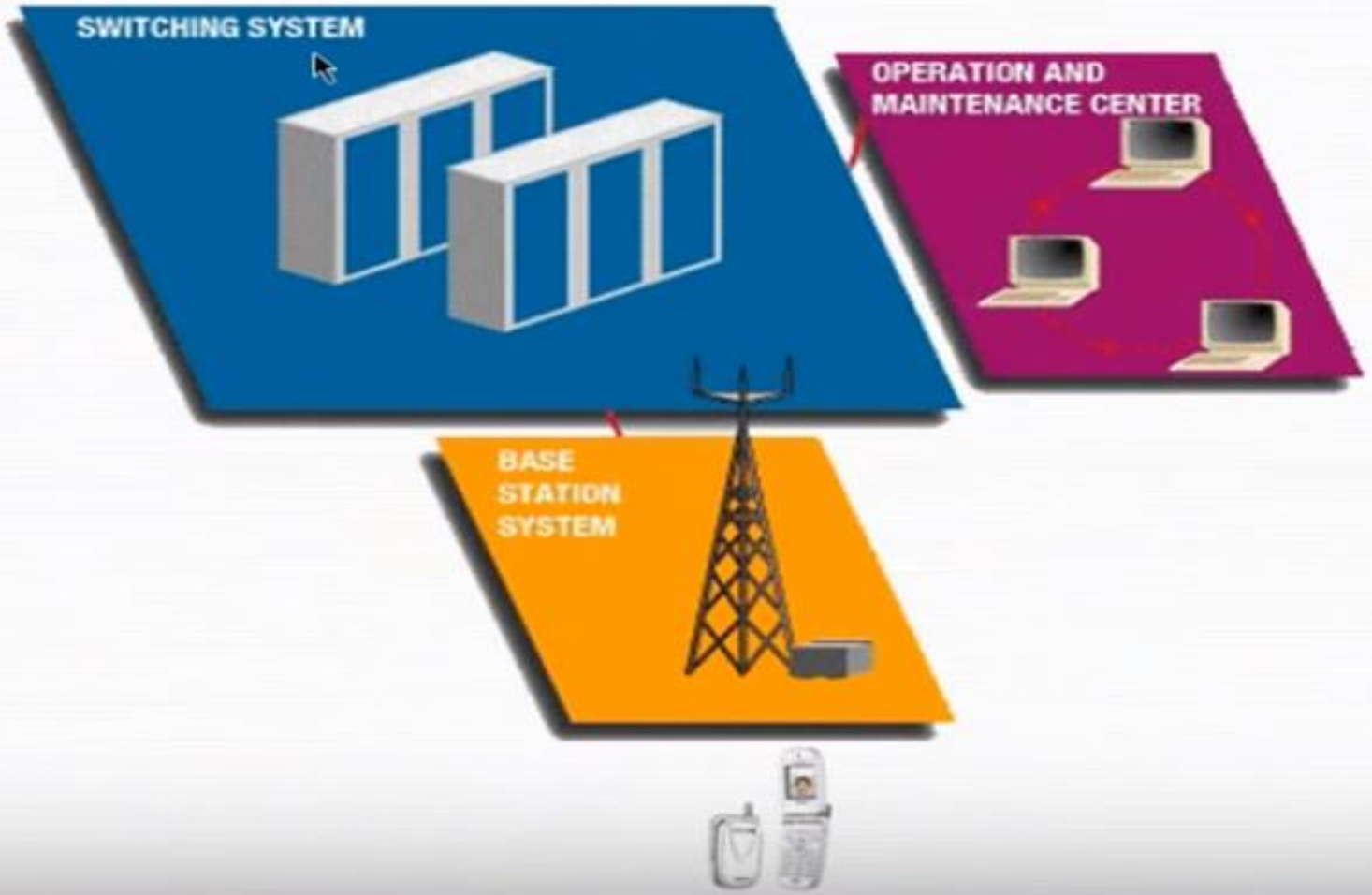
GSM
Global System for Mobile Communication

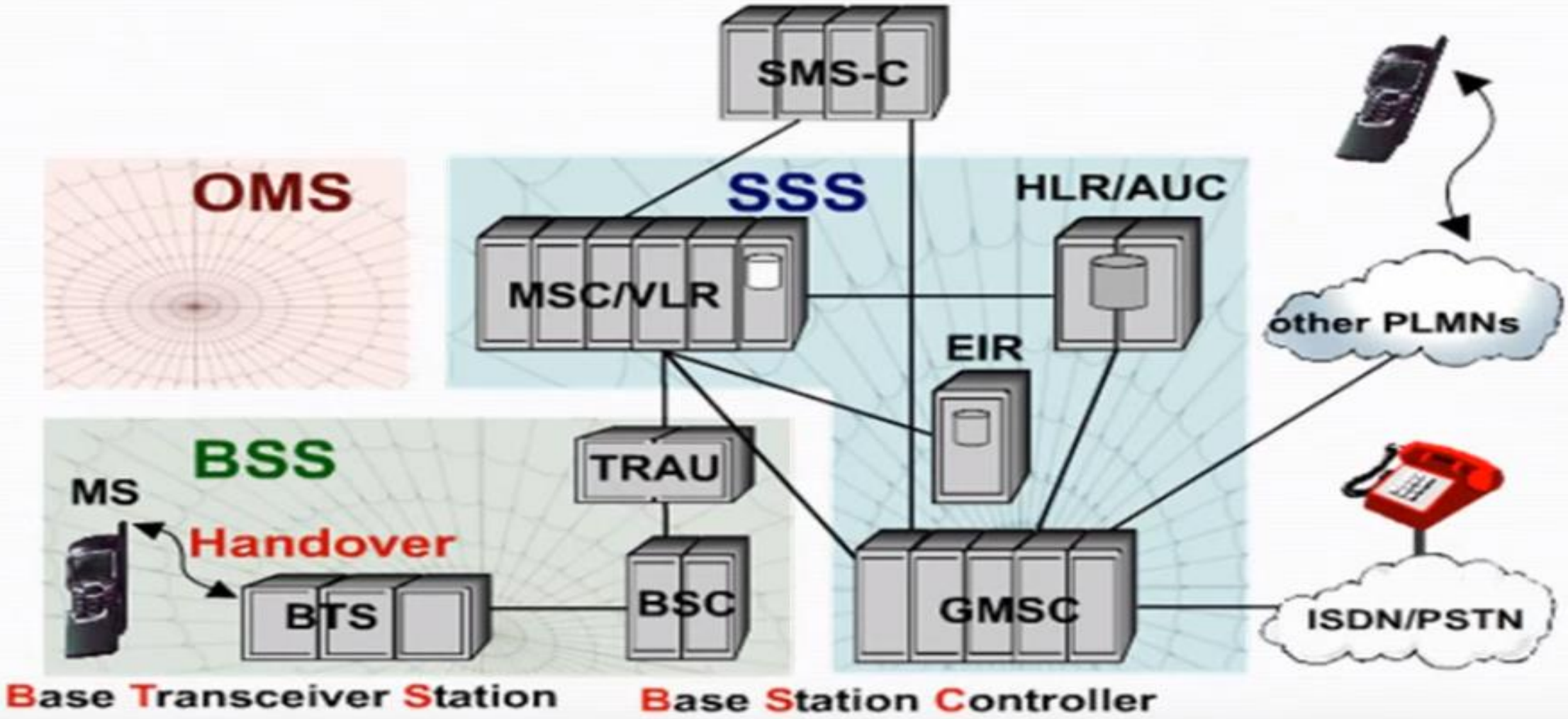
Hany El-Ghaish

GSM NETWORK ARCHITECTURE

- GSM NETWORK ARCHITECTURE



GSM NETWORK ARCHITECTURE



PLMN

RSS

MS

BSS → BSC

BTS

TRAU

OSS

SSS

MSC

GMSC

HLR

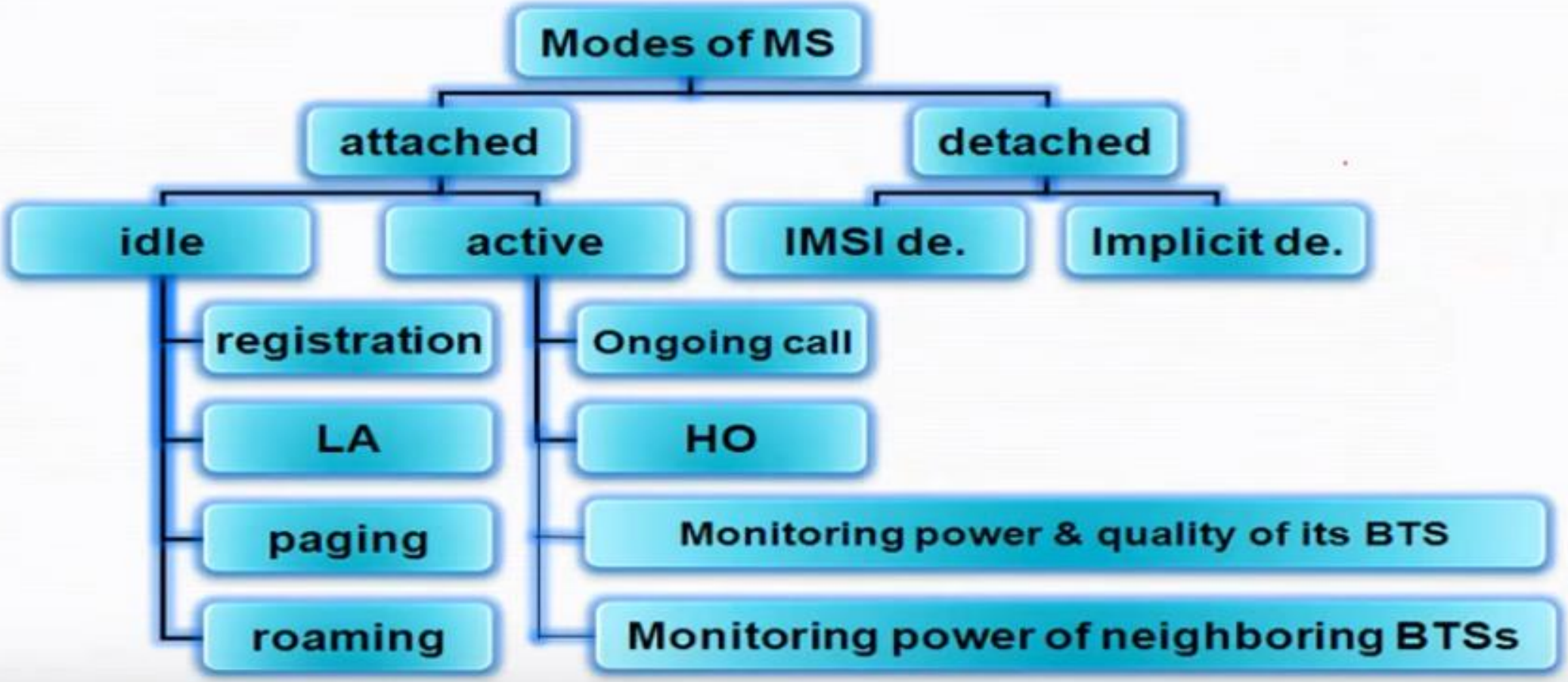
VLR

AUC

EIR

GSM NETWORK ARCHITECTURE

-The Mobile station (MS)



GSM NETWORK ARCHITECTURE

Types of MSs

Vehicle mounted MS

- Mounted to dashboard of vehicle.
- Antenna mounted on outside.
- More powerful.

Transportable MS

- Can be handheld.
- Antenna is not connected to handset.

Handheld MS

- Hand carried
- Antenna connected to handset.
- Pocket-sized.
- Can be vehicle mounted.

GSM NETWORK ARCHITECTURE

-The Mobile station (MS)

1- Mobile equipment (ME)

- it is the terminal used by user
- Can be purchased from any store
- Without SIM no calls can be made
- It has an International Mobile Equipment Identity (IMEI)

IDENTITY NUMBERS

The IMEI:

- Is a 15-digit number
- Verifies that the mobile station is type-approved and not stolen

GSM NETWORK ARCHITECTURE

2- Subscriber identity module (SIM) .

