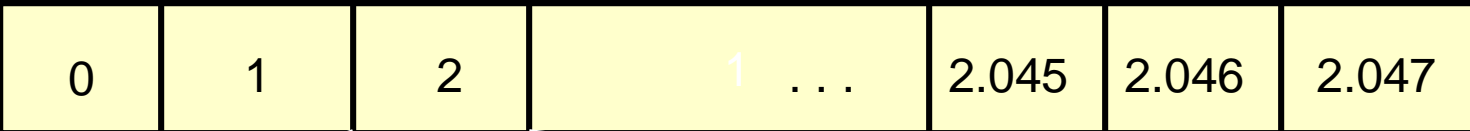


FDMA-TDMA Relationship

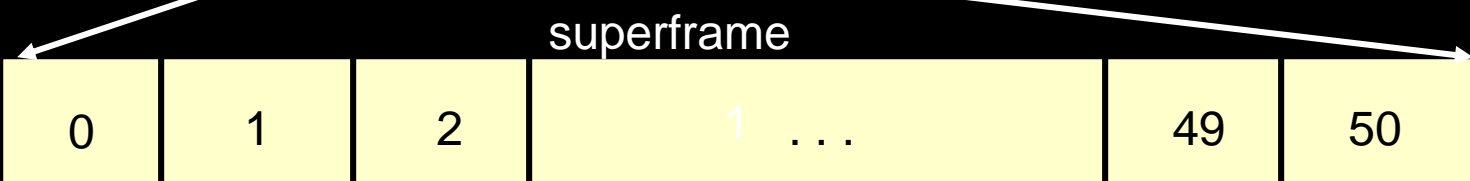


Upto eight mobile stations are assigned to a communication channel of 200 kHz. bandwidth

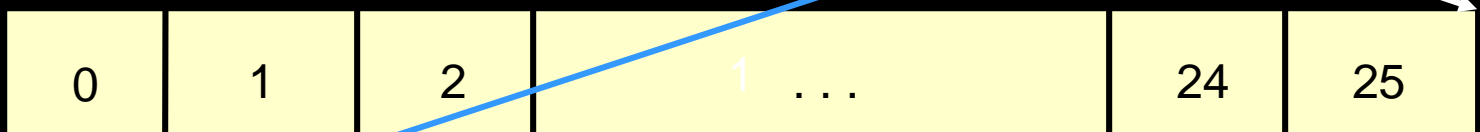
- Each TDMA channel occupies the 200 kHz. carrier for 577 μ s every 4.615ms.
- FDD is used to separate uplink and downlink
- TDMA frames are shifted in time for 3 slots (**time staggering**), hence half duplex transmission possible
- To avoid frequency selective fading, GSM specifies an optional slow **frequency hopping**, MS and BS may change carrier frequency after each frame based on a common hopping sequence.



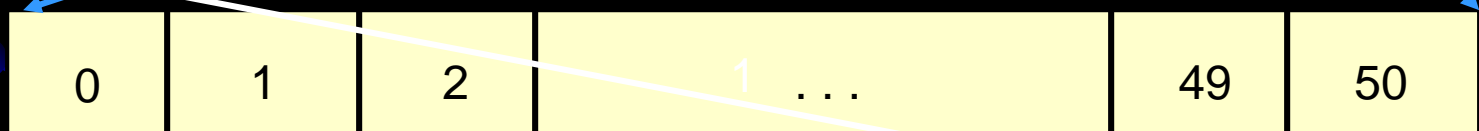
3 hr 28min
53.76s



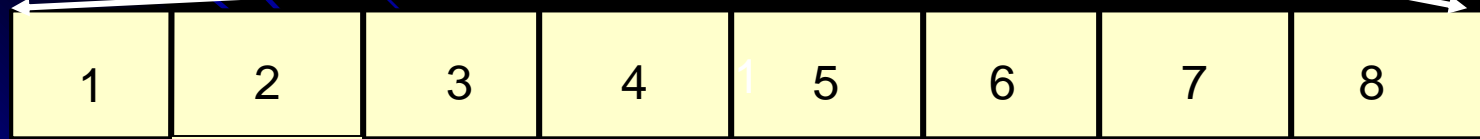
6.12 s



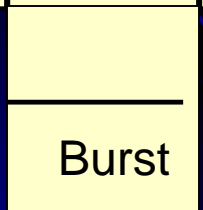
120 ms



235.4 ms



4.615 ms



frame

577 μ s

Logical Channels

- Physical channel consists of a slot repeated every 4.615 ms.
- GSM specifies two basic groups of logical channels
 - Traffic Channels (**TCH**)
 - Control Channels (**CCH**)

