

GSM-Mobile Networks

Procedures and Scenarios

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Resources and References

- **GSM-Signalisierung**

Gunnar Heine
Franzis' Verlag GmbH

- **Specifications of 3GPP**

<http://www.3gpp.org/>

- **Siemens internal documents and presentations**

■ What are the basic requests?

- A mobile subscriber wants to initiate calls to other parties.
- A mobile subscriber wants to receive calls from other parties.

■ Telephony in fixed networks

- Every subscriber can be reached by its fix connection to the network.
 - Identity is clear!
 - Location is clear!

■ Telephony in mobile networks

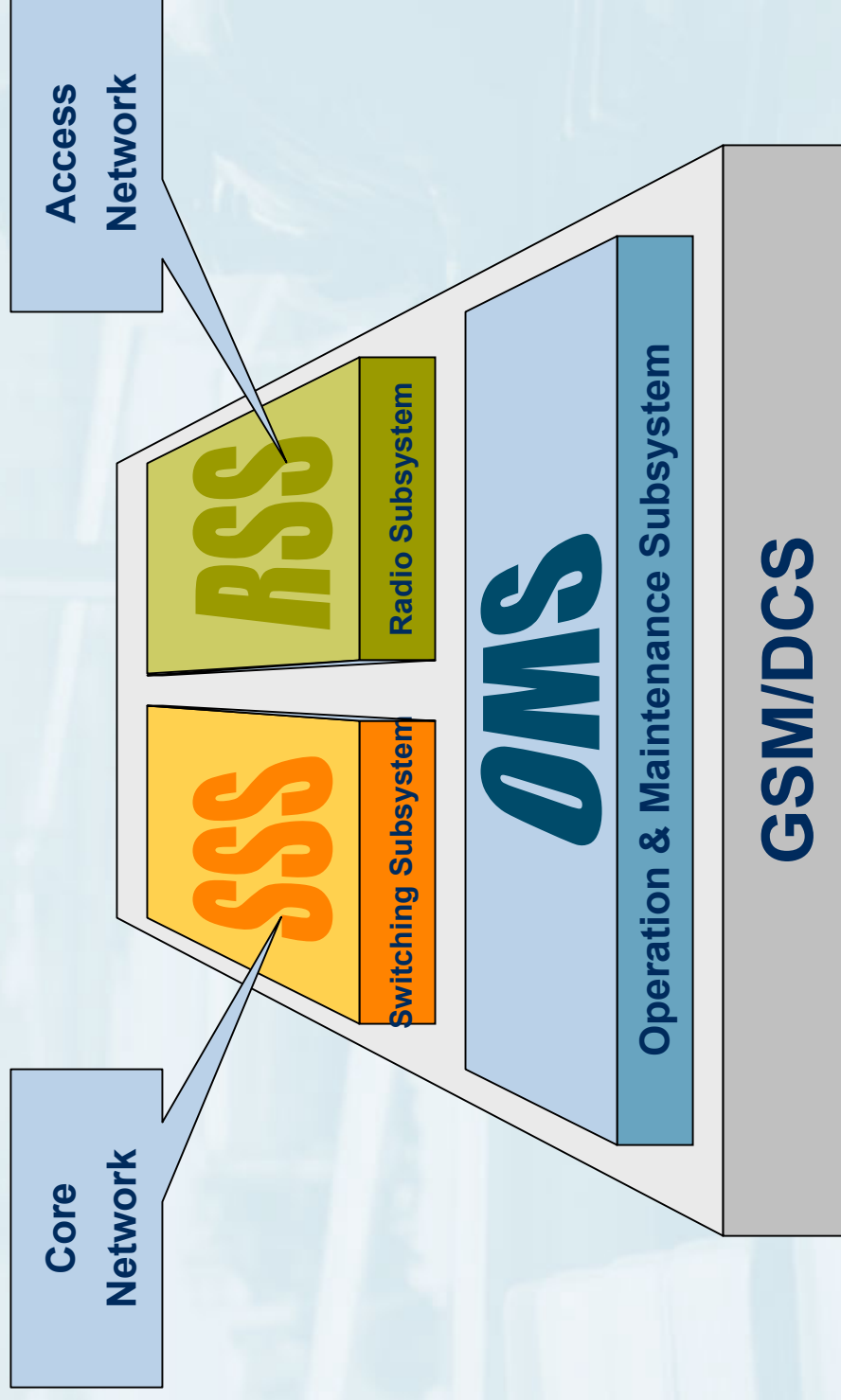
- Theoretically each subscriber can try to use services from every network everywhere!
 - Identity isn't clear!
 - Location isn't clear!

- **A mobile network needs additional mechanisms to realize mobile telephony!**
 - Detection of subscriber location
 - Verification of subscriber identity
 - Verification of mobile equipment identity
 - Communication security
 - Support of change of subscriber location during stable call
 - Support of foreign mobile subscriber

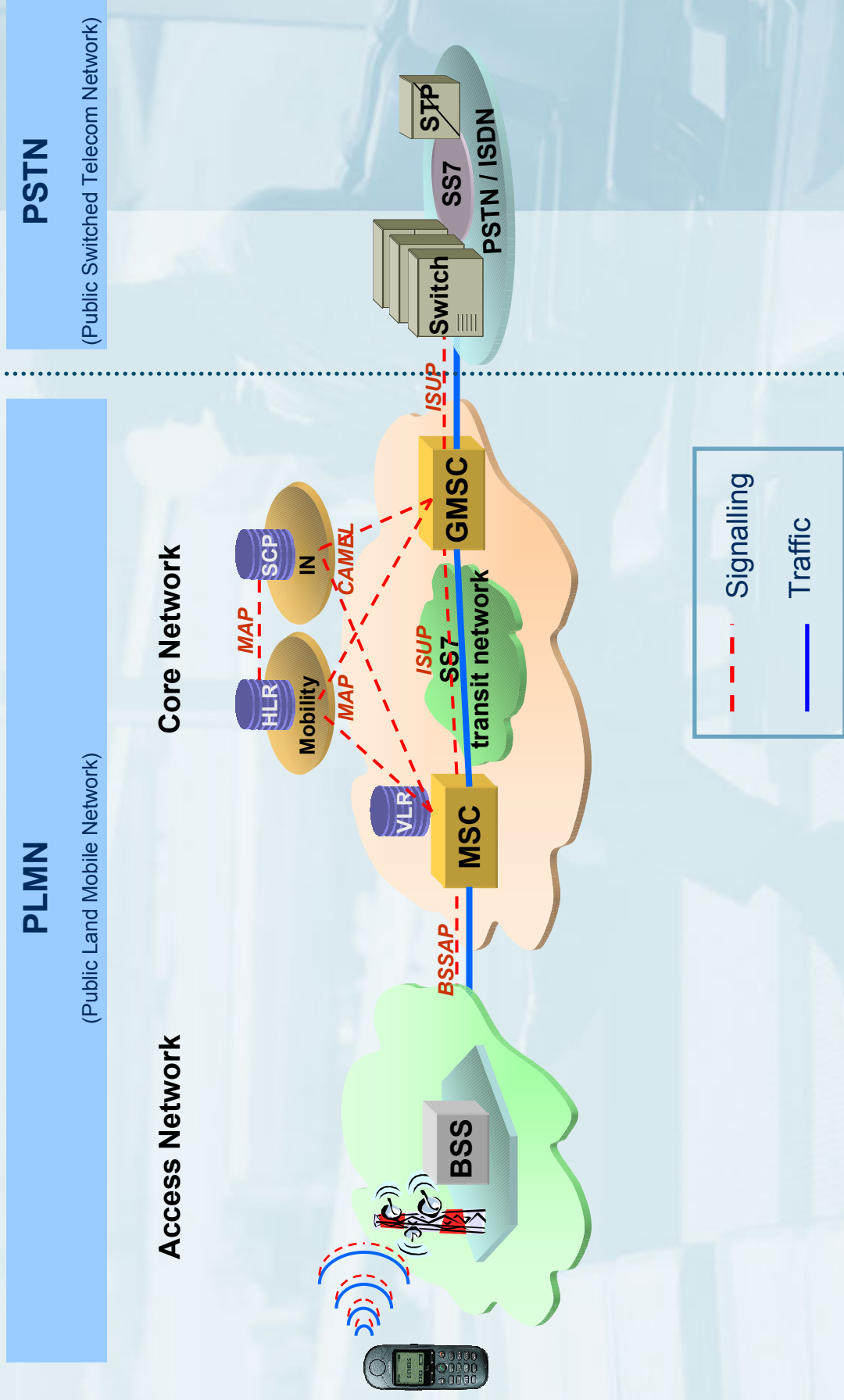
➔ Mobility Management!!

