
Mobile Communications

Mobility Management in 3GPP Networks

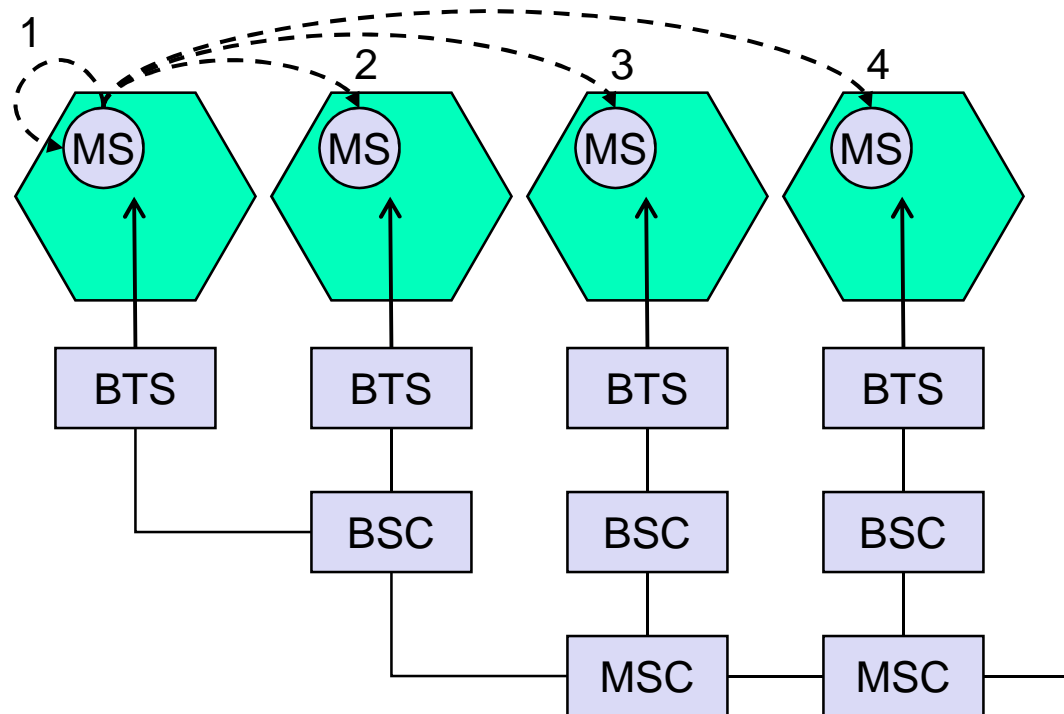
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- ◆ *How is the terminal mobility managed in GSM?*
- ◆ *How is the terminal mobility managed in GPRS?*
- ◆ *How is the terminal mobility managed in UMTS?*

