ज्ञानेन प्रकाशते जगत्
INDUS UNIVERSITY

Wireless Communication (EC0603)

Unit-IV

B.Tech (Electronics and Communication)

Semester-VI

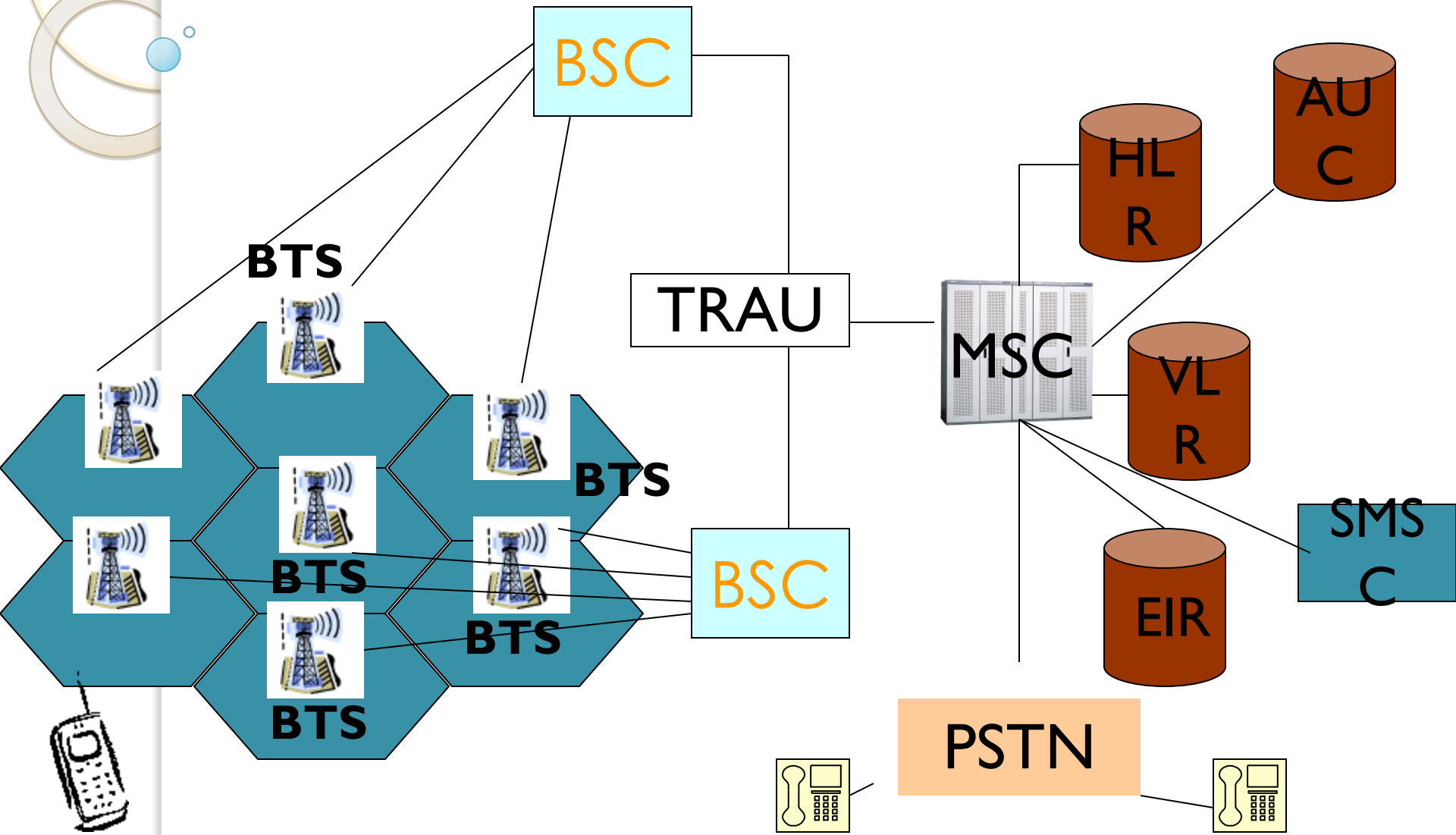
Omkar Pabbati

Academic Year 2019-2020

UNIT-IV

Wireless Systems

GSM Architecture

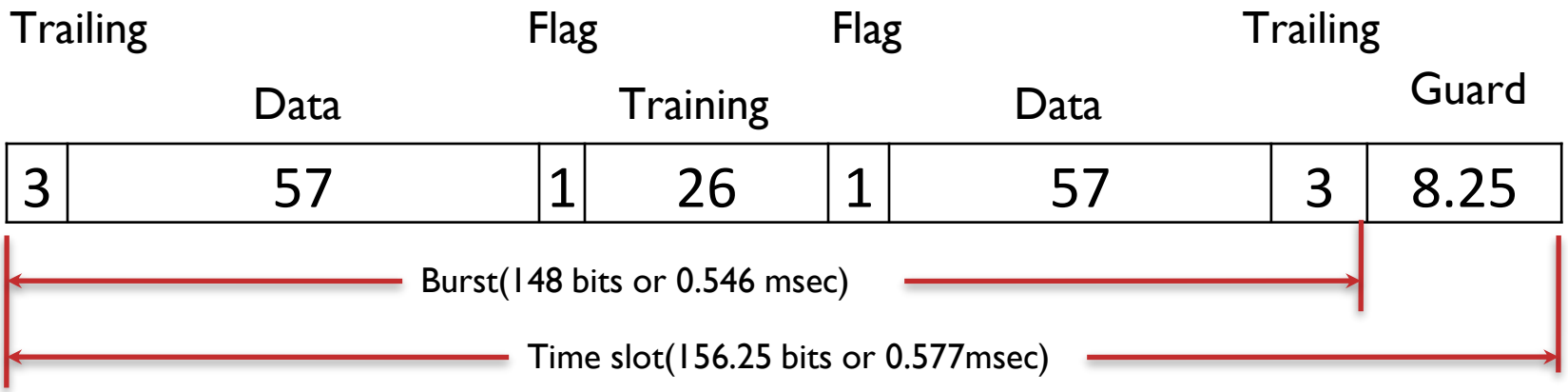


The characteristics of the initial GSM standard include the following:

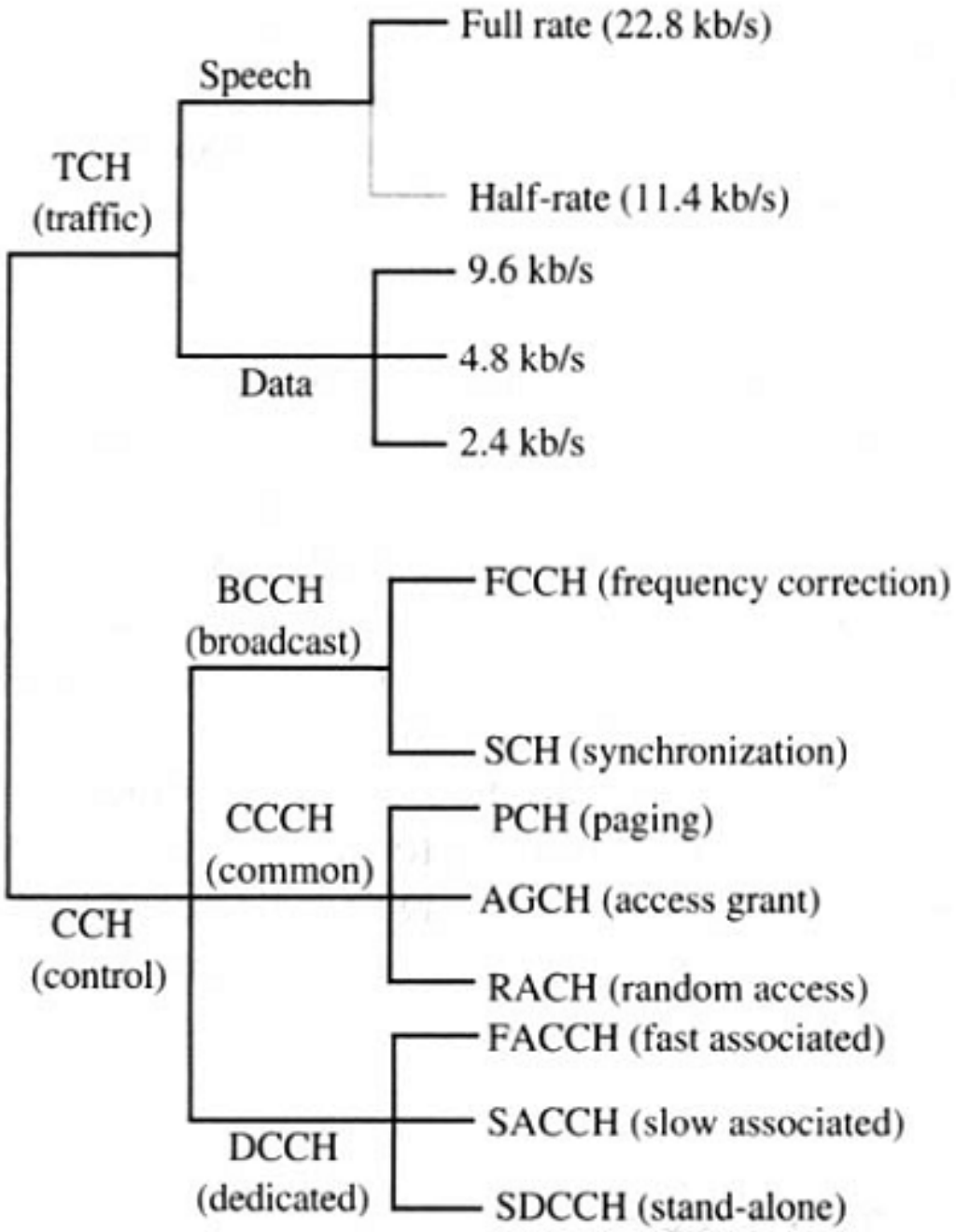
- fully digital system utilizing the 900 MHz frequency band
- TDMA over radio carriers (200 kHz carrier spacing)
- 8 full-rate or 16 half-rate TDMA channels per carrier
- user/terminal authentication for fraud control
- encryption of speech and data transmissions over the radio path
- full international roaming capability
- low speed data services (up to 9.6 kb/s)
- compatibility with ISDN for supplementary services
- support of short message service (SMS)

GSM radio interface

- To save MS power discontinuous transmission and reception is used in GSM.
- The time slot in the uplink are derived form the downlink by a delay of three time slots.
- Three time-slot delay cannot be accurately maintained if MS is far away from the BTS.
- Solution is to compute the *timing advanced value.*



GSM Burst structure


Full rate (22.8 kb/s)
Speech
TCH
(traffic)
Half-rate (11.4 kb/s)
9.6 kb/s
4.8 kb/s
Data
2.4 kb/s
BCCH
(broadcast)
FCCH (frequency correction)
SCH (synchronization)
CCCH
(common)
PCH (paging)
AGCH (access grant)
CCH
(control)
RACH (random access)
FACCH (fast associated)
SACCH (slow associated)
DCCH
(dedicated)
SDCCH (stand-alone)

Common control channels(CCCHs)

Paging channels (PCH)
Used by the network to page the destination MS in call termination

Access Grant Channel (AGCH)
Used by the network to indicate radio link allocation upon prime access of a MS.