Introduction

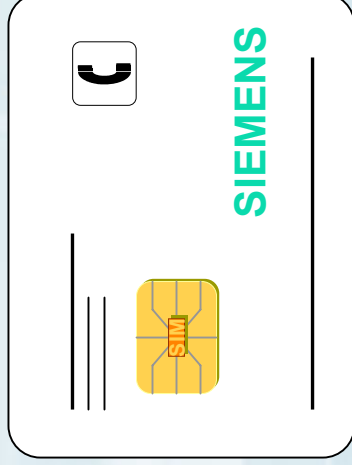
Scope of the presentation



GSM Network - Overview



ME + SIM / USIM = MS

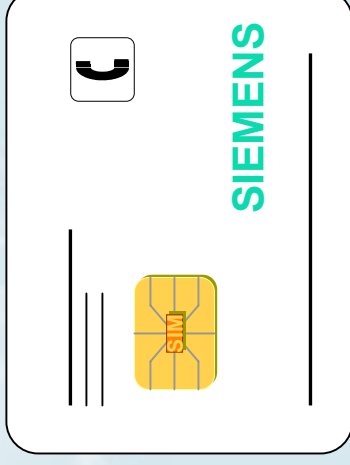


**Mobile
Equipment**
(HW & SW)

**„Mobile
Subscriber“**

**Mobile
Station**

- **SIM identifies the mobile subscriber (MSub)**
- **Consisting of microprocessor and memory for temporary and permanent data**
 - Temporary data:
 - Temporary subscriber identity (TMSI)
 - Current location information (LAI)
 - Encryption data
 - Permanent data:
 - Permanent subscriber identity (IMSI)
 - Key (Ki) – individual subscriber authentication key
 - Algorithms for authentication (A3) and encryption (A8)



Procedures & Scenarios

- **Authentication**
- **Location Update**
- **Mobile Originating Call (MOC)**
- **Mobile Terminating Call (MTC)**
- **Interrogation**
- **Paging**
- **Handover**

■ Purpose:

- Protection of the network against unauthorized access and usage of offered services
- Protection of the mobile subscriber against unauthorized usage of its own identity

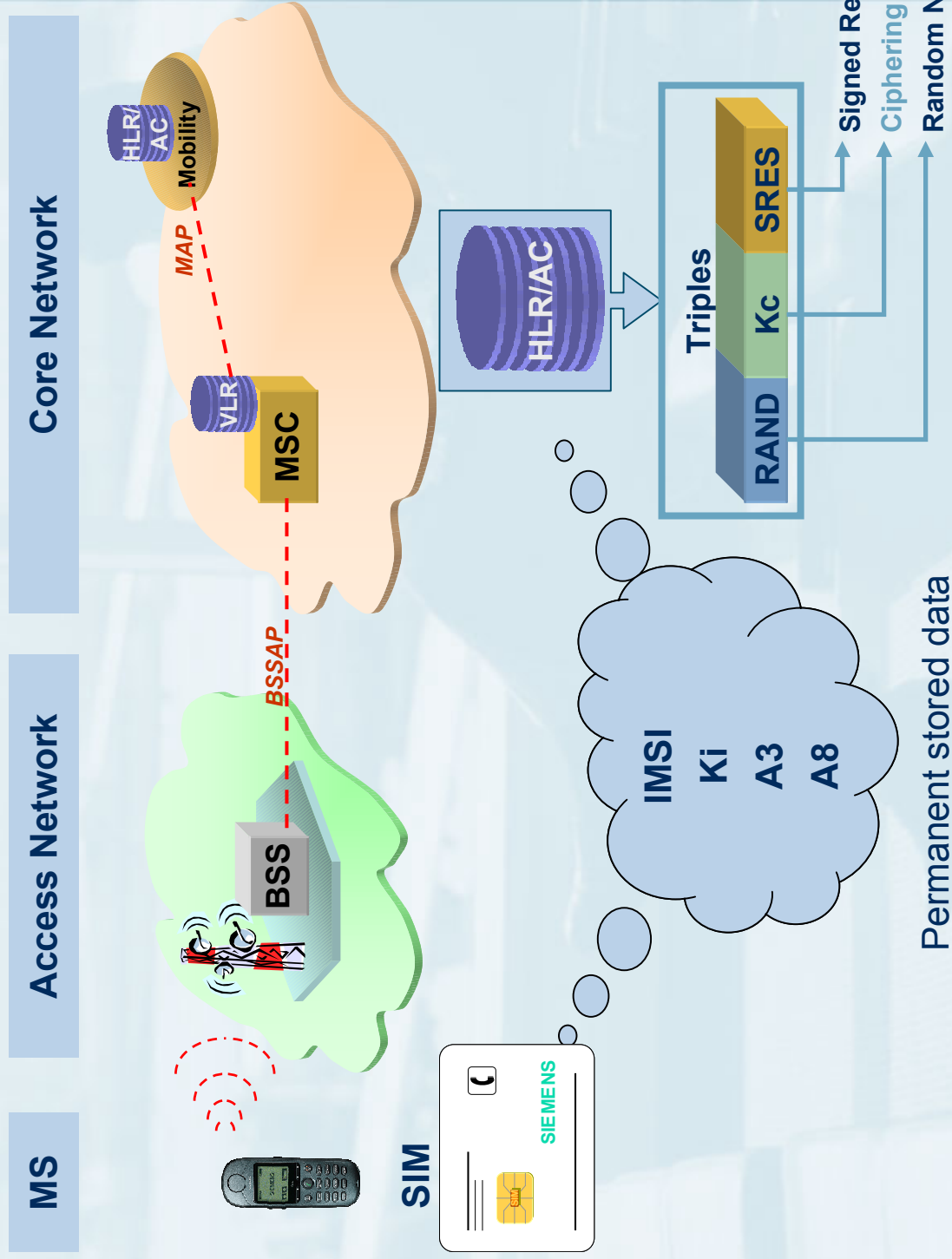
■ Trigger:

- No independent operation! Always in conjunction with an other scenario (LUP, MOC,...)!