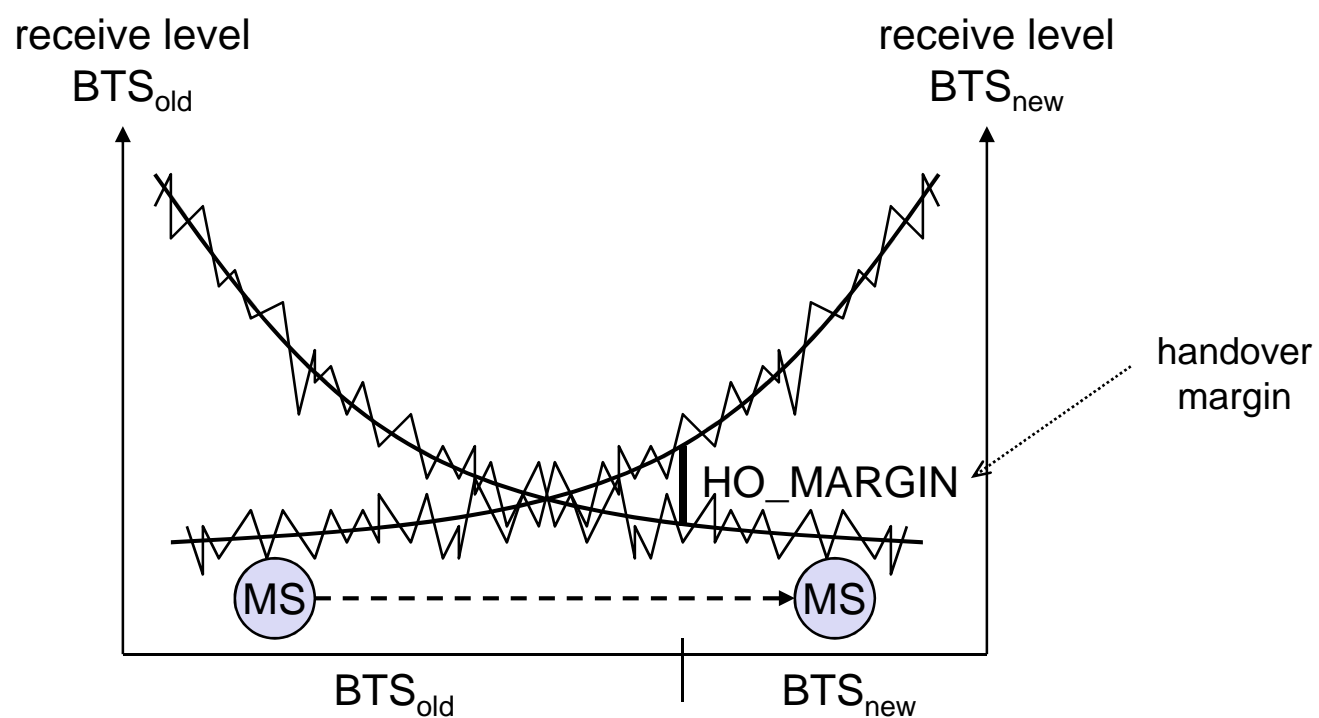
GSM

4 types of handover



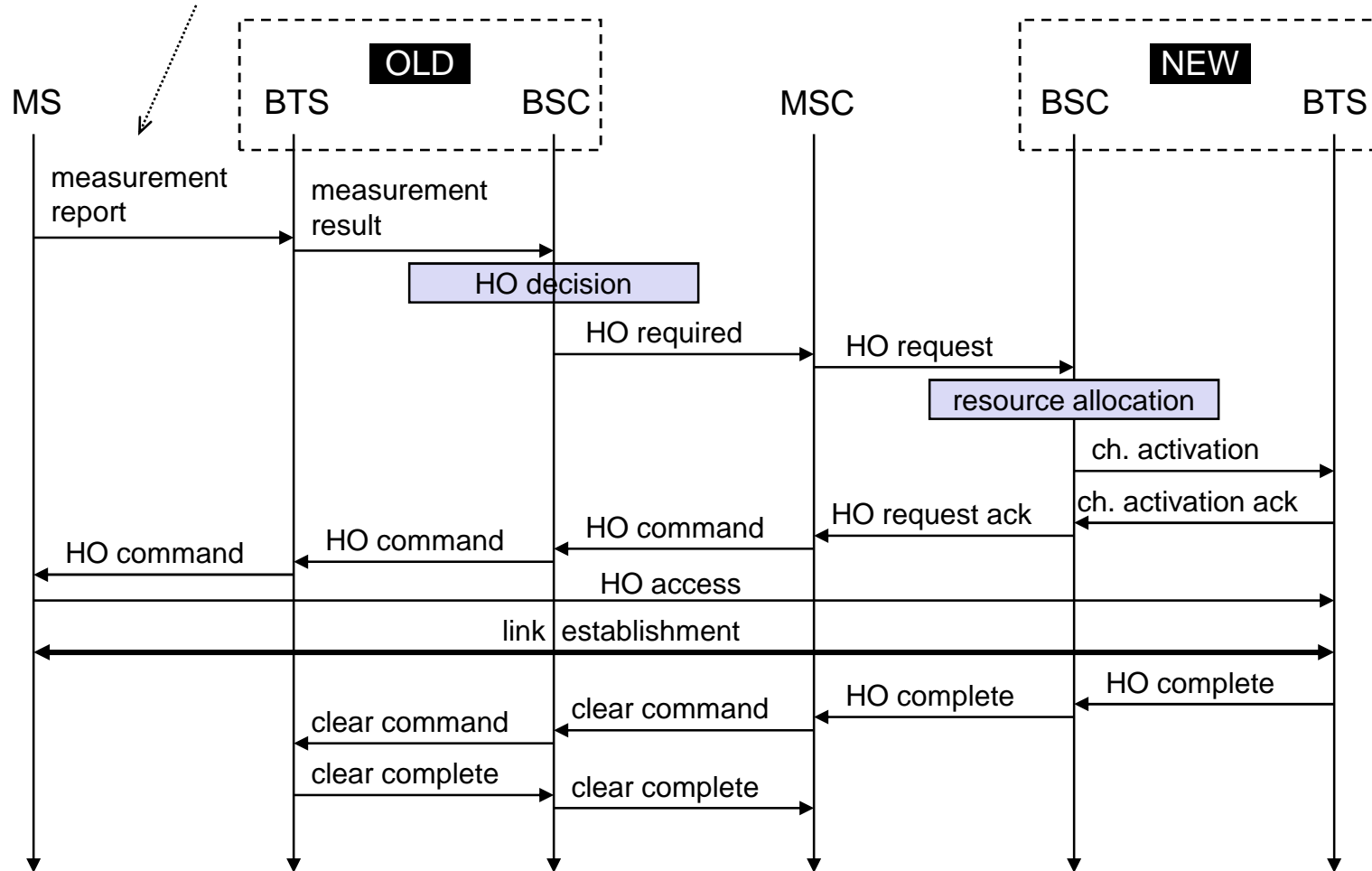
- 1 - between different sectors of the same cell
- 2 - between different cells within the same BSC domain
- 3 - between different BSC domains within the same MSC domain
- 4 - between different MSC domains

Handover decision



Mobile-Assisted Handover (MAHO)

MS scans, measures and reports power received from several RF carrier based on BCCH information



