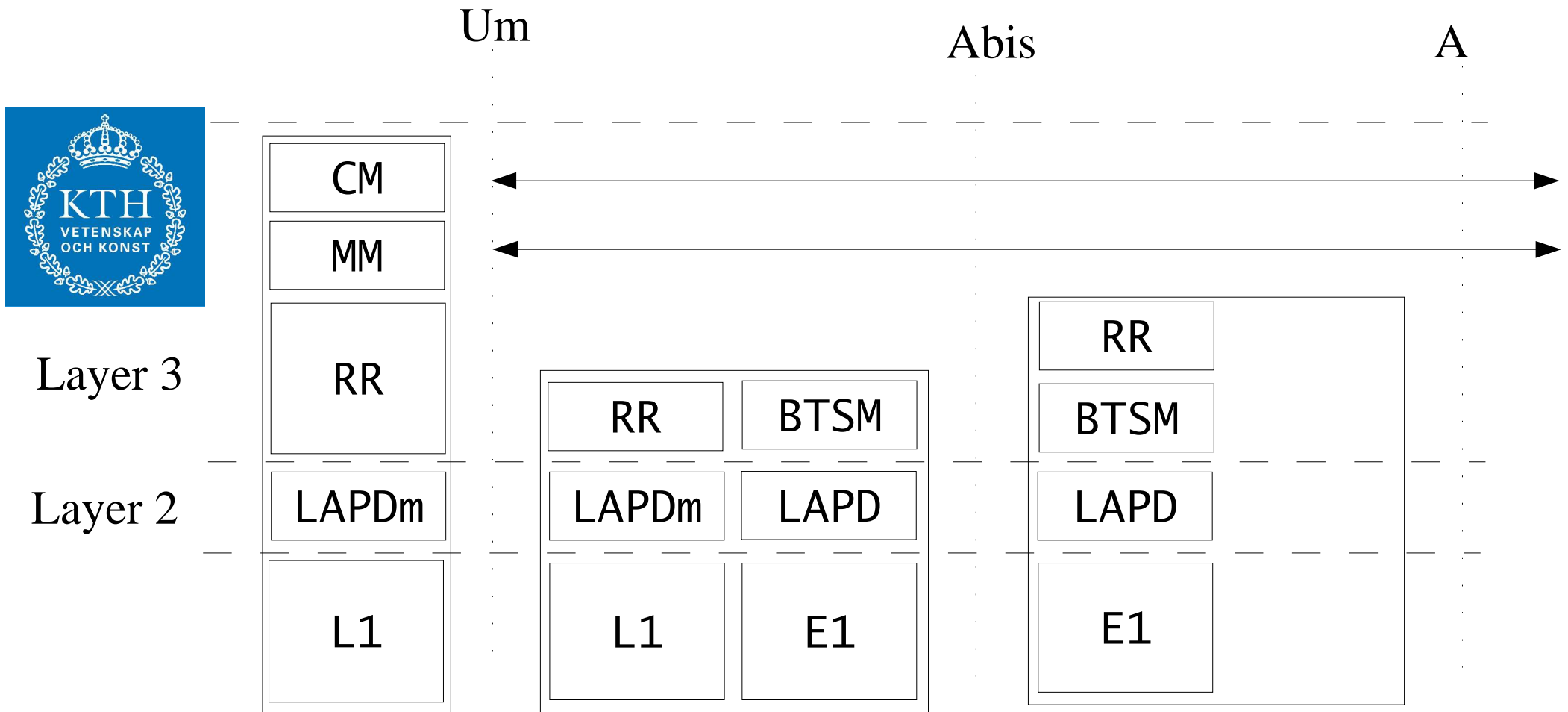


GSM Network and Services



Call Control, SMS and MAP signaling
- BSC/MSC/VLR/HRL/AUC/SMSC and more

Signaling protocols MS - BSS



Layer 3

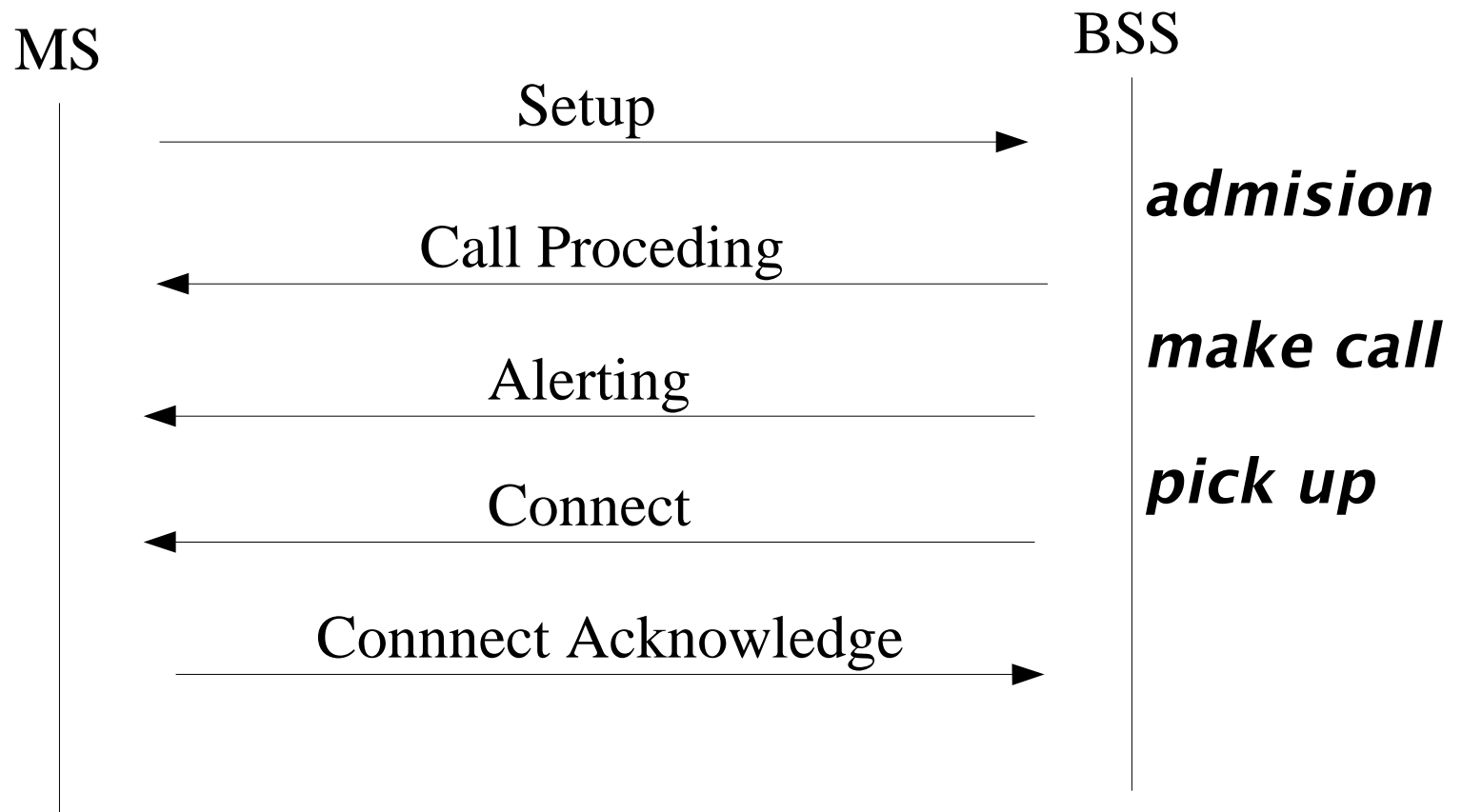
Layer 2

Connection Management



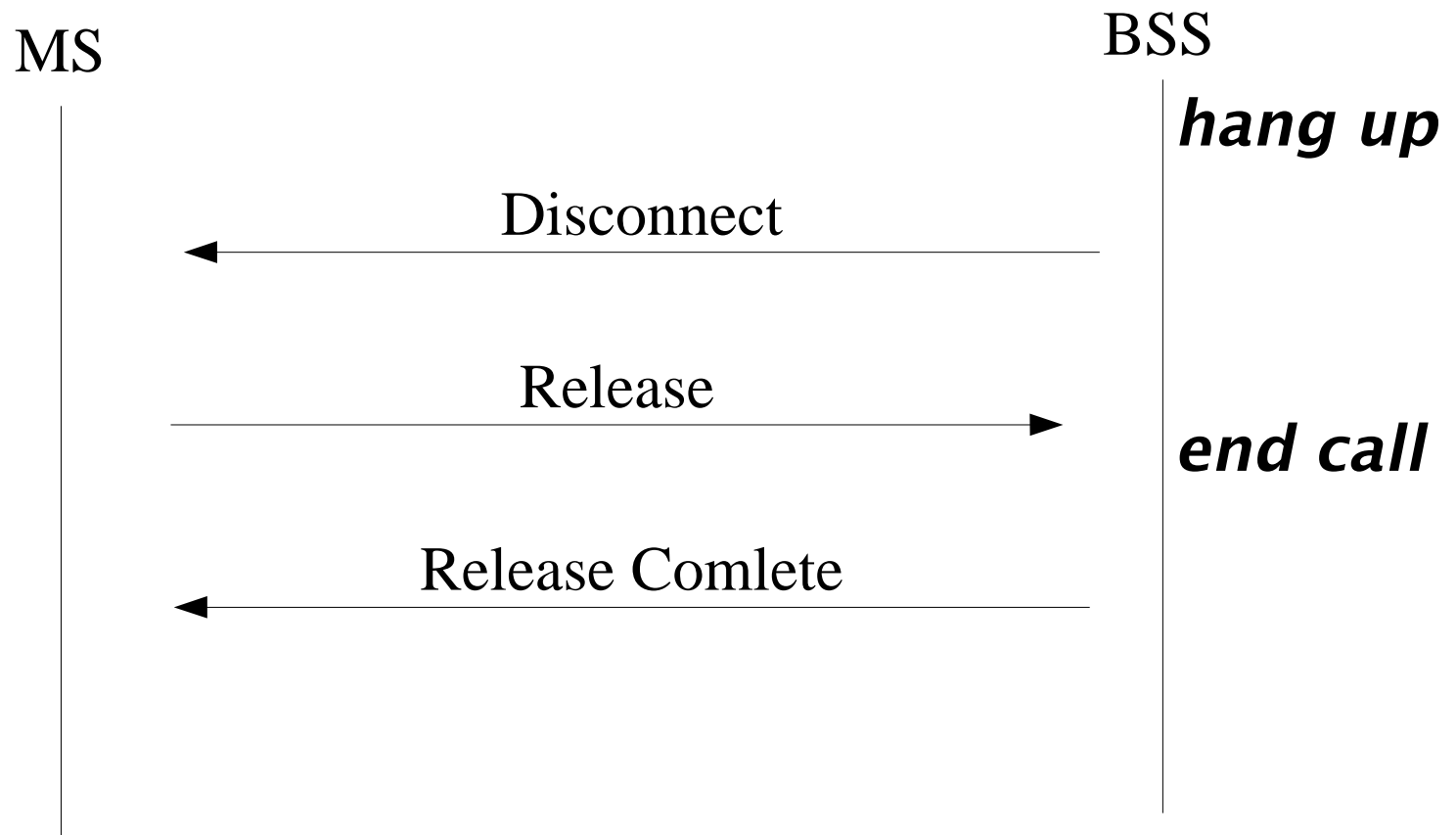
- Call Control
 - establish and terminate calls
