

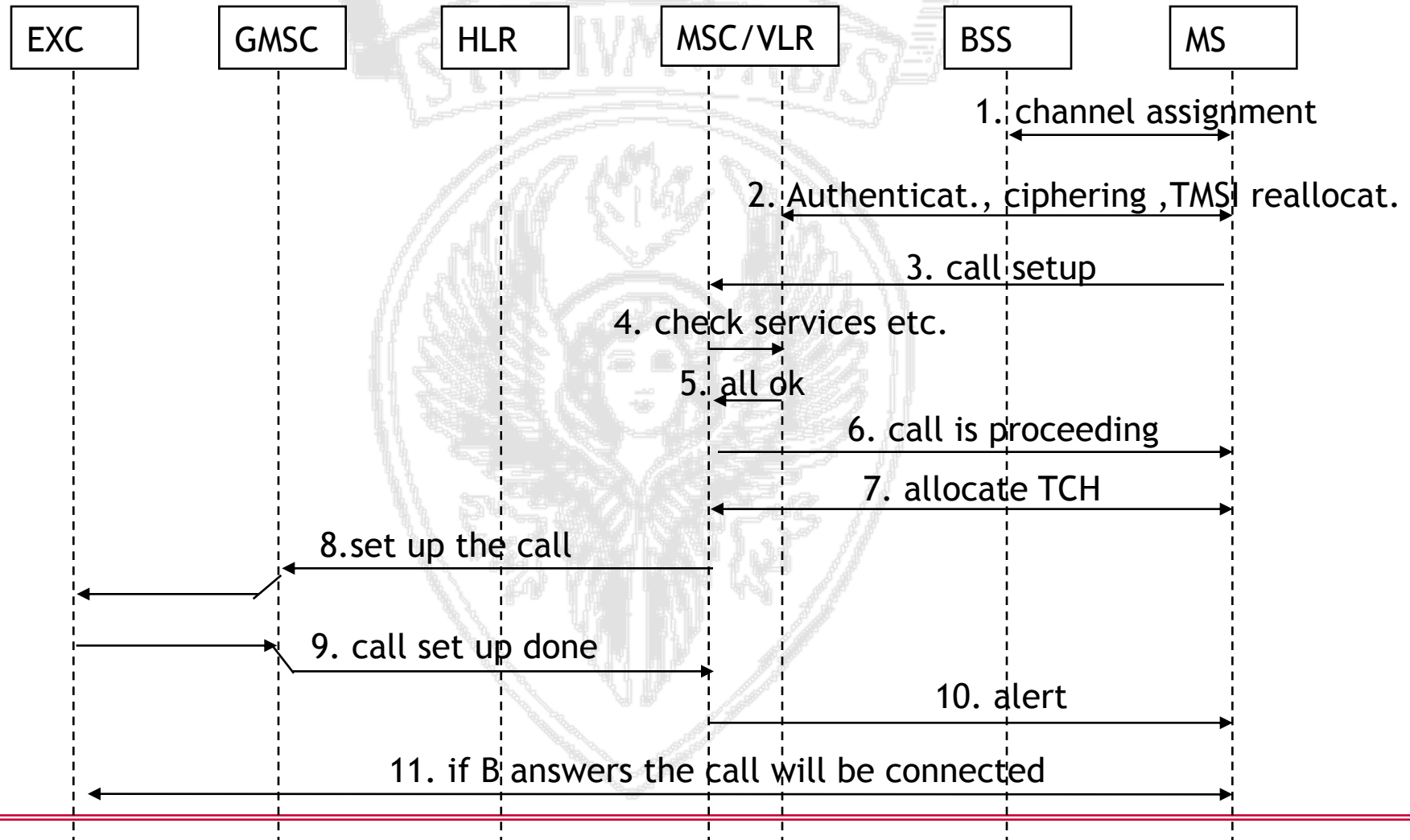


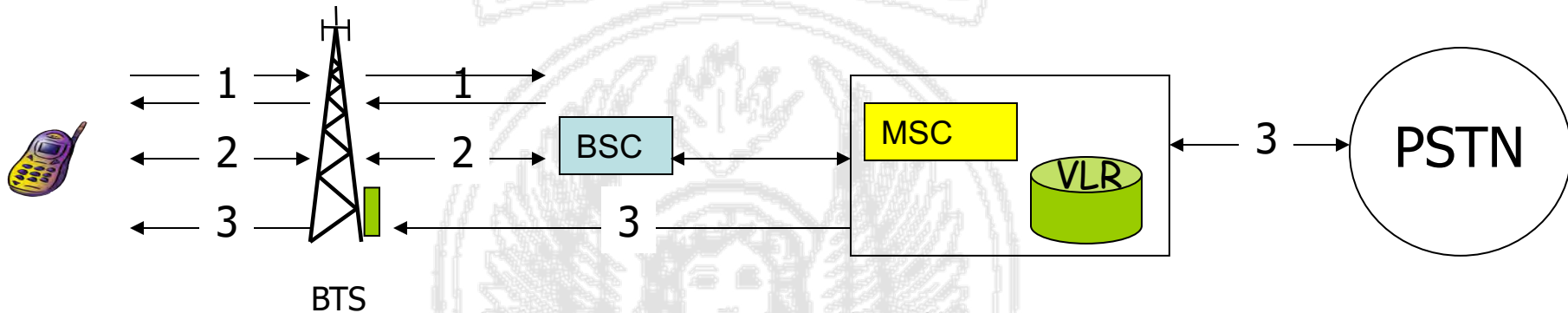
MS-originated call

- The called number is dialled by the MS
- The current MSC analyses the caller data and:
 - It either authorizes or deny the call
 - The call routing procedure is started
- If the called number is in the same GSM network, a “send routing info” procedure is started to obtain the MSRN