Traffic Channels (TCH)

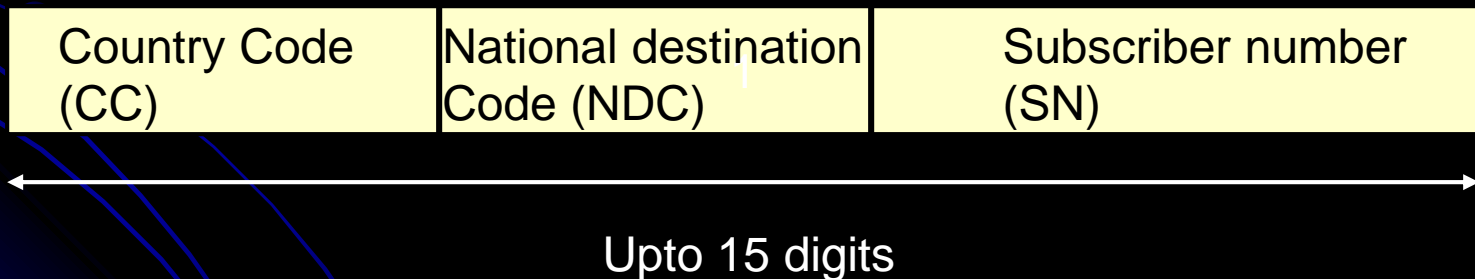
- Transmits user data (voice, fax etc.)
- Full-rate TCH (TCH/F)
 - 22.8 kbps data rate
- Half-rate TCH (TCH/H)
 - 11.4 kbps data rate
- Better voice coding with TCH/H
- Other logical channels TCH/F4.8, TCH/F9.6
TCH/F14.4 differs in their coding scheme and correction capabilities

Control Channels (CCH)

- Broadcast control channel (**BCCH**)
 - BTS uses this channel to send signal to all MSs within a cell
 - Information sent are cell identifier, frequency hopping, frequency correction via **FCCH**, synchronization via **SCH**.
- Common control channel (**CCCH**)
 - Connection set up between MS and BS
 - Paging channel (**PCH**), random access channel (RACH), access grant channel (**AGCH**)
- Dedicated control channel (DCCH)

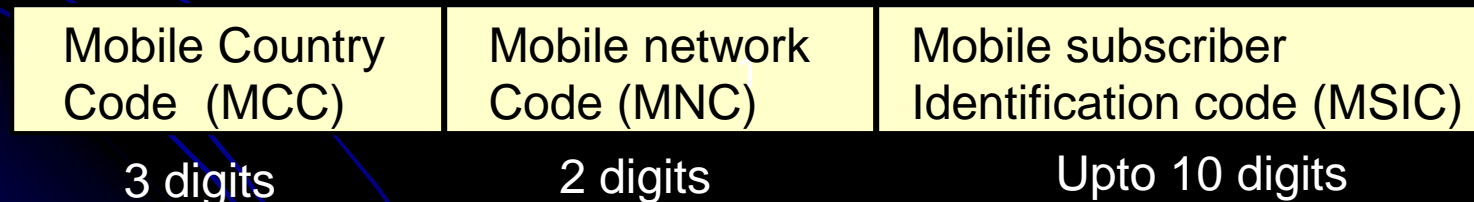
GSM Identifiers- MSISDN

- **Mobile station international ISDN number (MSISDN)**
 - Contains country code (**CC**) (49 for Germany), national destination code (**NDC**) (address of the network provider and HLR) and subscriber number (**SN**)



GSM Identifiers-IMSI

- International mobile subscriber identity (**IMSI**)
 - Internal unique identification of a subscriber
 - Mobile Country Code (240 for Sweden, 208 for France), mobile network code (code of the HLR), finally MSIN



GSM Identifiers-TMSI

- Temporary mobile subscriber identity (**TMSI**)
- Hides IMSI
- 4 byte TMSI for local subscriber identity
- TMSI is selected by a VLR and is valid temporarily within the location of the VLR.
- VLR changes TMSI periodically.