Random Access Channel (RACH)
Used by the MSs for initial access to the network.

Dedicated control channels

Standalone Dedicated Control Channel (SDCCH)

- Used only for signaling and for short messages.

Slow Associated Control Channel (SACCH)

Used for non-urgent procedures mainly the transmission of power and time alignment control information over downlink, and measurement reports from the MS over the uplink.

Fast Associated Control Channel (FACCH)

Used for time critical signaling like call-establishing progress, authentication of subscriber, or handoff.
FACCH “steals” the bandwidth of TCH.

Cell Broadcast Channel (CBCH)

Carries only the short message service cell broadcast messages, which use the same time slot as the SDCCH. It is used on the downlink only.

Broadcast channels (BCHs)

Used by the BTS to broadcast information to the MSs in its coverage area.

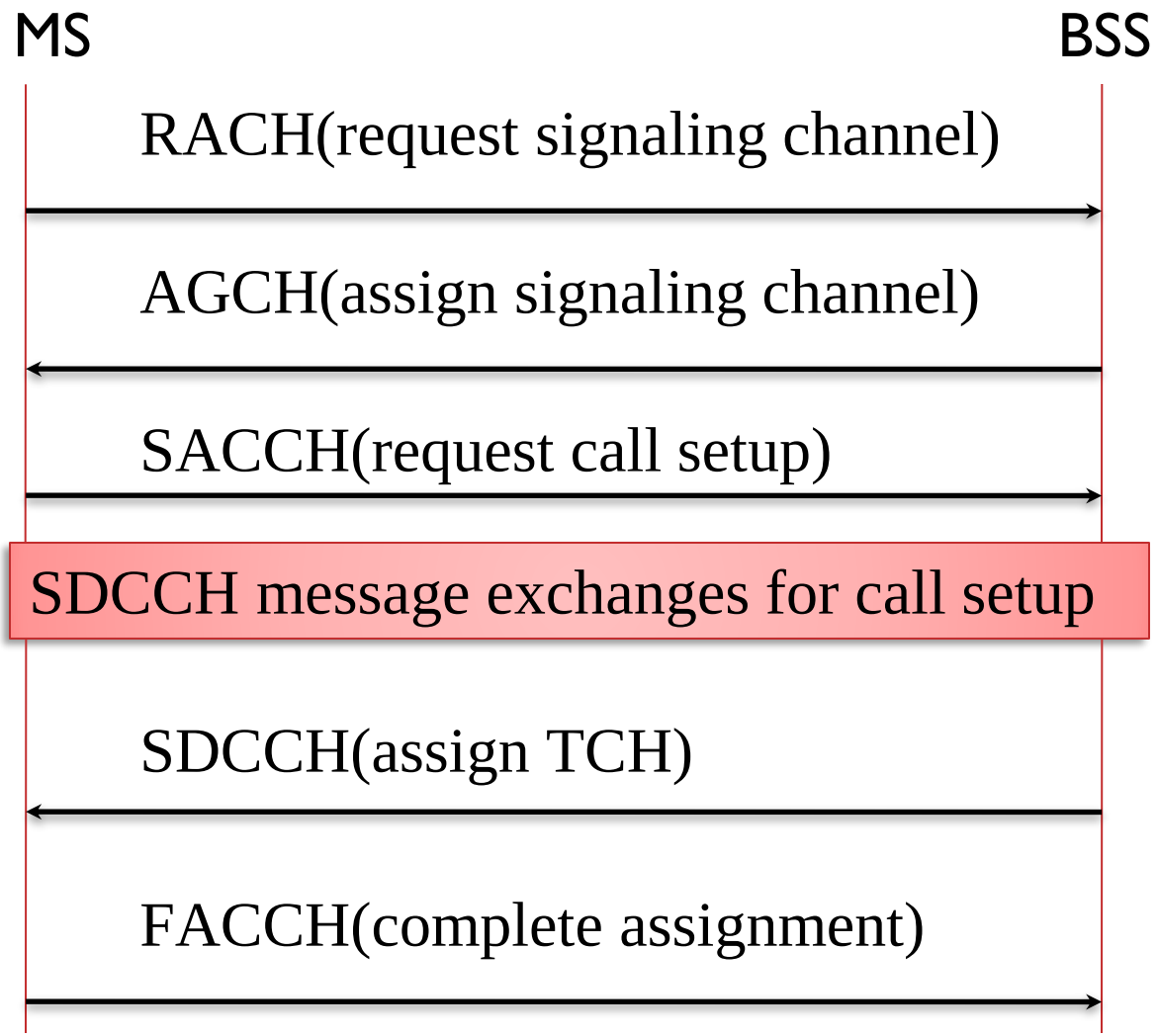
Frequency Correction Channel (FCCH)

Synchronization channel (SCH) carry information from the BSS to the MS. The information allows the MS to acquire and stay synchronized with the BSS.

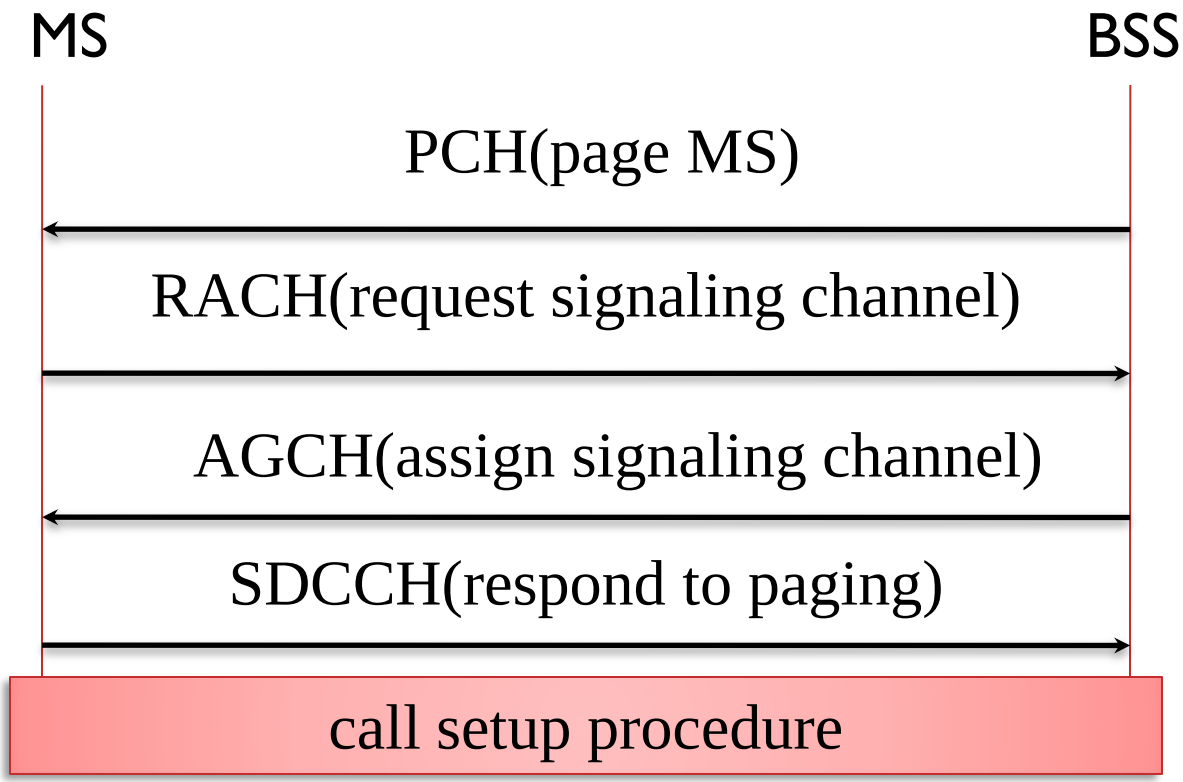
Broadcast Control Channel (BCCH)

Provides system information such as access information for the selected cell and information related to the surrounding cells to support cell selection and location registration procedures in a MS.

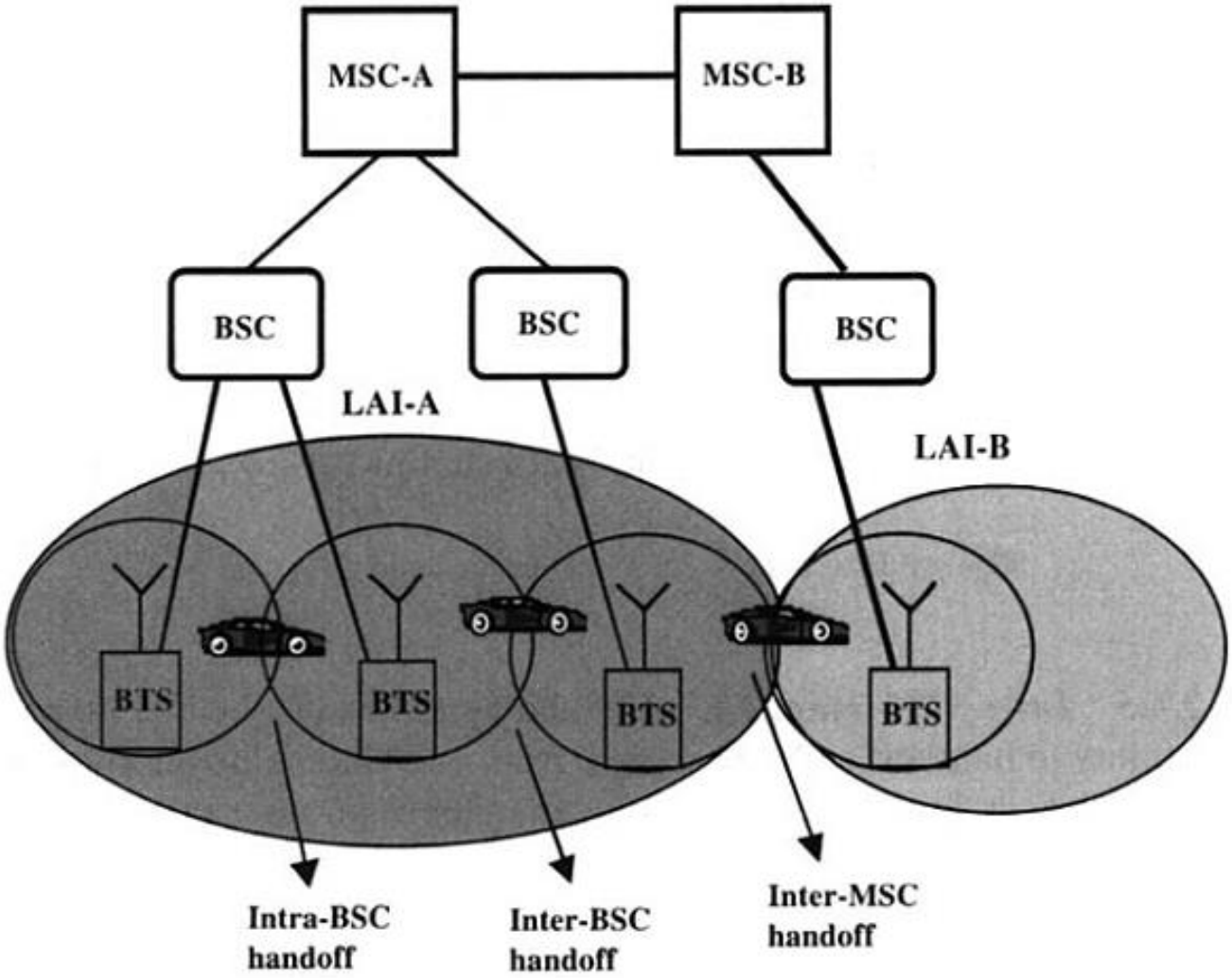
GSM call origination (radio aspect)