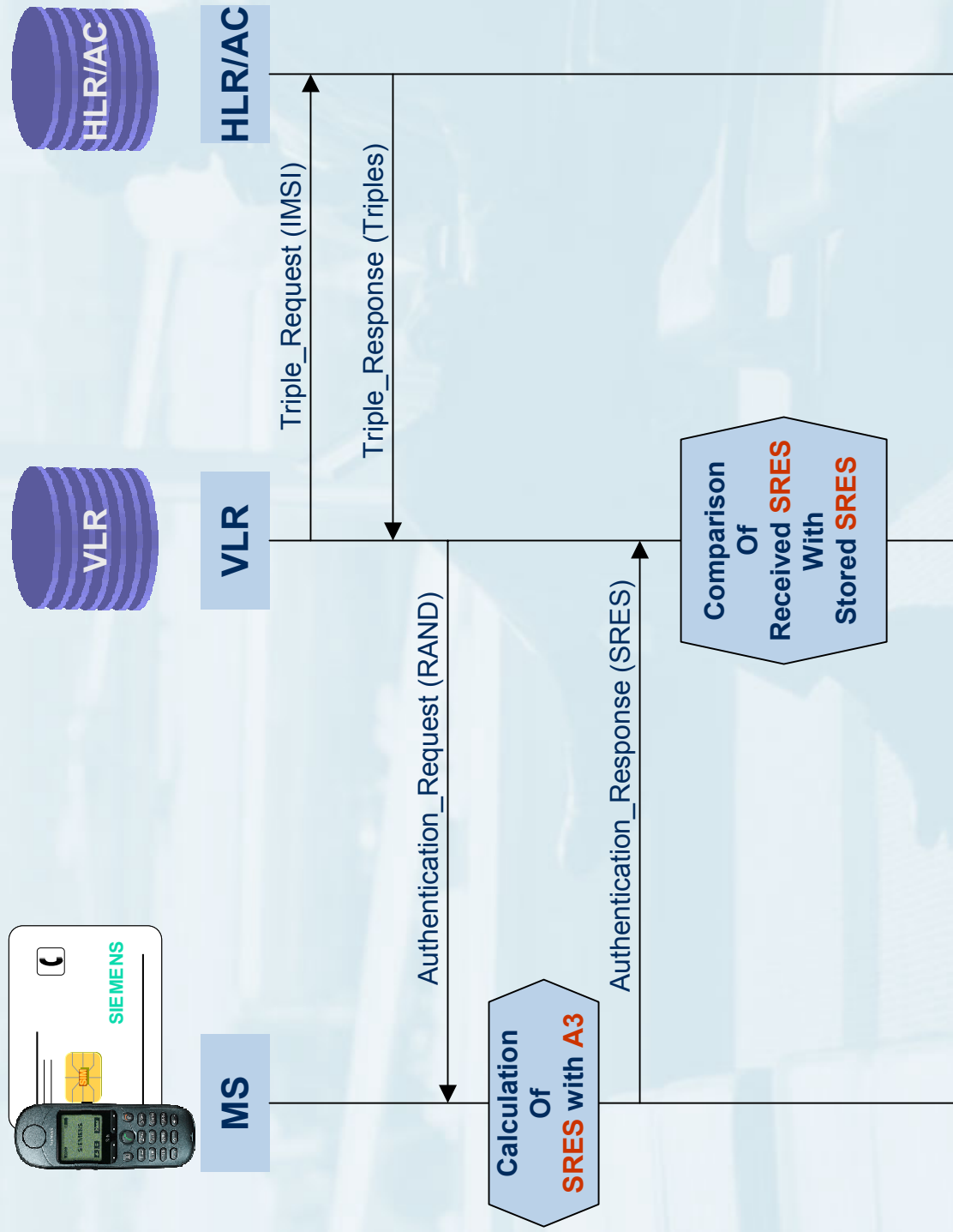
■ Affected entities:

- MS
- MSC/VLR
- HLR/AC

Authentication(II)



Authentication(III)



Location Update (I)

■ Purpose:

- Update of current location information on the SIM and in VLR

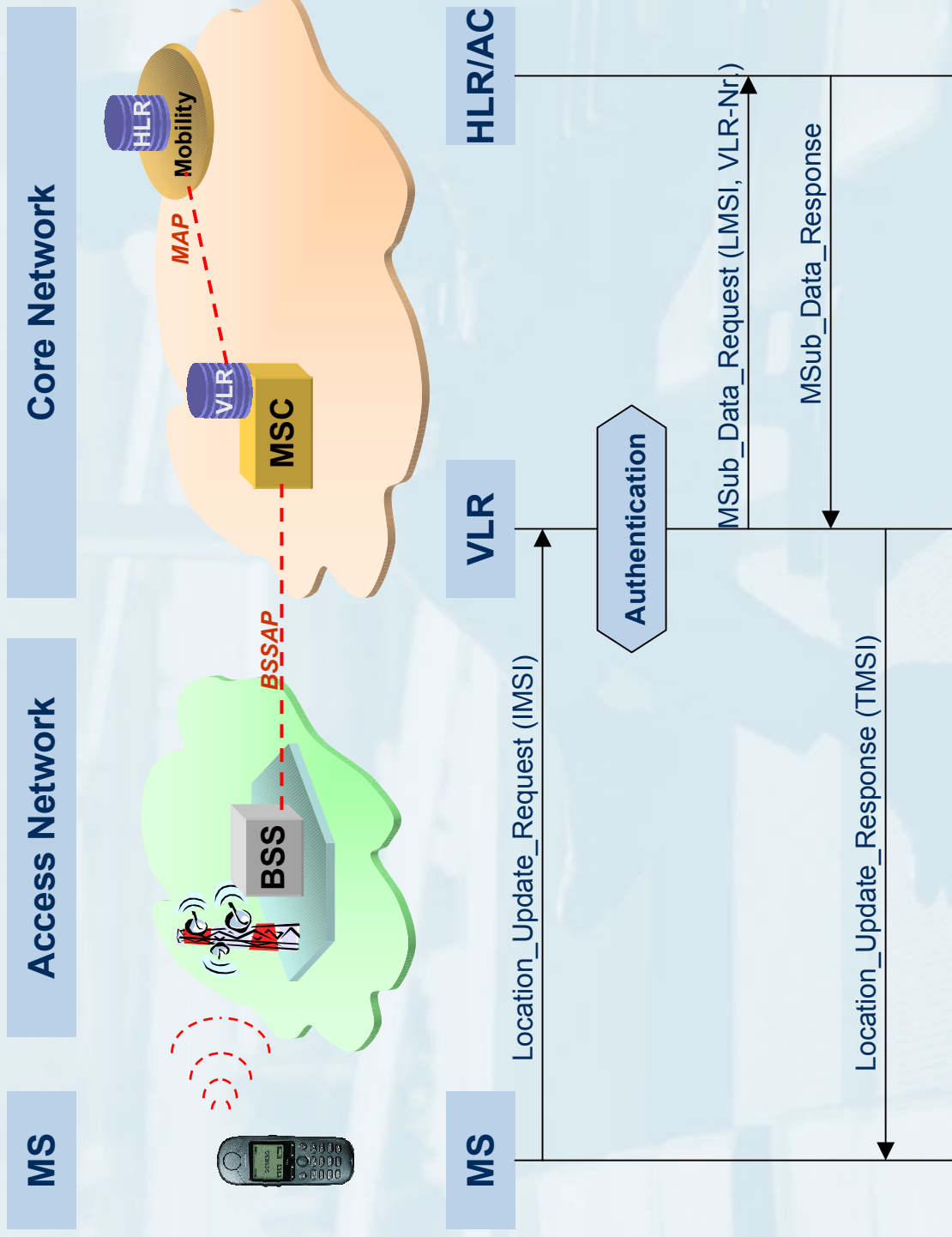
■ Trigger:

- MS detects that stored location information on SIM (LAI) is different to the received location information via broadcast channel (not during stable call!)