GSM Identifiers-MSRN

- Mobile station roaming number (**MSRN**)
- Another temporary address that hides mobile subscriber location
- VLR generates this address upon request from the MSC, it is stored in HLR also
- MSRN contains,
 - current visitor country code (**VCC**),
 - visitor national identification code (**VNDC**), identification of current MSC together with the subscriber number
- MSRN helps HLR to find the subscriber

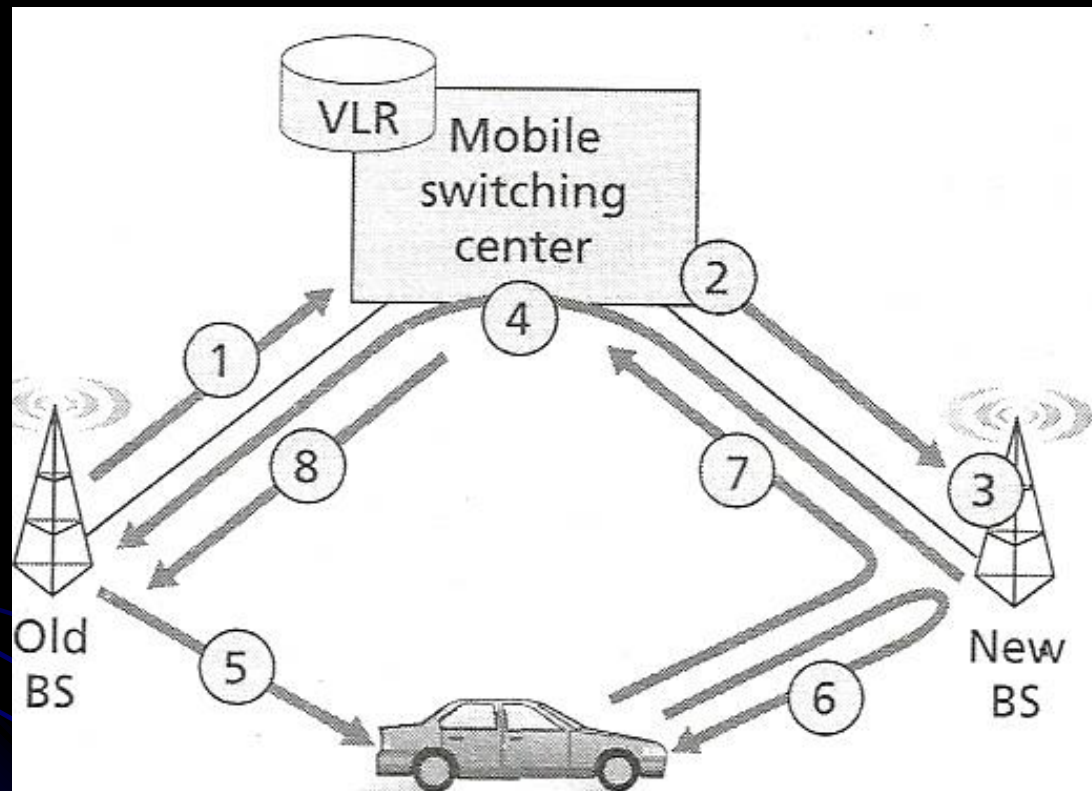
Handover in GSM

Handoff

- At any time instant, a mobile phone logically belongs to one cell and under control of its BS.
- When it moves physically from the cell, the BS notices the phone's fading signal and finds out from other neighboring BSs as to which one is getting the strongest signal.
- It then transfers ownership of the mobile to the BS of that cell.
- If a call is in progress, the mobile is asked to switch to the new channel used in that adjacent cell.
- This process is called *handoff* or *handover*.

Types of Handoff

- Handoffs can be either soft or hard.
- In a **soft handoff**, the mobile is acquired by the new BS before the old one signs off. Thus there is no loss of continuity. But it requires the mobile to be able to tune to two frequencies at the same time. Neither first nor second generation devices can do this. 3G CDMA systems provide soft handover, resulting in seamless connectivity to the mobile.
- In a **hard handoff**, the old BS drops the mobile before the new one acquires it. The call is disconnected abruptly, if there is no available frequency with the new BS, or there is a call drop till the new frequency is received. This is noticeable by the user but is typically of very short duration of about 60ms in GSM systems.
- Different kinds of Handover are possible when a mobile moves from one cell to another or when through a specific stage becomes very high.