 - call related supplementary services
- Supplementary Services
 - call forwarding / barring
 - Number identification
 - Charging
- SMS
 - Sending and receiving of short messages

CC procedures – mobile originated call



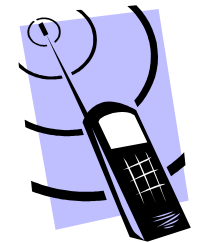
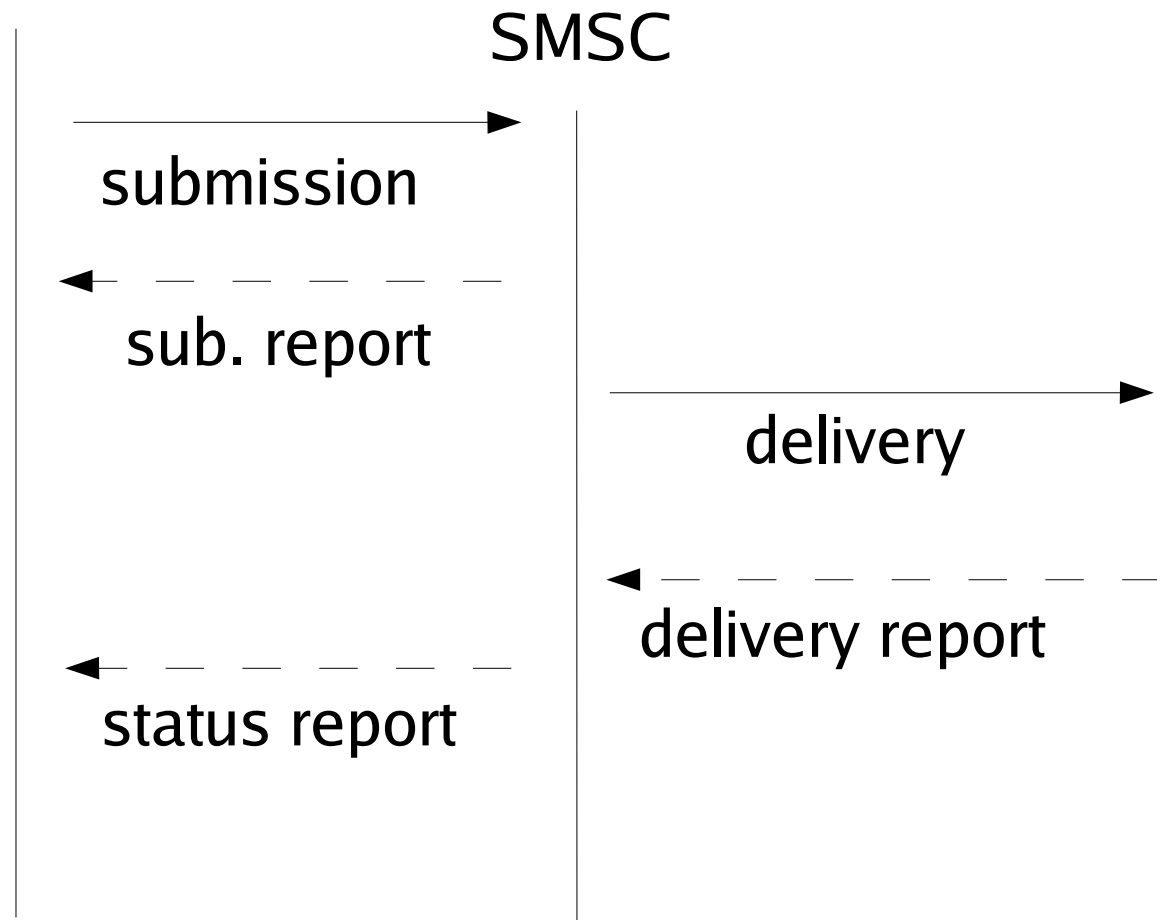
This is only the CC procedures!