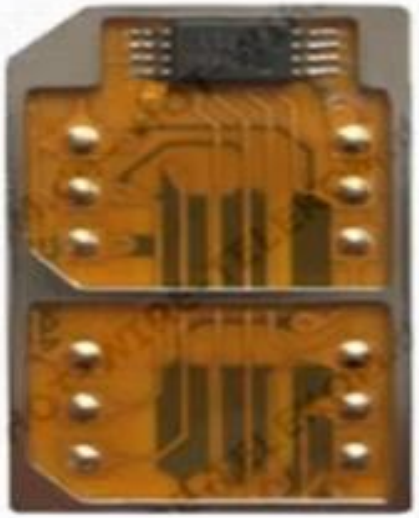
An electronic microchip for storing information

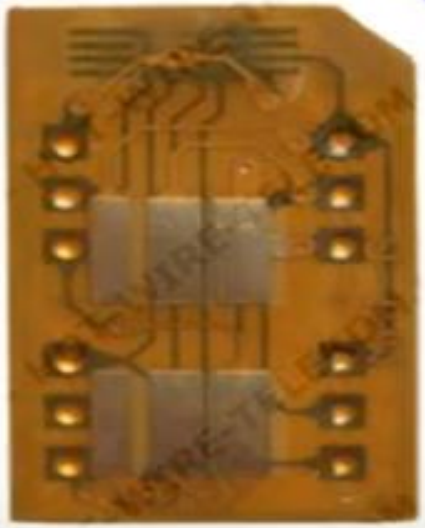
Information stored on SIM includes:

- Subscriber identification
- Charging
- Security

GSM NETWORK ARCHITECTURE

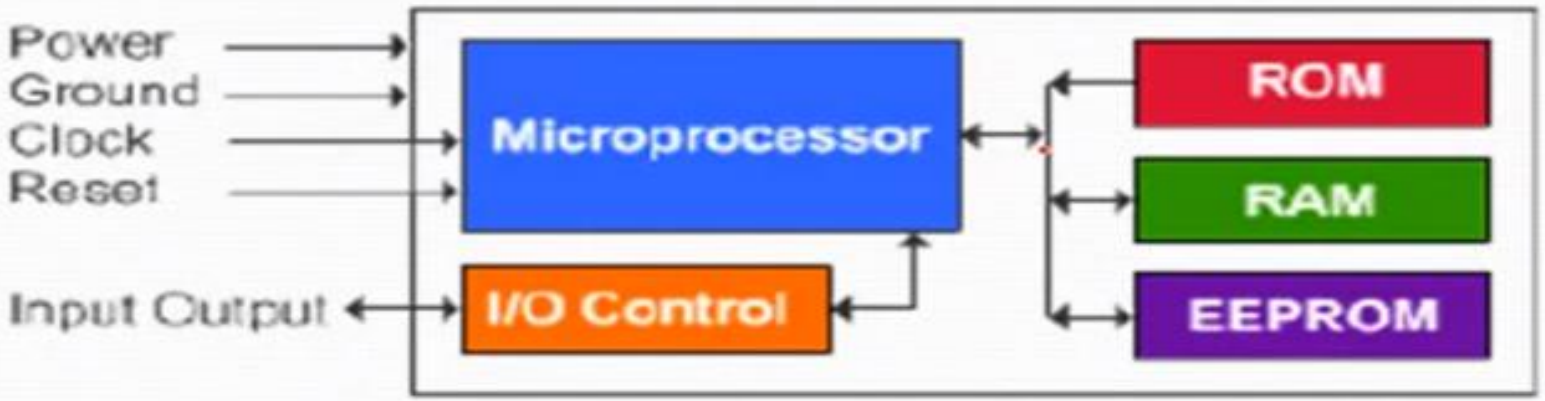
2- Subscriber identity module (SIM)





GSM NETWORK ARCHITECTURE

2- Subscriber identity module (SIM)



- CPU: Central Processing Unit - Microprocessor
- ROM: Read Only Memory (Non Volatile)
- EEPROM: Electrically Erasable Programmable RO Memory (Non Volatile)
- RAM: Random Access Memory (Volatile)

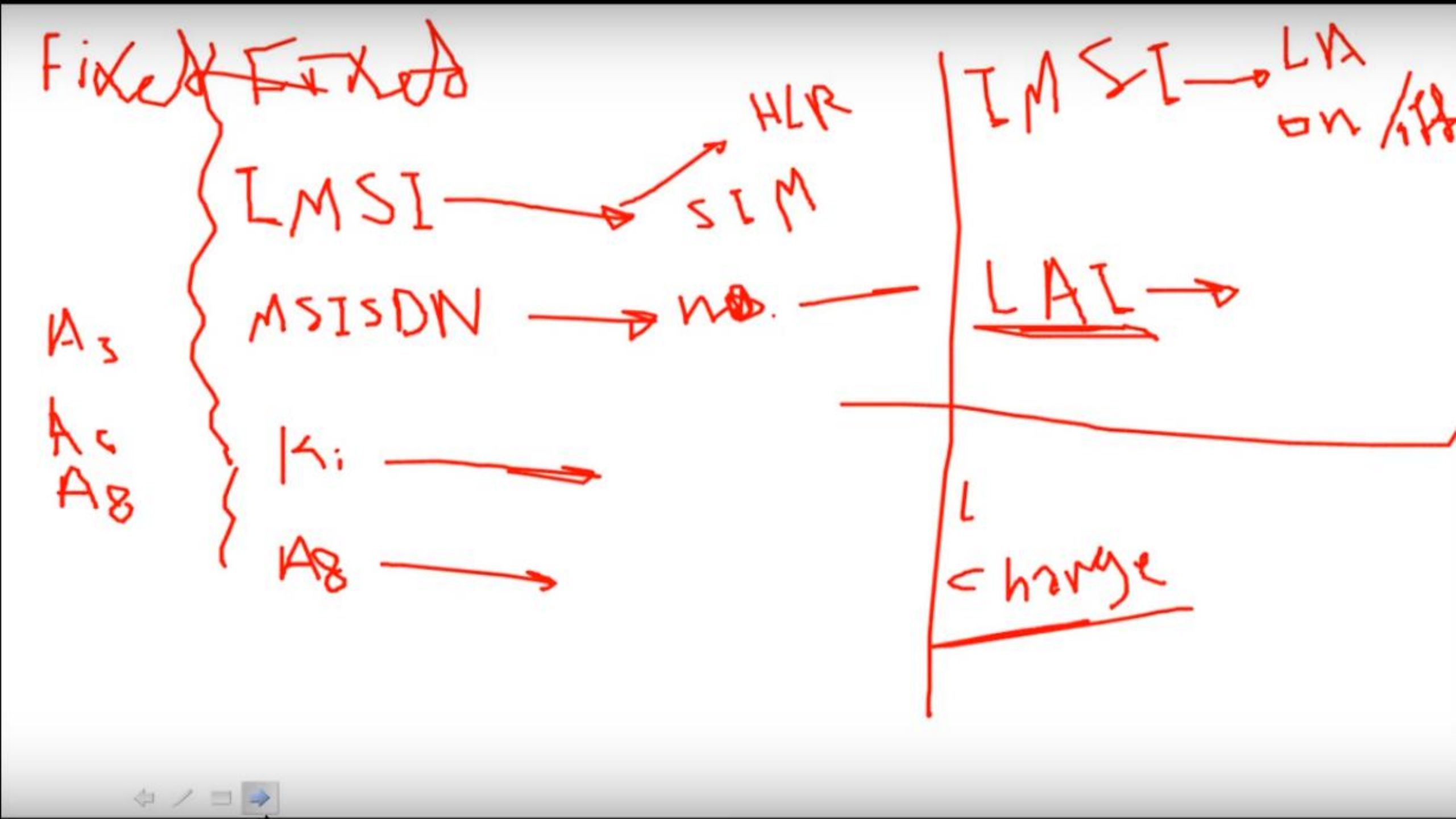
IDENTITY NUMBERS

Mobile Station ISDN

International Mobile Subscriber Identity

Mobile Station Roaming Number

Temporary Mobile Subscriber Identity Number


Fixed
HLR
IMSI
SIM
MSISDN
A3
Ki
A8
IMSI → LA
LAI →
change

IDENTITY NUMBERS

The MSISDN:

- Is the number dialed to reach a mobile station
- Has a maximum of 15 digits

SWEDEN: [ ] - 46 - 705 - 123456

International Prefix	CC Country Code	NDC National Destination Code	SN (7 digits in North America) Subscriber Number

IDENTITY NUMBERS

MSISDN	Mobile Station ISDN
IMSI	International Mobile Subscriber Identity
MSRN	Mobile Station Roaming Number
TMSI	Temporary Mobile Subscriber Identity Number

IDENTITY NUMBERS

The MSISDN:

- Is the number dialed to reach a mobile station
- Has a maximum of 15 digits

SWEDEN: [ ] - 46 - 705 - 123456

International Prefix	CC Country Code	NDC National Destination Code	SN (7 digits in North America) Subscriber Number

IDENTITY NUMBERS

The IMSI is the non-dialable number for identifying a subscriber in the GSM network. The IMSI is stored on the SIM card.

AUSTRALIA: 505 - 01 - 0987654321

505	01	0987654321
MCC Mobile Country Code	MNC Mobile Network Code	MSIN Mobile Subscriber Identity Number

IDENTITY NUMBERS

The MSRN is used to route a call to the serving MSC/VLR service area of the called subscriber.

FRANCE: [ ] - 33 - 007 - 987654

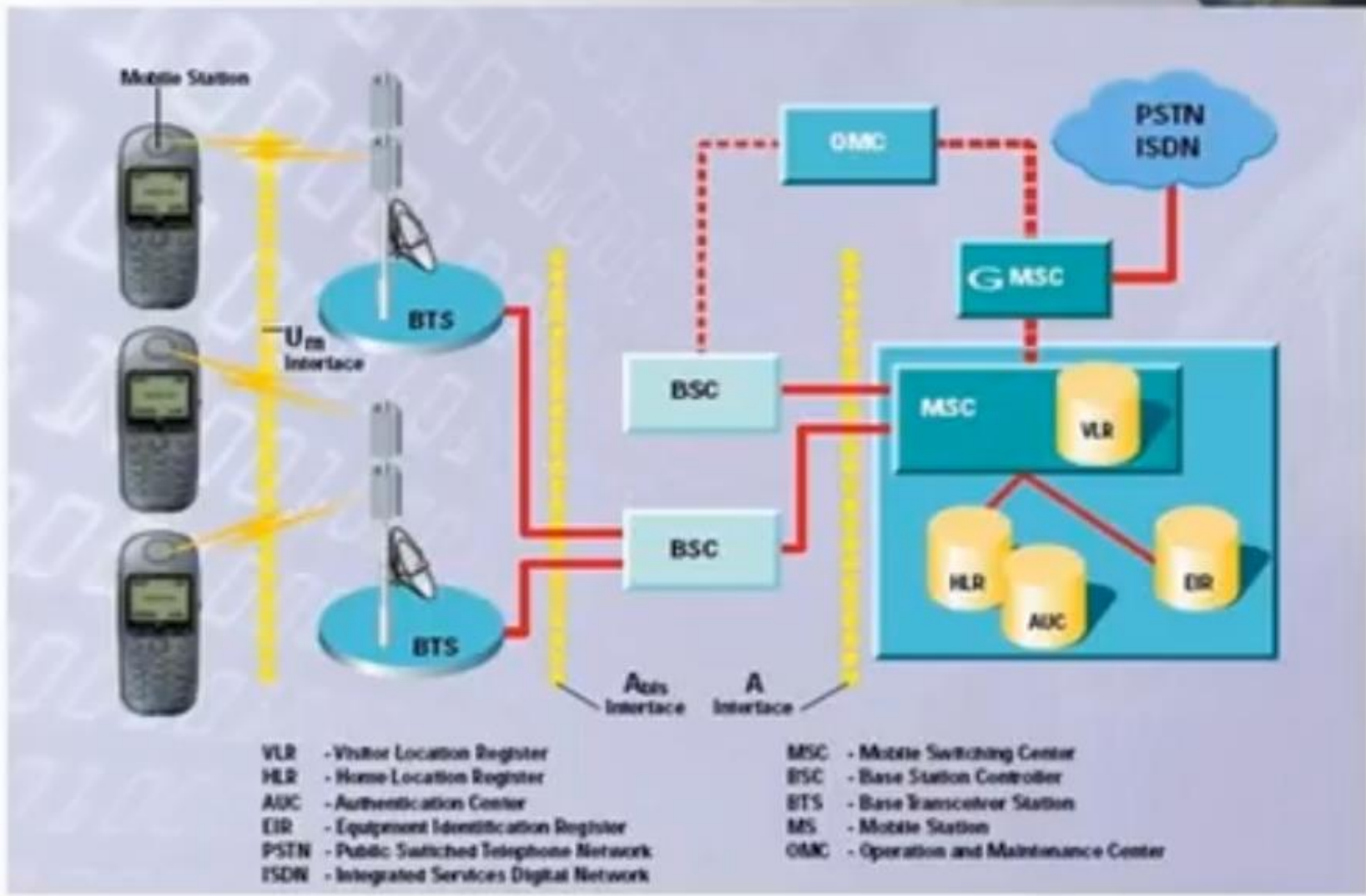
International Prefix	CC Country Code	NDC National Destination Code	SN Subscriber Number

IDENTITY NUMBERS

A TMSI:

- Used instead of the IMSI within an MSC/VLR service area
- Keeps the subscriber's IMSI confidential