Steps in accomplishing a handoff between base stations with a common MSC

Performance Metrics

- Cell blocking probability
 - BS is blocked due to heavy traffic, MS is handed off to the neighboring cell
- Call dropping probability
 - A call is terminated due to handoff
- Call completion probability
 - A call is not dropped before completion
- Unsuccessful handoff
 - Reception condition is inadequate
- Handoff probability
 - Handoff occurs before call termination
- Rate of handoff
 - Number of handoffs per unit time
- Interruption duration
- Handoff delay
 - Distance between MS actual position and desired position for handoff

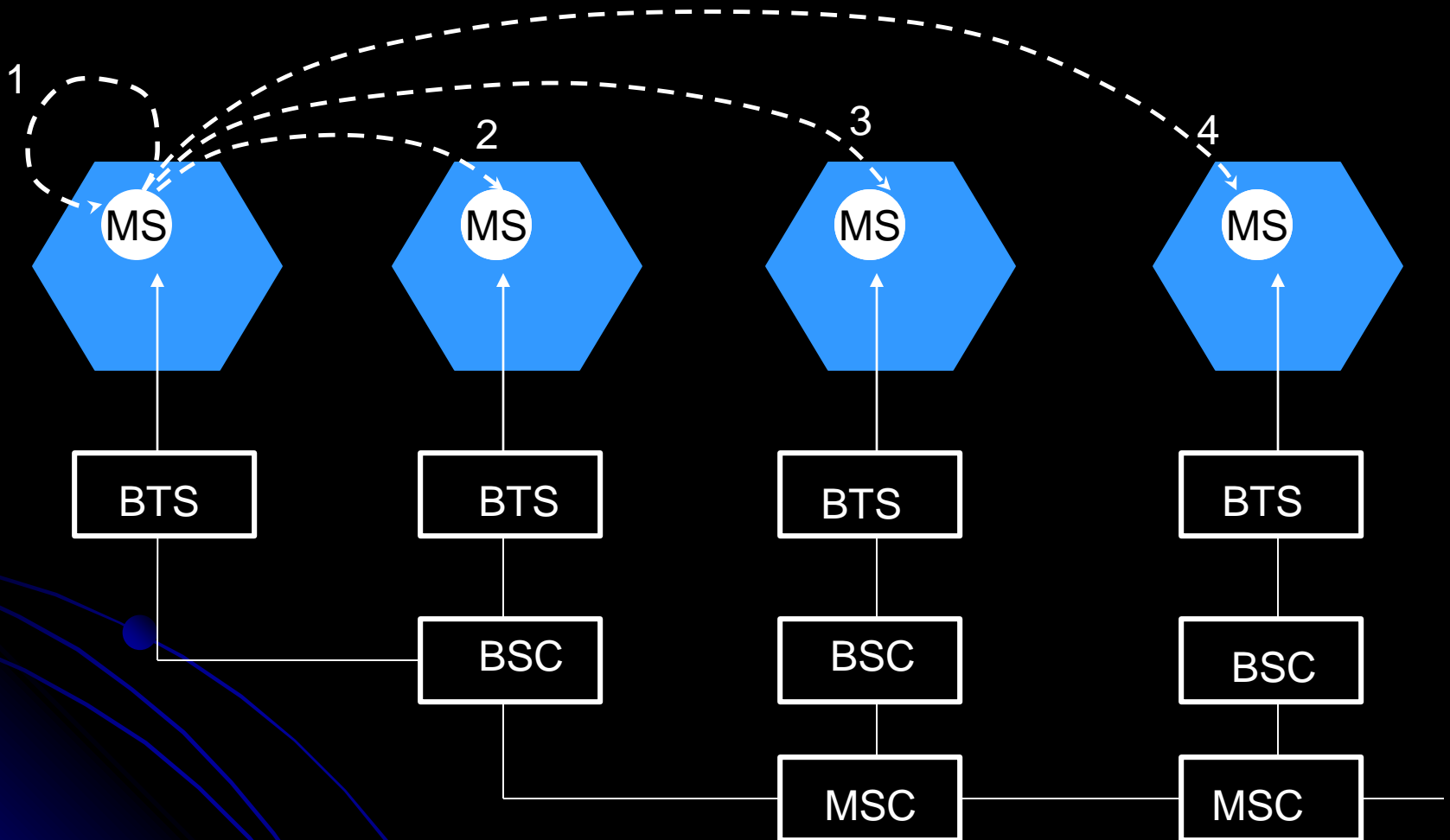
Classifications of Handover

- 1) Intra-cell handover
- 2) Inter-cell handover
- 3) Inter-BSC, Intra-MSC handover
- 4) Inter-MSC handover