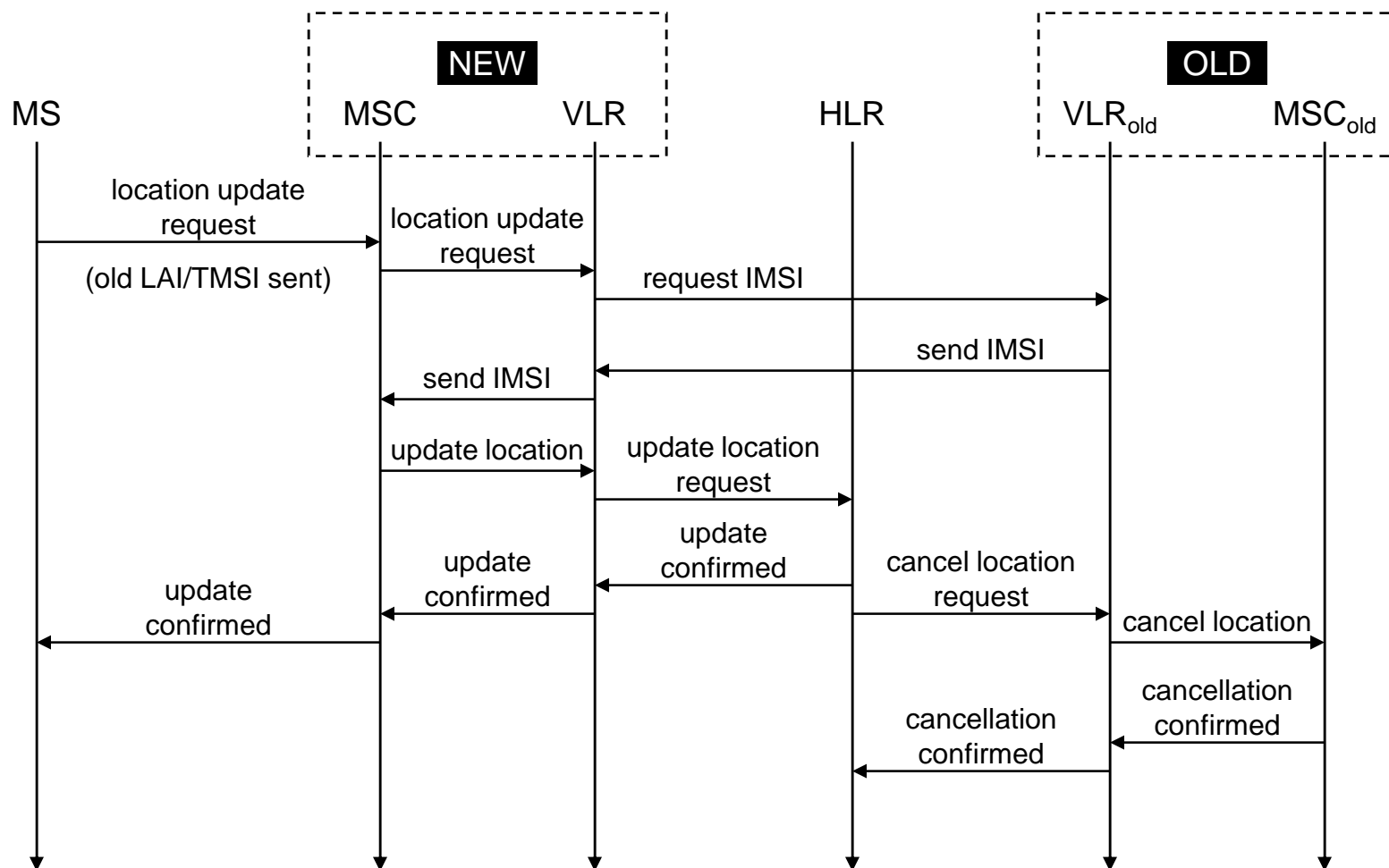
Location update

- ◆ MS is aware of location
 - » BTS broadcasts **Location Area Identification** (LAI) on BCCH
 - » SIM stores current LAI and TMSI

- ◆ Events which determine a **current** location update
 - » MS is switched on and current LAI equals the stored LAI
 - » a timer set by the network expires and MS reports position
TMSI may be updated and stored in SIM

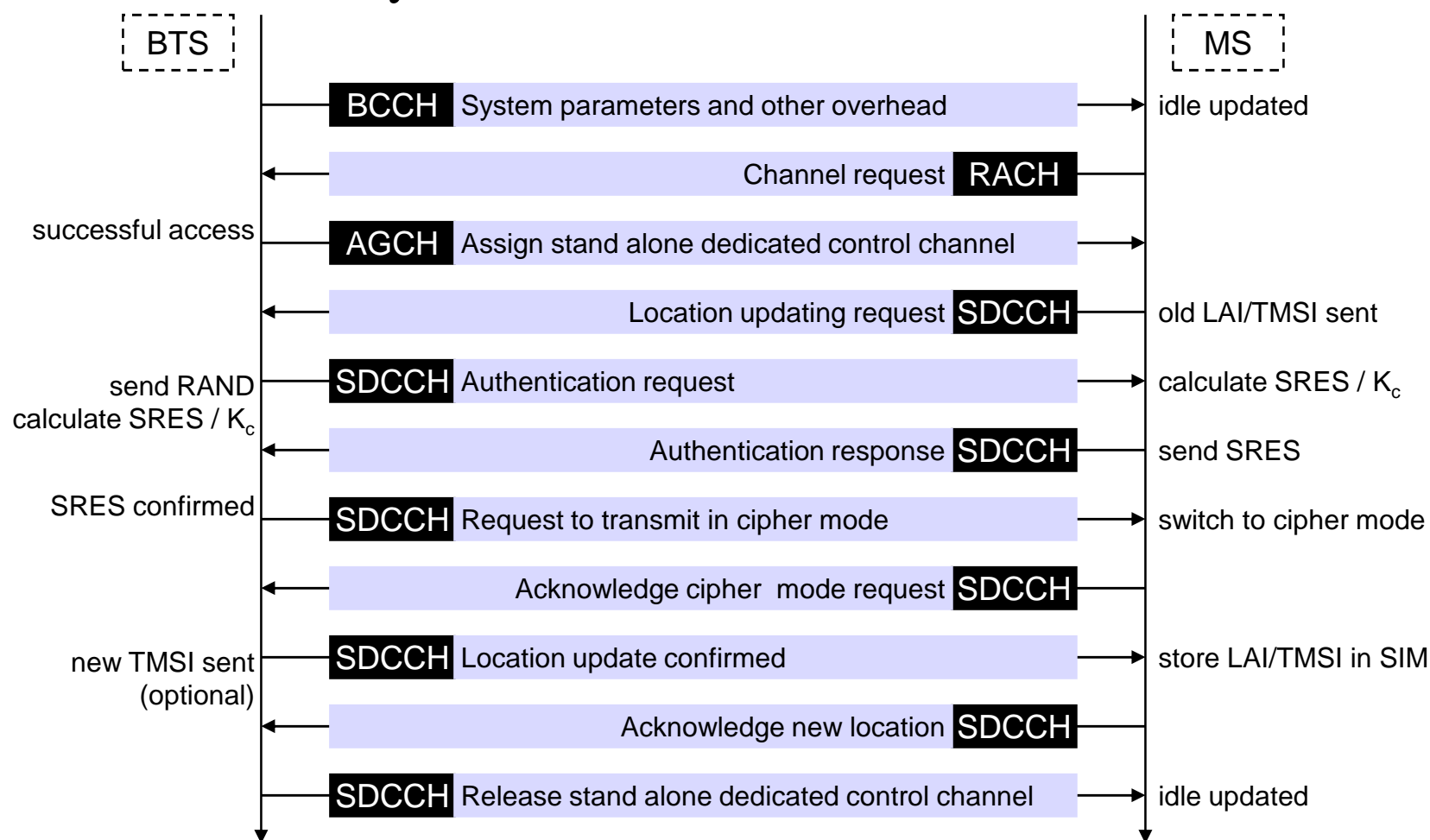
- ◆ Events which determine a **new** location update
 - » MS is switched on and current LAI differs from stored LAI
 - » MS enters a new location area
TMSI and LAI are updated and stored in SIM

Location update – new location



Location update

Channel activity at radio interface



GPRS, 2G

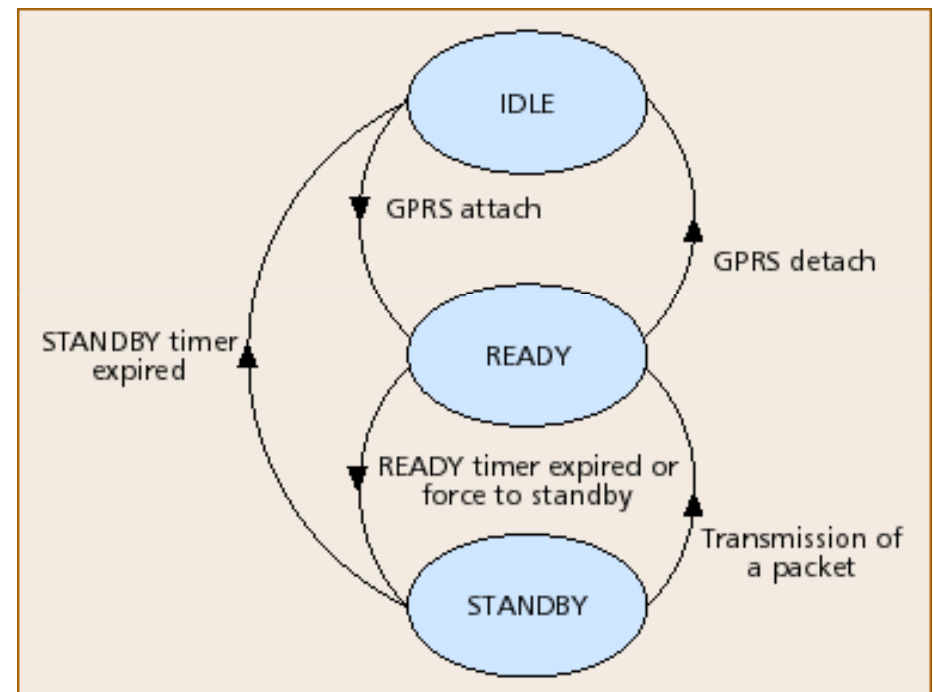
(3GPP TS 23.060)