GSM NETWORK ARCHITECTURE

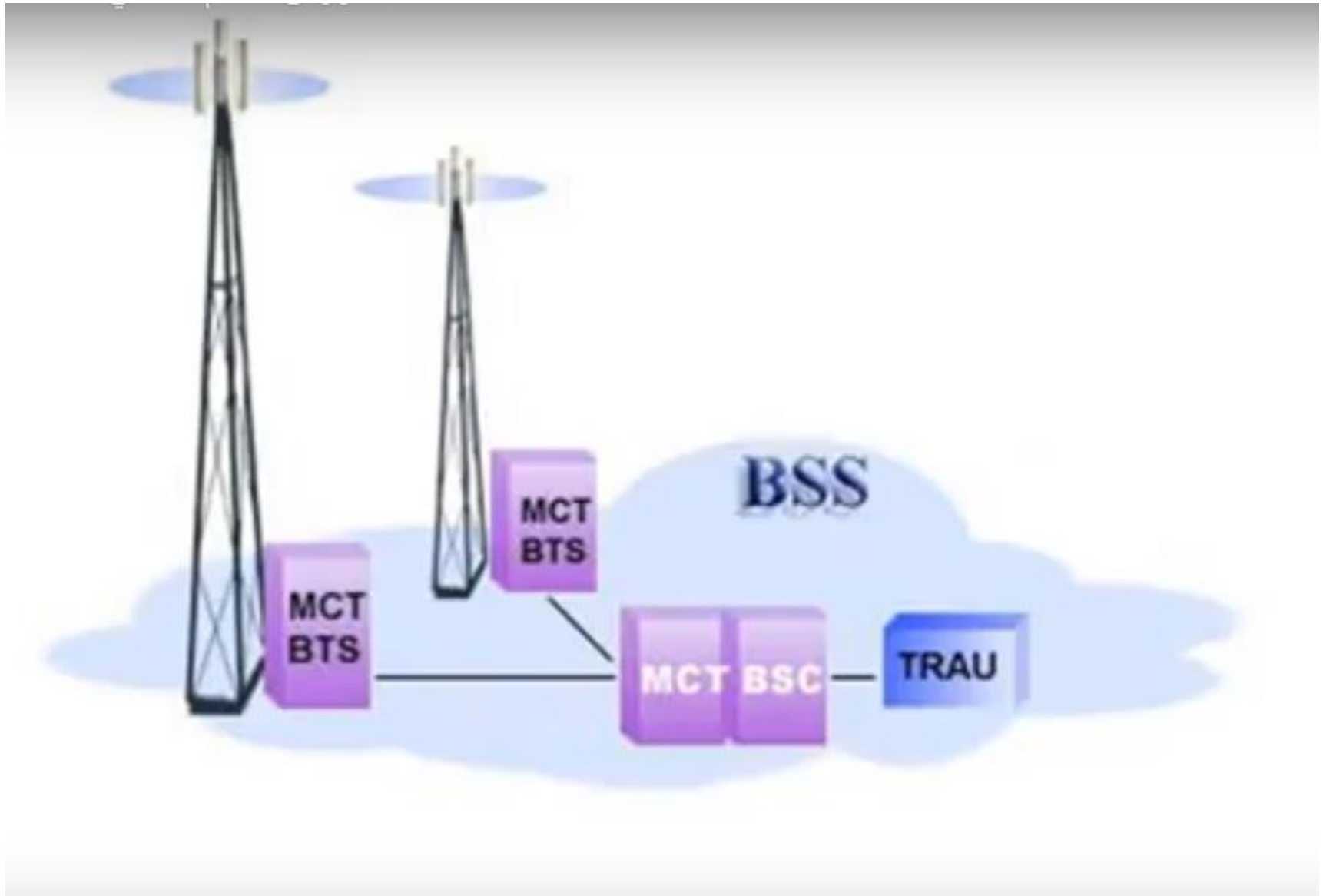


GSM NETWORK ARCHITECTURE

-The base station subsystem (BSS)

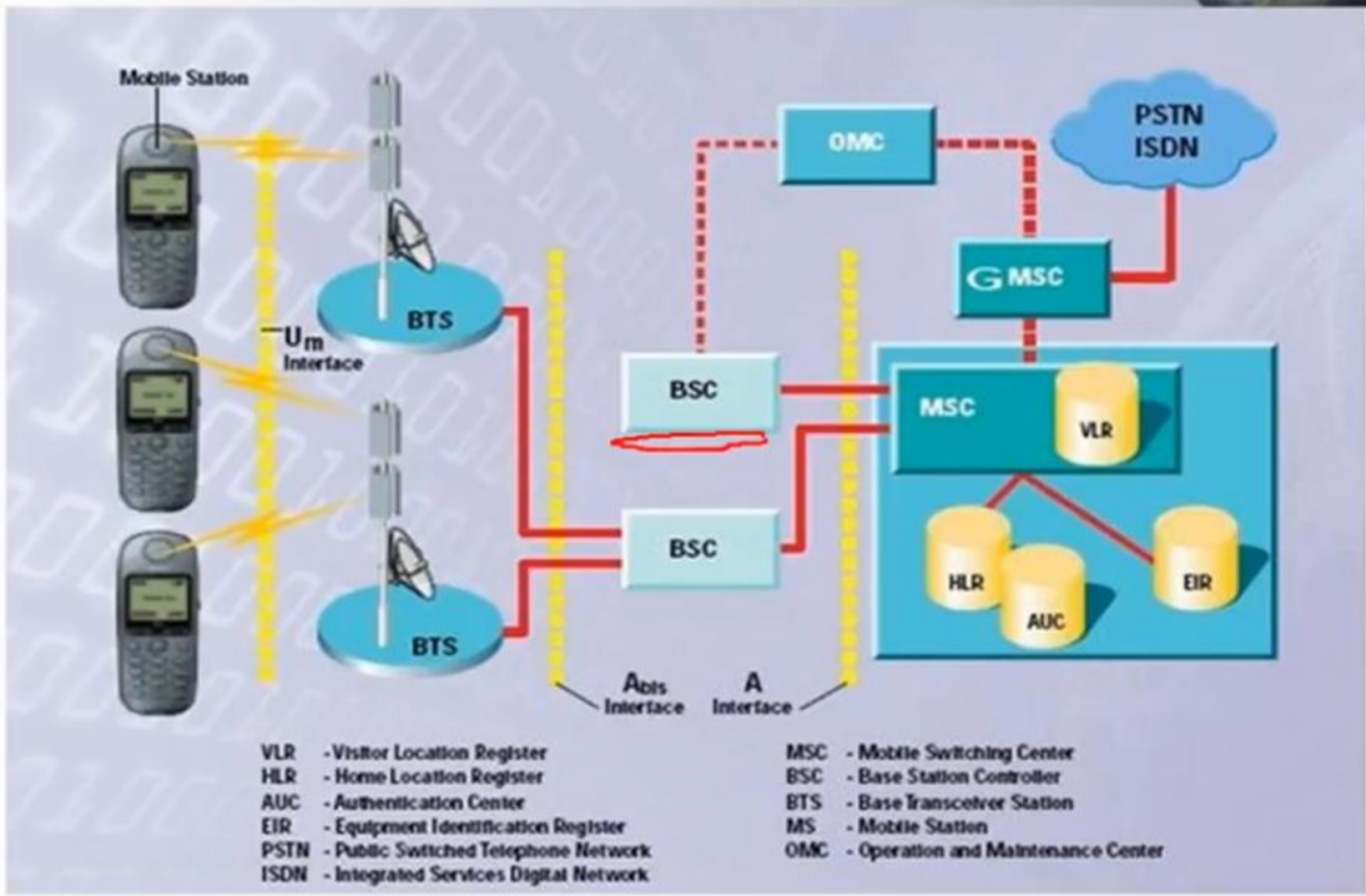
1- The Base Transceiver station (BTS)

- it contains the RF transmission equipment
- Each cell has one BTS
- Each BTS consists of one or more transceiver
- It has an International cell global Identity (CGI)
- It performs channel coding, ciphering and modulation


BSS
MCT
BTS
MCT
BTS
MCT
BSC
TRAU

- Base Transceiver station

GSM NETWORK ARCHITECTURE



VLR - Visitor Location Register
HLR - Home Location Register
AUC - Authentication Center
EIR - Equipment Identification Register
PSTN - Public Switched Telephone Network
ISDN - Integrated Services Digital Network

MSC - Mobile Switching Center
BSC - Base Station Controller
BTS - Base Transceiver Station
MS - Mobile Station
OMC - Operation and Maintenance Center

GSM NETWORK ARCHITECTURE

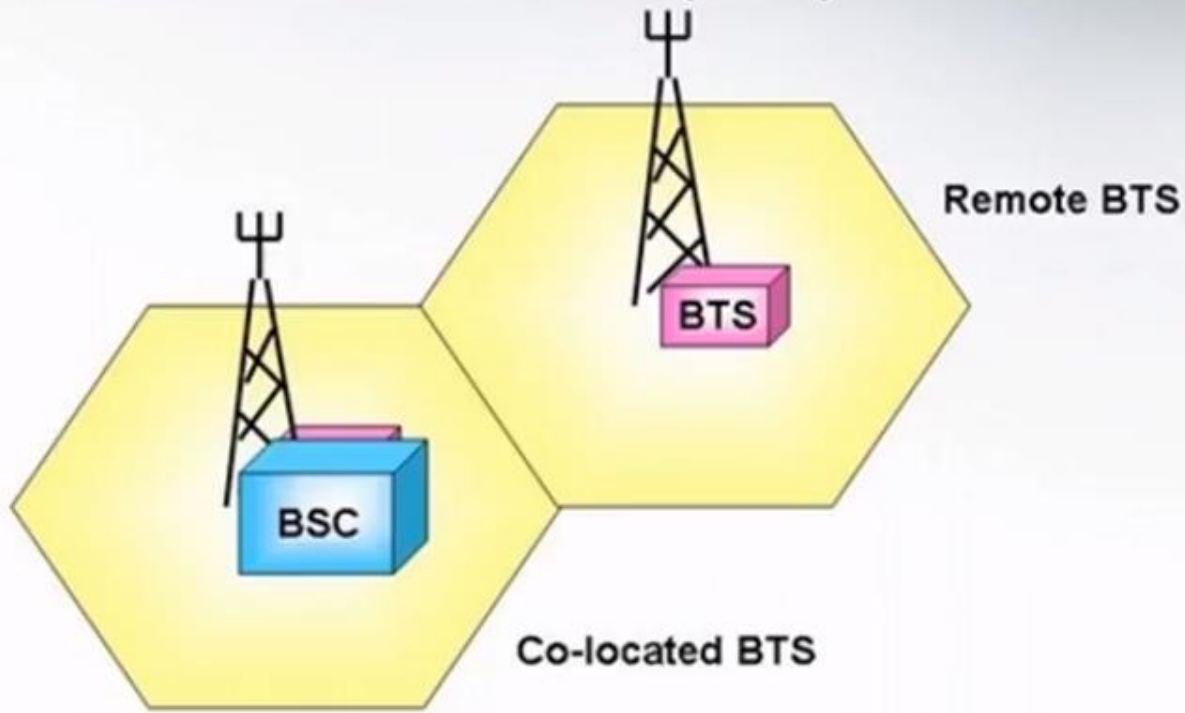
2- The base station controller (BSC)

-It carries out all control functions in the BSS as:

1. Paging
2. Channel allocation
3. Dynamic power control
4. Handover
5. Frequency hopping

GSM NETWORK ARCHITECTURE

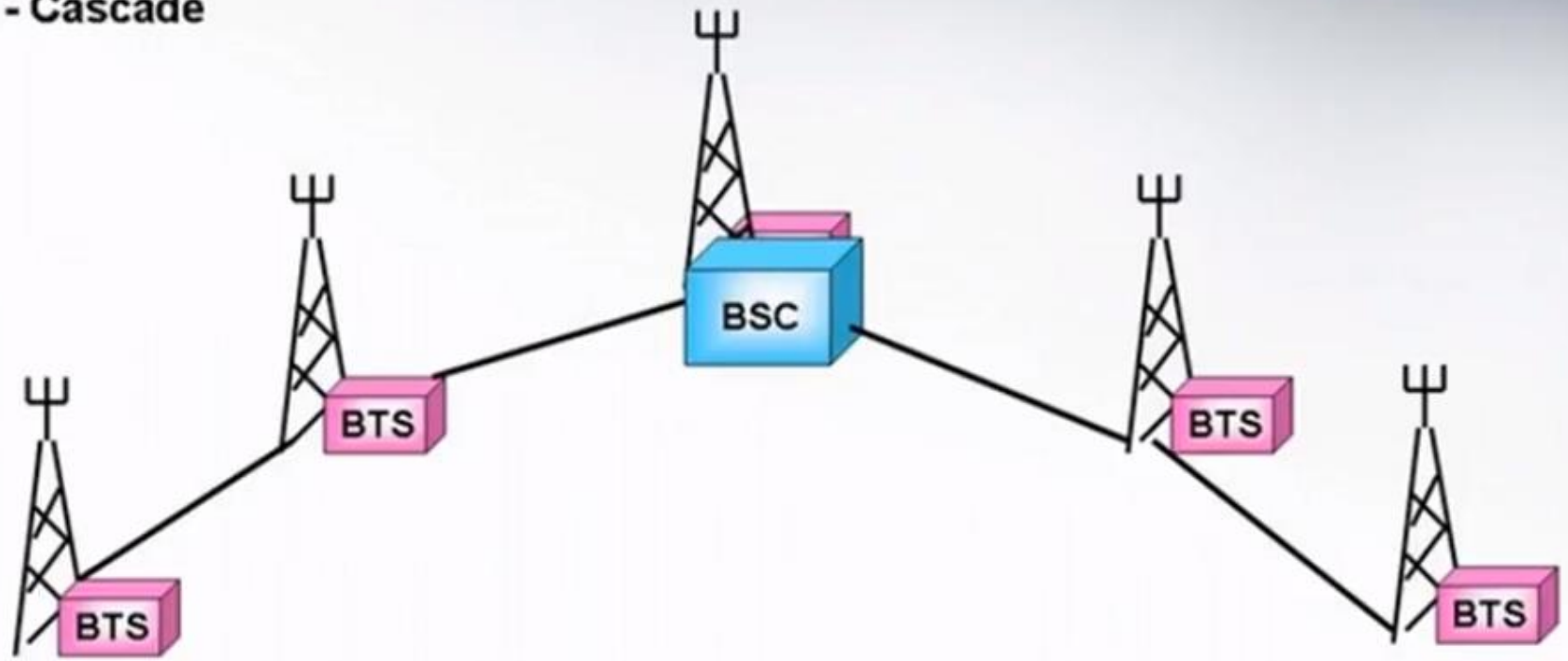
- The base station controller (BSC)