 - Same procedure as PSTN-originated calls
- If the called number is in another GSM network, the call is routed to the GMSC.



Summary of the Call Set-up Steps

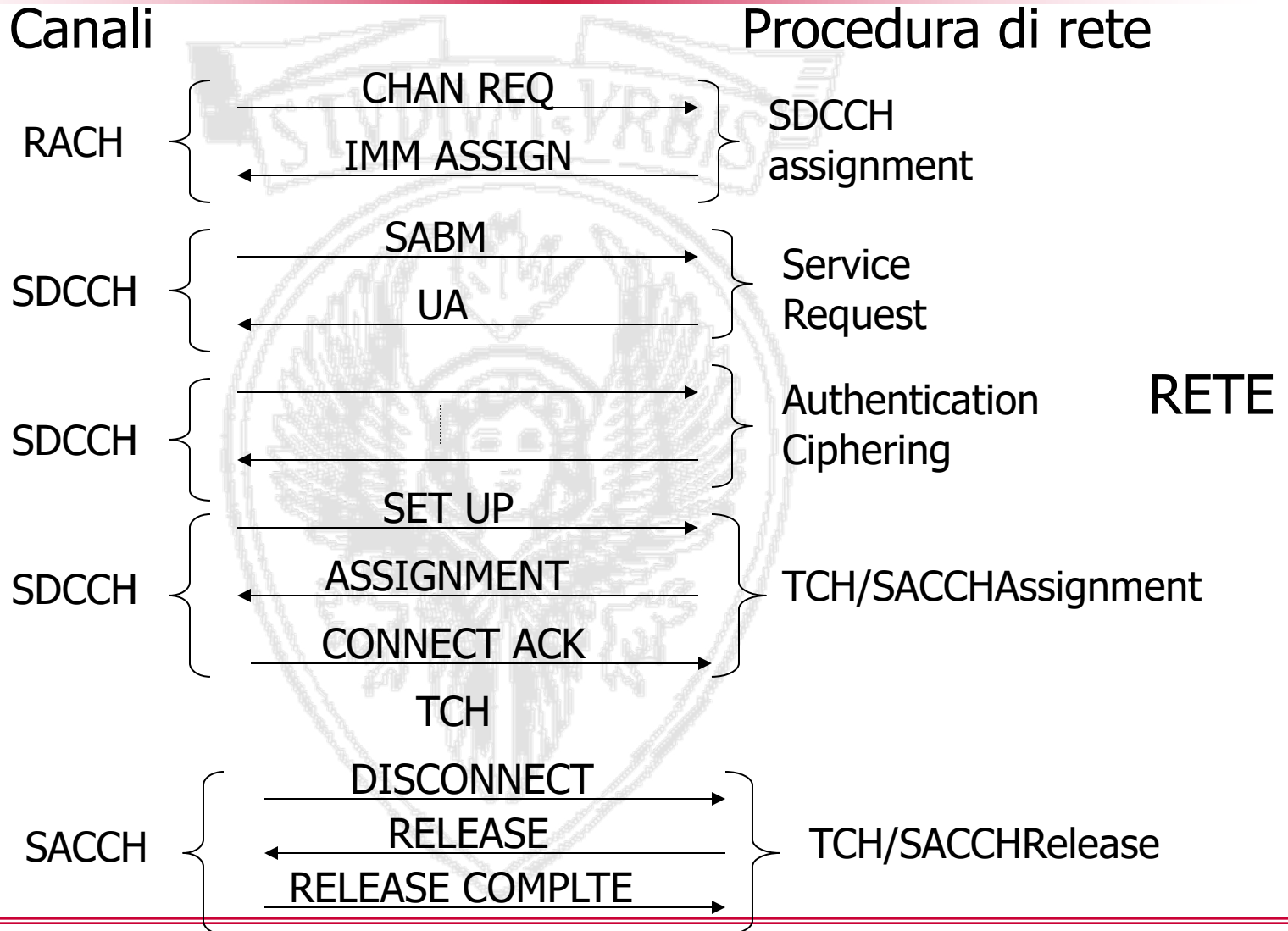




- 1- Access request, resource allocation for signaling
- 2 – Authentication and ciphering, caller id is transmitted, traffic channel is allocated
- 3 –Call routing