CC procedures – terminate call

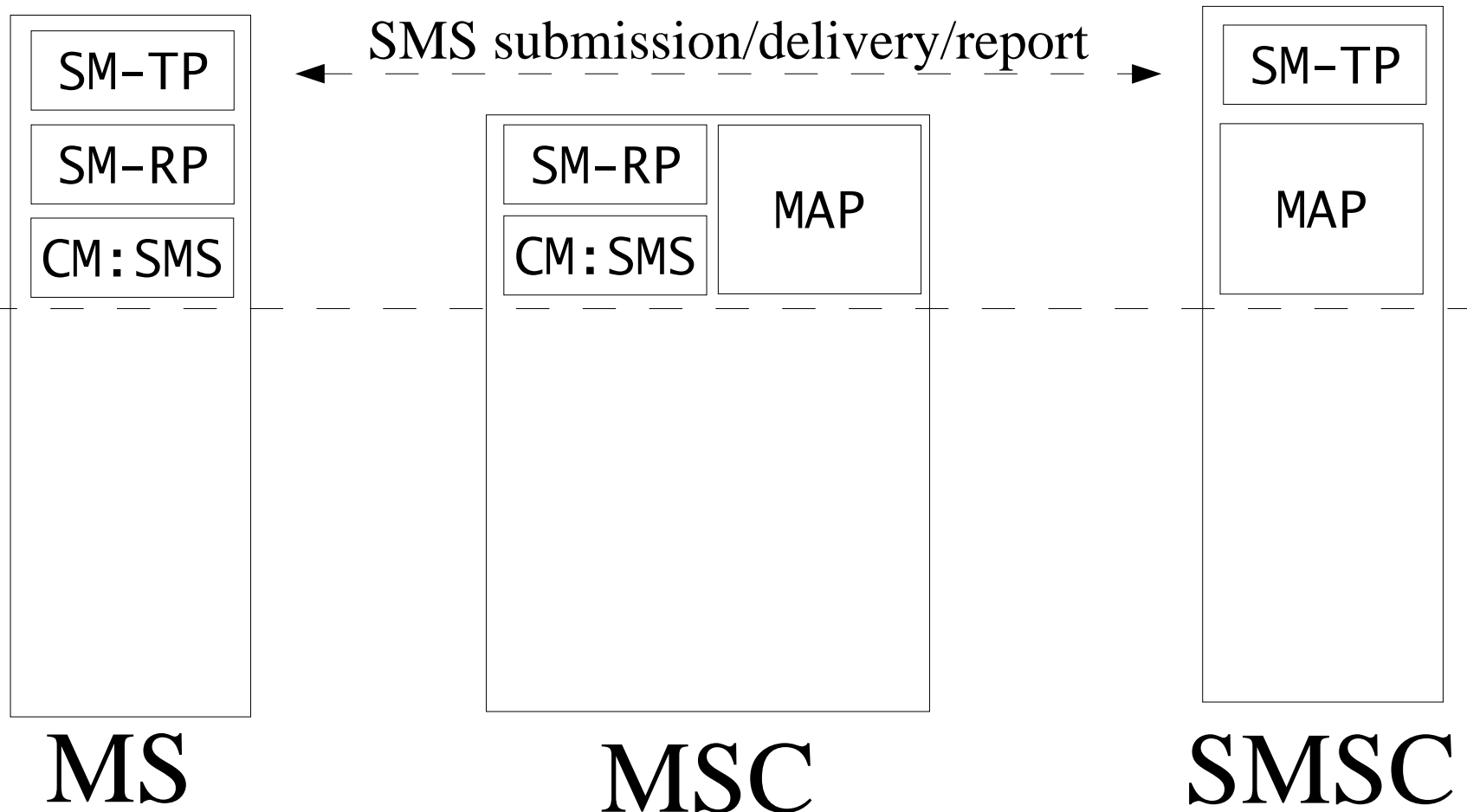


This is only the CC procedures!

SMS signaling



Signaling protocols – SMS





SMS - signaling

- SM-TP – short message transport protocol
 - The high level communication between the MS and the SMSC.
- SM-RP – short message relay protocol
 - Holds a state between submission and submission report (or delivery and delivery report) so that the MM/RR resources can be released between messages.
- SM-CP – short message control protocol (CM:SMS)
 - ARQ over the air interface



SMS services

- Mobile Terminating and Mobile Originating SMS is treated as two different services.
- Mobile has the address of a SMS service center (in the home PLMN) to which all messages are sent.
- The SMSC can be reached from external nodes (Short Message Entities) through a number of protocols.

SMS-SUBMIT



- Message Type Indicator
- Reject Duplicate
- Validity Period Format
 - no, relative (1), absolute (7) or extended (7)
- Status Report Request
- User Data Header Ind.
- Reply Path Request
- Message reference
 - to identify duplicates etc
- Protocol identifier
- Coding scheme

7	6	5	4	3	2	1	0
RP	DHI	SRR	VPF	RD	MTI		
message reference							
destination address (2 – 12 octets)							
protocol identifier							
coding scheme							
validity period (0, 1 or 7 octets)							
user data length							
user data (0 – 140 octets)							

Coding scheme



- Character coding
 - GSM 7-bit (3GPP 23.038)
 - Universal Character Set (ISO 10646)
 - Text compression
- Coding group
 - automatic deletion, message waiting
- Message class
 - immediate display
 - store: mobile, SIM, terminal eq (PDA, computer ...)