GSM NETWORK ARCHITECTURE

BSS Link configuration

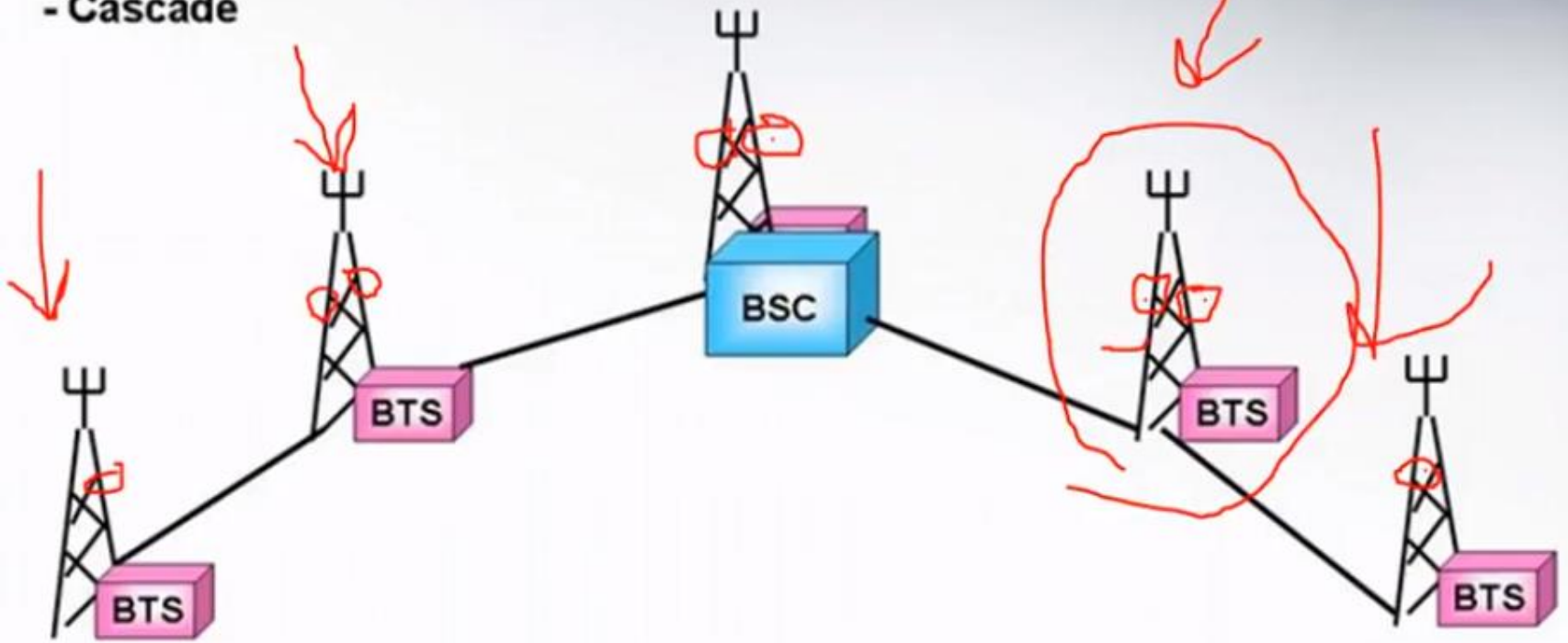
- Cascade



GSM NETWORK ARCHITECTURE

BSS Link configuration

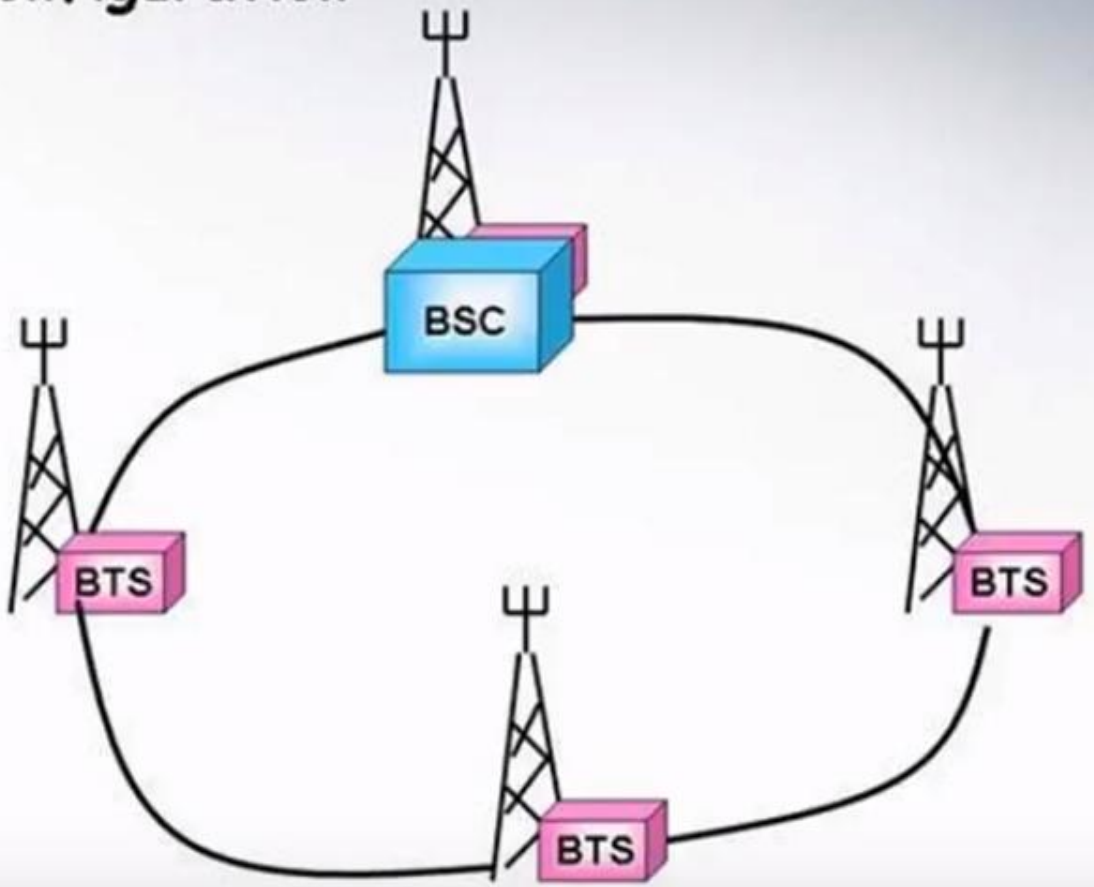
- Cascade



GSM NETWORK ARCHITECTURE

BSS Link configuration

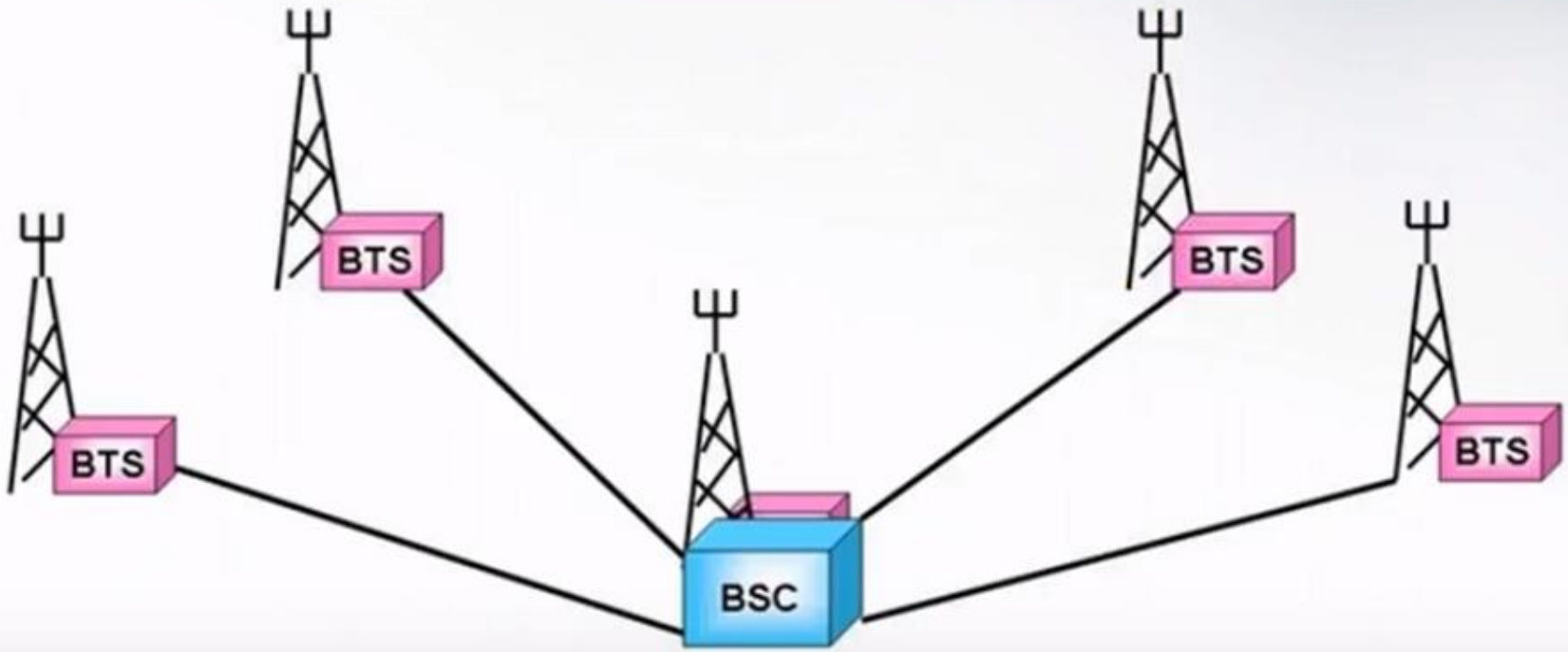
- loop

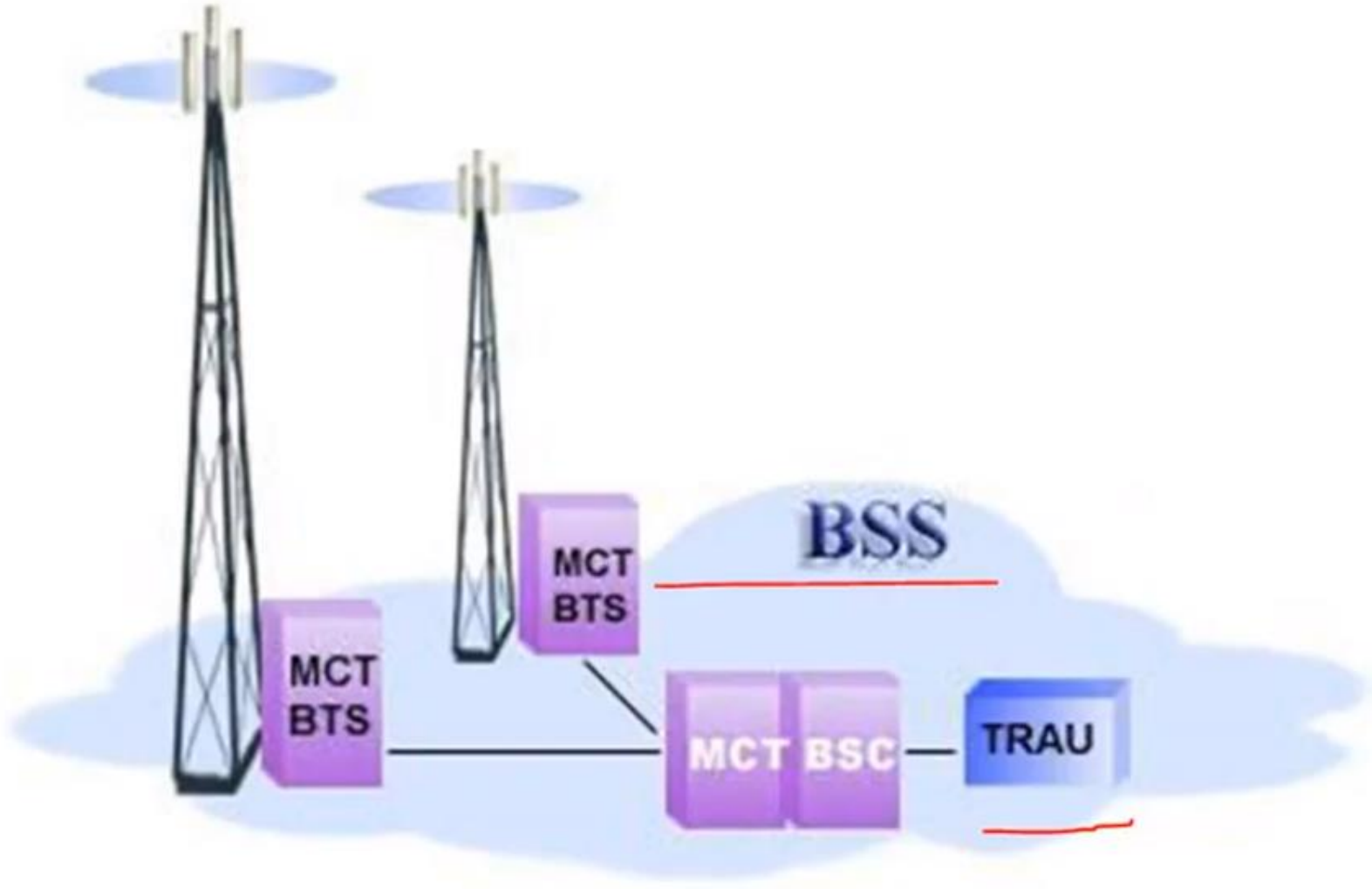


GSM NETWORK ARCHITECTURE

BSS Link configuration

- Star

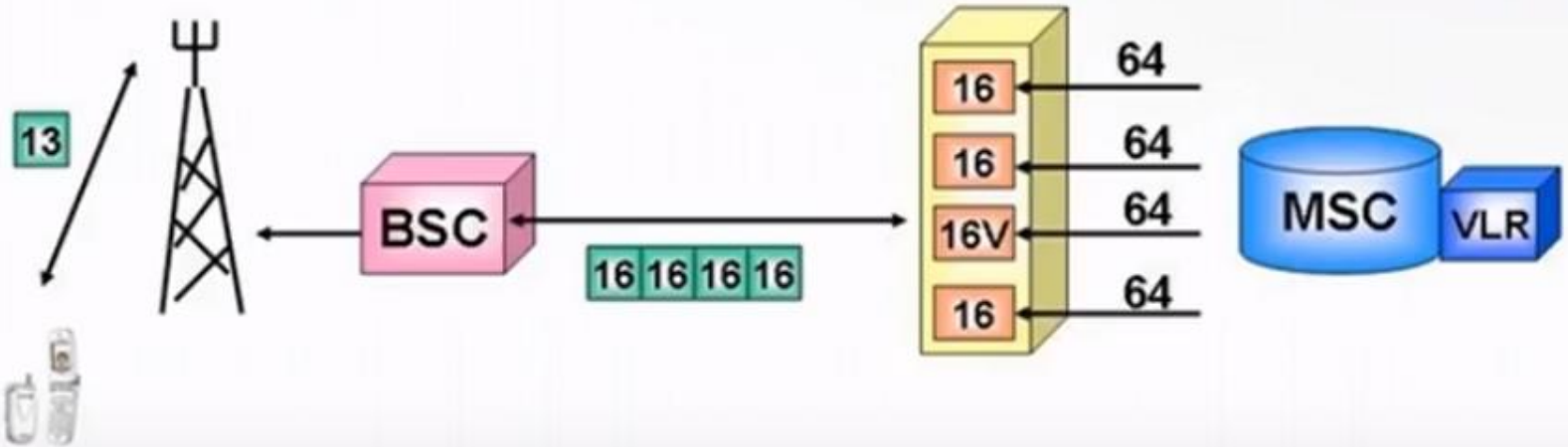



BSS
MCT
BTS
MCT
BTS
MCT
BSC
TRAU

GSM NETWORK ARCHITECTURE

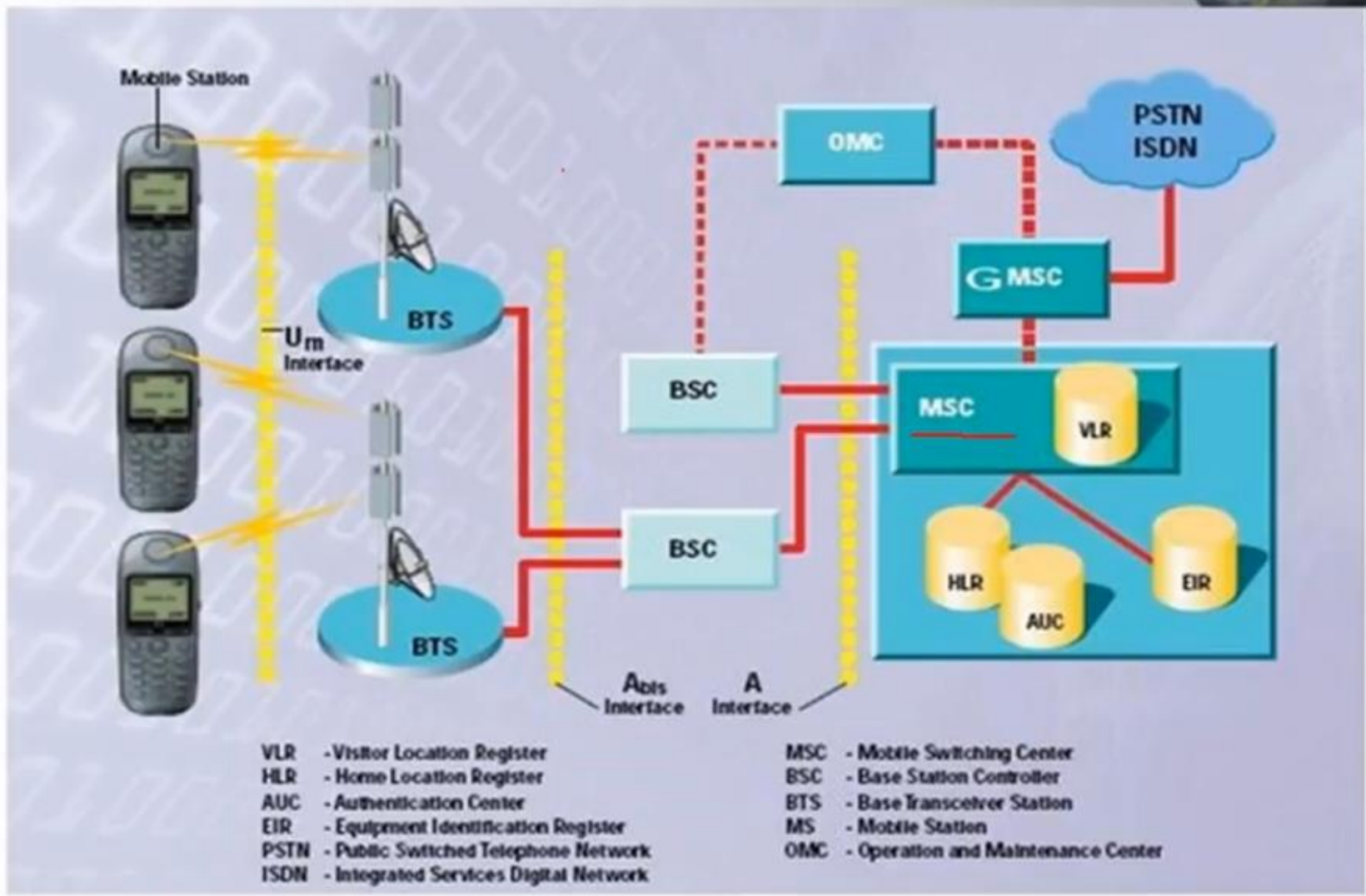