Terminal Mobility Management

- ♦ Packet forwarding in downlink
 - ➔ demands knowledge of terminal location
 - » If terminal informs frequently the network about its location
 - network is aware of the terminal's cell
 - ➔ fast packet forwarding, but high consumption of battery and radio resources
 - » If terminal does not inform frequently the network about its location
 - network needs to “page” the terminal before each packet transmission
 - ➔ slow forwarding
- ♦ Solution - divided the space in more areas than in GSM
 - » **Routeing Areas (RA)**, in GPRS
 - 1 Location Area (LA) of GSM → n Routeing Areas (RA)
 - 1 RA → n cells

Terminal Mobility Management - updating states

- Frequency of actualization in terminal
3 states
- **IDLE**
Terminal **does not inform SGSN**
about its position
- **READY**
Terminal informs SGSN
when it enters a new cell élula
 - Precise location
 - No *paging required*
- **STANDBY**
Terminal inform SGSN
when it enters in a new RA
 - Cell changes are not communicated
 - Packet transmission in downlink → paging of the cells of the RA



Mobility Management

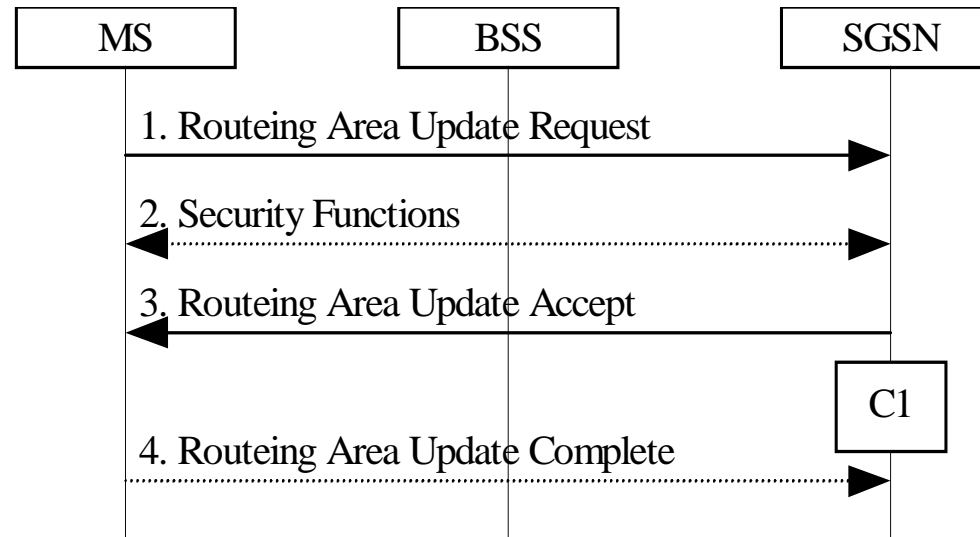
◆ Micro Mobility

- Terminal moves between cells under control of the same SGSN
1 SGSN \rightarrow n RAs; 1 RA \rightarrow n cells
- Mobility is managed by the SGSN
- New terminal position is not communicated to other network elements (GGSN, HLR)