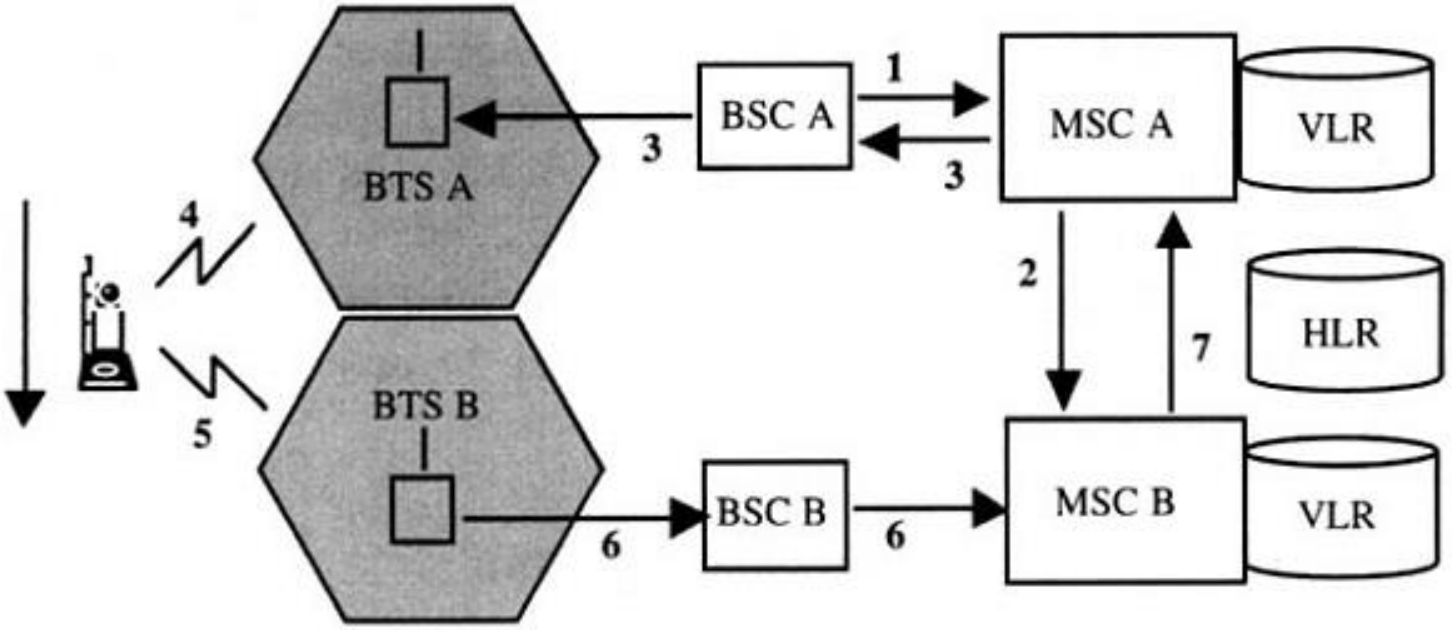
GSM call termination (radio aspect)