3- The transcoding and rate adaptation unit (TRAU)

- It is used for speech compression/decompression
- Also adaptation of data to the requirement of the air interface



- Transcoding and rate adaptation unit

GSM NETWORK ARCHITECTURE



GSM NETWORK ARCHITECTURE

- The Mobile service switching center (MSC)

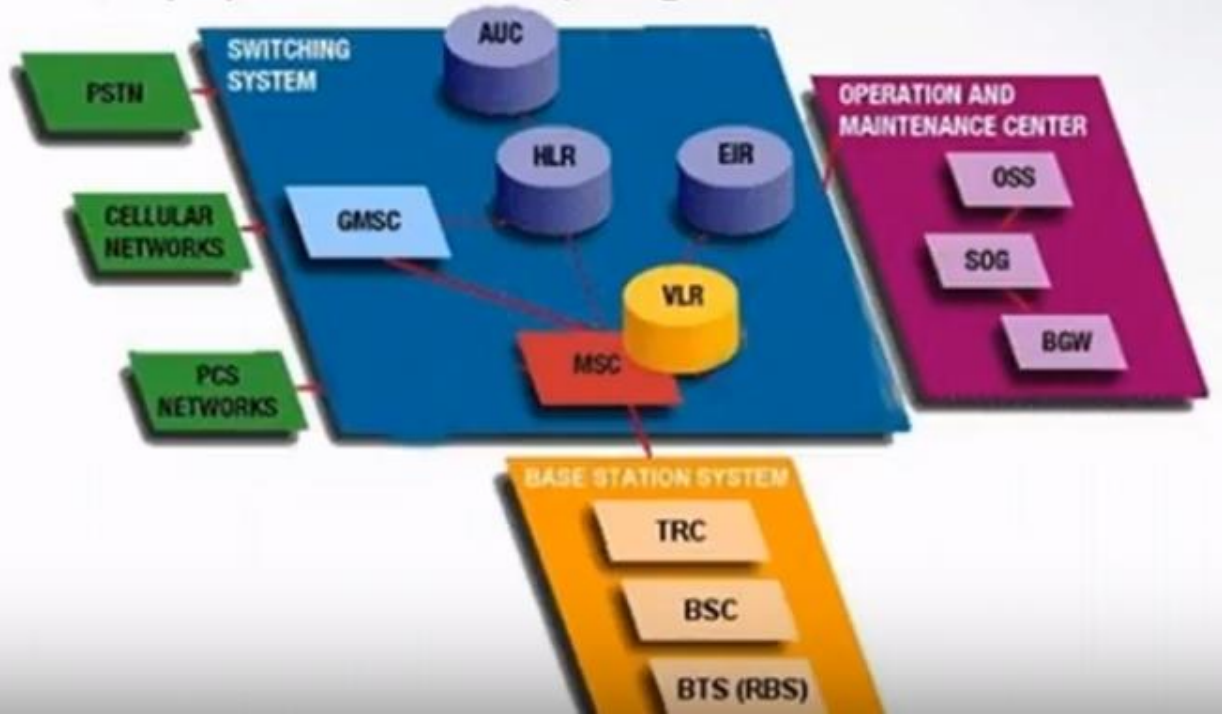
-It is an electronic computerized exchange provides the interface between MS and the fixed network

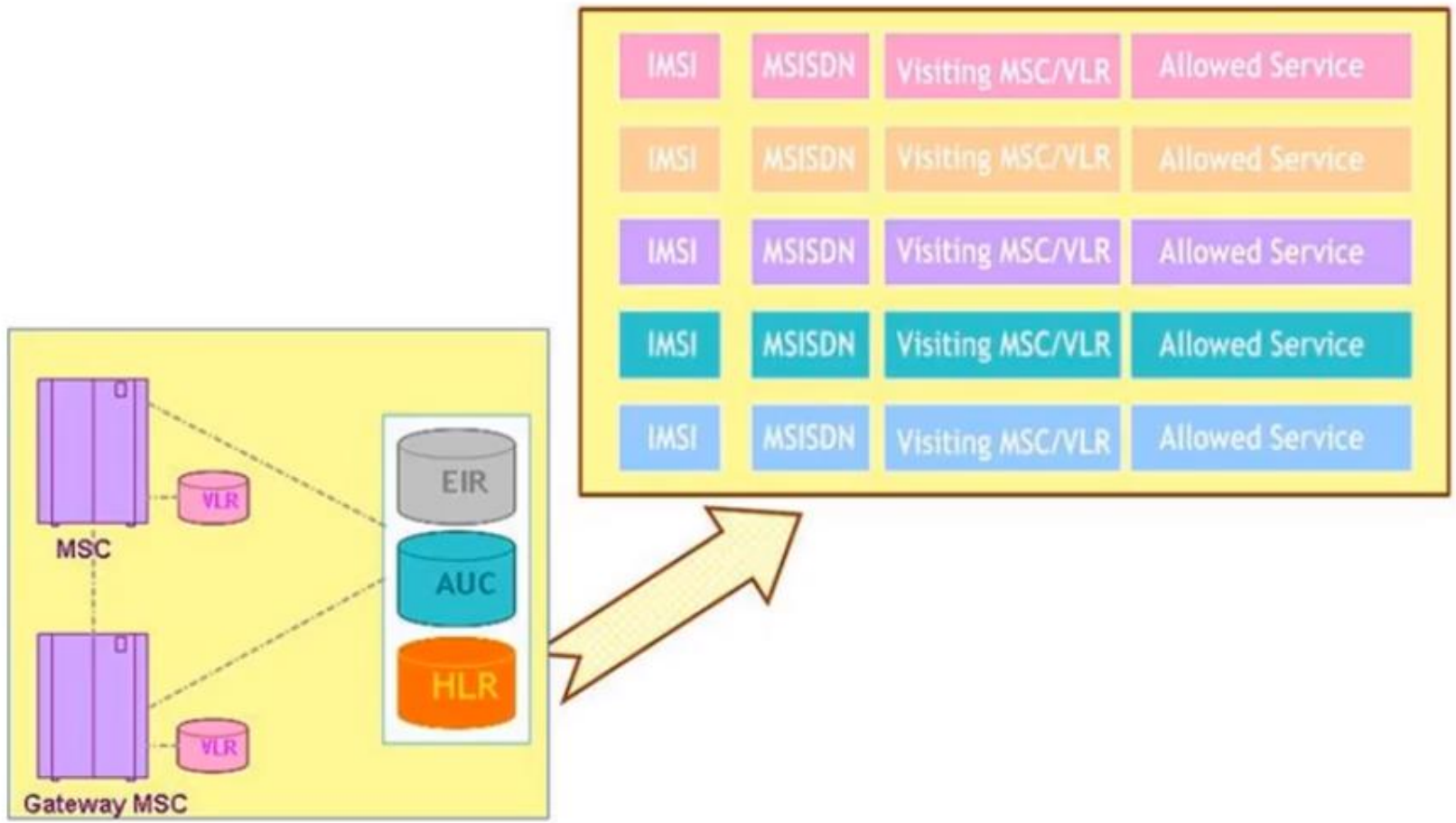
-It will not contain any subscriber parameters