Protocol Identifier

- regular: SME to SMSC
- page: acknowledge but do not notify user
- mobile: handled by the terminal
- SIM: handled by the card
- telematic services: fax, telex, email
- many more

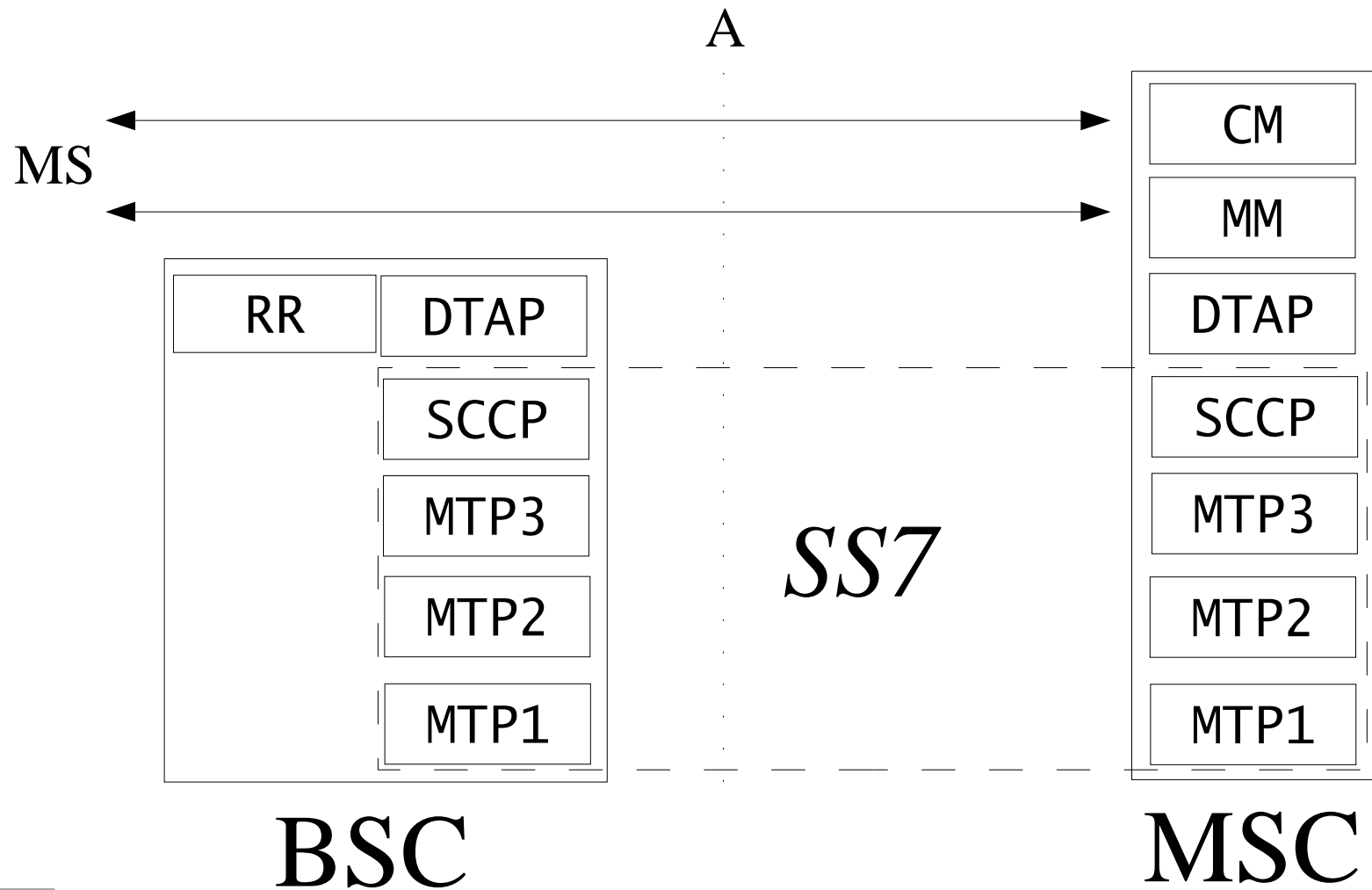
SMS-DELIVERY



- Message Type Indicator
- More messages
- Status Report Ind.
- Originator address
- Protocol identifier
- Coding scheme
- Time stamp

7	6	5	4	3	2	1	0
RP	DHI	SRI			MM		MTI
originator address (2 -12)							
protocol identifier							
coding scheme							
time stamp (7 octets)							
user data length							
user data (0 – 140 octets)							