Types of Handoff

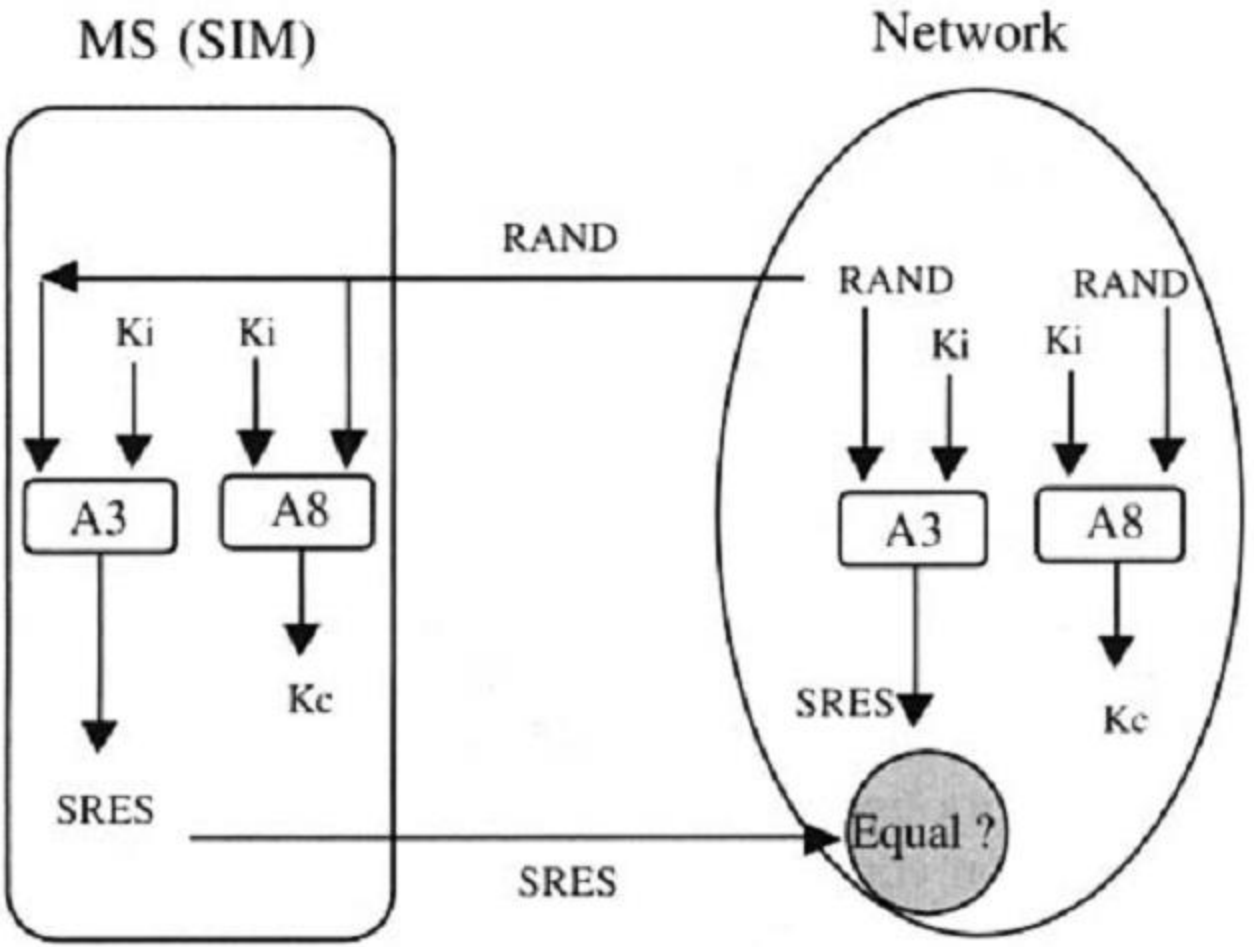


Handoff procedure

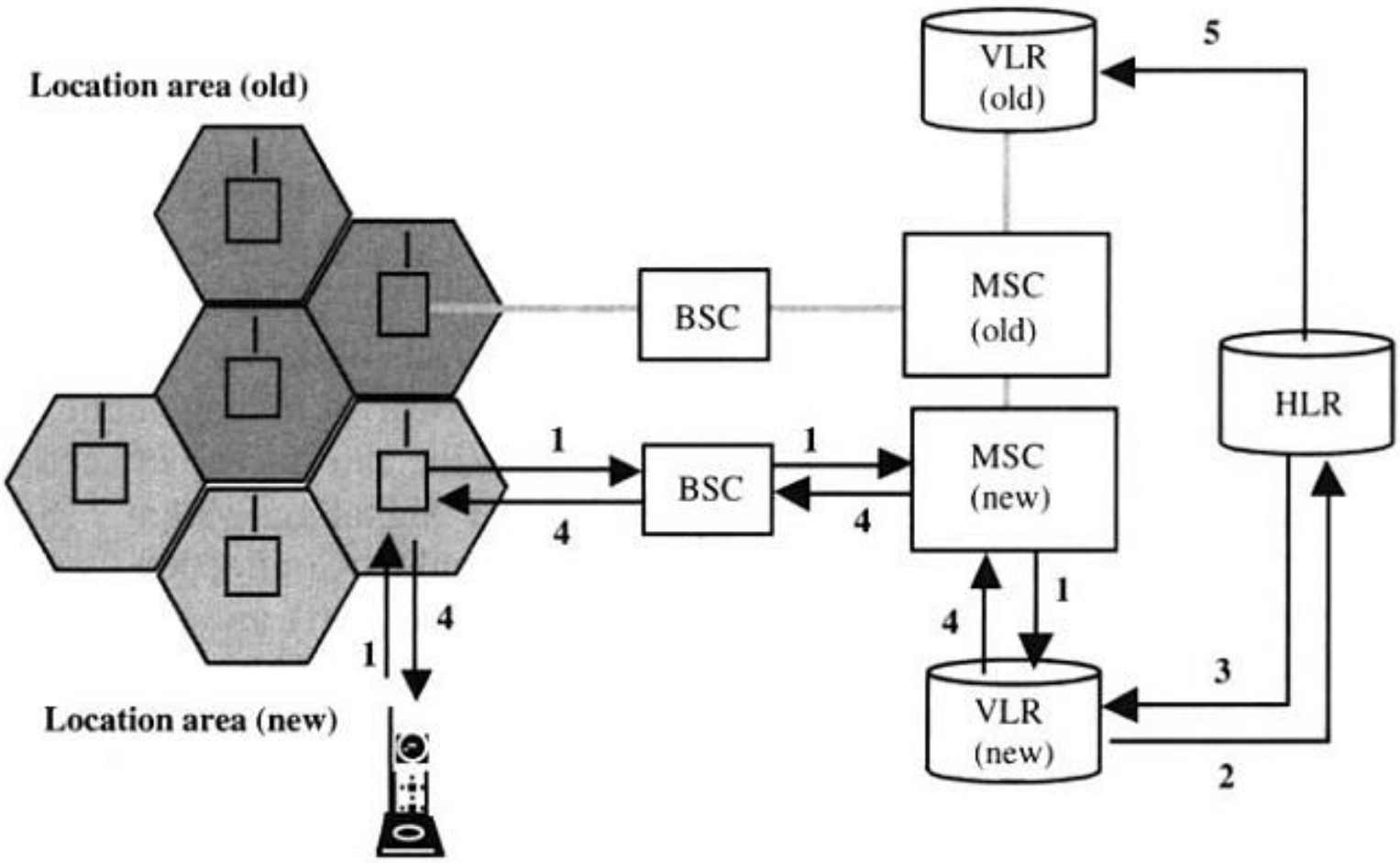


MS moves from cell A to cell B

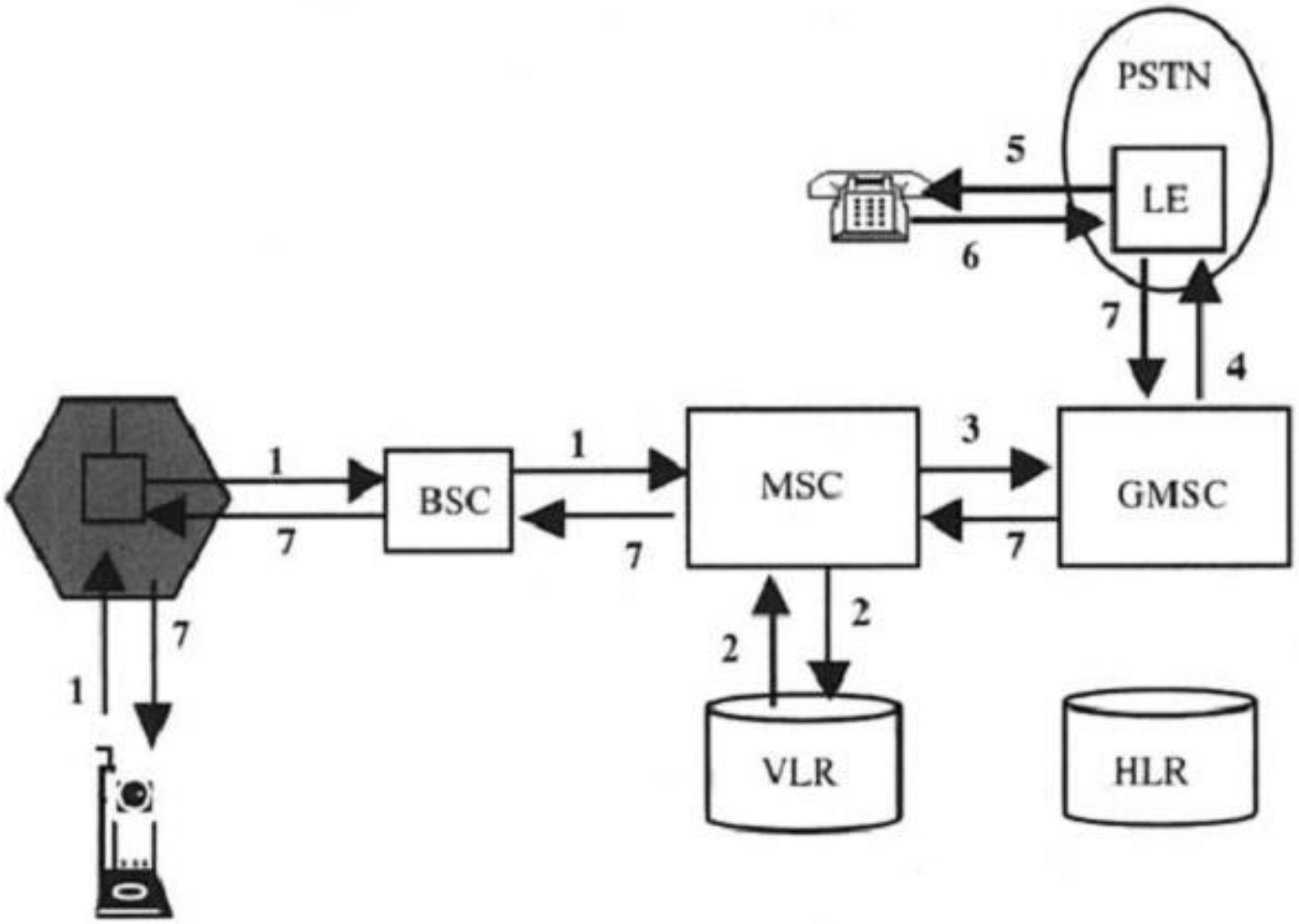
Authentication process in GSM network



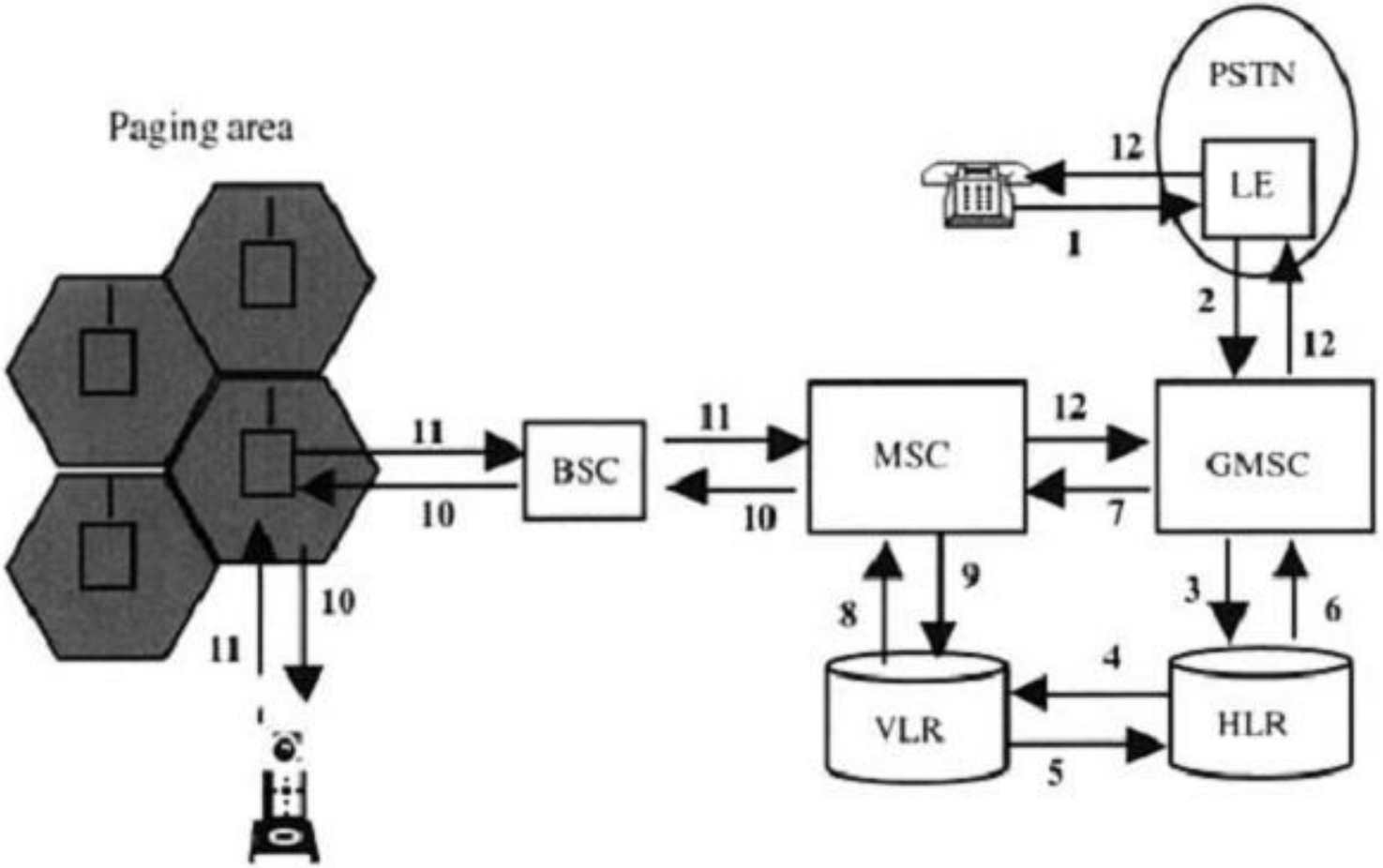
Location updating



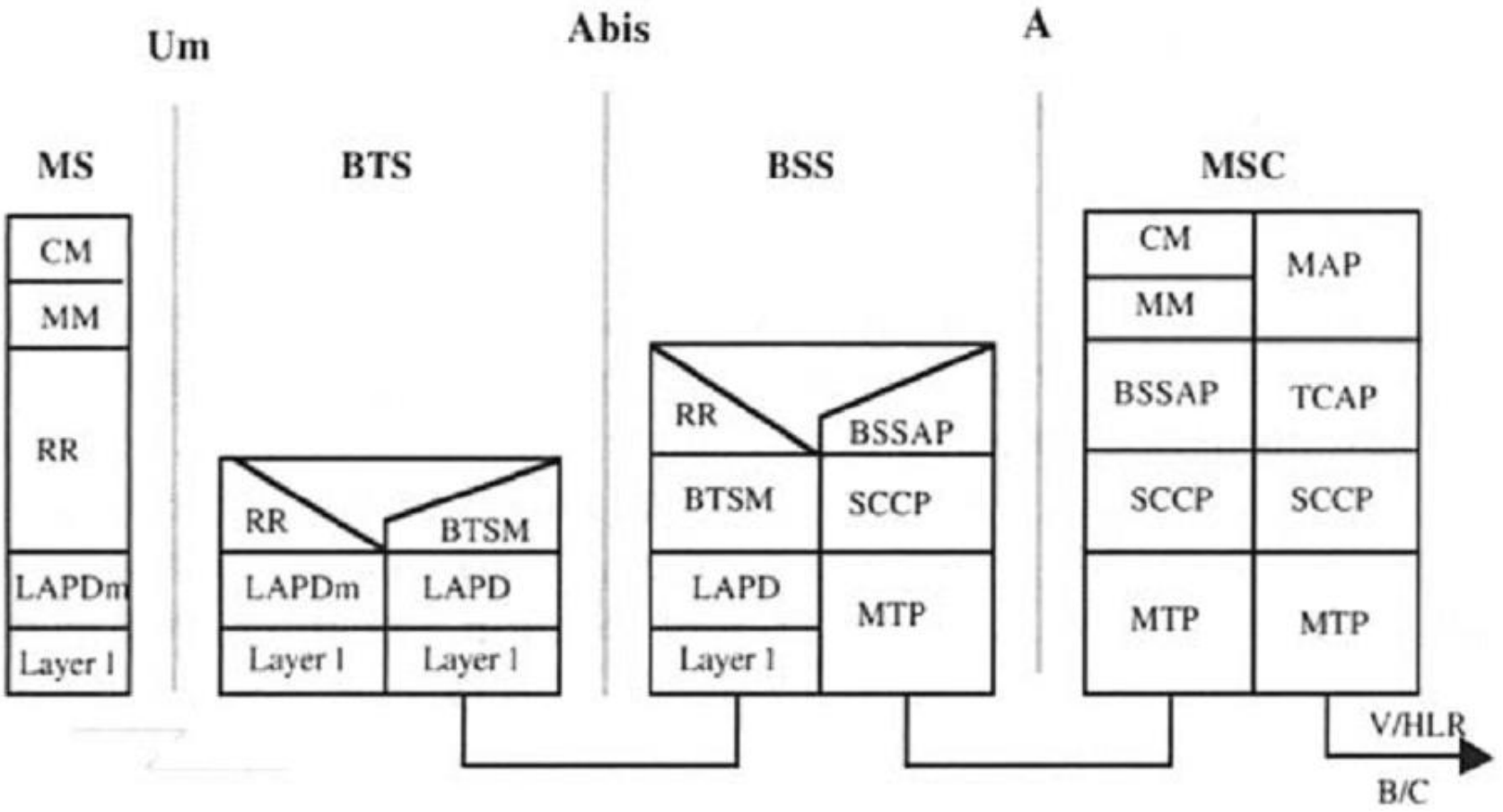
Call origination process



Call termination process