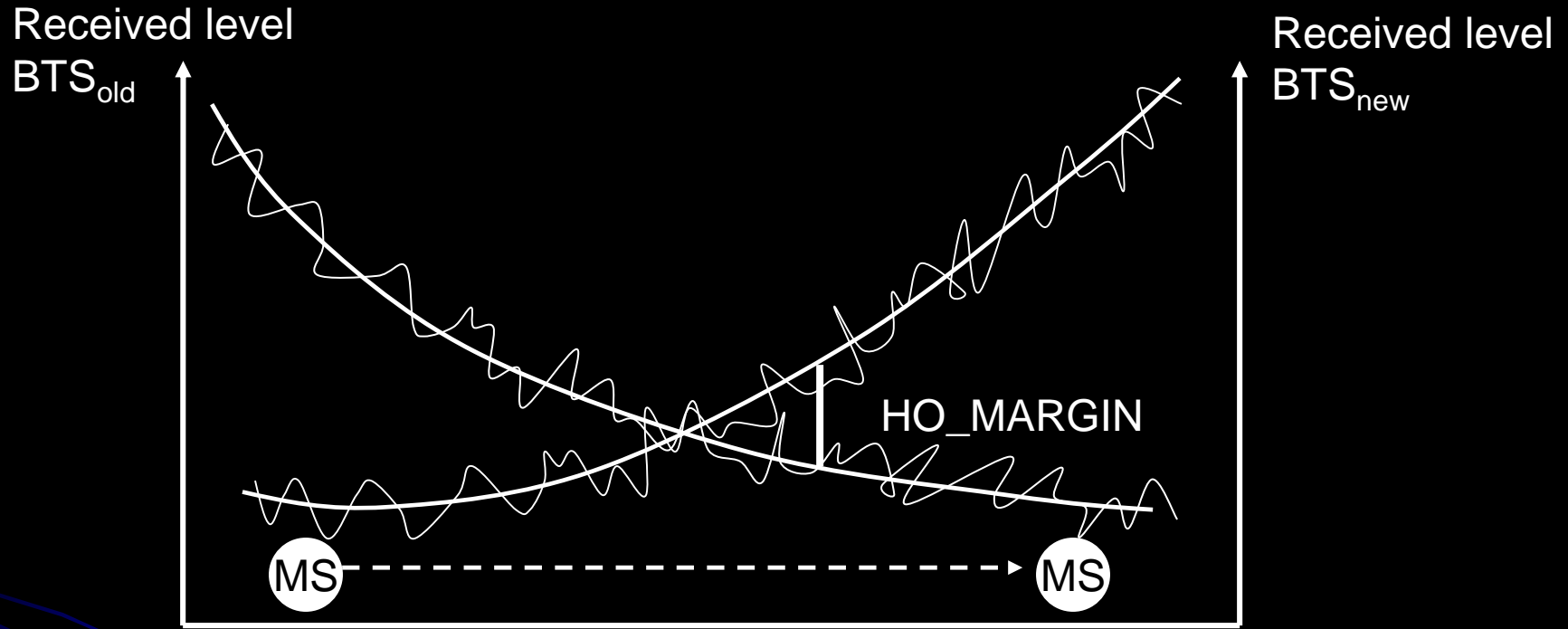
Handover may be due to,

- quality of radio link
- load balancing

Handover in GSM



Handover Decision



- Handover depends on average value
- BSC takes values like BER, signal level
- Compared with a threshold, HO_MARGIN