◆ Macro Mobility

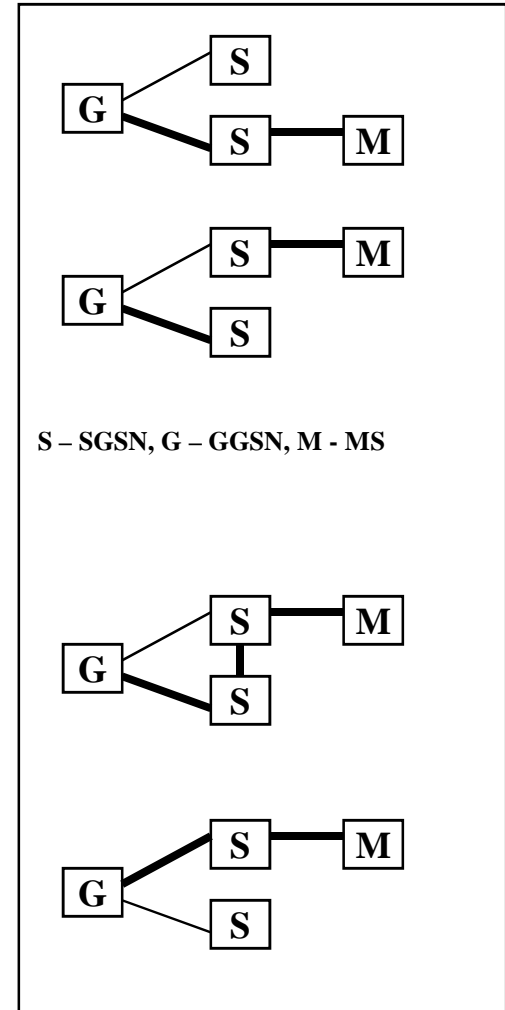
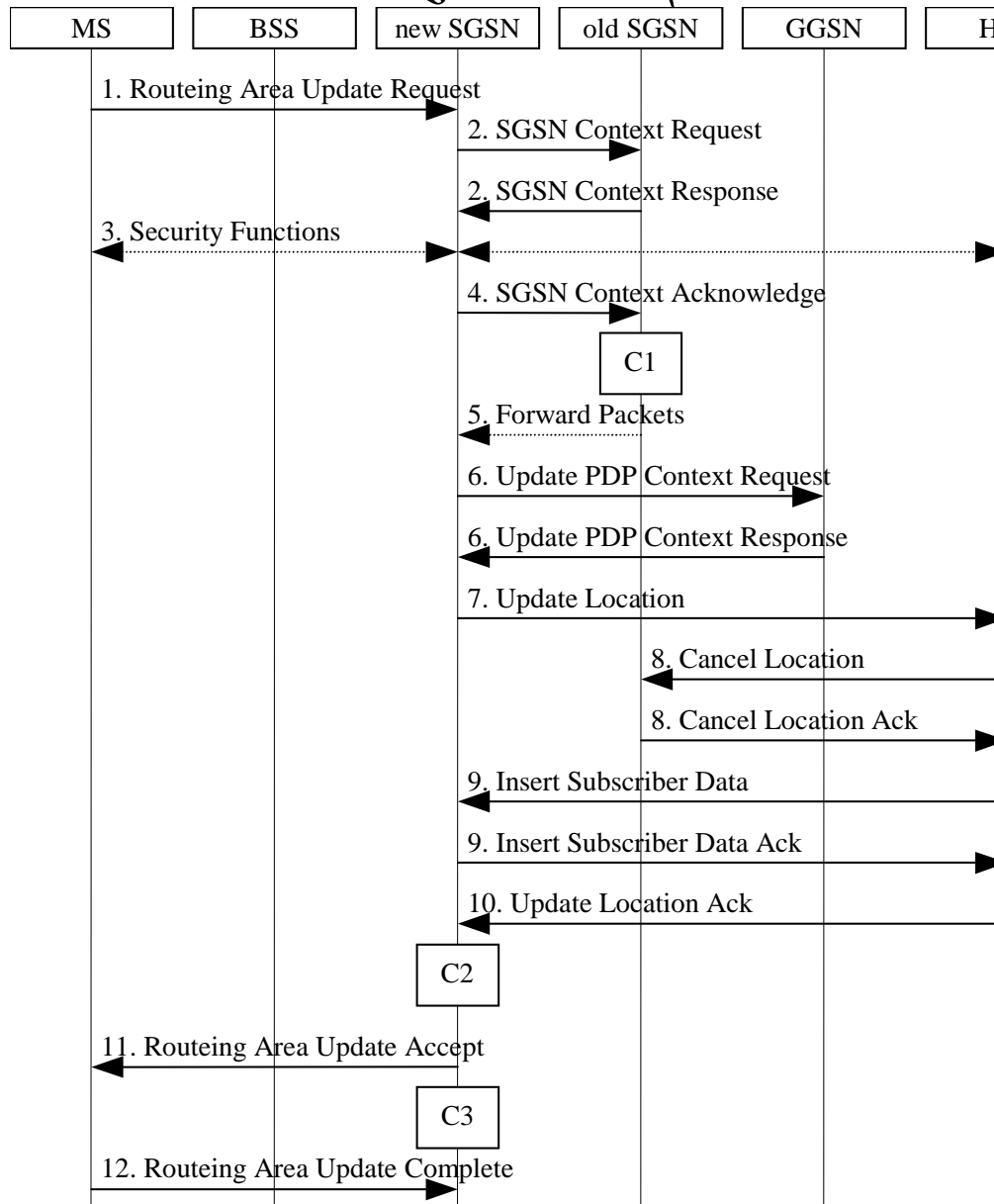
- Terminal moves between cells under control of different SGSNs
- New SGSN requests PDP Contexts (session descriptors) to old SGSN
- New SGSN requests GGSN to update the forwarding tables (L2 tunnels)
- SGSN updates HLR

Micromobility - Routing Area Actualization (Intra SGSN)



1. Routeing Area Update Request (P-TMSI, old RAI, P-TMSI Signature, Update Type)
Update Type indicates RA update or periodic RA update.
2. Security functions may be executed
3. The SGSN validates the MS's presence in the new RA.
If all checks are successful, the SGSN can reallocate a new P-TMSI.
A Routeing Area Update Accept (P-TMSI, P-TMSI Signature) is returned to the MS
4. If P-TMSI was reallocated, the MS acknowledges the new P-TMSI by returning a Routeing Area Update Complete message to the SGSN.

RA Actualization (Inter SGSN)

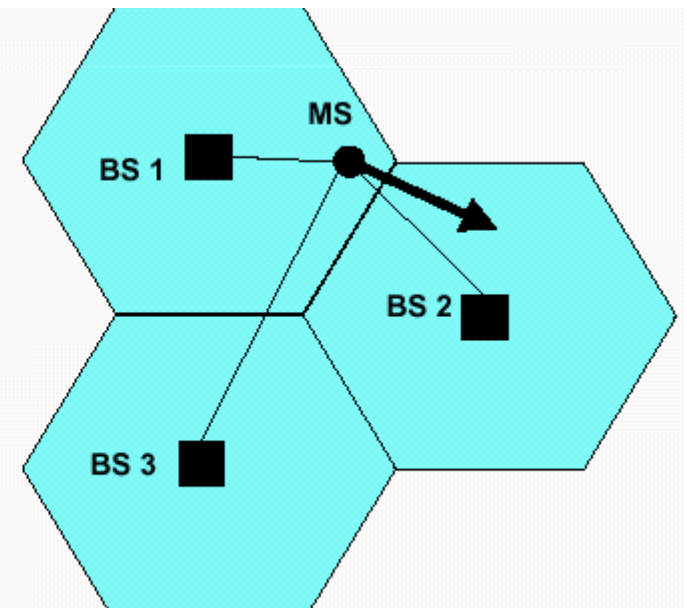
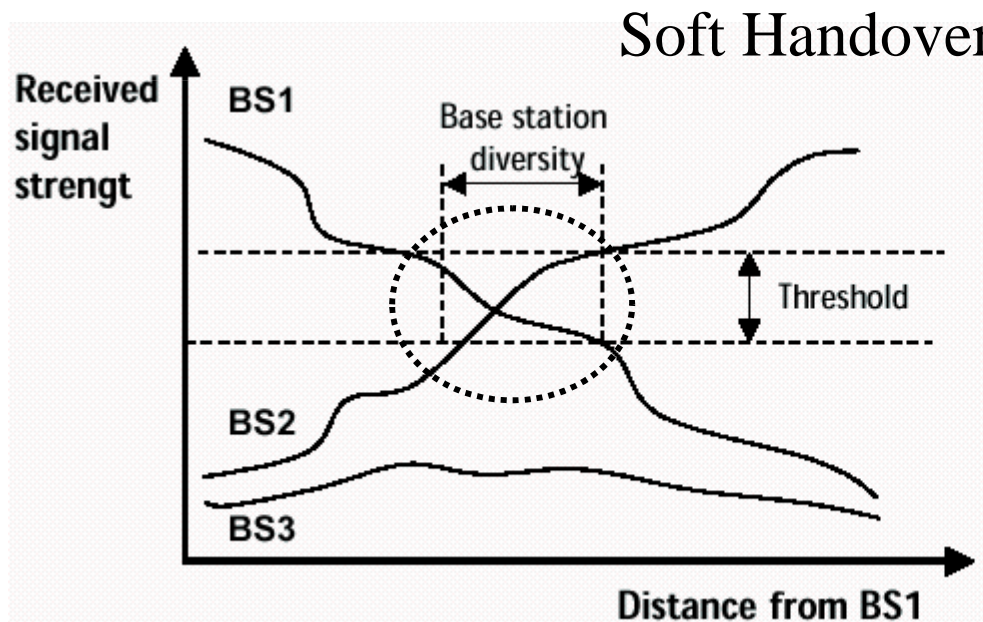