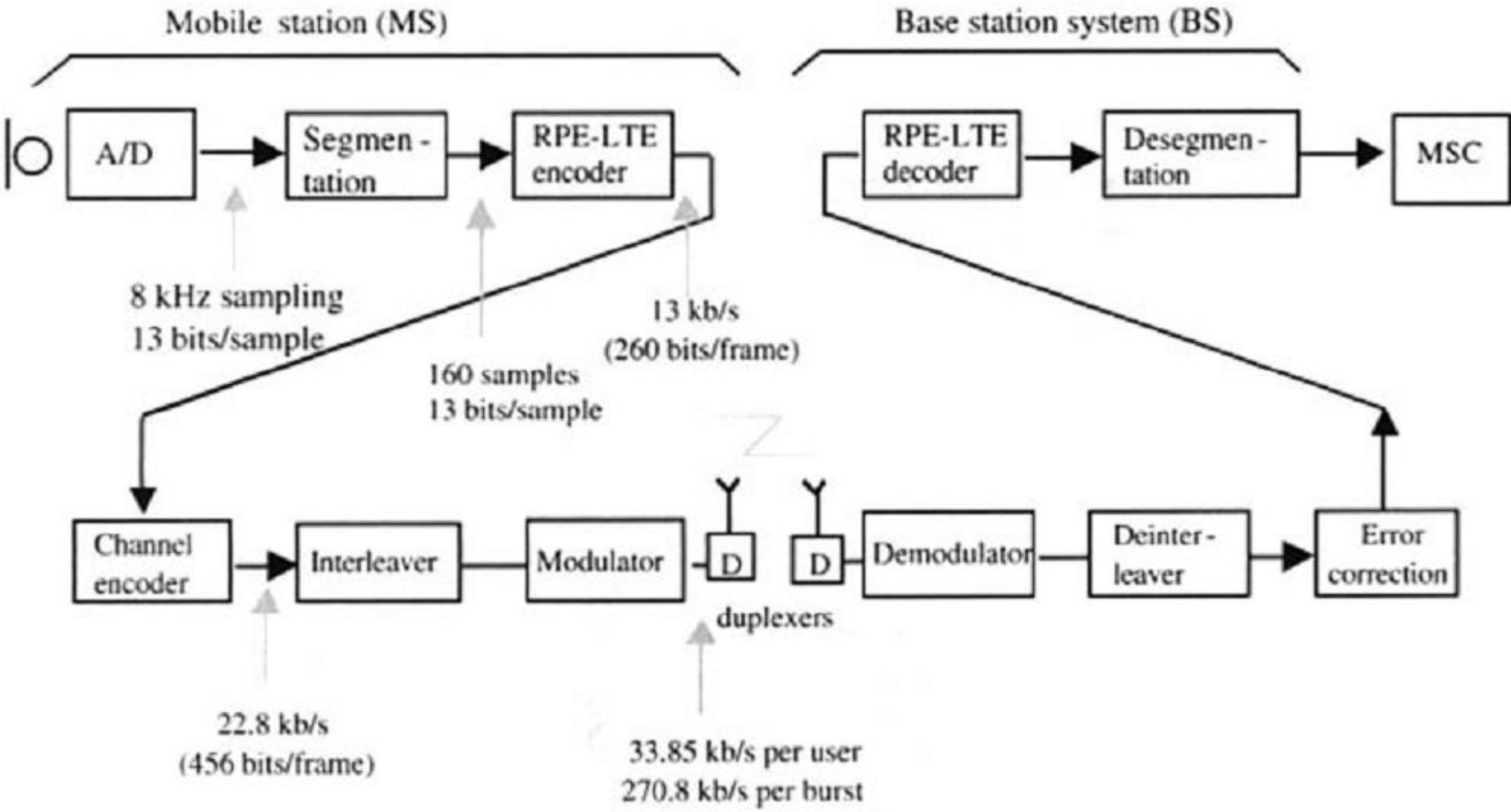


GSM Protocol Model

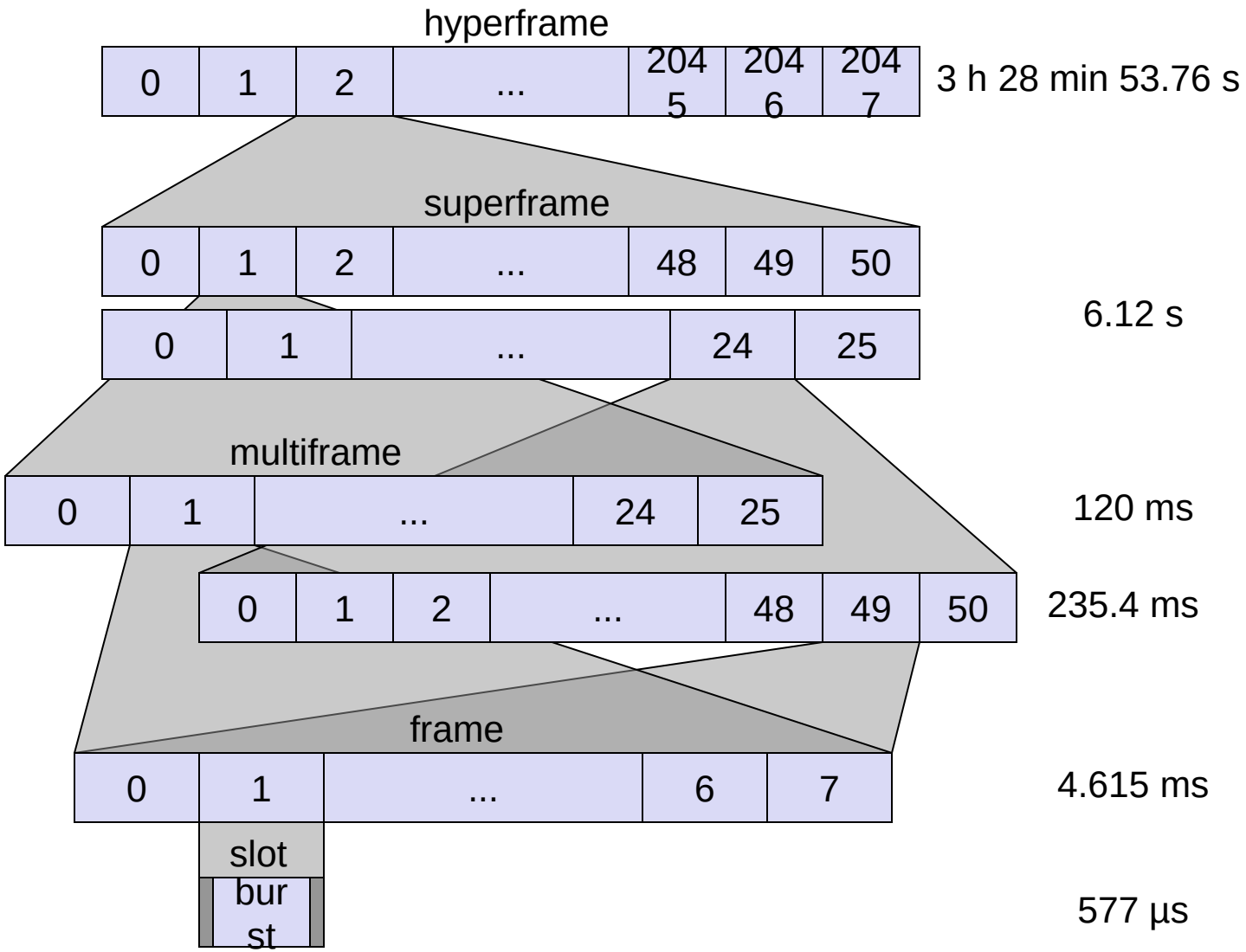


CM : Connection Management
MM : Mobility Management
RR : Resource Management
LAPD : Link Access Protocol for D channel
BTSM : BTS Management
SCCP : Signaling Connection Control Part
TCAP : Transaction Capability Application Part
MAP : Mobile Application Protocol
MTP : Message Transfer Part
BSSAP : BSS Application Protocol