Signaling protocols – MS/BSC/MSC

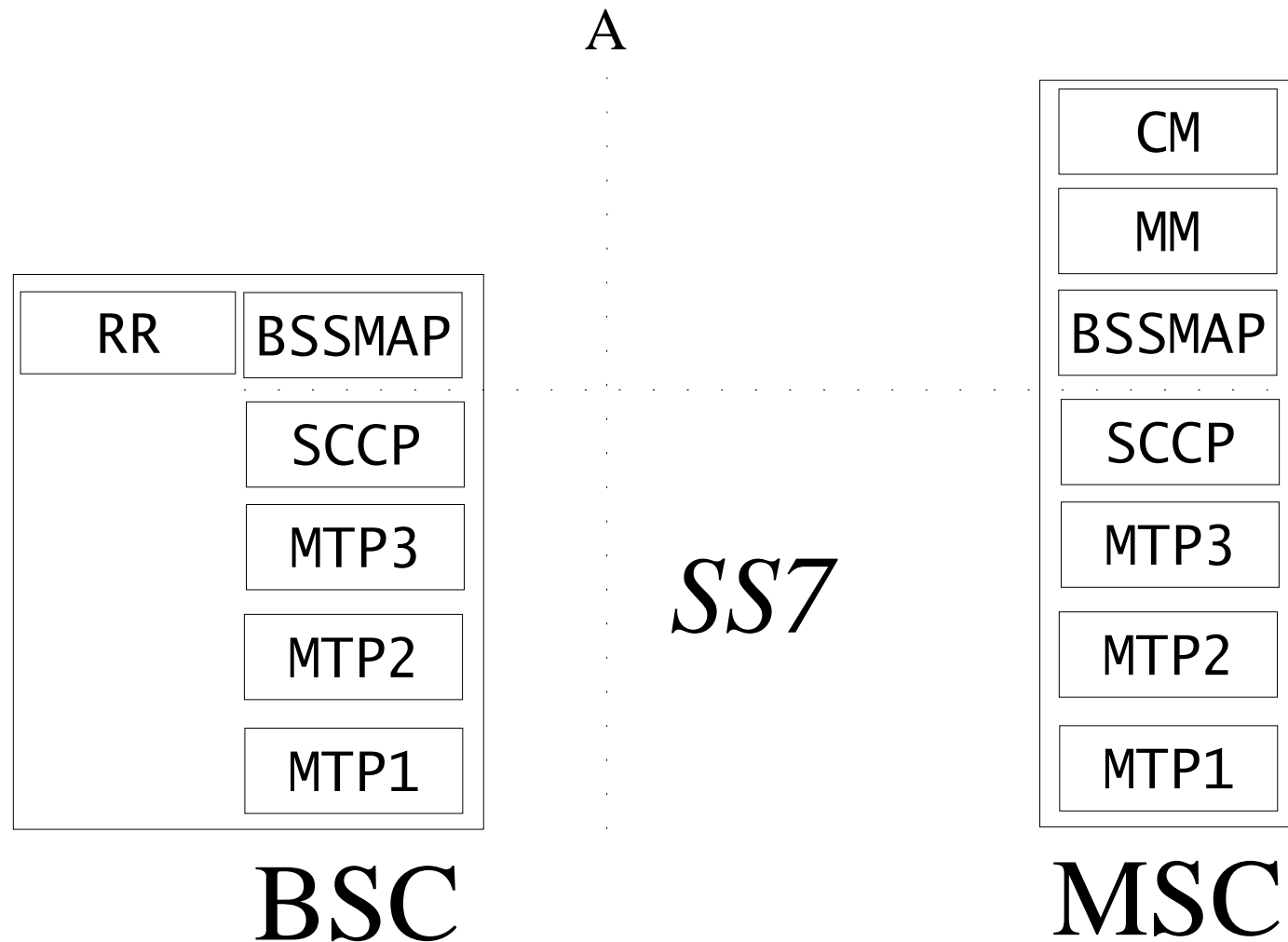




DTAP - Direct Transfer Application part

- Transports MM and CM messages transparently through the BSC to the mobile station.
- DTAP sessions uses connection oriented SCCP
 - each session has a unique SCCP connection to the mobile
- New SCCP connections are established
 - Location updates
 - Handover to another BSC

Signaling protocols – BSC/MS

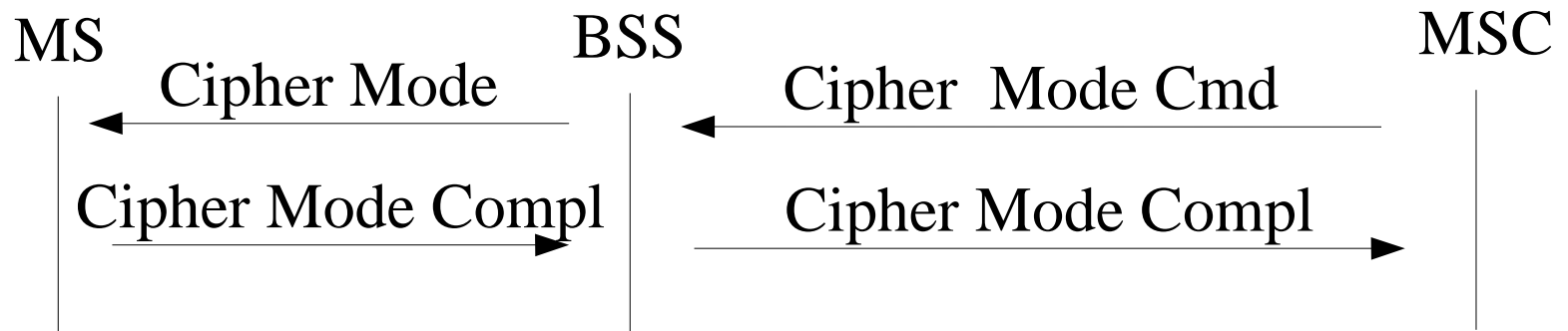
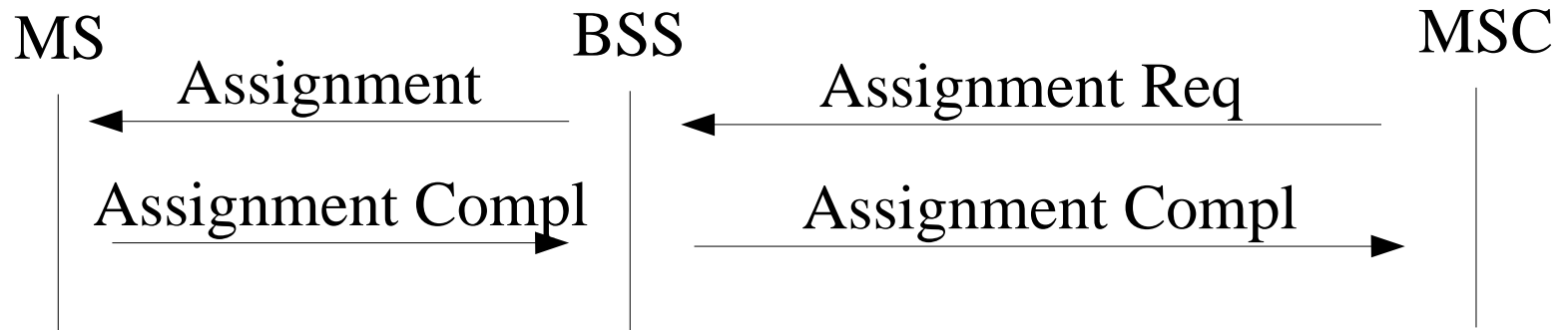