UMTS, 3G, Packet Domain

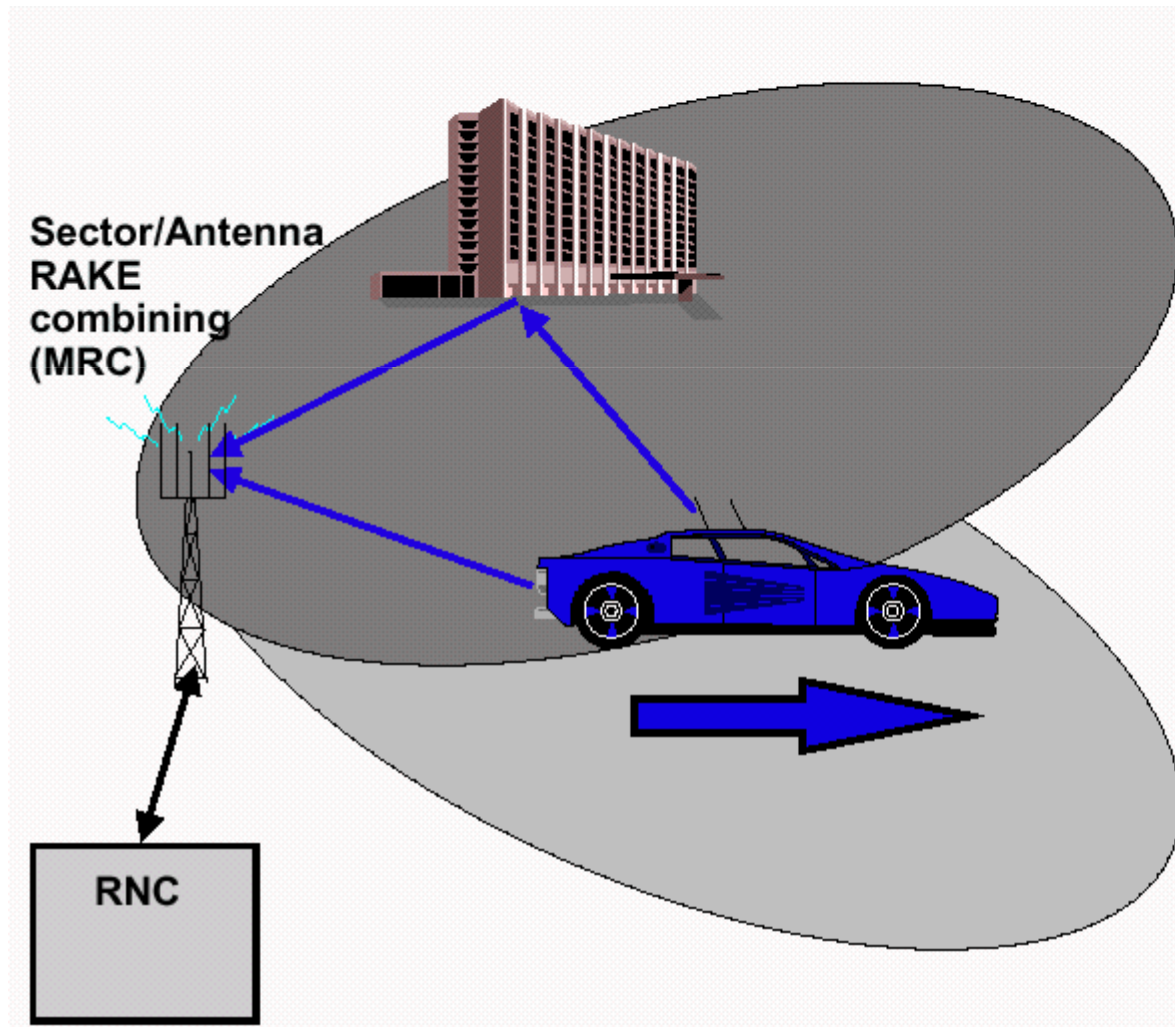
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Macrodiversity and Handover

- » Softer handover → between 2 sectors of same cell
- » Soft handover → between 2 cells of same RNC
- » Hard handover → between different systems