MS





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Handover Procedure



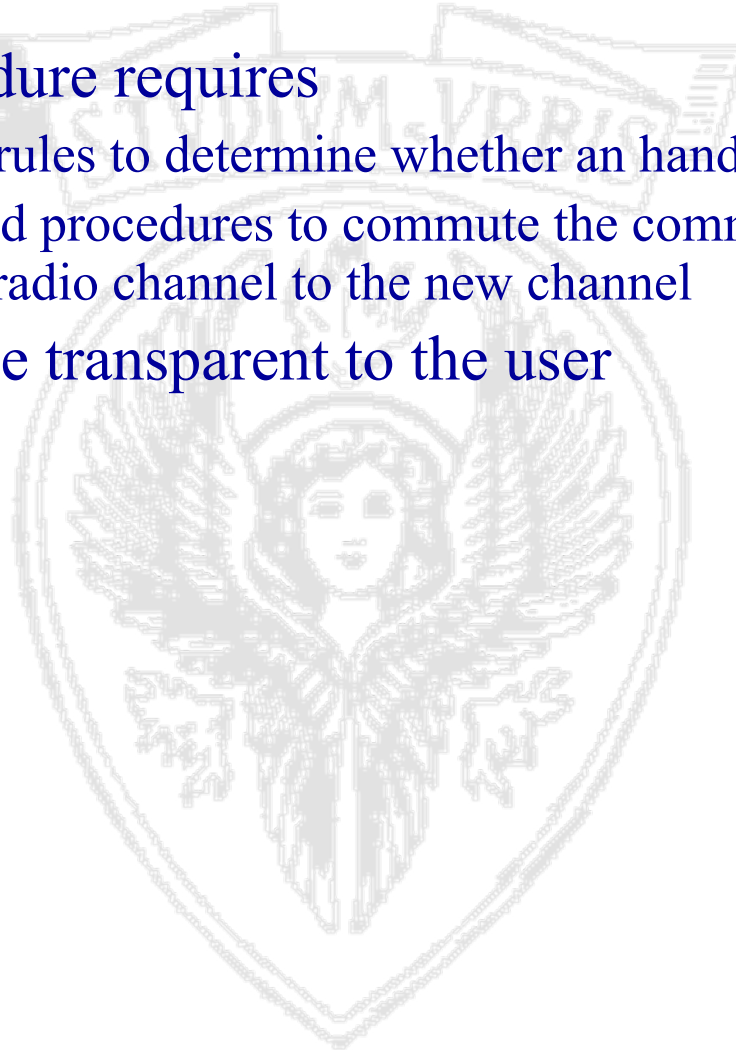
Handover e GSM

- The handover procedure is initiated by the network, based on measurements provided by the MS
- When the MS connects to a cell, the BSC sends to it a list of “alternative channels” (the BCCH of 6 adjacent cells) whose signal strength should be monitored by the MS;
- The results of such measurements is transmitted by the MS to the BSC using the SACCH channel every 480 msec
- An handover may be started by the BSC based on measurements performed by both the MS and the BTS



Handover parameters

- The procedure requires
 - A set of rules to determine whether an handover is necessary
 - Dedicated procedures to commute the communication from the original radio channel to the new channel
- It should be transparent to the user