Security

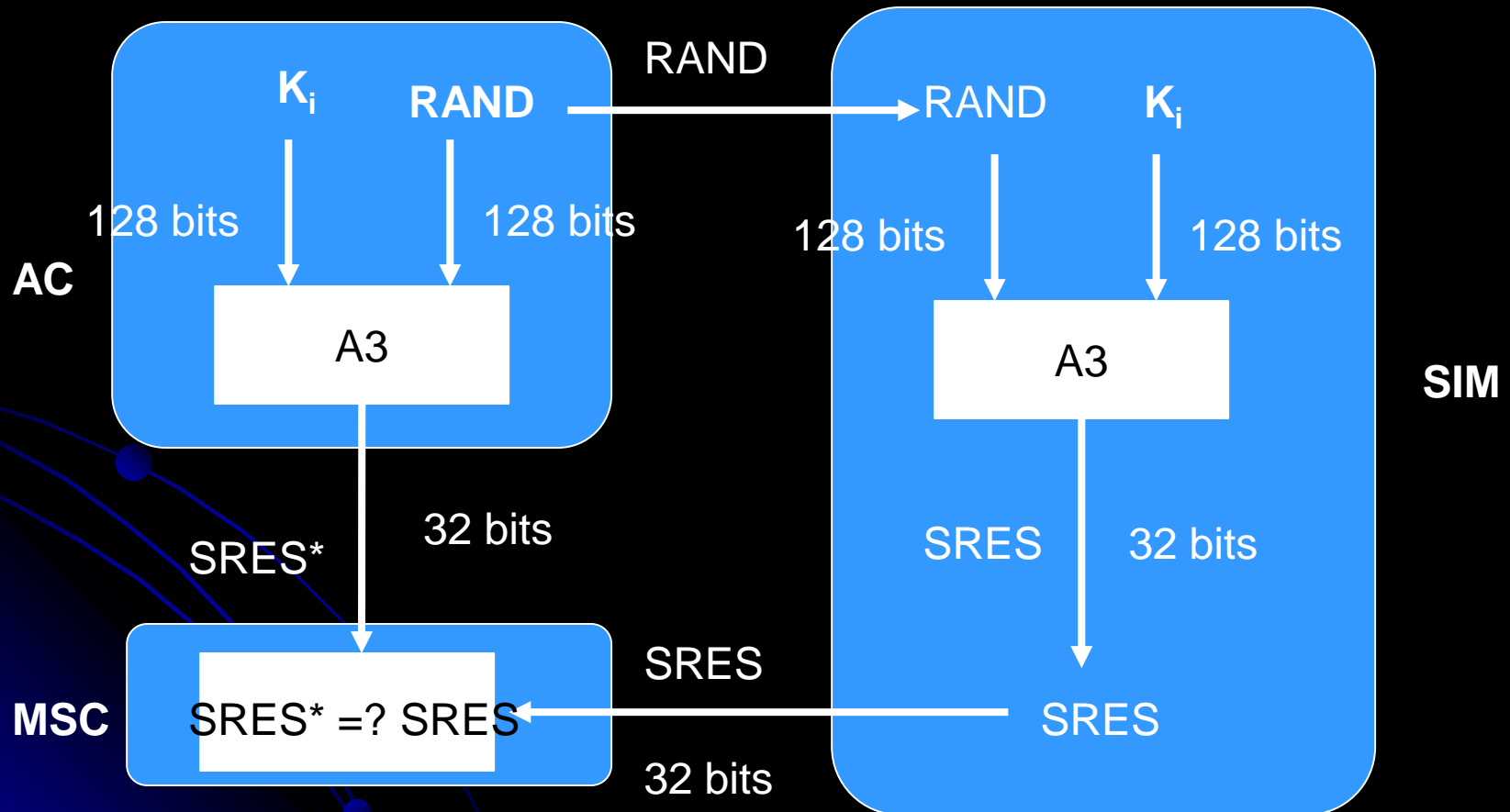
- **Access control and authentication**
 - Authentication of a valid user for the **SIM** (subscriber identity module)
 - User needs a secret **PIN** (personal identification number) to access SIM
- **Confidentiality**
 - User related data is encrypted
- **Anonymity**
 - User identifiers are not used over air

Authentication

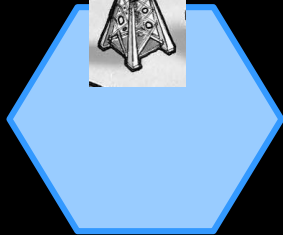


Mobile network

SIM



Encryption



Mobile network

SIM