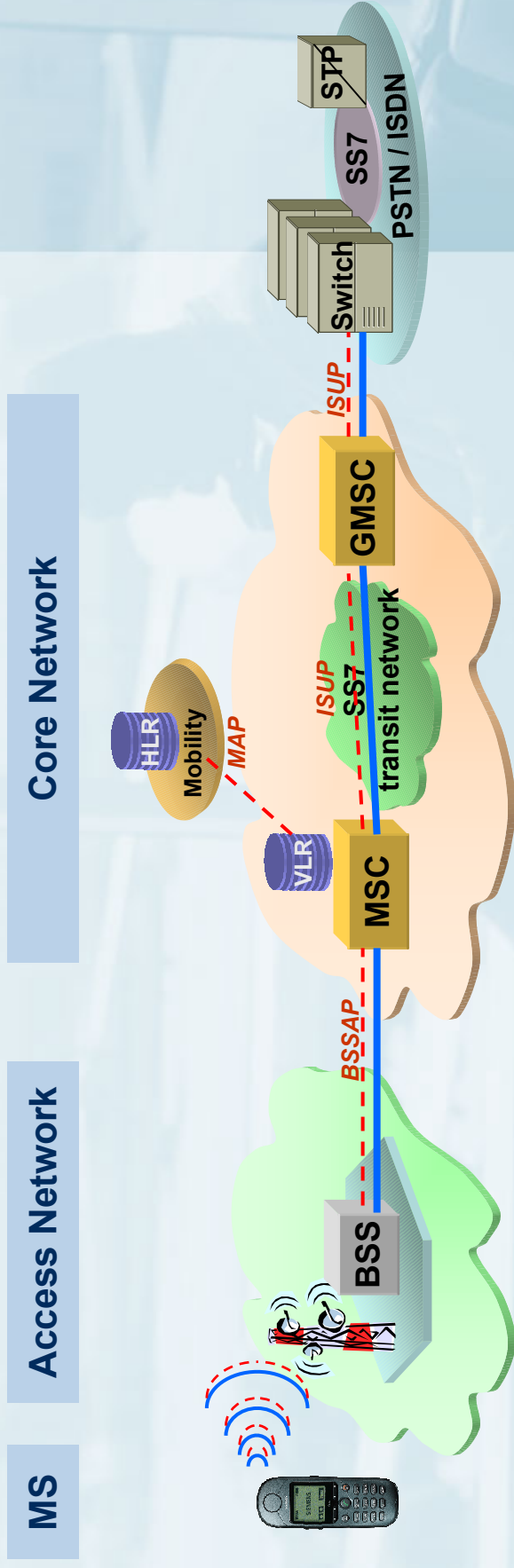
■ Affected entities:

- MS
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Location Update (II)

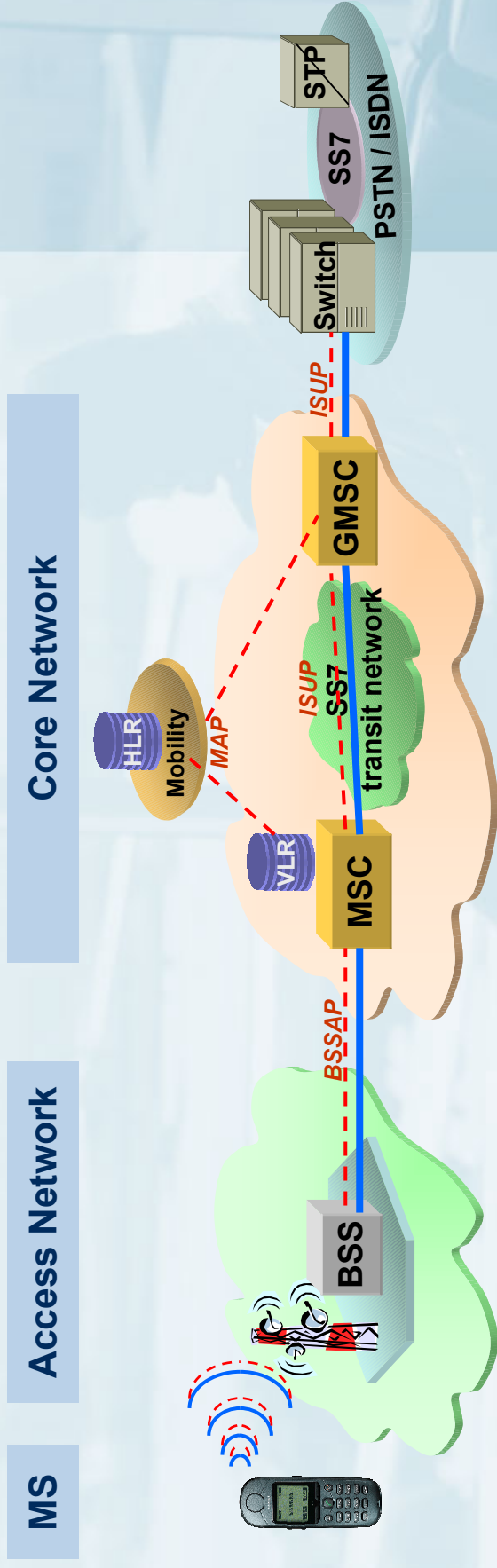


Mobile Originating Call (MOC) to PSTN



1. Location Update → MSub-A is known in VLR!
2. MSub-A dials MSISDN of B-Subscriber → MOC Request!
3. Traffic Channel Request
4. Authentication by VLR
5. Subscription check (Authorisation for services)
6. Traffic Channel Assignment and Routing to B-Subscriber by MSC
7. Connection will be established when B-Subscriber answers.

Mobile Terminating Call (MTC)



1. PSTN Subscriber dials MSISDN from MS.
2. Digit analysis in PSTN results routing into PLMN.
3. Network access to a PLMN always via GMSC (Gateway-MSC).
4. GMSC needs routing information to VMSC of MS! → **Interrogation**
5. GMSC establishes a connection to MSC and sends forward the MSRN.
6. MSC requests by means of MSRN the TMSI and the LAI of MS from the VLR stored during last LUP of MS.