Handover parameters - MS

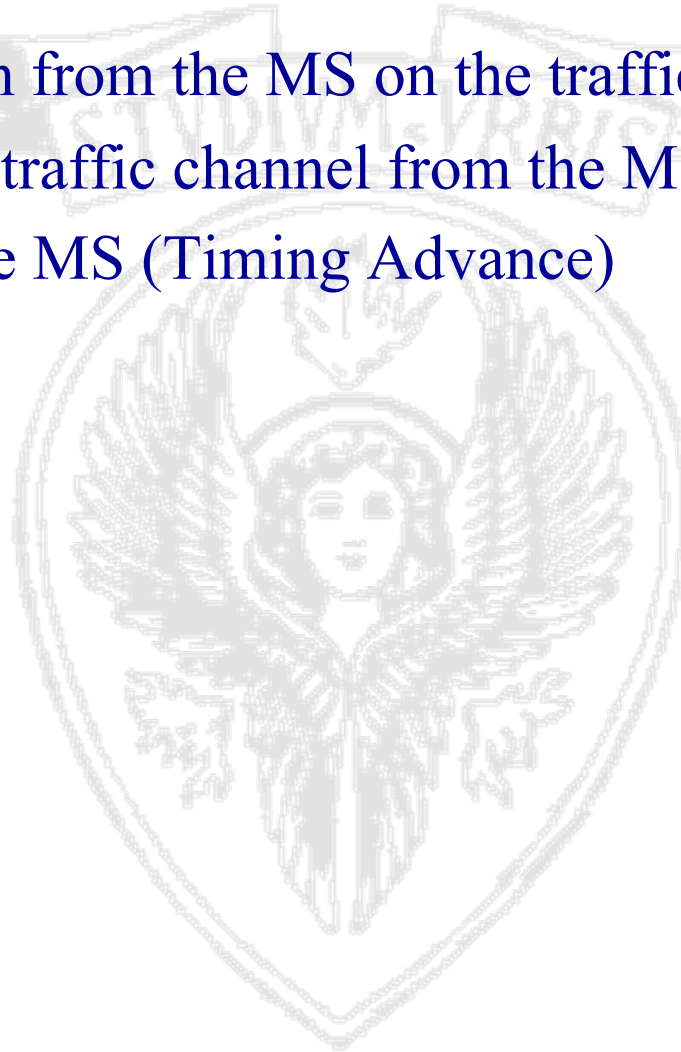
- Signal strength on the BCCH carrier of adjacent cells (RXLEVNCCELL_n)
- Signal strength on the active TCH channel (RXLEV)
- Quality of the active TCH channel (RXQUAL)





Handover parameters - BTS

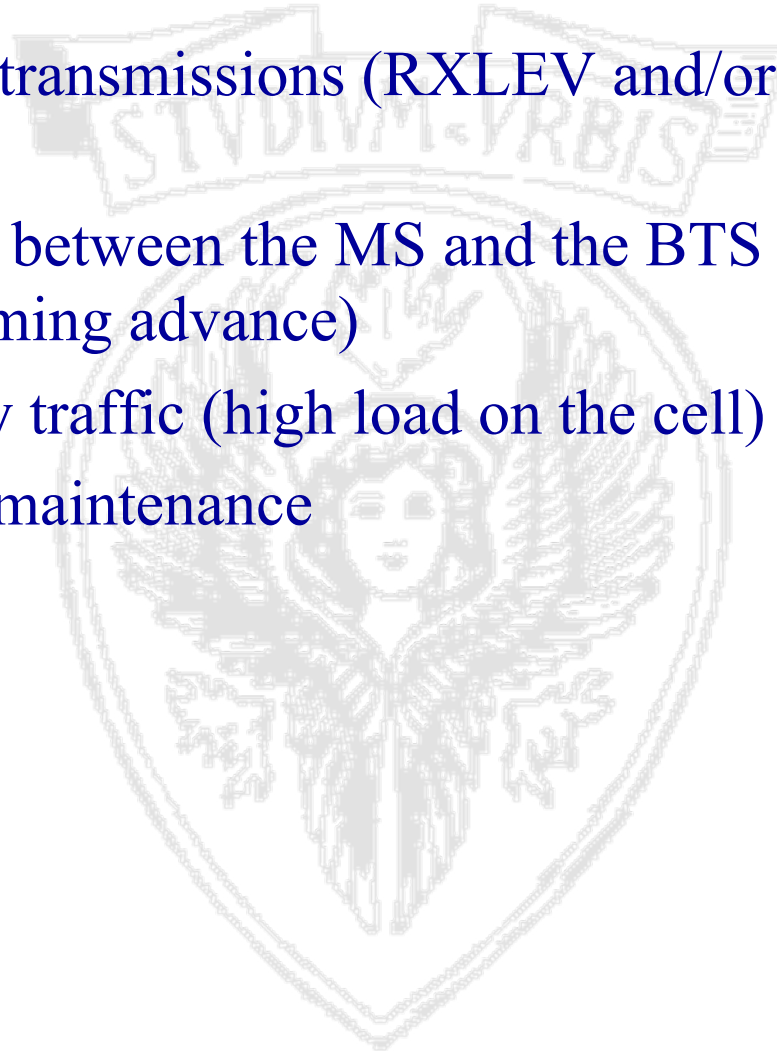
- Signal strength from the MS on the traffic channel (RXLEV)
- Quality of the traffic channel from the MS (RXQUAL)
- Distance of the MS (Timing Advance)





Reasons for handovers

- Low quality transmissions (RXLEV and/or RXQUAL below threshold)
- The distance between the MS and the BTS is above a given threshold (timing advance)
- Motivated by traffic (high load on the cell)
- Control and maintenance