1. **Charging**
2. **Switching and call routing**
3. **Communication with HLR and VLR**
4. Communication with other MSCs
5. **Control of connected BSCs**

GSM NETWORK ARCHITECTURE

- The MSC is connected to:
  1. HLR (Home location register)
  2. VLR (Visitor location register)
  3. AUC (Authentication register)
  4. EIR (Equipment identity register)




IMSI
MSISDN
Visiting MSC/VLR
Allowed Service
IMSI
MSISDN
Visiting MSC/VLR
Allowed Service
IMSI
MSISDN
Visiting MSC/VLR
Allowed Service
IMSI
MSISDN
Visiting MSC/VLR
Allowed Service
IMSI
MSISDN
Visiting MSC/VLR
Allowed Service
VLR
MSC
VLR
Gateway MSC
EIR
AUC
HLR

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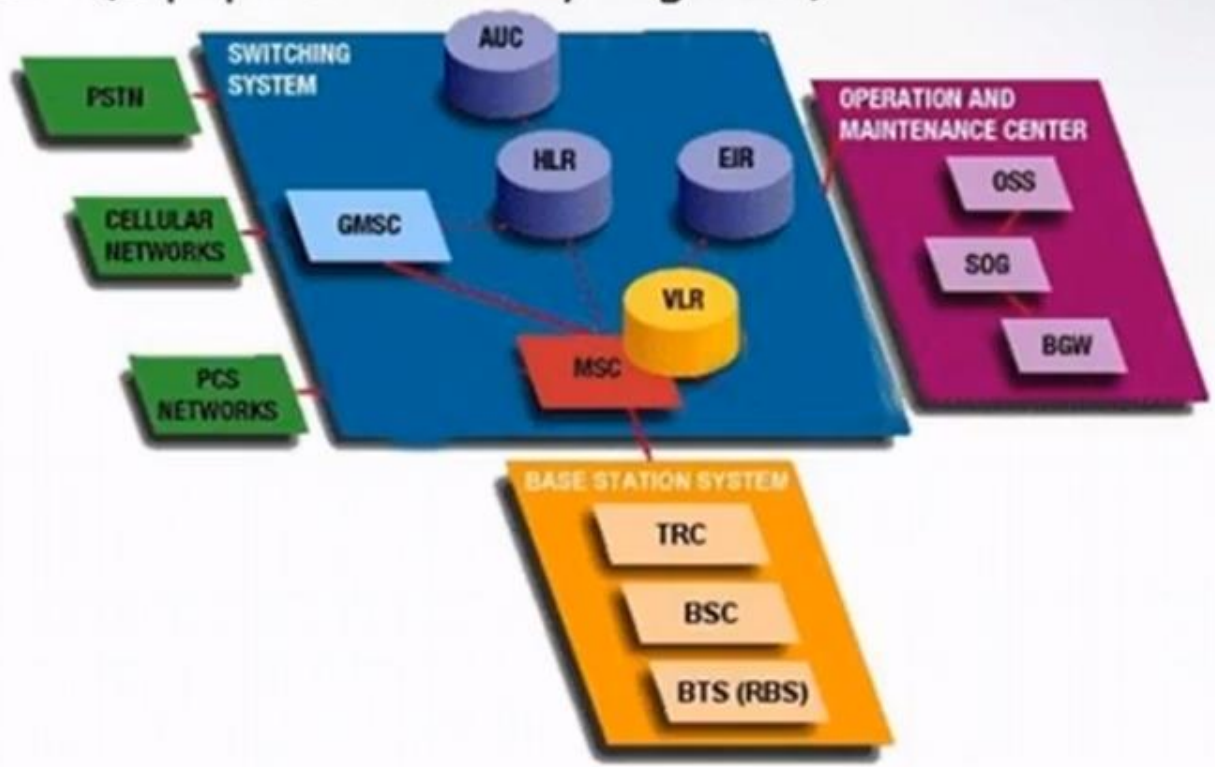

GSM NETWORK ARCHITECTURE

2. VLR (Visitor location register)

   - A temporary storage location for subscription information for MSs which are within MSC service area

   - VLR contains :

     - Mobile status (free, busy,…etc)
     - Temporary MS identity (TMSI)
     - Temporary MS roaming number (MSRN)

GSM NETWORK ARCHITECTURE

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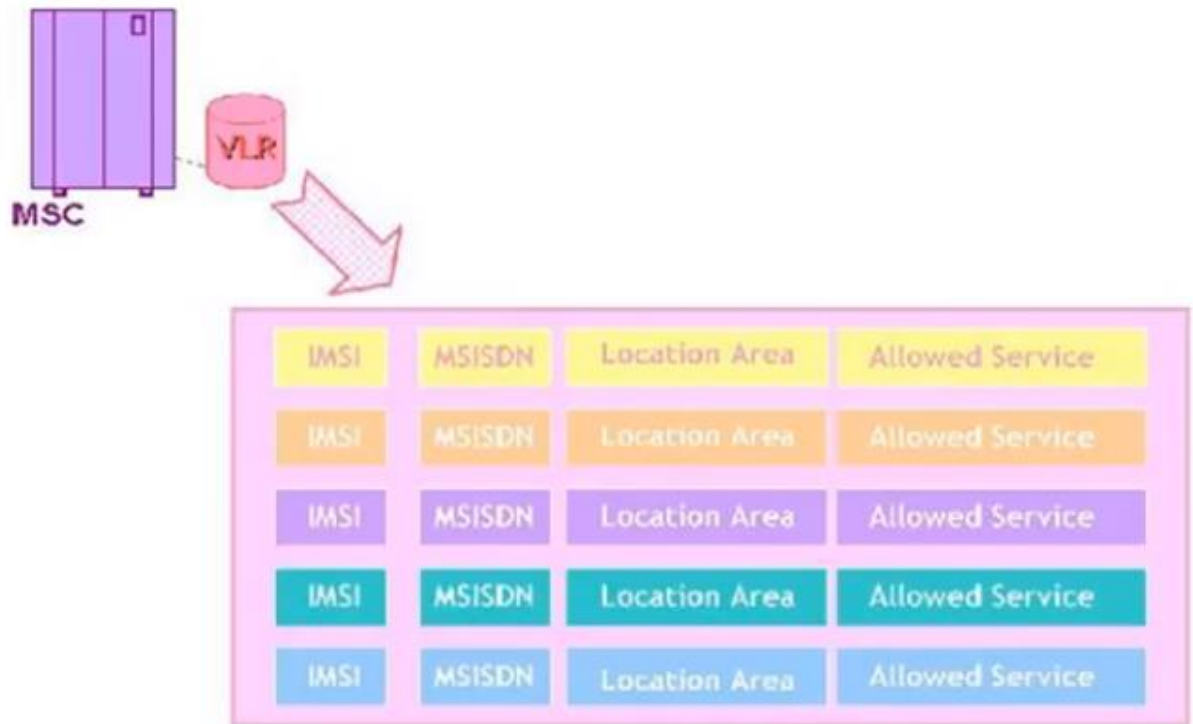
VLR
MSC
IMSI
MSISDN
Location Area
Allowed Service
IMSI
MSISDN
Location Area
Allowed Service
IMSI
MSISDN
Location Area
Allowed Service
IMSI
MSISDN
Location Area
Allowed Service
IMSI
MSISDN
Location Area
Allowed Service