Paging

■ Purpose:

- Provisioning of routing information from GMSC to VMSC for incoming calls (MTC)

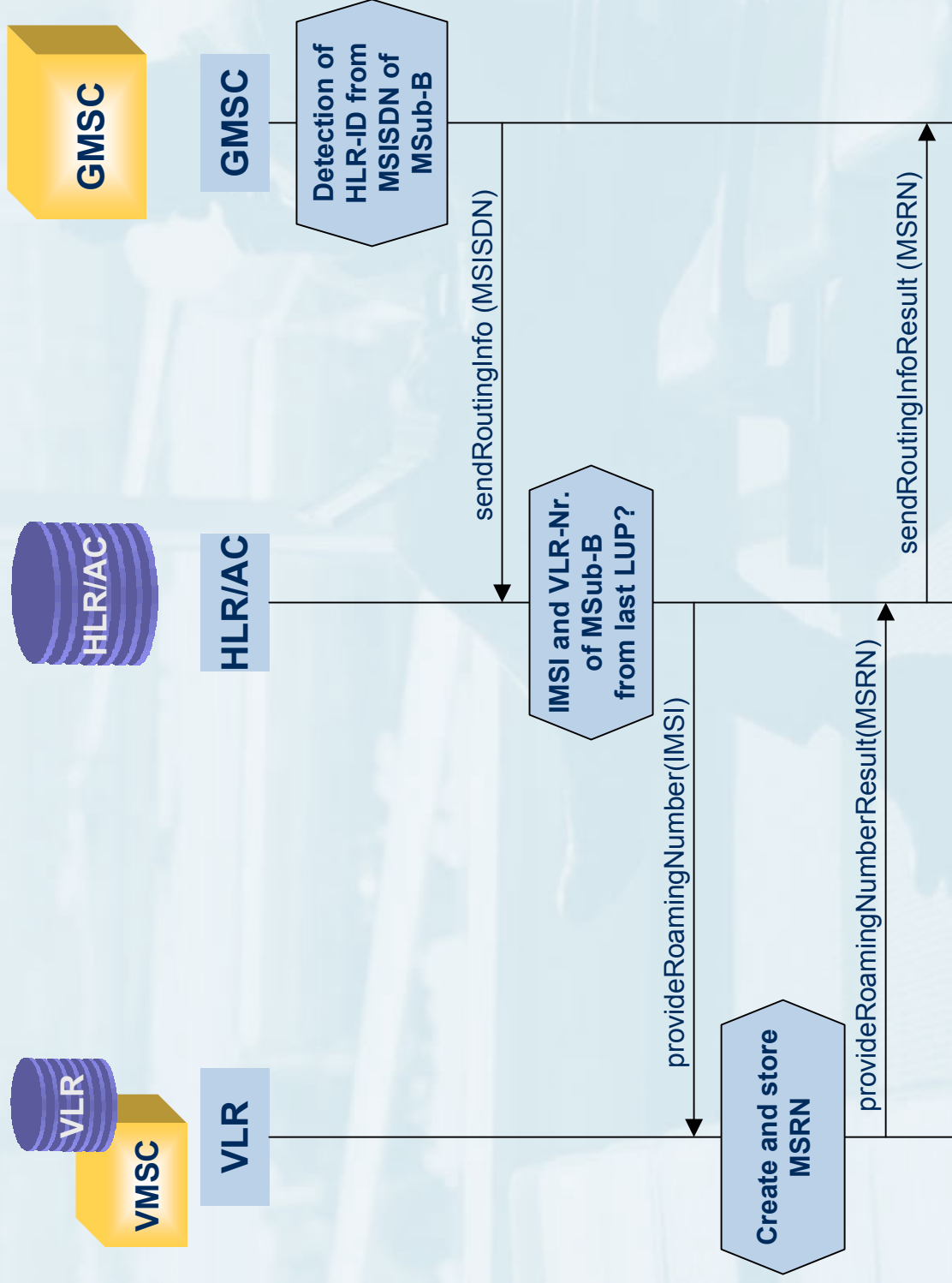
■ Trigger:

- Always in GMSC
- Digit processing of MSISDN (MSub-B) detects „interrogation“ necessary

■ Affected entities:

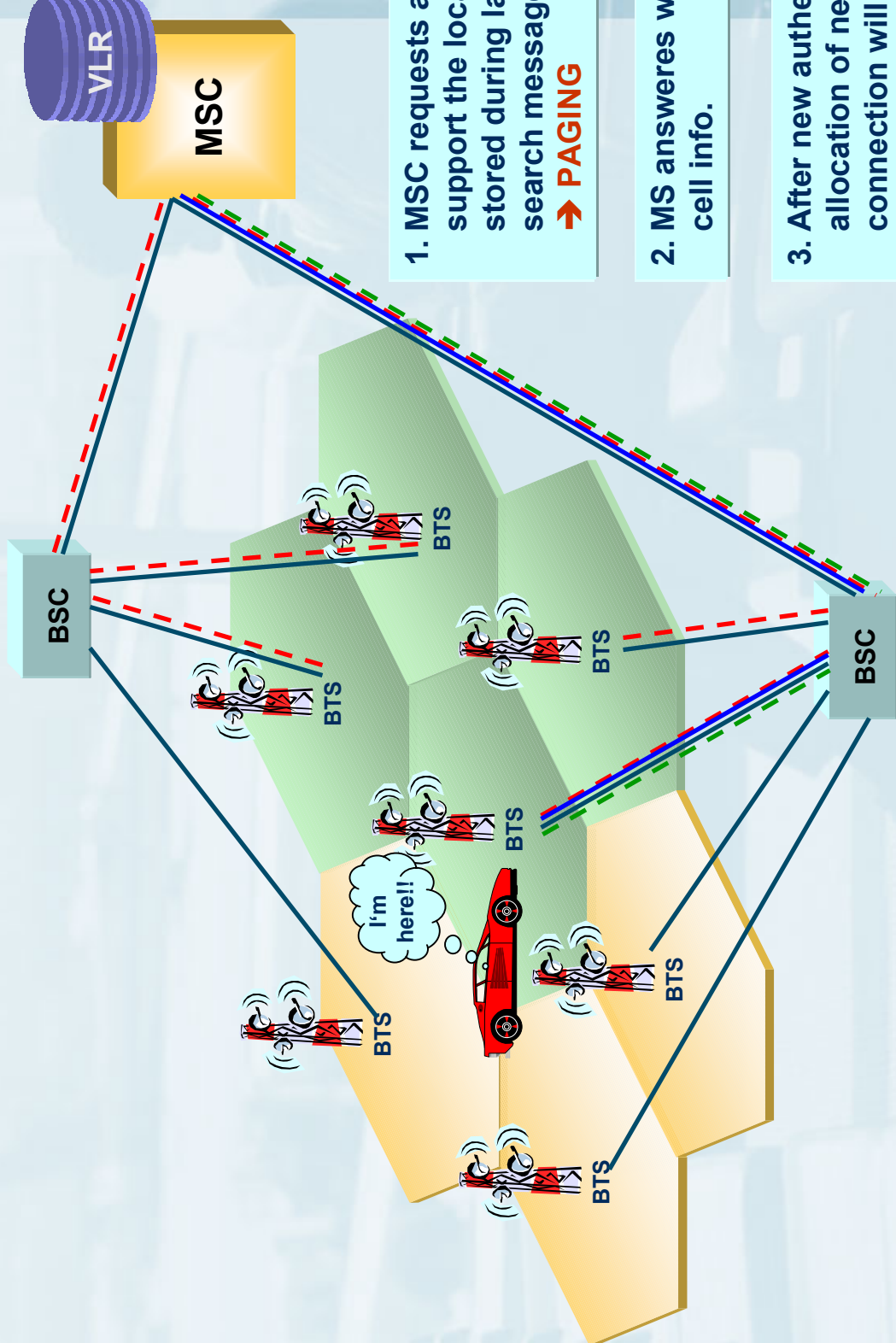
- GMSC
- HLR
- MSC/VLR

Interrogation(II)