Types of Handovers

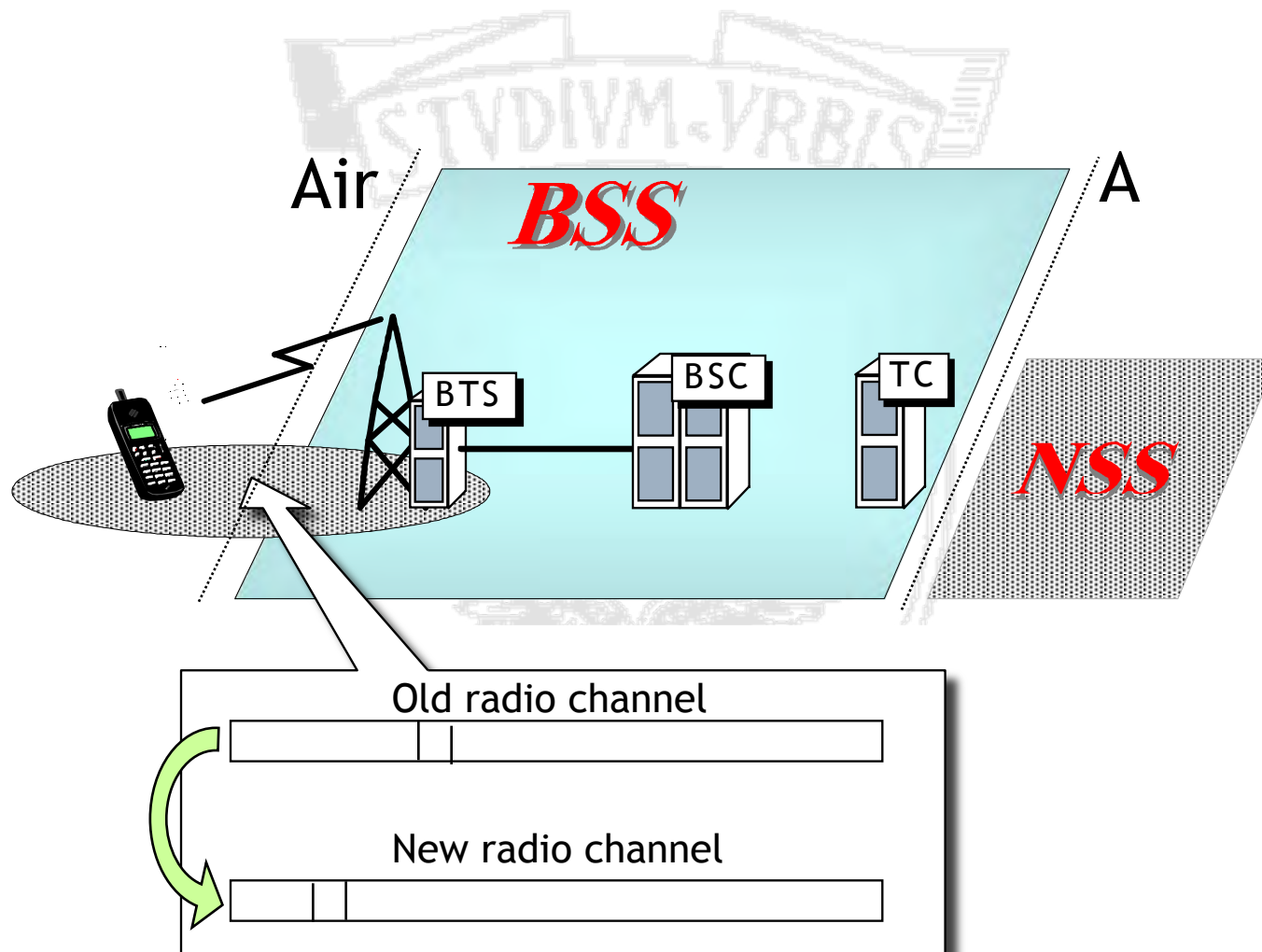
4 types of Handovers

- Intra Cell - Intra BSC
- Inter Cell - Intra BSC
- Inter Cell - Inter BSC
- Inter MSC

Handovers must be performed quickly! (≤ 100 ms)