BSSMAP – BSS Mobile Application Part

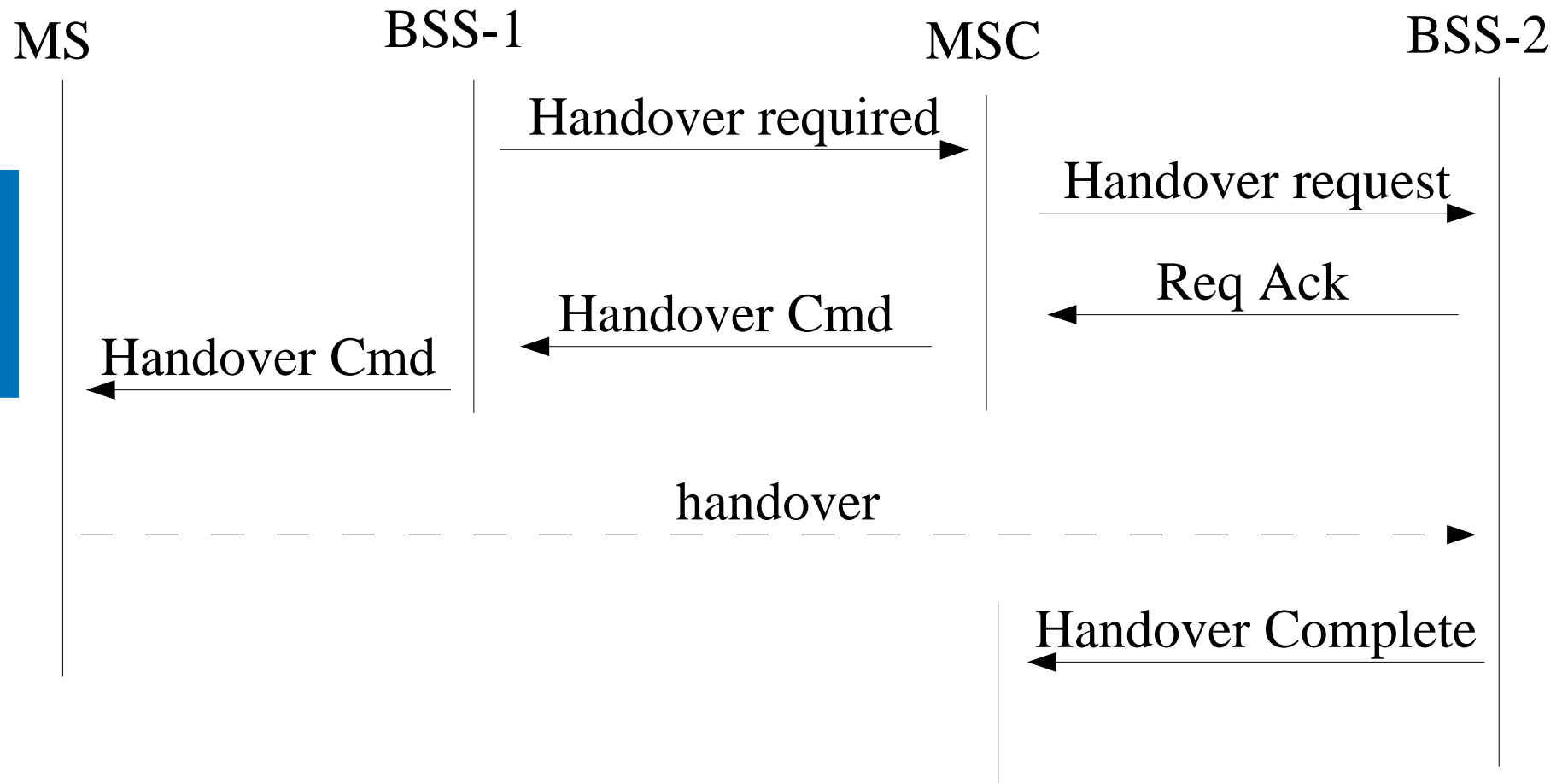


- For the Mobility Management layer (and CM) to control the RR layer.
- Global procedures
 - using connectionless SCCP
 - paging, channel control, over flow,...
- Dedicated procedures
 - using connection-oriented SCCP
 - channel assignment, ciphering, handover control, ...

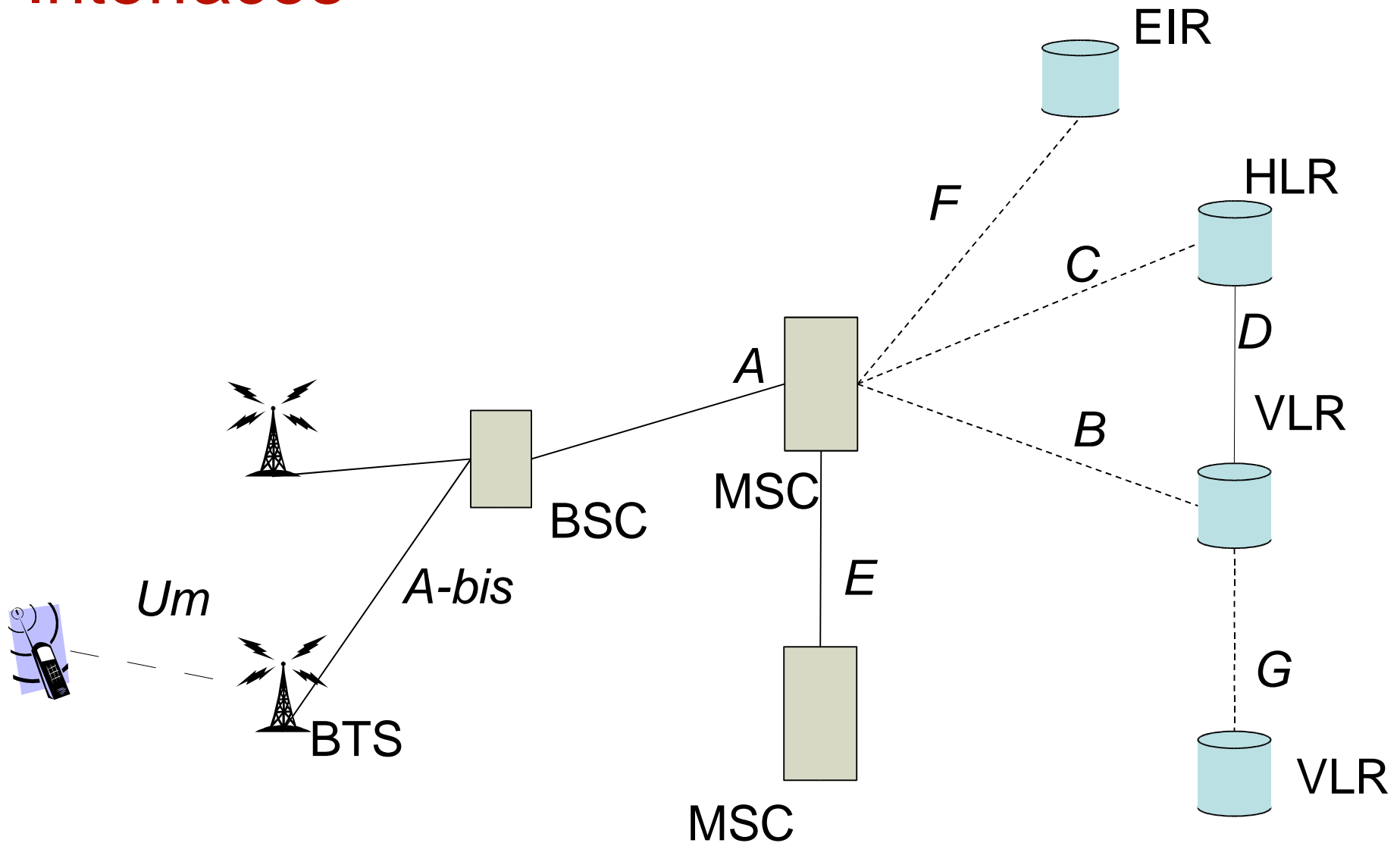
BSSMAP dedicated procedures



BSSMAP handover procedures



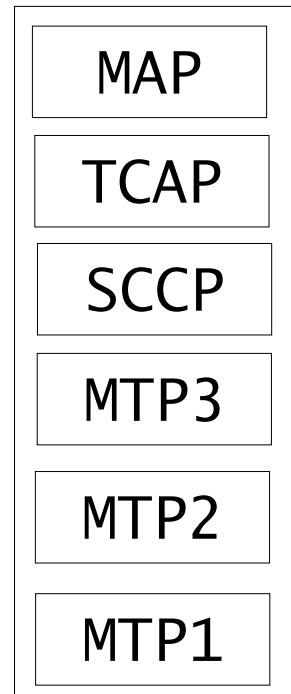
Interfaces



Signaling protocols – MSC/HLR/VLR/...



- TCAP - transaction capabilities application part, defined in the SS7 stack
- MAP – mobile application part, this is the application layer protocol used by MSC/VLR/HLR communication.