GSM speech coding and modulation

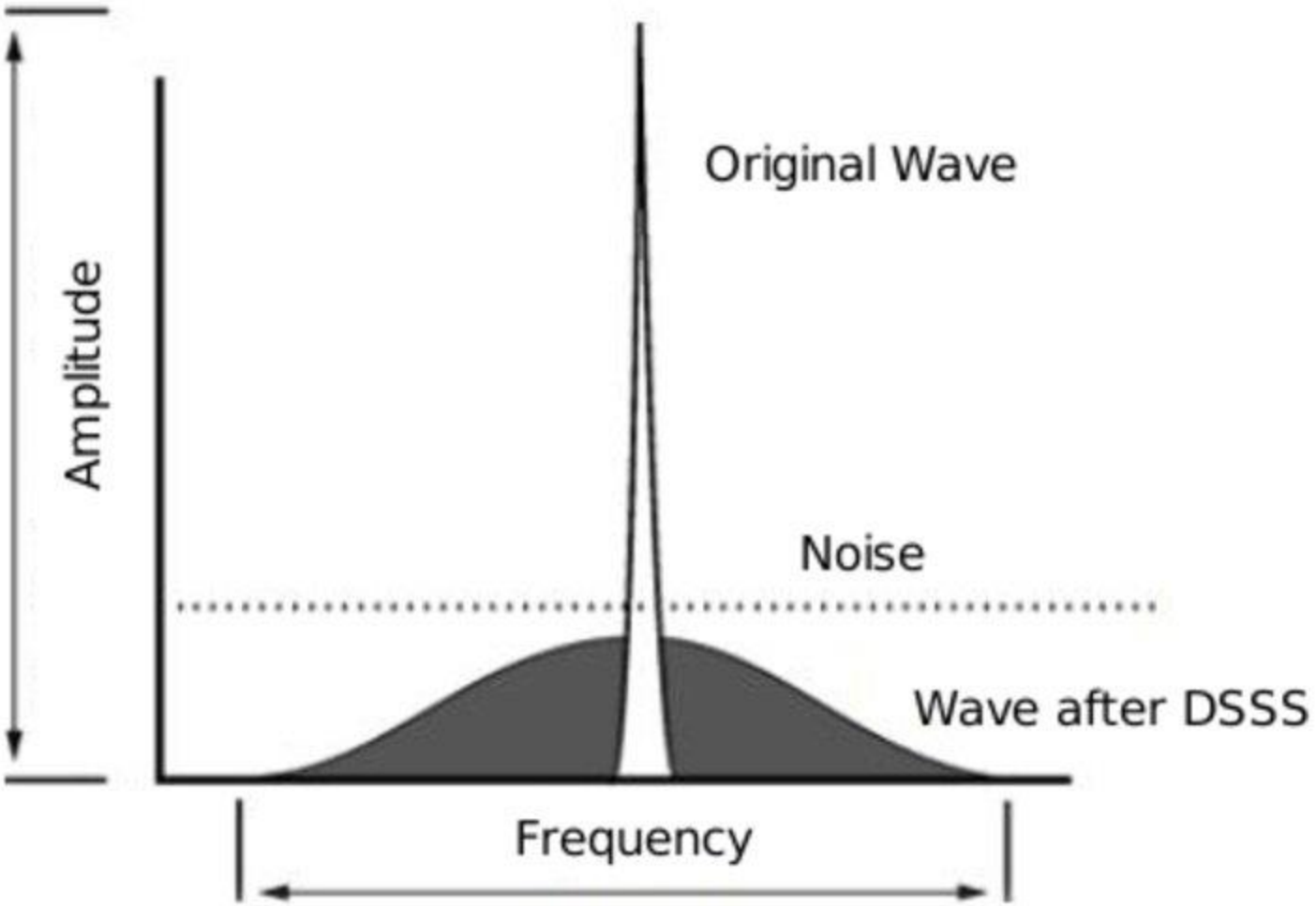


GSM hierarchy of frames



Concept of Spread Spectrum

- In these techniques, the set of normal payload data is modulated and trans-mitted using a special spreading code.
- All the PN-code-modulated signals from different users are then trans-mitted over the entire CDMA frequency channel
- At the receiving end, the desired signal is recovered by despreading the signal with an exact copy of the spreading code in the receiver correlator.
- Other signals (within the same frequency band) remain fully spread and are perceived as noise.
- No guard bands of any kind are necessary within the allocated block

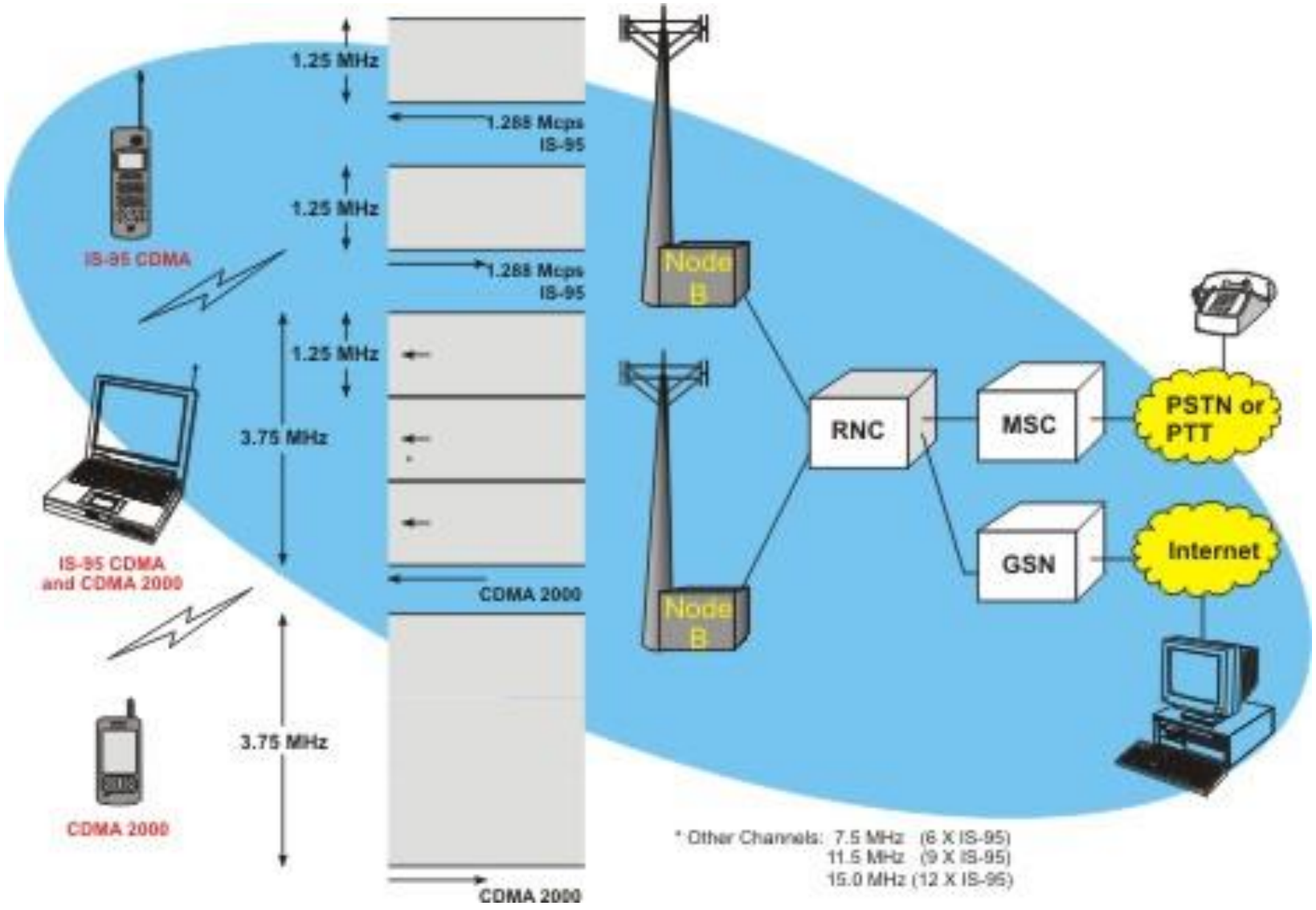

Amplitude
Original Wave
Noise
Wave after DSSS
Frequency

Channel types in IS-95 CDMA cellular systems

Channel Type	Application	Quantity	Maximum Rate (b/s)	Spreading Code
Forward				
Pilot	System monitoring	1	NA	Walsh code 0
Synchronization	Synchronization	0 or 1	1200	Walsh code 32
Paging	Signaling (BS-to-idle MS)	≤ 7	9600	Walsh codes 1–7
Traffic	Voice/data (BS-to-MS)	≤ 63	9600/14,400	Walsh codes 8–31 and 33–63
Reverse				
Access	Signaling (idle MS-to-BS)	≤ 14*	4800	Access channel long code mask
Traffic	Voice/data (MS-to-BS)	≤ 63	9600/14,400	Mobile-specific long code mask

* Generally 1 to 2 access channels per paging channel.