GSM NETWORK ARCHITECTURE

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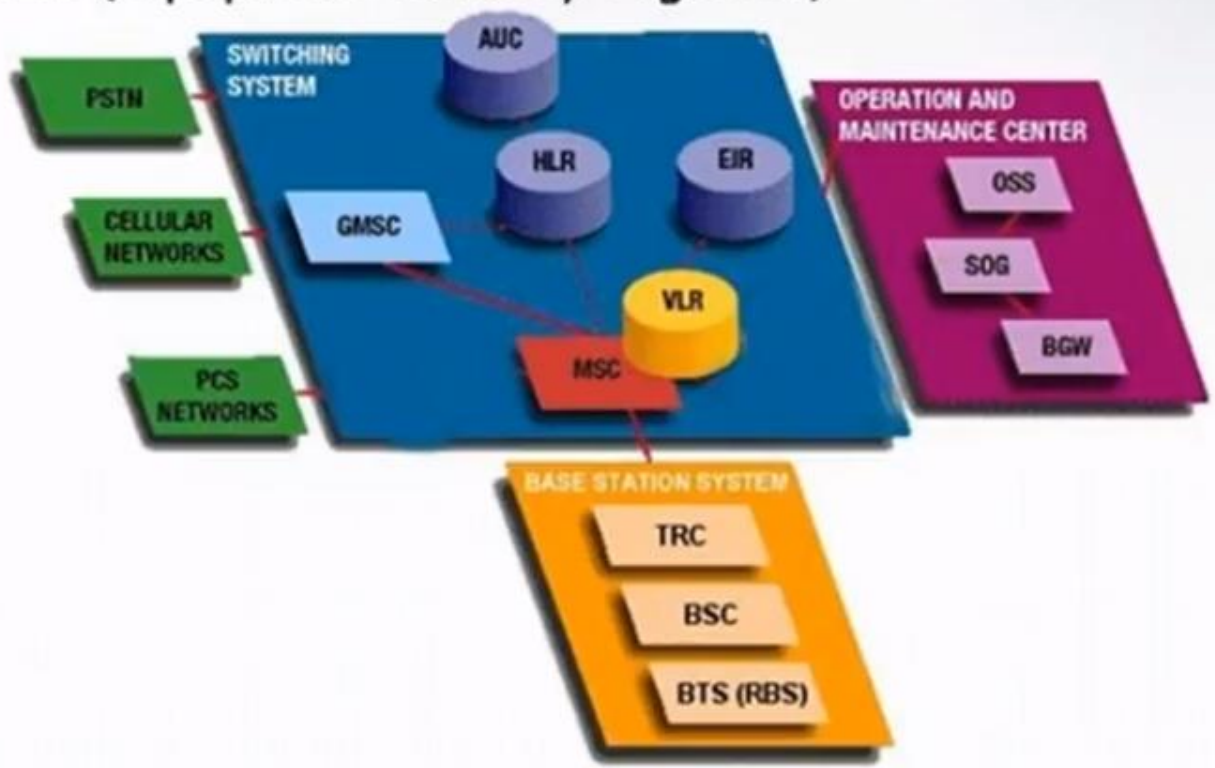
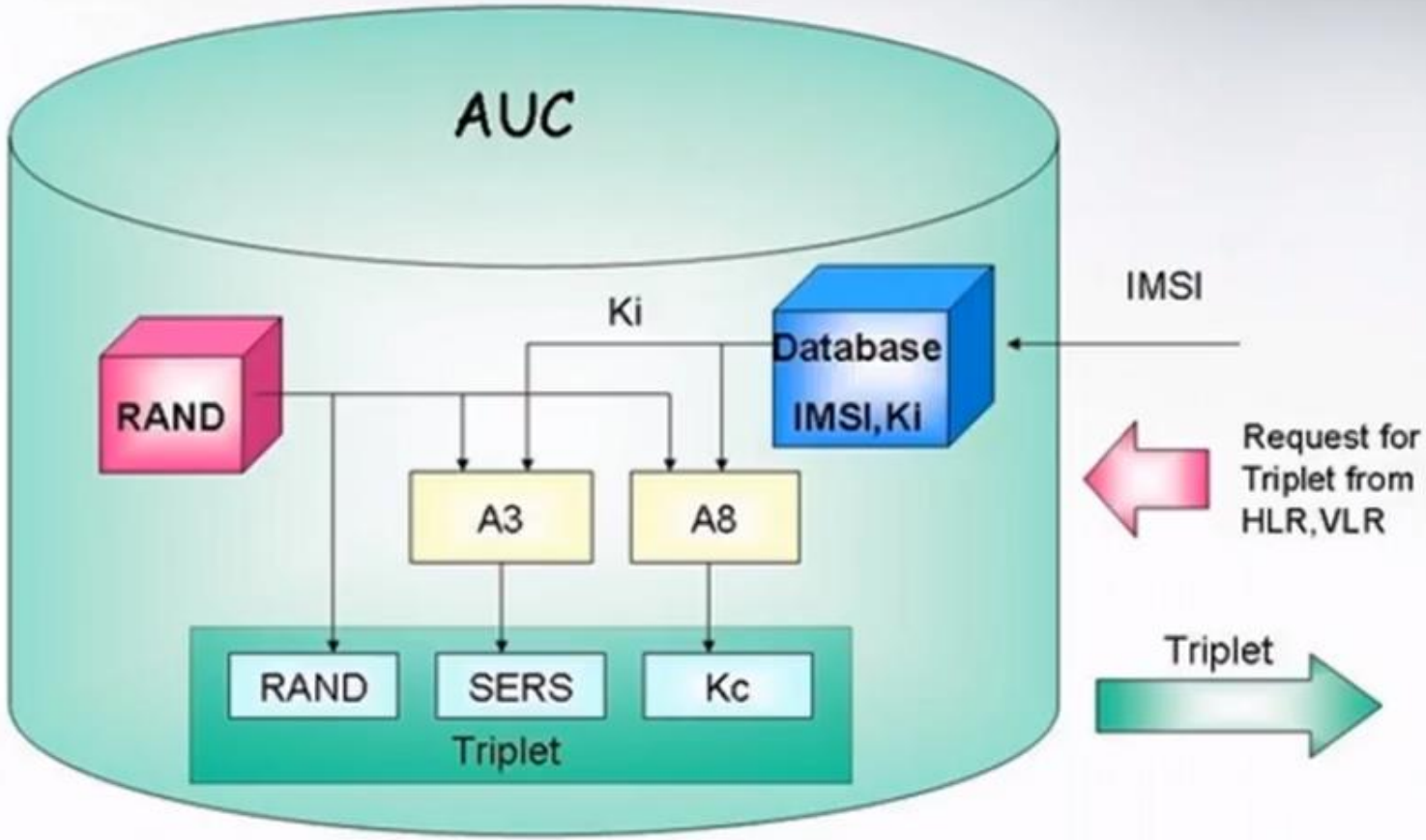
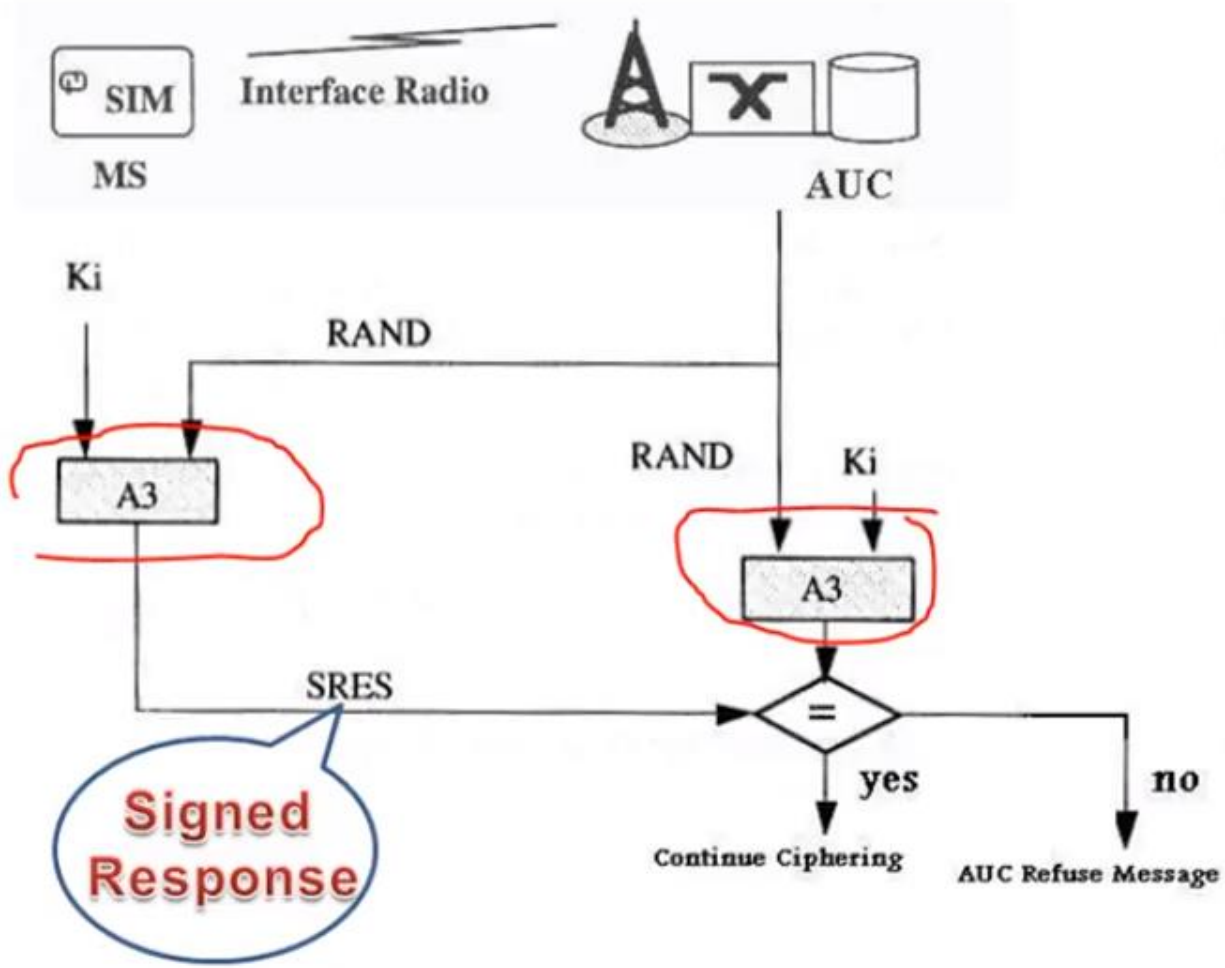


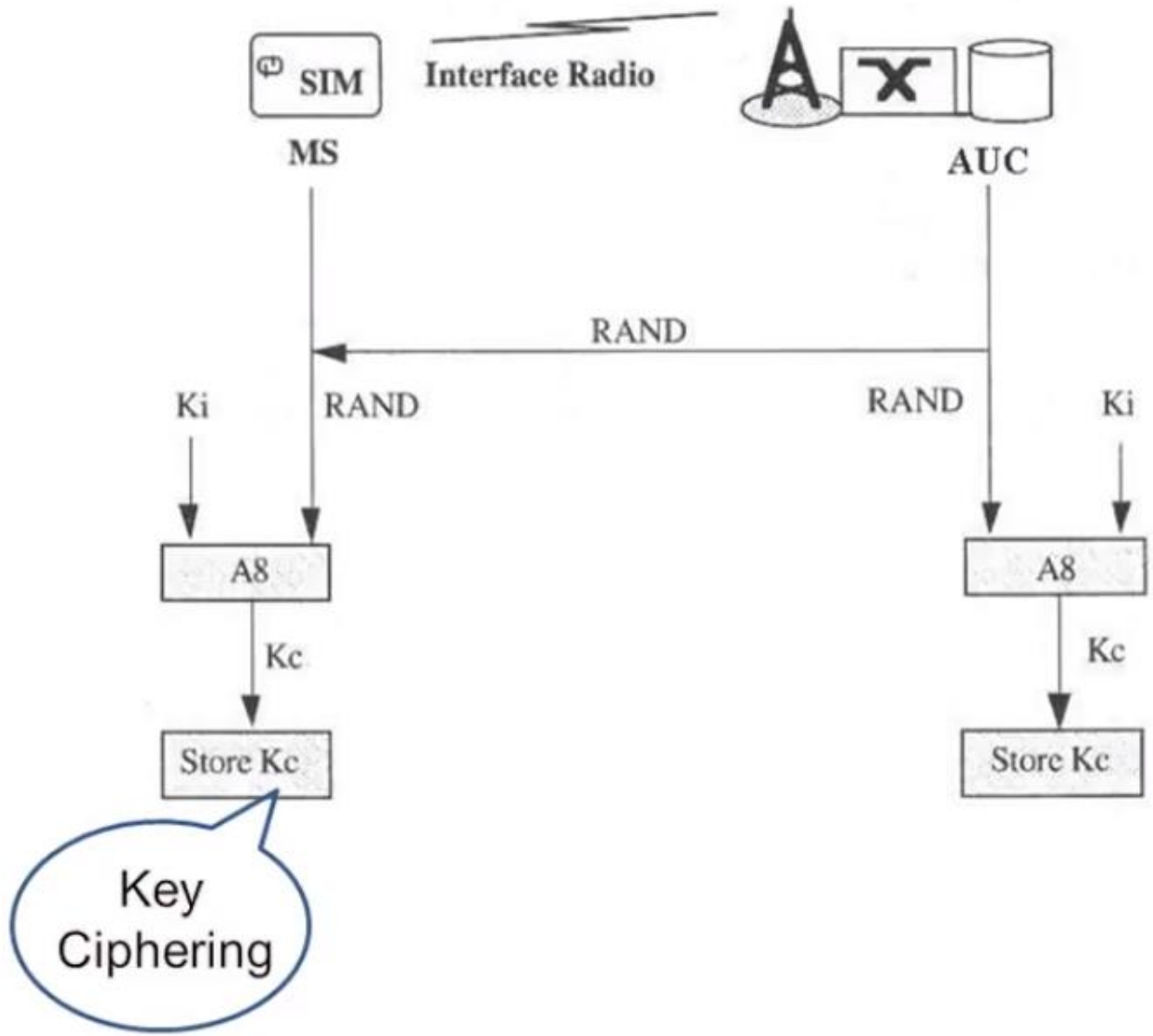
GSM NETWORK ARCHITECTURE

3. Authentication

- It is a processor system that performs the authentication function




SIM
MS
Interface Radio
AUC
Ki
RAND
A3
RAND
Ki
A3
SRES
=
yes
no
Continue Ciphering
AUC Refuse Message
Signed Response


SIM
Interface Radio
MS
AUC
RAND
Ki
RAND
RAND
Ki
A8
A8
Kc
Kc
Store Kc
Store Kc
Key
Ciphering

GSM NETWORK ARCHITECTURE

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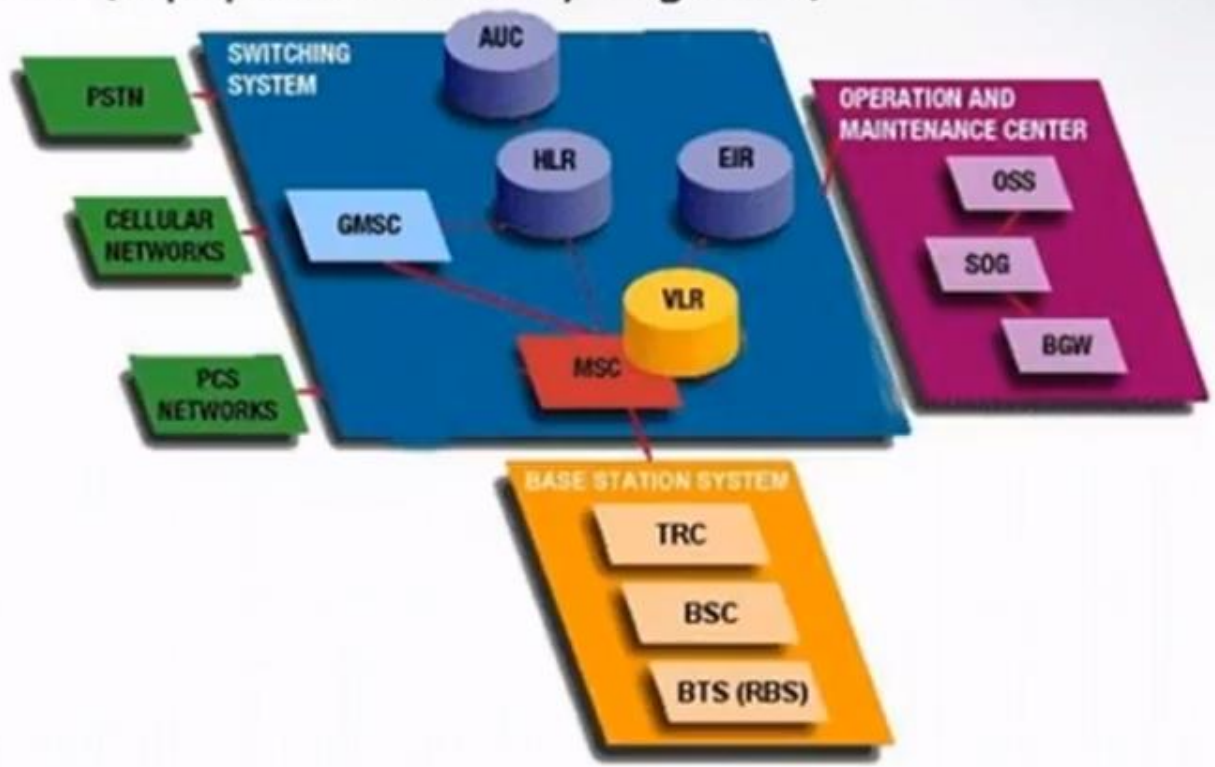
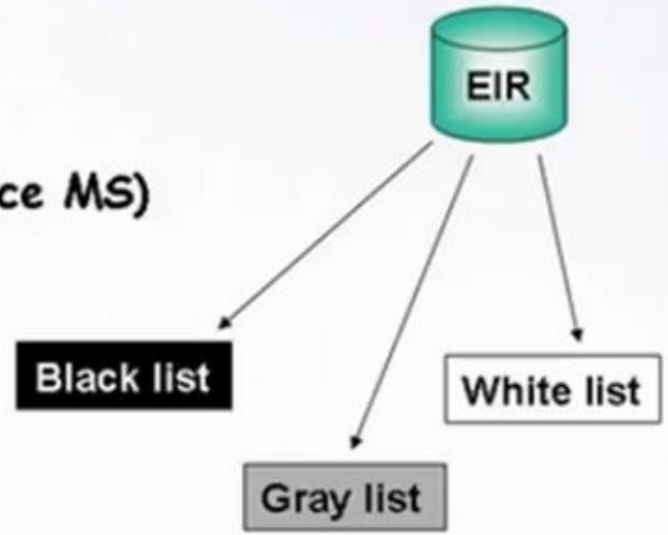