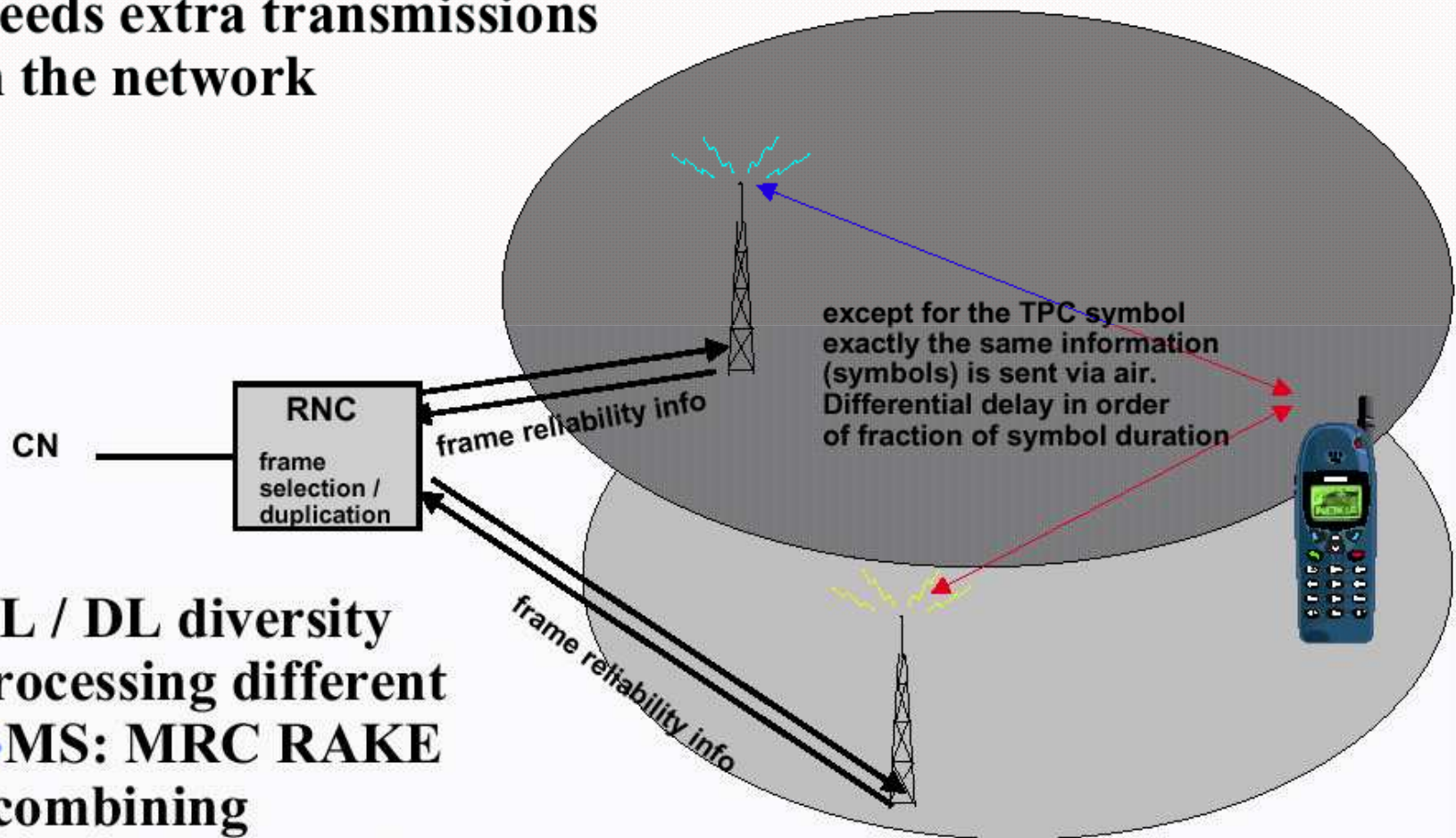
Softer Handover – between 2 sectors of same cell



- Internal to Node B
- No extra transmissions in networks
- Rake receiver
- Additional diversity gain

Soft Handover – between 2 cells of same RNC

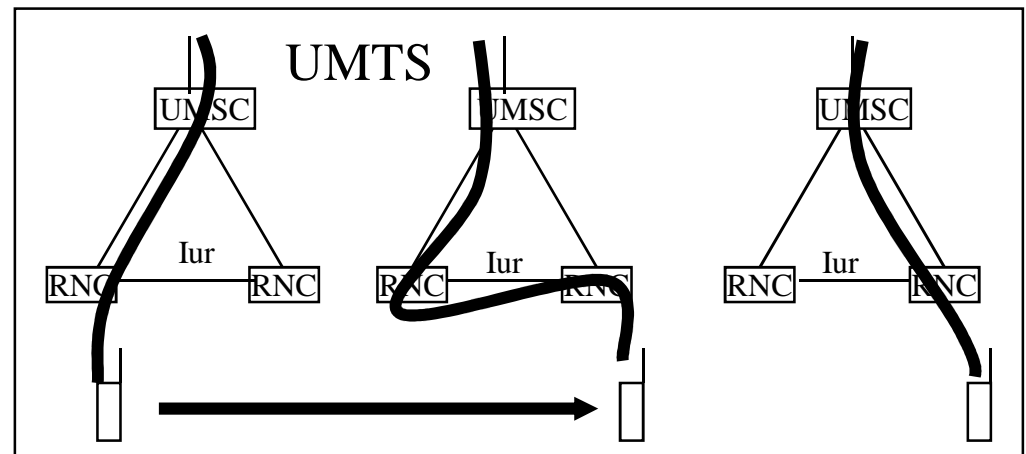
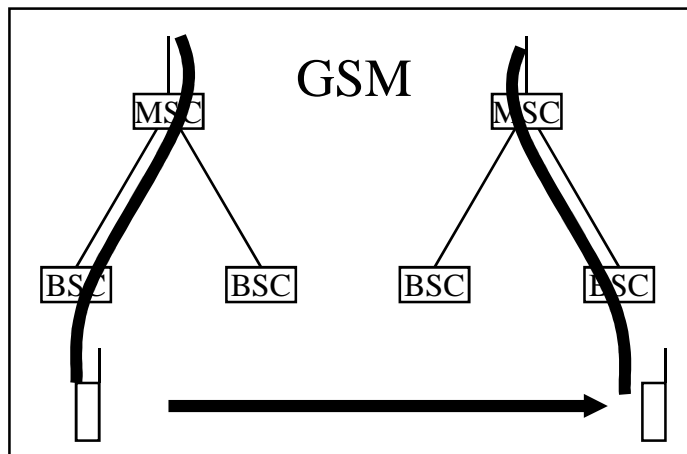
- Needs extra transmissions in the network



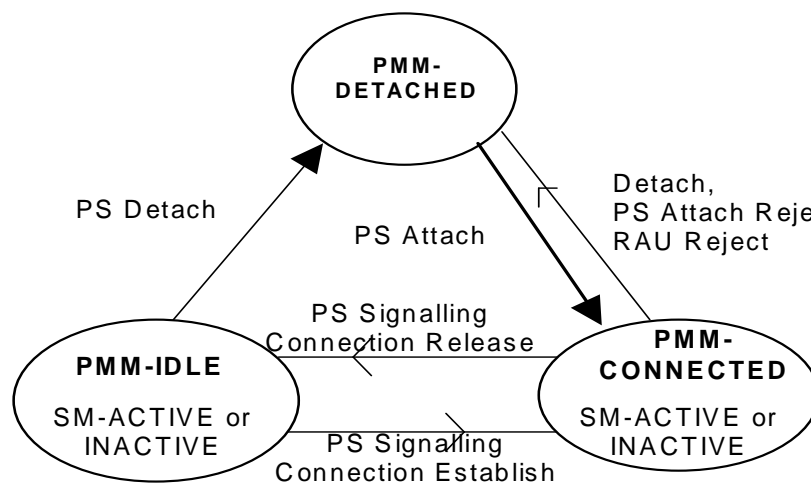
- UL / DL diversity processing different
 - MS: MRC RAKE combining
 - RNC: frame selection