- **Purpose:**
 - Determination of current subscriber location
- **Trigger:**
 - Incoming call (MTC)
- **Affected entities:**
 - MS
 - MSC/VLR

Paging (II)



1. MSC requests all BSCs that support the location area stored during last LUP to sent a search message to the MS.
→ **PAGING**

2. MS answers with the current cell info.

3. After new authentication and allocation of new TMSI by VLR connection will be established!

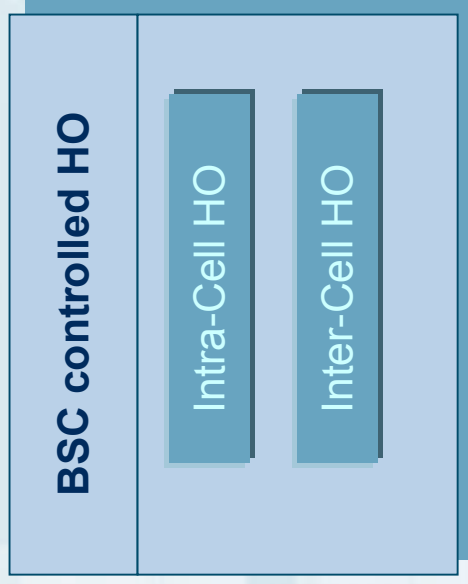
■ What is Handover?

If a mobile subscriber changes the cell during stable call the BTS of the new cell takes over the connection without interruption.

➔ ***Handover (HO)***

■ General 4 kinds of Handover

Controlled by Access Network



Controlled by Core Network



■ BSC controlled HO

- Intra-Cell HO
 - *Changing the physical channel inside a cell*
- Inter-Cell HO
 - *Changing the cell*

■ MSC controlled HO

- Intra-MSC HO
 - *Changing the serving BSC*
- Inter-MSC HO
 - *Changing the visited MSC*

Common Phases of every HO

■ Basically there are 4 phases:

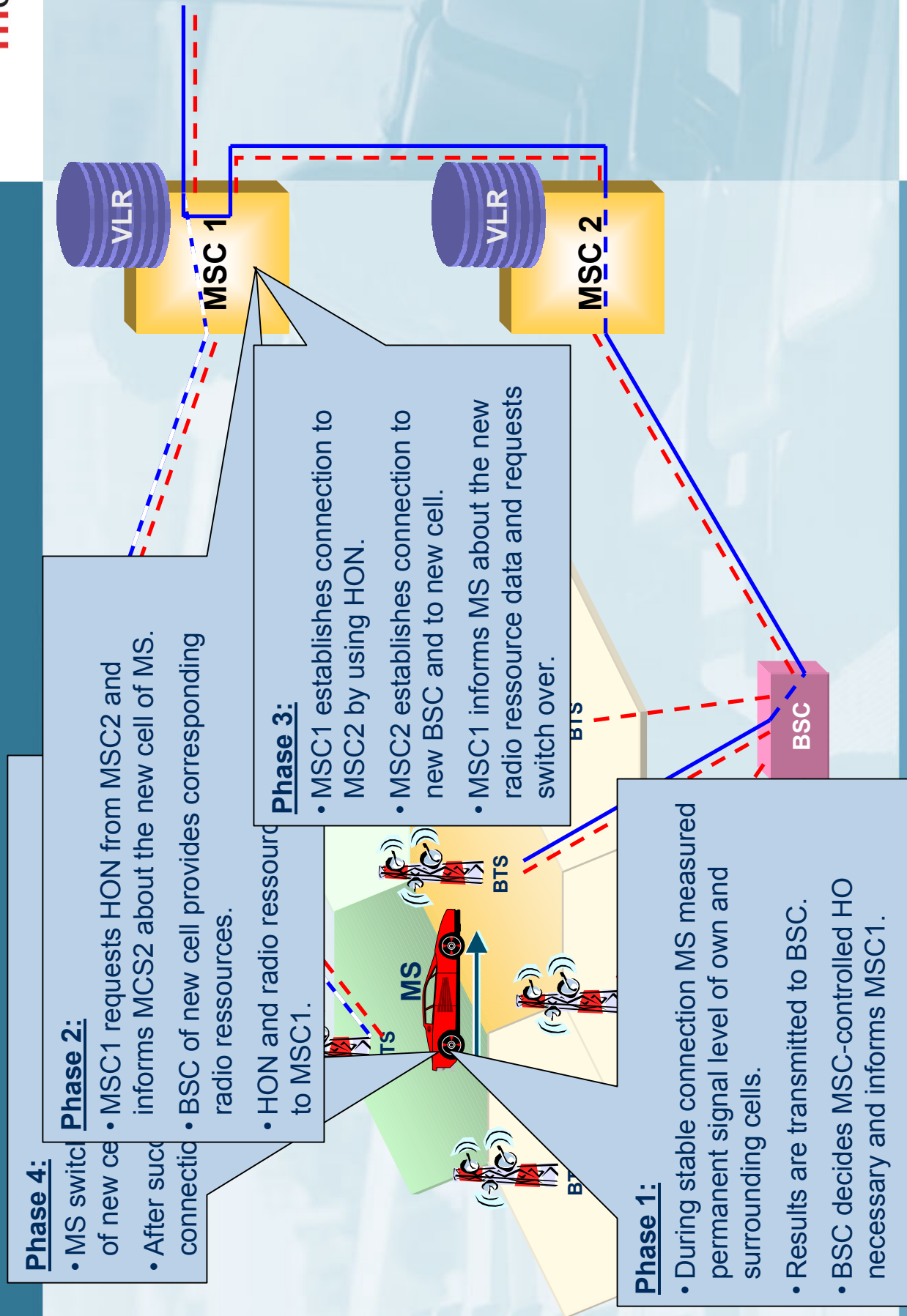
Phase 1: BSC decides if HO is necessary!

Phase 2: Parallel to existing connection a second connection will be established!

Phase 3: MS switches over to new connection!

Phase 4: Originally connection will be released!