GSM NETWORK ARCHITECTURE

4. EIR (Equipment identity register)

- As the subscriber and equipment are separate in GSM so we use a separate authentication process for MS equipment
- EIR is a centralized database for validation of international mobile equipment identity (IMEI)
- EIR contains 3 lists:
  - White list (for valid MS equipment)
  - Black list (for stolen or denied service MS)
  - Gray list (for mal-performance MS [e.g. faulty software])



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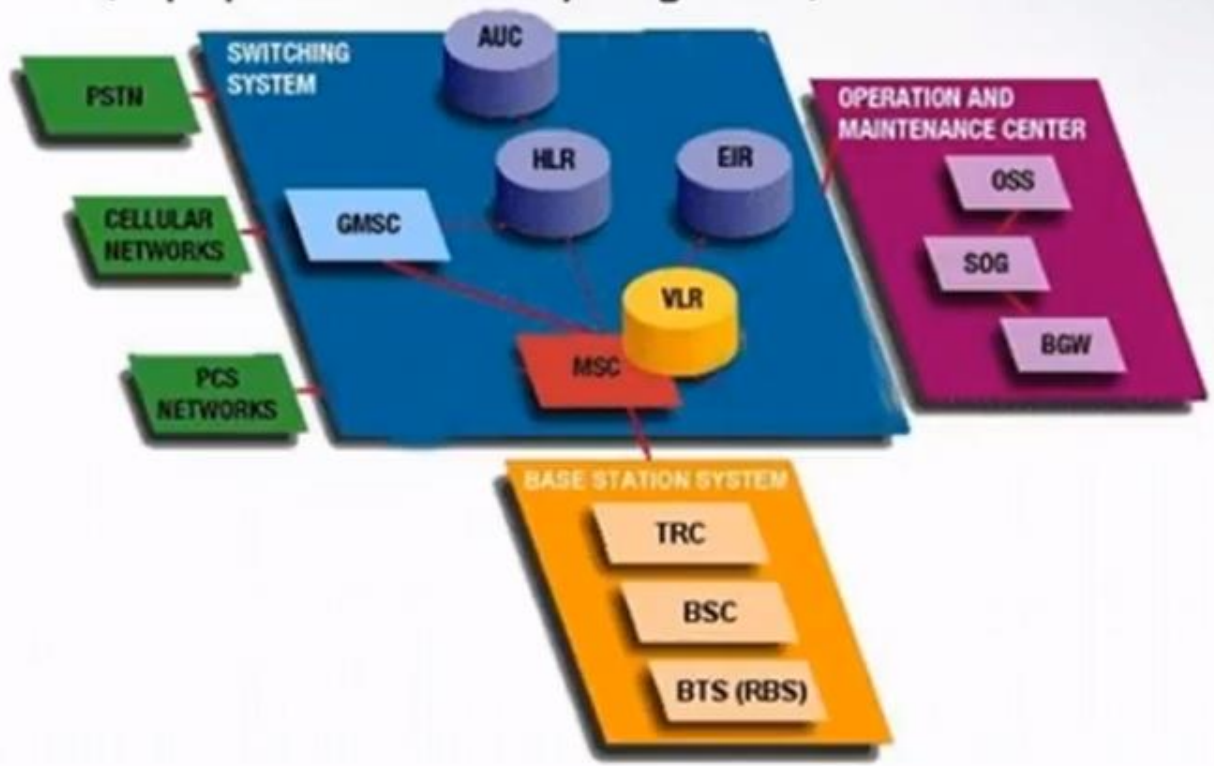

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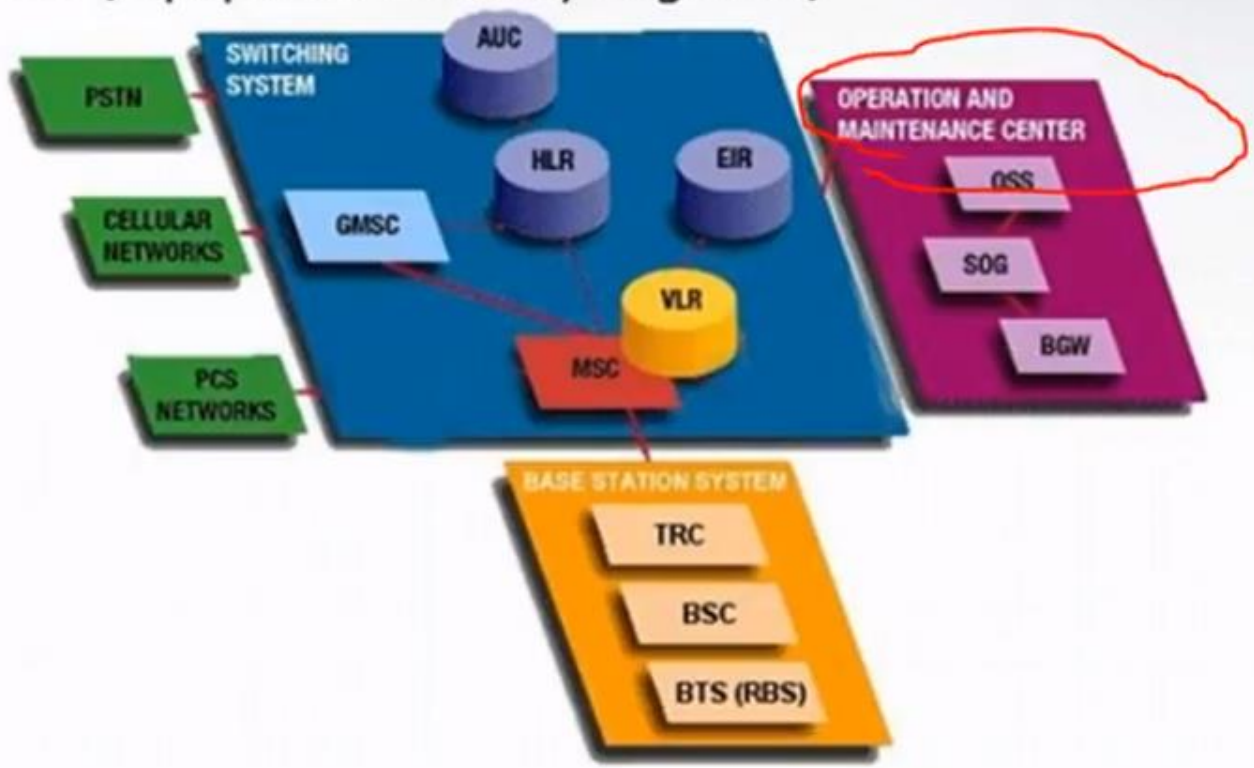


GSM NETWORK ARCHITECTURE

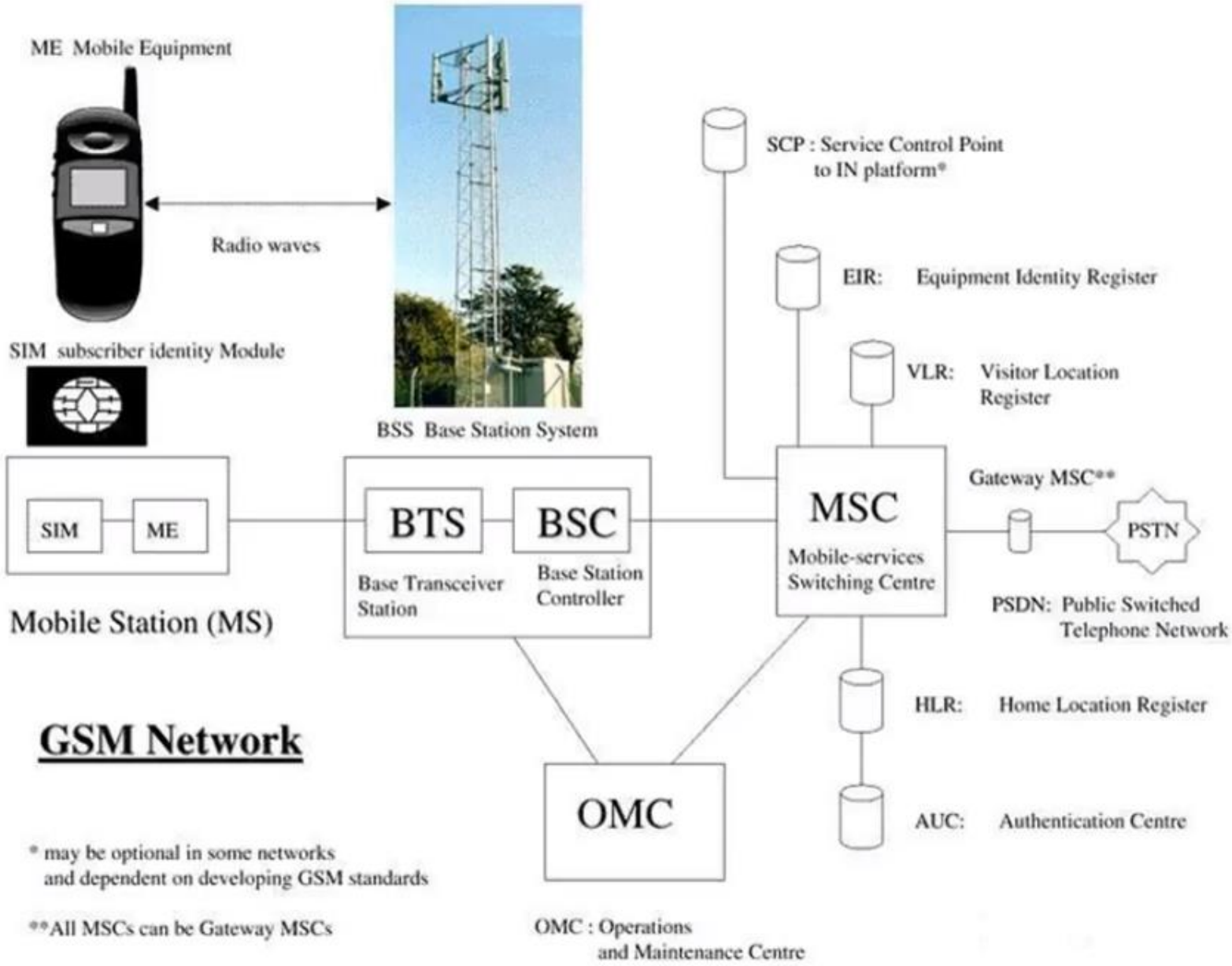
3-The Operation and maintenance center (OMC):-

A-The Operation and Maintenance Center for Radio part (BSS) (OMC-R)

B-The Operation and Maintenance Center for switching parts (OMC-S)

GSM NETWORK ARCHITECTURE

The Operation and maintenance center (OMC)


ME Mobile Equipment
Radio waves
SIM subscriber identity Module
BSS Base Station System
SCP : Service Control Point
to IN platform*
EIR: Equipment Identity Register
VLR: Visitor Location
Register
Gateway MSC**
SIM
ME
BTS
BSC
Base Transceiver
Station
Base Station
Controller
MSC
Mobile-services
Switching Centre
PSTN
PSDN: Public Switched
Telephone Network
Mobile Station (MS)
HLR: Home Location Register
OMC
AUC: Authentication Centre
GSM Network
* may be optional in some networks
and dependent on developing GSM standards
**All MSCs can be Gateway MSCs
OMC : Operations
and Maintenance Centre

Thanks