Intra Cell – Intra BSC Handover

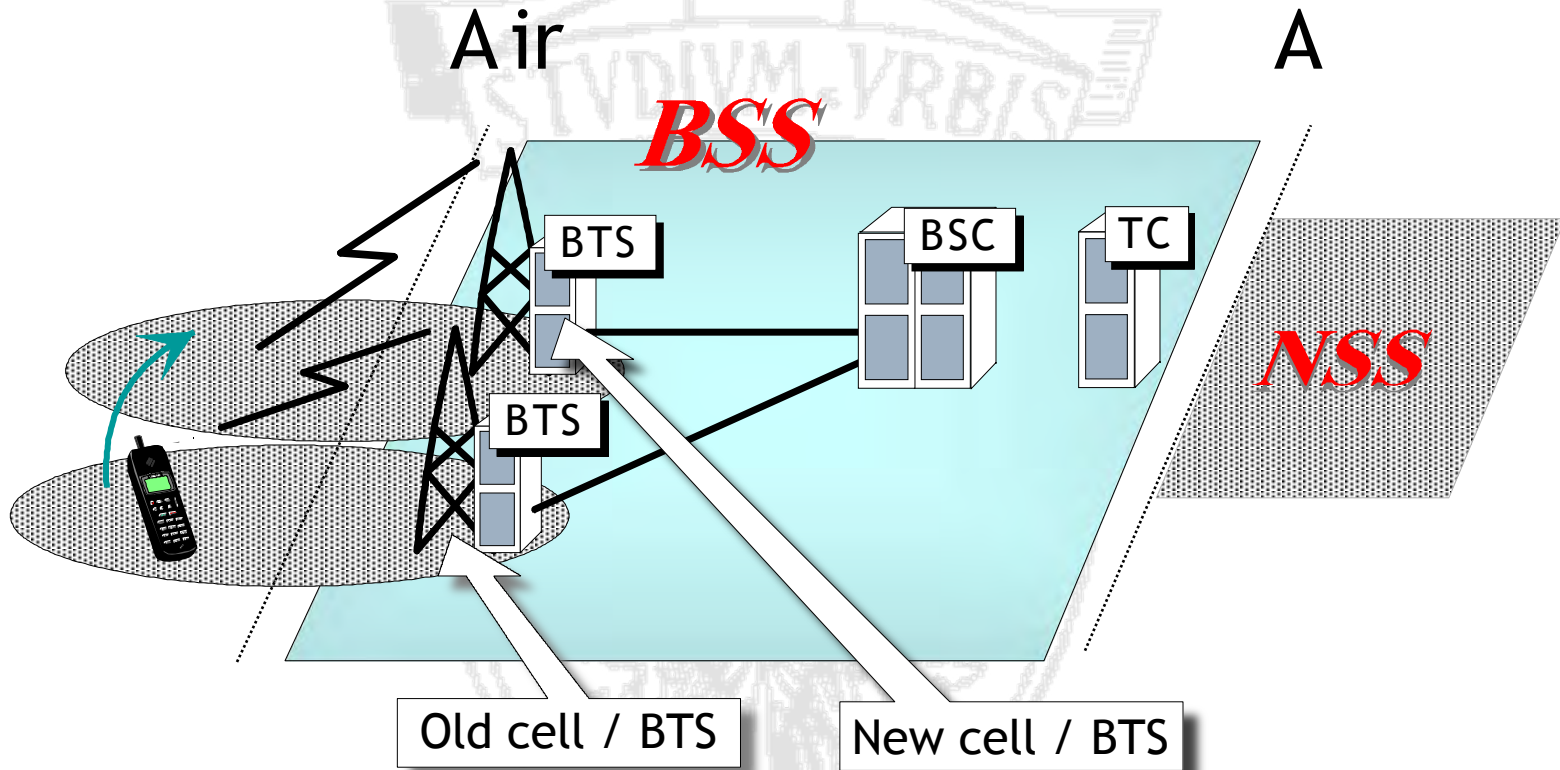




Intra Cell – Intra BSC Handover

- Simpler handover, decided by the BSC only
- A new traffic channel is allocated, usually the frequency within the BTS is modified as well
- Triggered by:
 - Low-quality TCH, high received signal strength
 - No adjacent BTS can provide better quality