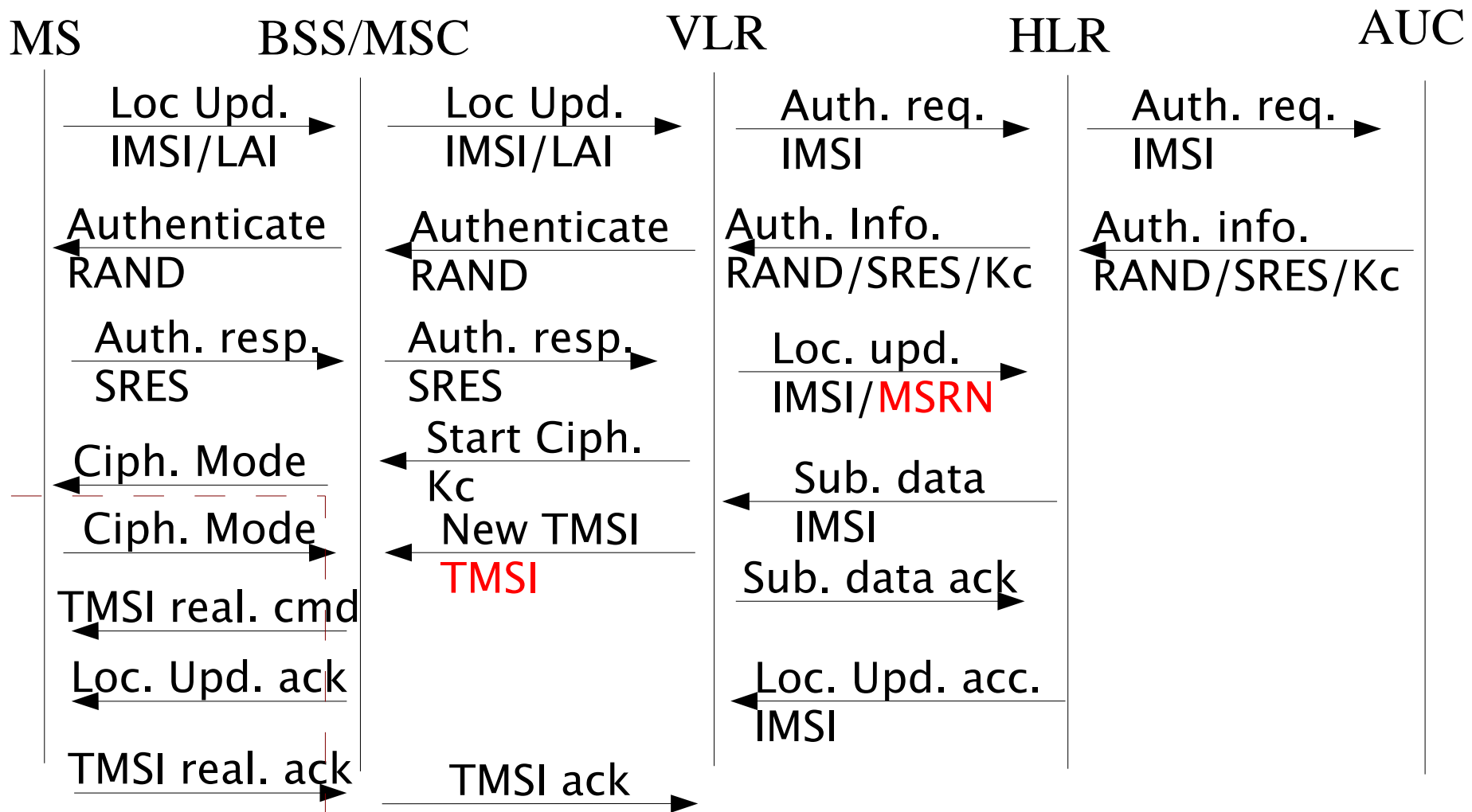




MAP – mobile application part

- The network side of Mobility Management
- Defines the interface between the MSC and the VLR/HLR/AUC databases.
- Also defines the interface between multiple MSCs and multiple PLMN.
- Responsible for mobility inside a PLMN and roaming between different PLMN.
- Also used by to implement for example SMS services in side a PLMN.

Location Update procedure





Location update

- If MS does not have a TMSI it will identify itself with IMSI.
- VLR might have to do a new authentication but this can be avoided if TMSI and Kc is know.
- HLR might have to ask AUC for new set of triplets.
- A new TMSI is generated by the VLR that is the address to the MSC of the location area and when asked identifies the TMSI in the VLR.



Location update - optional procedures

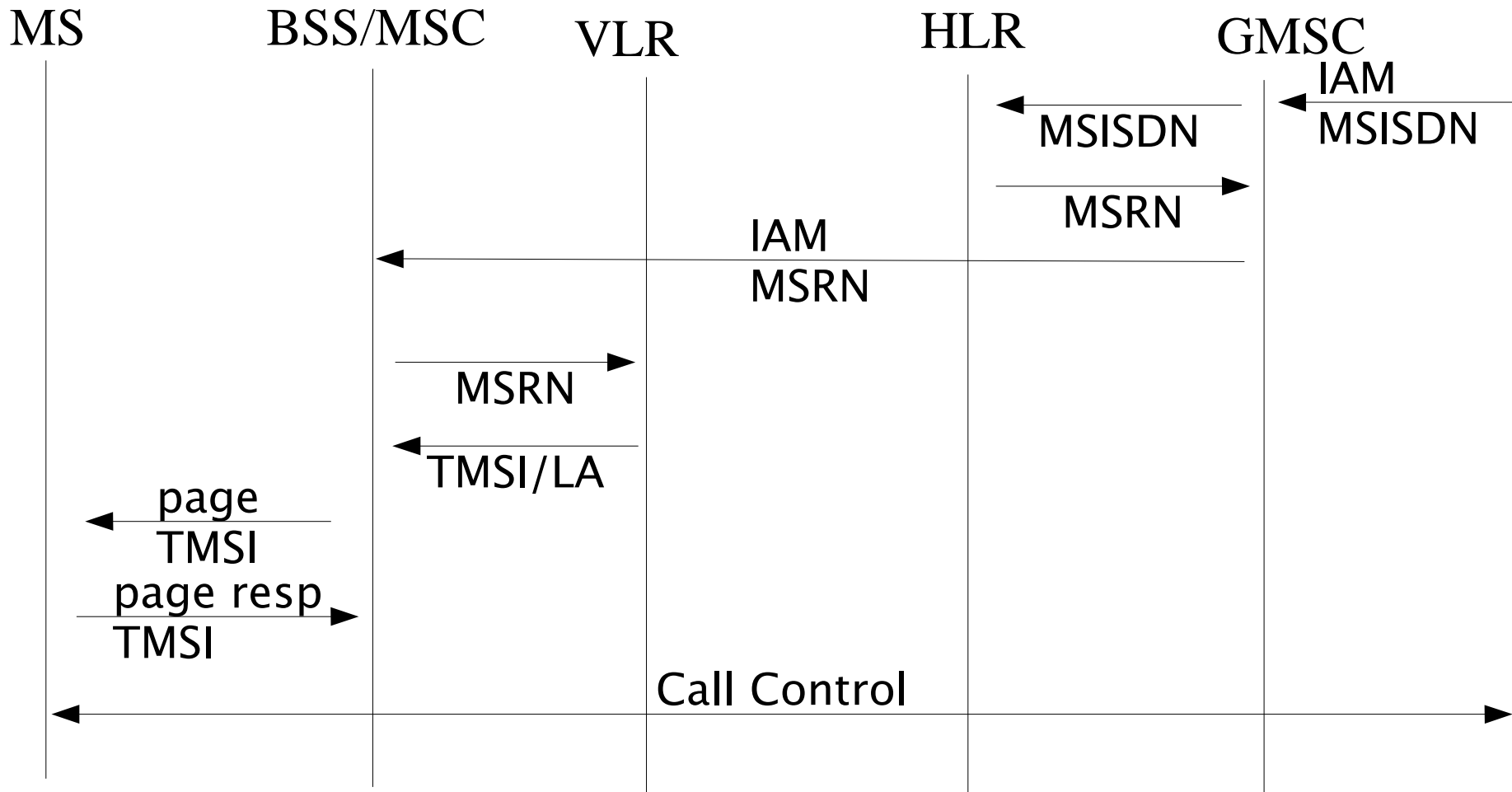
- VLR initiates ciphering in order to send the new TMSI in encrypted form.
- If the location are is under the same MSC the HLR need not be informed. If it is under a new MSC under the sam VLR a new MSRN is generated and sent to the HLR.