IS-95 Architecture

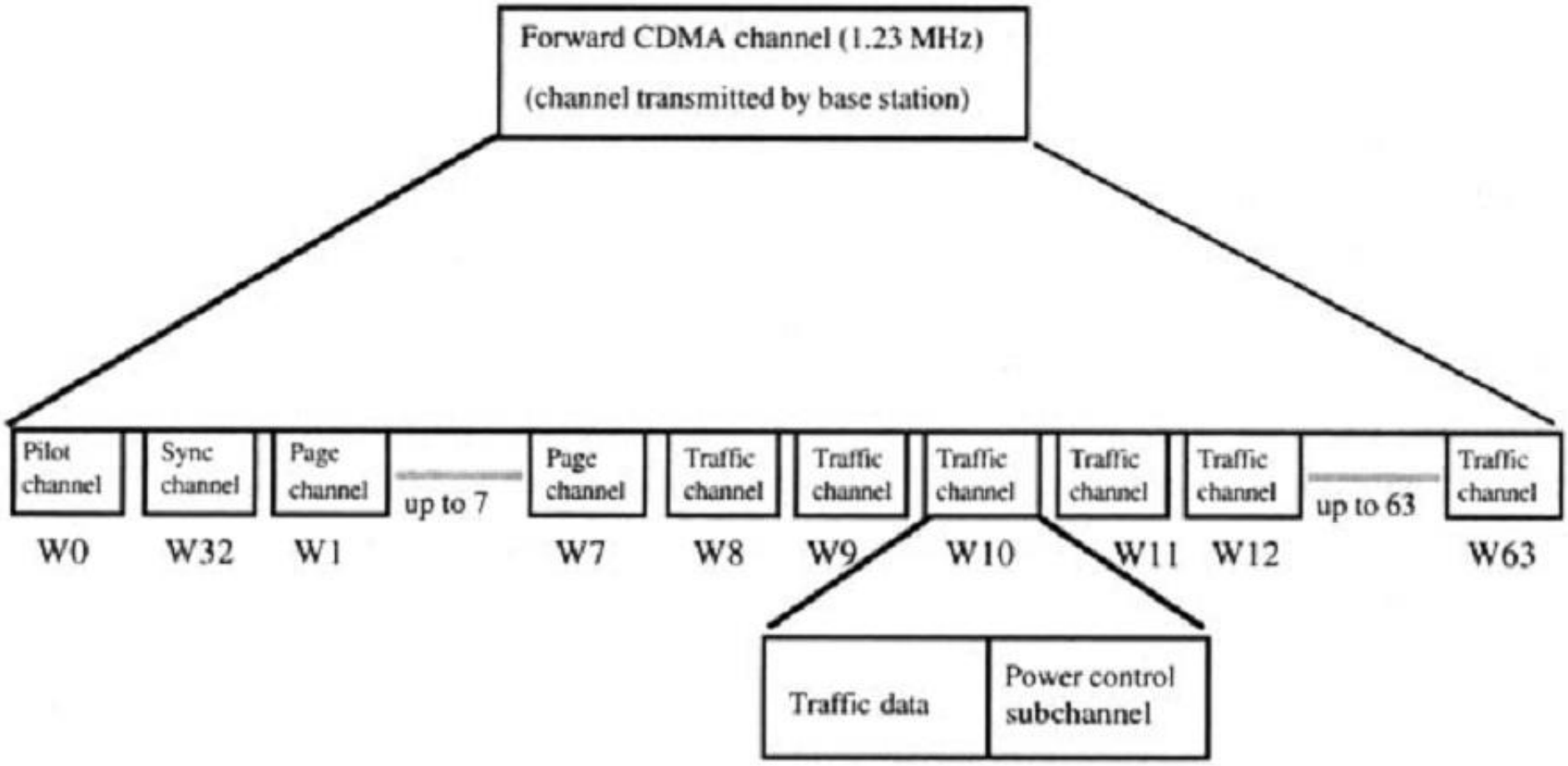


CDMA

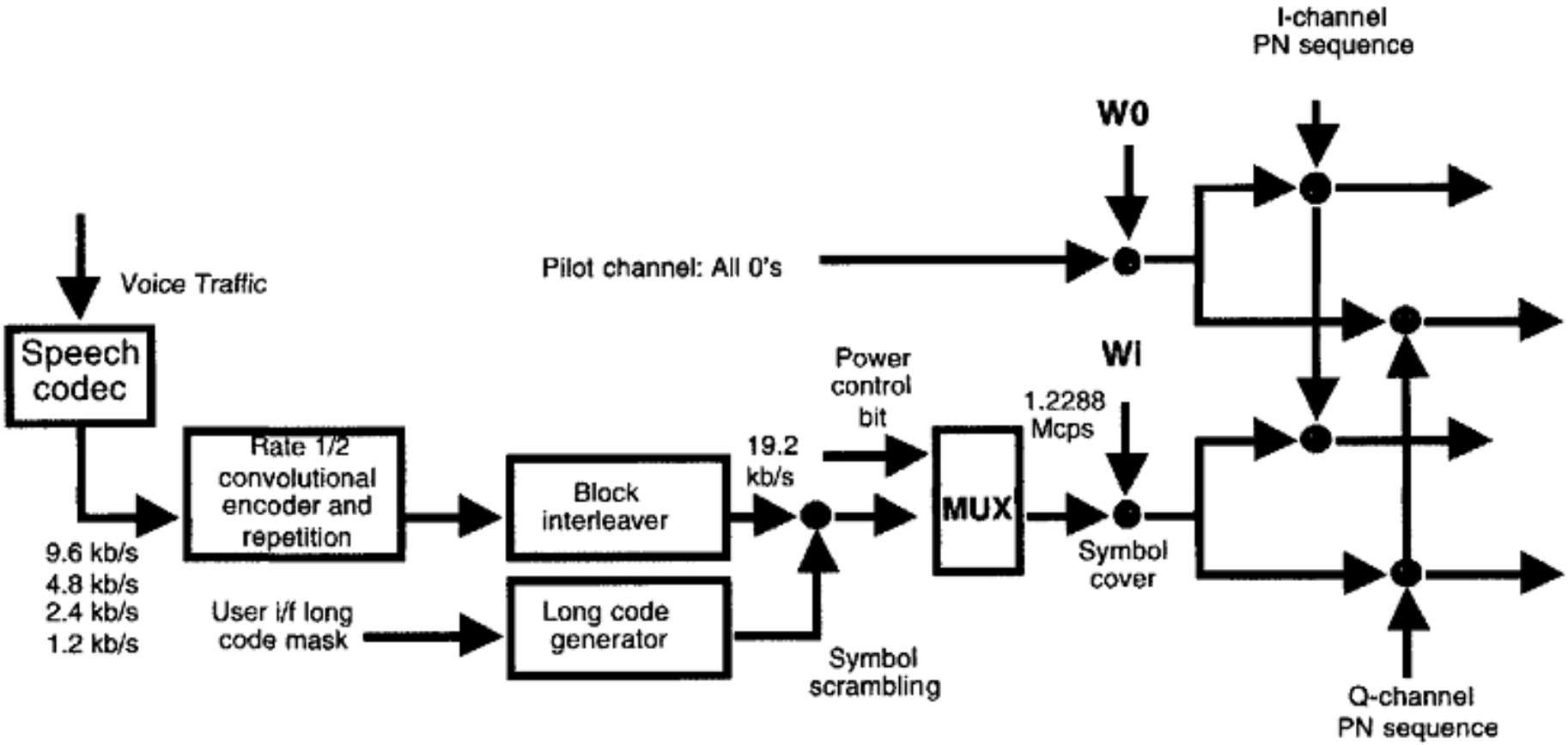
- In 1990 Qualcomm developed and demonstrated a CDMA-based digital cellular system that claimed a twentyfold increase in capacity over the analog system.
- The IS-95 standard for the CDMA common air interface was adopted in 1993, followed by an enhanced and revised version (IS-95A) in 1995.

Service Aspects

- Short message service (SMS)
- Slotted paging
- Over-the-air activation (OTA)
- Enhanced mobile station identities
- Temporary mobile station identities (TMSI)
- Asynchronous data and group 3 fax
- Synchronous data
- Packet data
- Supplementary services

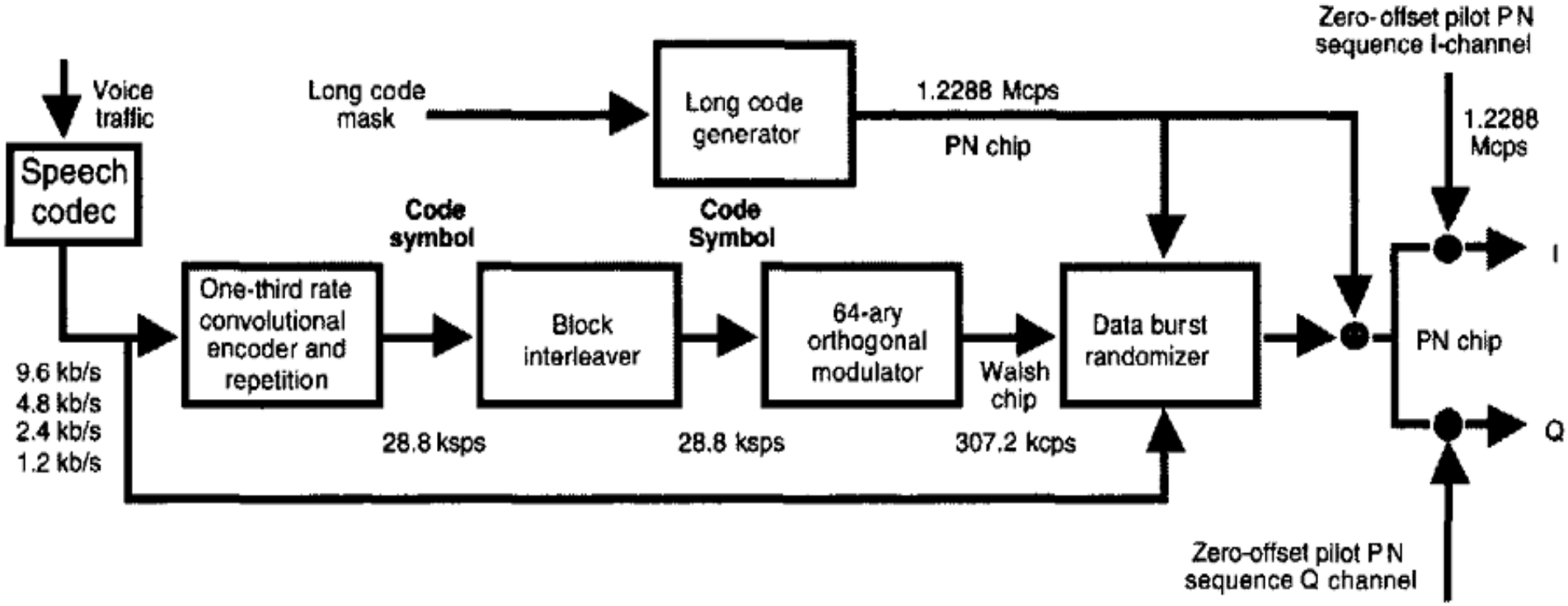


Structure of an IS-95 CDMA forward waveform.



Modulation process for IS-95 CDMA forward traffic channels.