Inter Cell – Intra BSC Handover



The *MS* moves to a new cell under the same BSC



Inter Cell- Intra BSC Handover

The handover procedure is fully controlled by the BSC

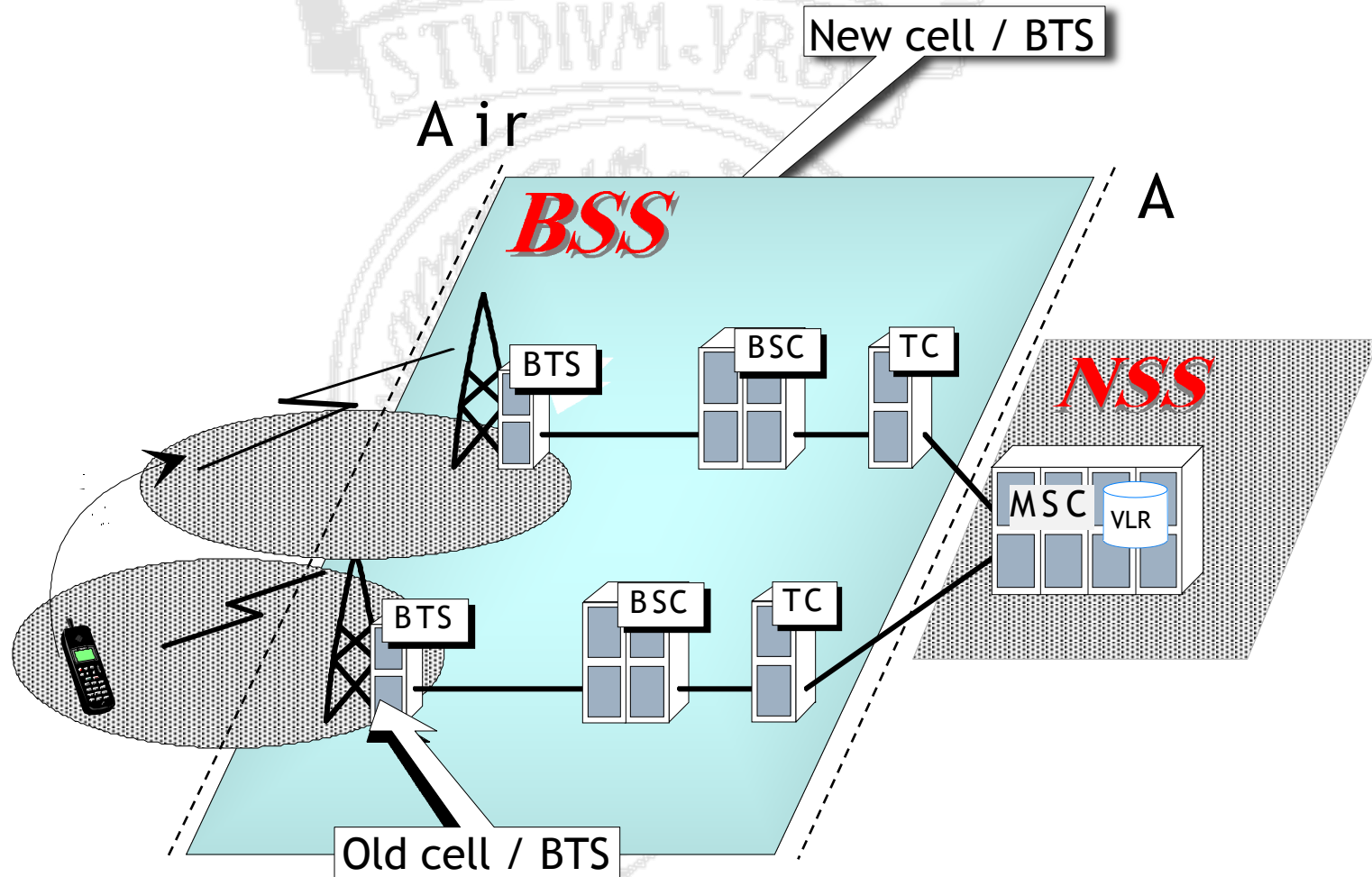
- The BSC identifies the best BTS and the best TCH for the MS, based on MS and BTS measurements
- The BSC connects to the new BTS and requires the allocation of a new TCH
- The BSC signals to the MS (using the logical channel FACCH) to use the new TCH. The old radio carrier is released.
- The MS starts sending traffic on the new TCH
- The old connection is released
- The BSC notifies the handover to the MSC/VLR



- After the handover the MS must acquire information about the new adjacent cells. It uses the Slow Associated Control CHannel (SACCH)
- If the LA is changed by the handover, a Location Procedure must be triggered by the MS