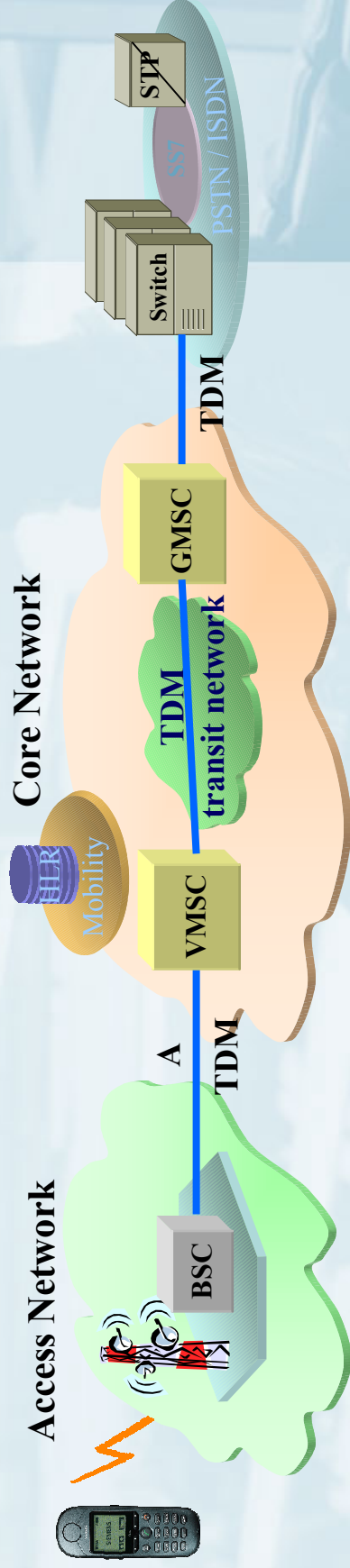
Example Inter-MSC HO

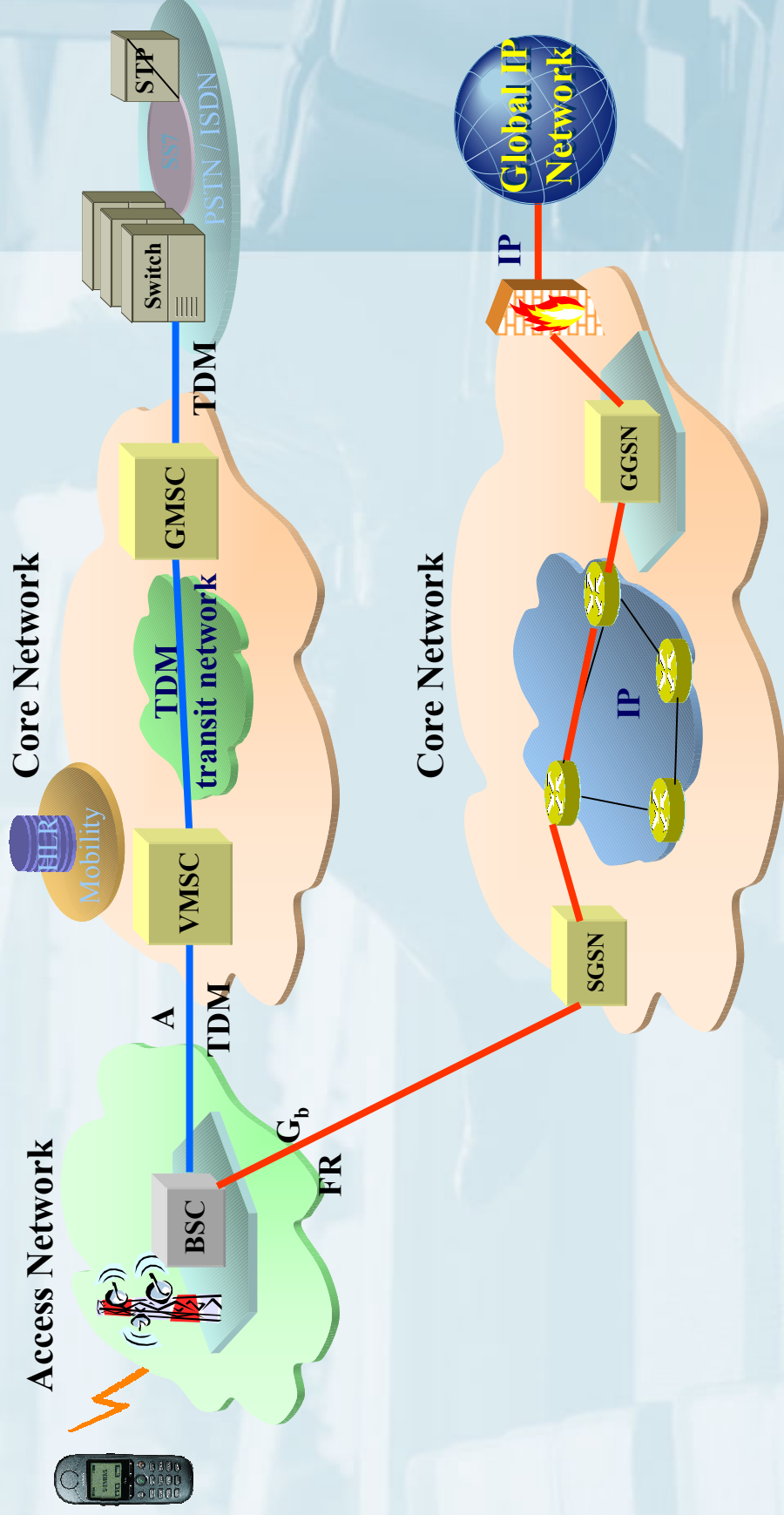


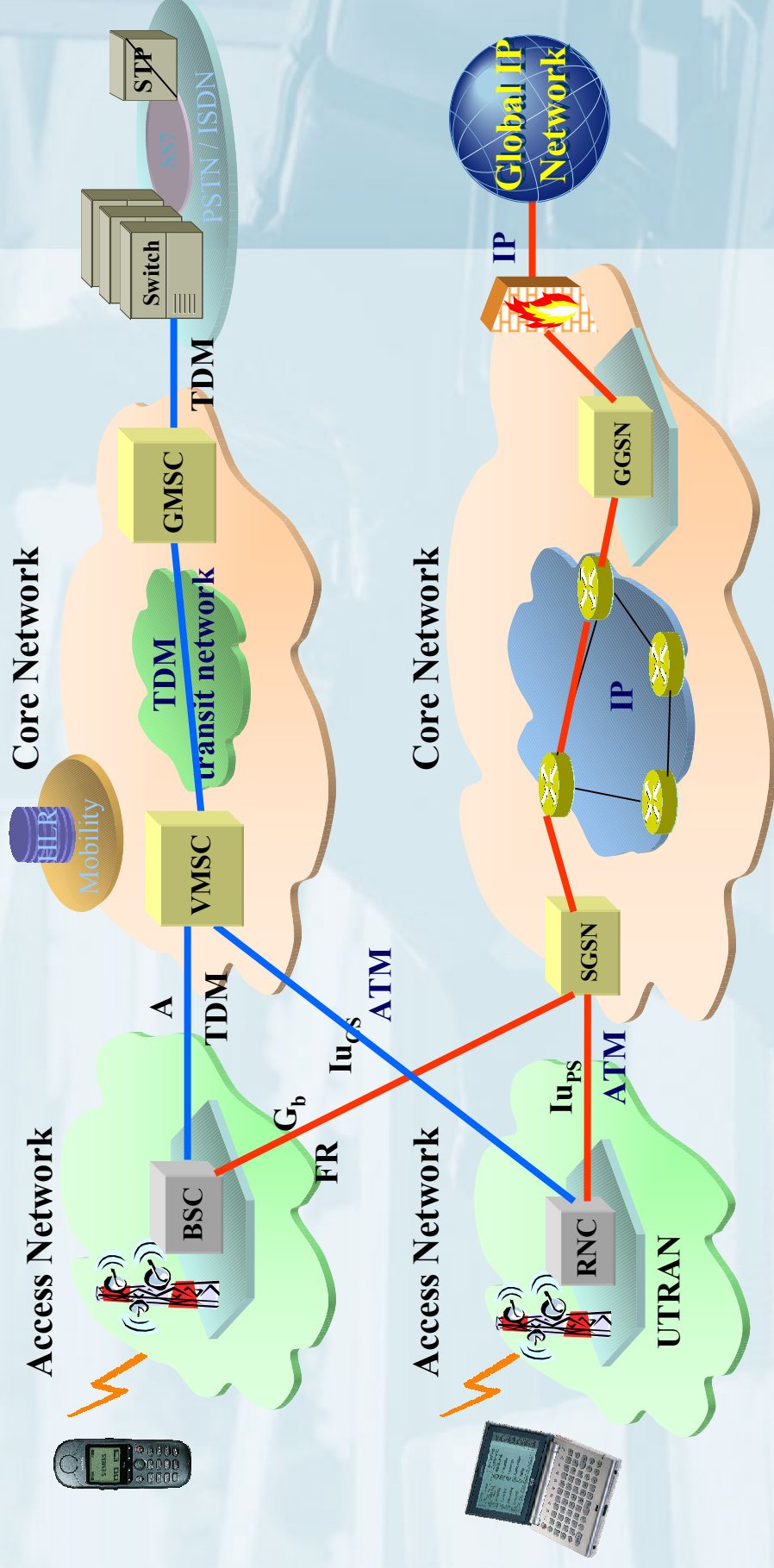
Network Migration from GSM to UMTS

Overview about Network Migration from **GSM** Over **GPRS** To **UMTS**

Classic GSM – 2G







Back Up

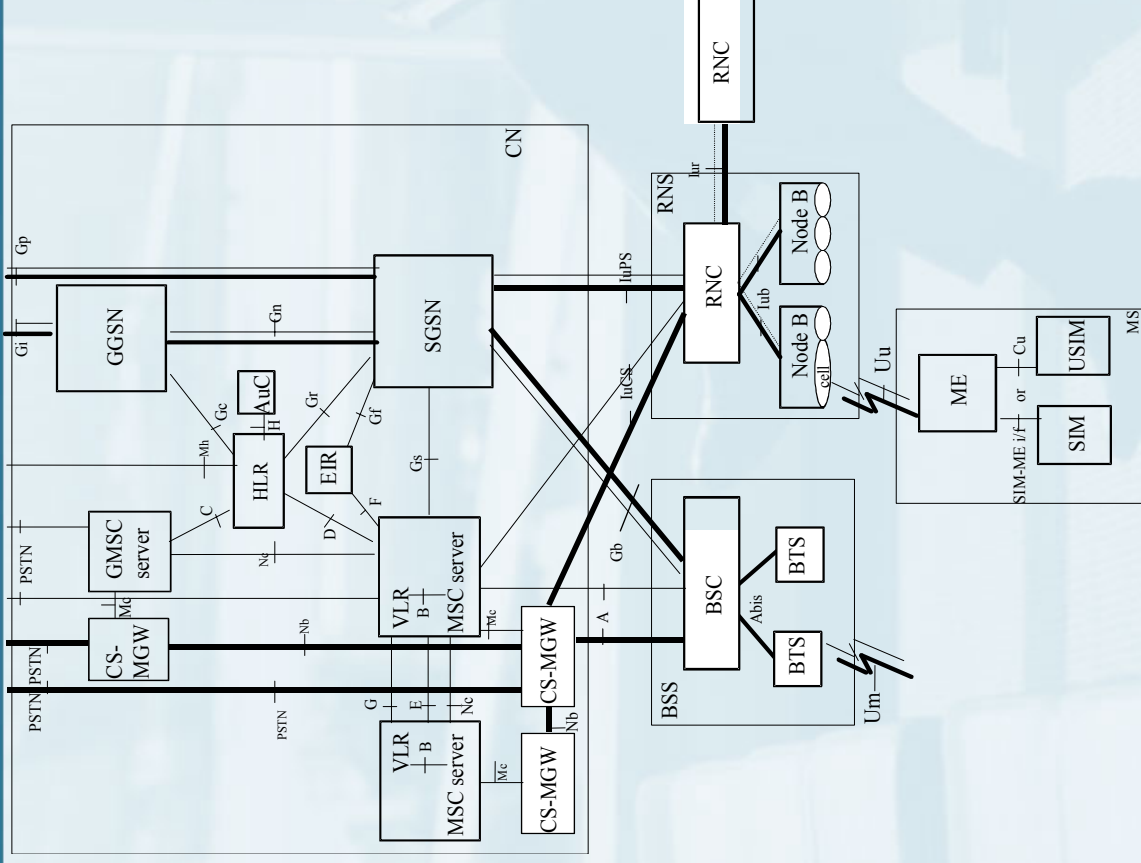
Abbreviations (I)

A3	Encryption algorithm for authentication (SRES)
A8	Encryption algorithm for ciphering (Kc)
AC	Authentication Centre
ATM	Asynchronous Transfer Mode
BSC	Base Station Controller
BSS	Base Station Subsystem
BSSAP	BSS – Application Part
BTS	Base transceiver station
CAMEL	Customized Applications Mobile network Enhanced Logic
CAP	CAMEL – Application Part
CN	Core Network
CS	Circuit Switched
DCS	Digital Cellular System
EIR	Equipment Identity Register
FR	Frame Relay
GGSN	Gateway GPRS Support Node
GMSC	Gateway – MSC
GPRS	General Packet Radio System
GSM	Global System for Mobile Communication
HLR	Home Location Register
HON	HandOver Number
IMSI	International Mobile Subscriber Identity
IN	Intelligent Network
IP	Internet Protocol
ISDN	Integrated Services Digital Network
ISUP	ISDN – User Part
Kc	Cipher Key
Ki	Individual Subscriber Authentication Key
LAI	Local Area Identity
LMSI	Local Mobile Subscriber Identity
LUP	Location Update
MAP	Mobile Application Part

Abbreviations (II)

ME	Mobile Equipment
MGW	Media Gateway
MOC	Mobile Origination Call