Location update - inter VLR update

- If the location update arrives to a new VLR the VLR has to ask the old VLR for encryption triplets identified by the TMSI.
- Once the mobile is authenticated the HLR is updated.
- The HLR asks the old VLR to cancel its register for the mobile.

Connection establishment





Connection establishment

- If the HLR does not have the MSRN then it has the address of the VLR. It will then ask the VLR for a MSRN given the IMSI that is tied to the MSISDN.
- If the calling network is MAP capable, and is allowed to, it can ask the HLR directly for the MSRN.
- If the subscriber is roaming in another PLMN then the local VLR will talk to the HLR of the home PLMN.

Handover



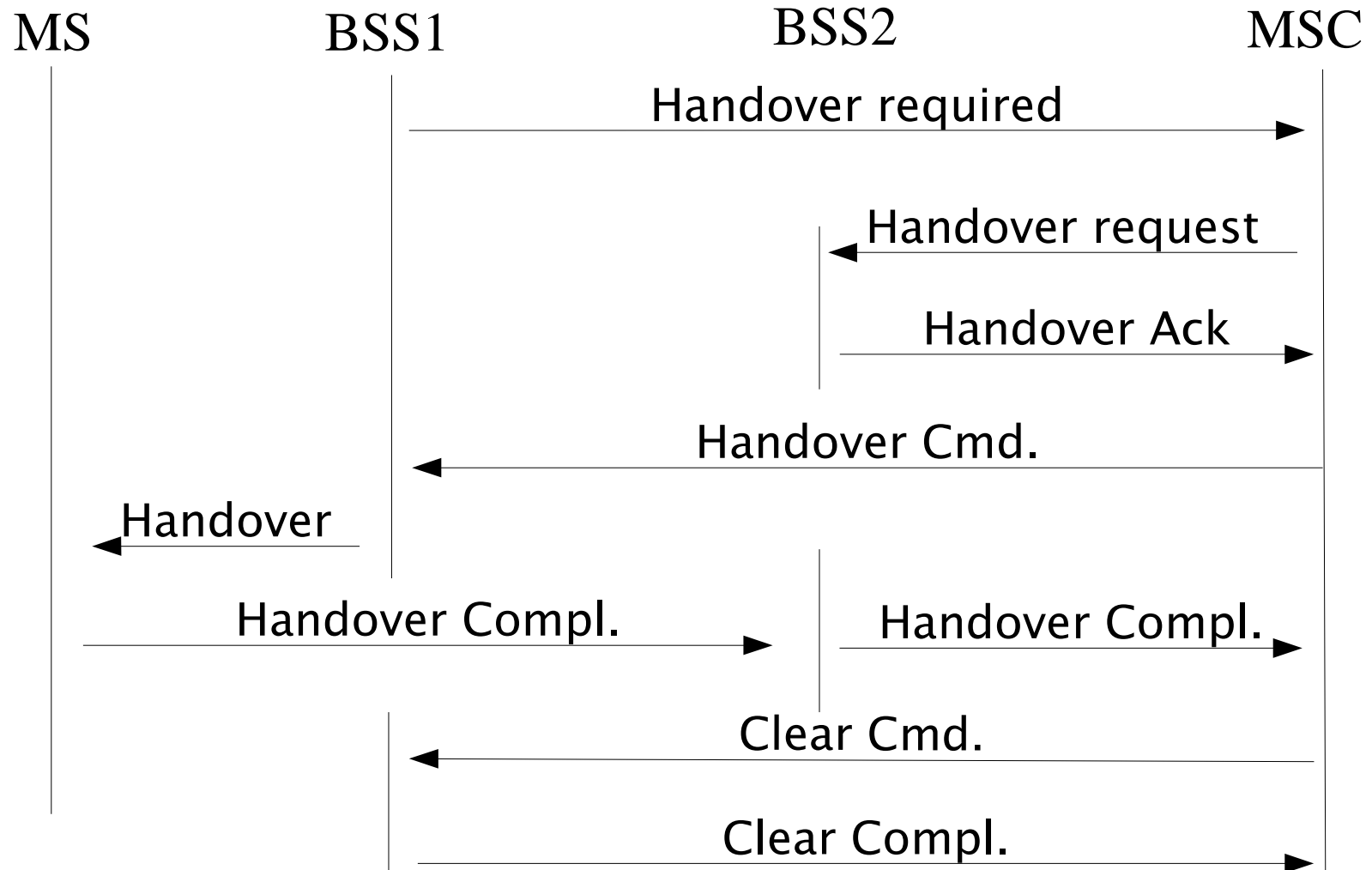
- Intracell handover: local decision of the RR in the BSC to switch to a timeslot or frequency with better radio conditions or a traffic channel with other (FR/HR/EFR) coding.
- Intercell handover:
 - decision made by the BSC
 - internal handover, MSC not involved
 - external handover, MSC involved
 - decision made by the MSC to improve load balancing in the network

Intra-MSC Handover

- A inter-MSC handover is an external handover (the MSC is involved) that does a handover from one BSC to another but the two BSC are controlled by the same MSC.



Intra-MSC handover





Inter-MSD Handover

- The *anchor MSC* is the MSC that handled the first call procedure. It will always be in charge of the call.
- If mobile moves to another MSC the call will go to the anchor MSC and then to the second MSC.
- If the mobile moves to a third MSC the second MSC will no longer be part of the call.