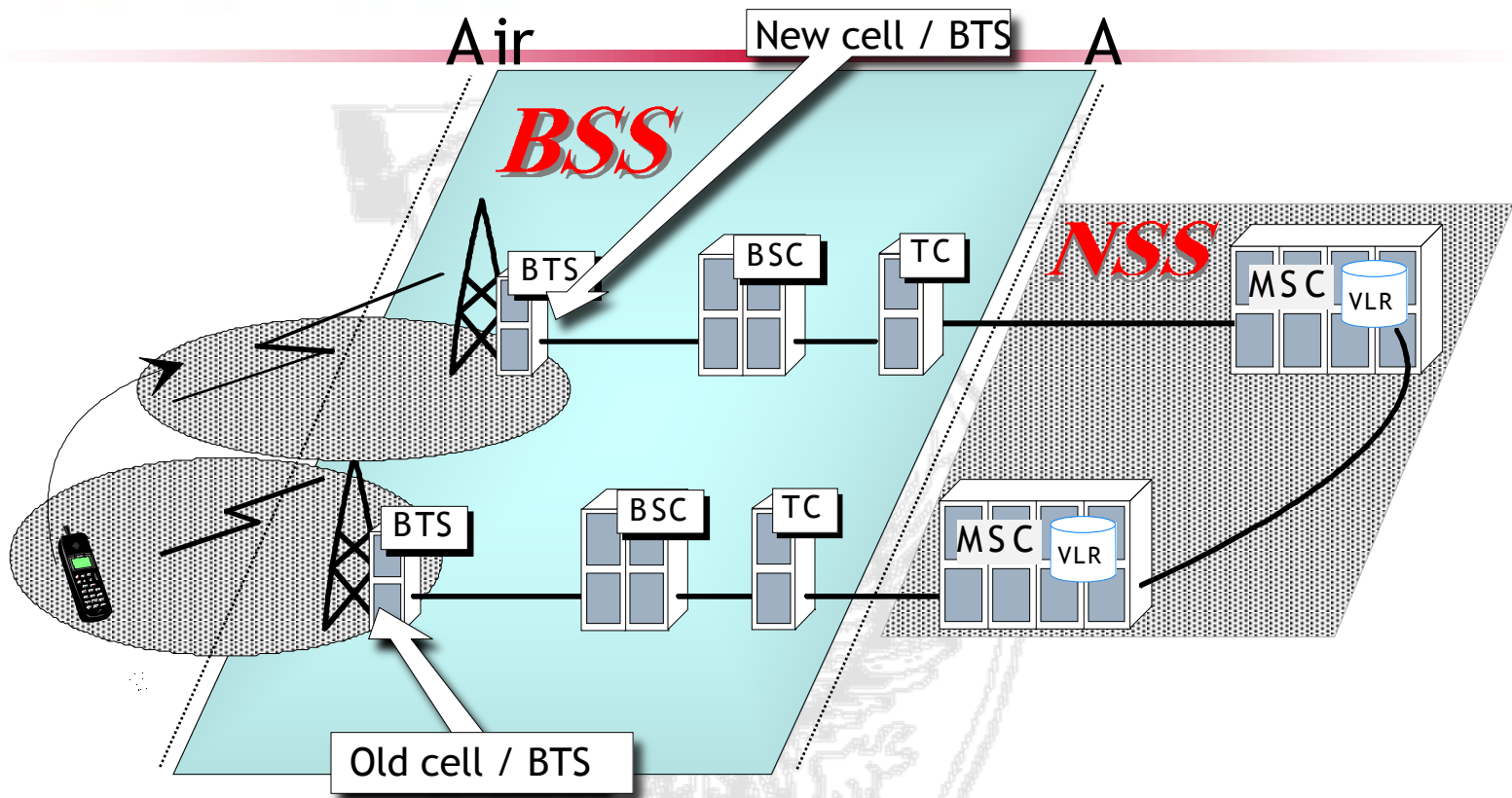
Inter Cell – Inter BSC Handover





The handover procedure is initiated by the BSC

- The BSC identifies the best BTS and the best TCH for the MS
- The current BSC sends a message to the MSC/VLR, as the new BTS is controlled by another BSC
- The MSC creates a connection to the new BSC
- The new BSC reserves a radio channel for the MS. The old carrier is released
- The new BSC sends a command to the MS, which should now use the new radio channel (TCH)
- The MS starts sending traffic on the new channel. The connection is routed by the MSC towards the new BSC
- The old connection is released



Handover is more complex because different MSC/VLR are involved

- The call is routed by the initial MSC to the final MSC



Inter MSC Handover (1)

The handover procedure is initiated by the BSC

- The current BSC decides an handover towards a BTS controlled by another MSC/VLR
- The current BSC sends an handover command to the initial MSC/VLR
- The initial MSC/VLR sends a request to the final MSC/VLR
- The final MSC/VLR allocates an HandOver Number (HON), which is transmitted to the initial MSC/VLR



Inter MSC Handover (2)

- The destination MSC/VLR starts a connection to the new BSC
- A traffic channel is reserved to the MS by the new BSC
- The initial MSC/VLR sends an handover command to the MS by using the FACCH channel of the old BSC and BTS
- The MS switches to the new channel and starts sending traffic over the new TCH
- The old connection is released



HandOver Number

- Same format as MSRN and MSISDN
- $HON = CC + NDC + SN$
 - CC = Country Code
 - NDC = National Destination Code
 - SN = Subscriber Number
- SN points to a database
 - in case of MSISDN located in the HLR
 - in case of HON and MSRN located in VLR
- HON contains enough information to allow the GMSC to route the call towards the destination MSC



MS is switched off

- When a MS is switched off, it sends to the network a ***IMSI detached*** message
- The MSC/VLR flags the user as detached
- Paging is no longer performed until the MS is switched on again