*** Chip is the bit but not to confuse with message (data) bit we use the word Chip (Chips is the bits pattern)



Modulation process for IS-95 CDMA reverse traffic channels

Power Control

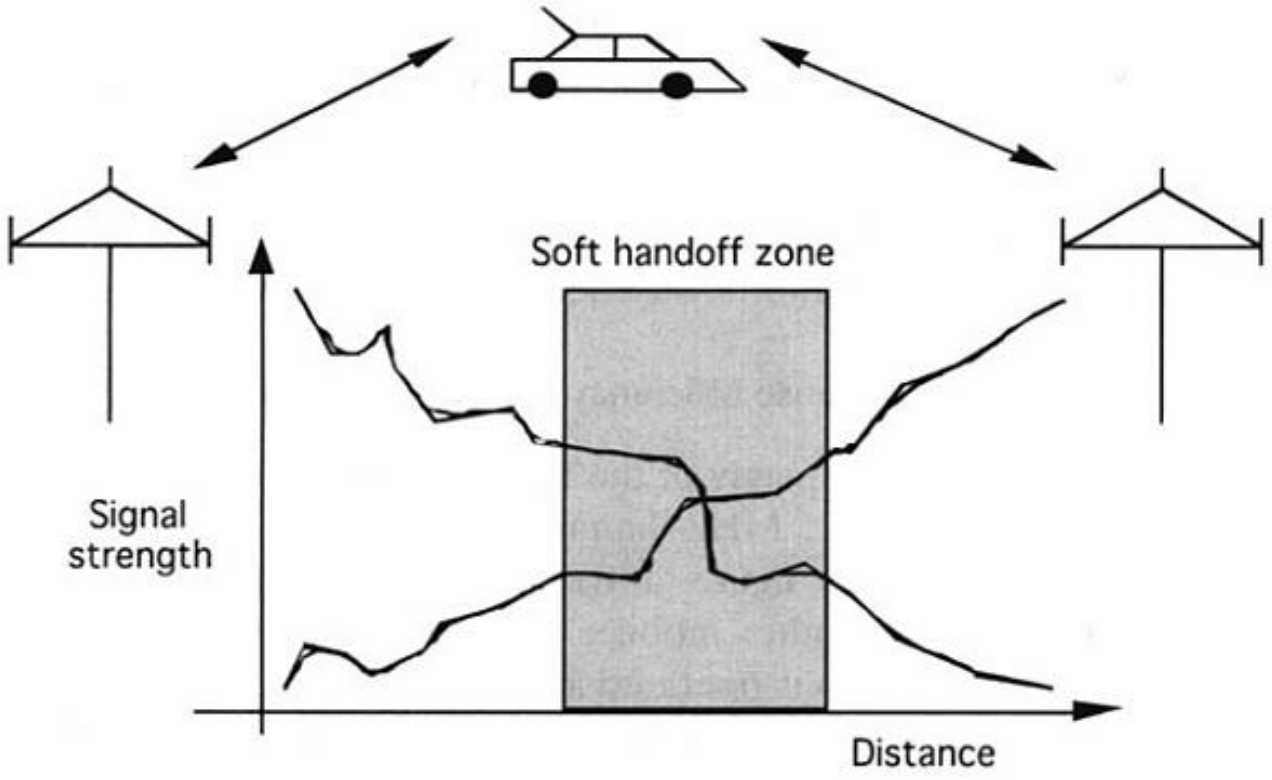
In a CDMA system, the mobile-to-base station link is subject to the so-called near-far problem

Power control requirements have two key components:

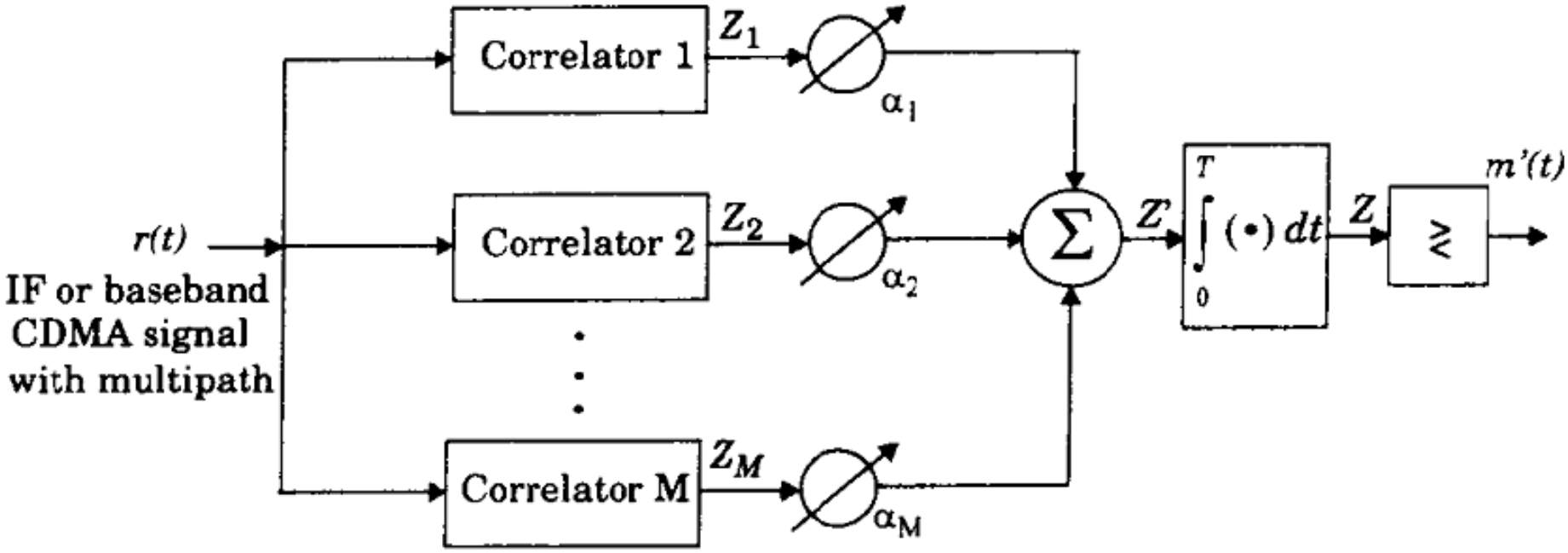
1. First, and most important, all the transmissions from the mobiles must be received at the base station's receiver at approximately the same strength (within 1 dB), even under conditions of fast multipath fading.
2. To maximize the number of users sharing a cell, only the minimum RF power required for reliable communication should be allowed from the base station transmitter.

Soft Handoff

Soft handoff in a CDMA system results from the system's capability to simultaneously deliver signals to a mobile through more than one cell.



RAKE Receiver



$$\alpha_m = \frac{Z_m^2}{\sum_{m=1}^{M} Z_m^2}$$

$$Z' = \sum_{m=1}^{M} \alpha_m Z_m$$

CDMA feature

- **Diversity**

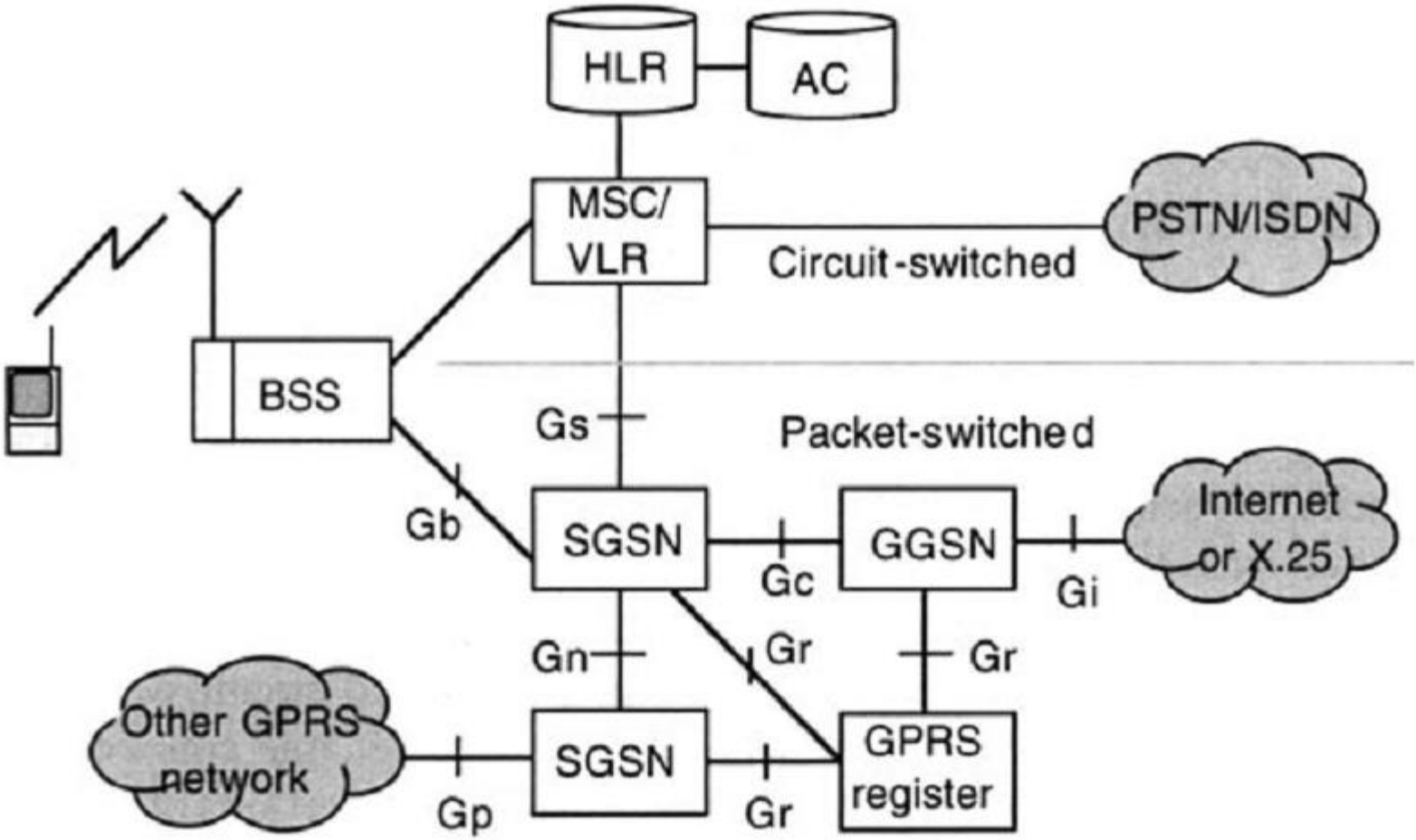
  Time, Frequency, Space

- **Power control**
- **Soft handoff**
- **System Capacity**

$$N_p = \frac{(W/R)vS}{(E_b/N_o)F}$$

- **Soft capacity**

GPRS network architecture



SGSN serving GPRS support node
GGSN gateway GPRS support node

Key service features of GPRS :

- Bandwidth on demand for point-to-point transmission
- Negotiated quality of service (QOS)
- Multicast and group call services
- Value-added services like broadcast information services
- Design for easy Internet access and Web browsing

Thank You…