MS	Mobile Station
MSC	Mobile Switching Centre
MSISDN	Mobile Subscriber ISDN
MSRN	Mobile Subscriber Roaming Number
MSub	Mobile Subscriber
MTC	Mobile Terminating Call
OMS	Operation & Maintenance Subsystem
PLMN	Public Land Mobile Network
PO	Paket Oriented
PSTN	Public Switched Telephone Network
RAND	Random Number
RNC	Radio Network Controller
RNS	Radio Network System
RSS	Radio Subsystem
SCP	Service Control Point
SGSN	Serving GPRS Support Node
SIM	Subscriber Identity Module
SRES	Signed Response
SS7	Signalling System No.7
SSS	Switching Subsystem
STP	Signalling Transfer Point
TDM	Time Division Multiplexing
TMSI	Temporary Mobile Subscriber Identity
UMTS	Universal Mobile Telecommunications System
USIM	UMTS – SIM
VLR	Visitor Location Register
VLR-Nr	VLR-Number
VMSC	Visited – MSC

Network structure defined by 3GPP



PSTN:	Public Switched Telecommunication Network
CN:	Core Network
CS:	Circuit Switched
MGW:	Media Gateway
MSC:	Mobile Switching Centre
GMSC:	Gateway-MSC
PO:	Packet Oriented
GSN:	GPRS Support Node
SGSN:	Serving-GSN
GGSN:	Gateway-GSN
VLR:	Visitor Location Register
HLR:	Home Location Register
EIR:	Equipment Identity Register
BSS:	Base Station System
BSC:	Base Station Controller
BTS:	Base Transceiver Station
RNC:	Radio Network Controller
RNS:	Radio Network System
ME:	Mobile Equipment
SIM:	Subscriber Identity Module
USIM:	UMTS-SIM
MS:	Mobils Station