UMTS, Handover, Interface Iur

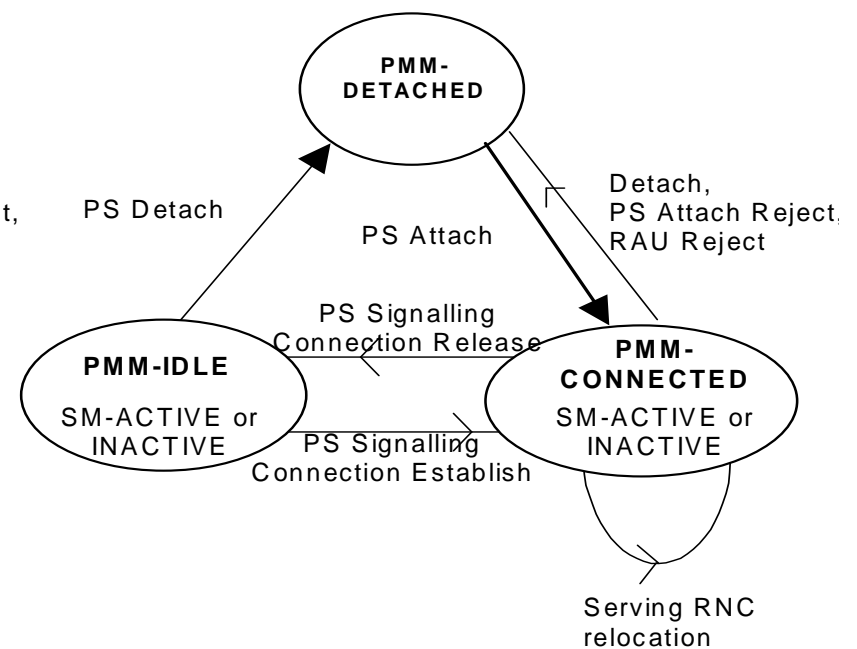
- ♦ Handover – uses Interface Iur; between RNC



Mobility Management – 3G, Iu mode (UMTS)



MS MM States



3G-SGSN MM States

Mobility Management States

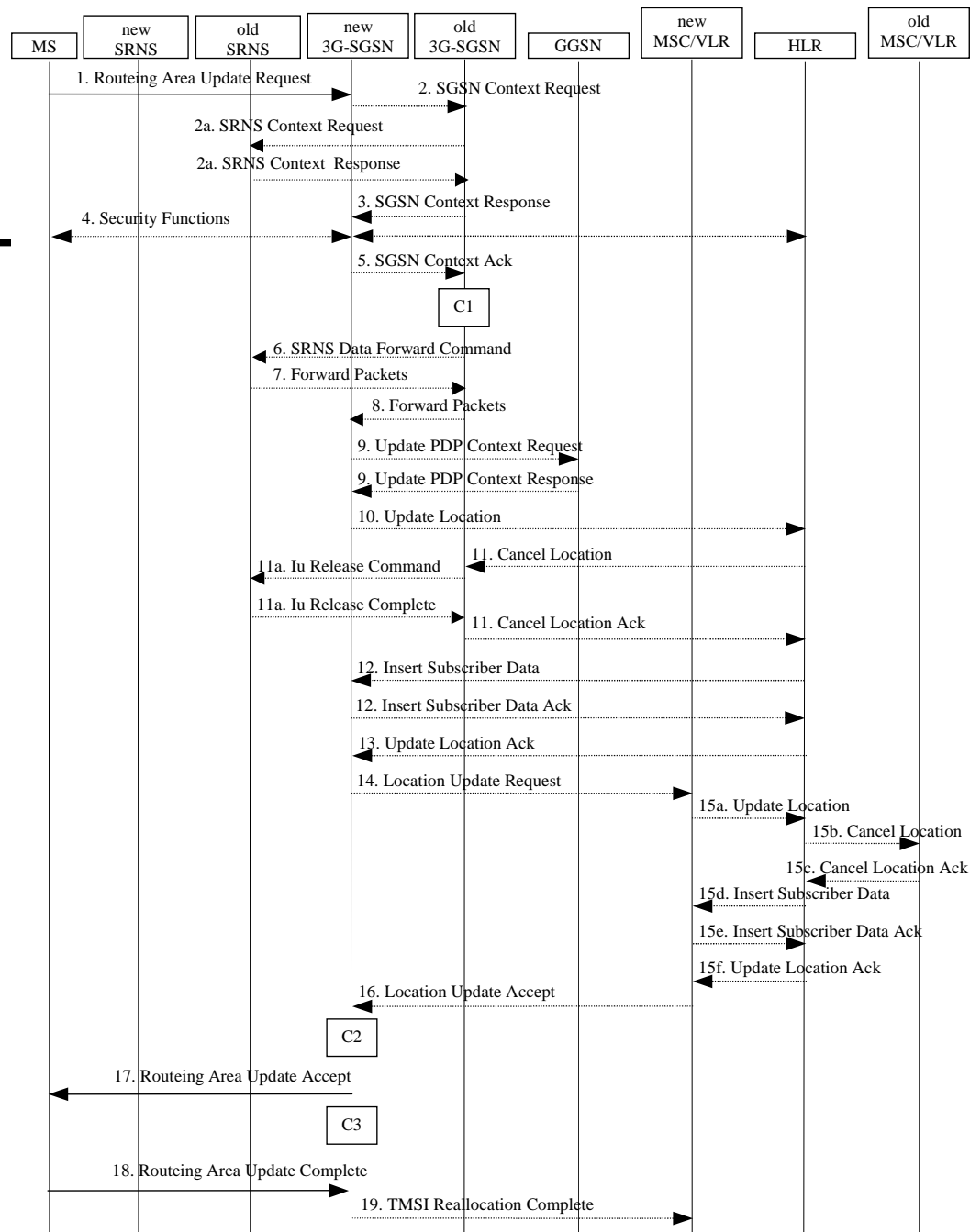
- ◆ PMM-DETACHED state
 - » no communication between the MS and 3G-SGSN
 - » MS location un-known
 - » If MS performs the GPRS Attach procedure
 - ➔ MM contexts in the MS and the SGSN
- ◆ PMM-IDLE state
 - » The MS location known; accuracy of a Routeing Area
 - » Paging needed
 - » MS performs **Routeing Area update** if RA changes
- ◆ PMM-CONNECTED state
 - » MS location known with an accuracy of a serving RNC
 - » MS location tracked by serving RNC

Location Management Function, in 3G

- ◆ In 2G, MS tracked in 2 levels: cell, RA
- ◆ In 3G, MS tracked in 3 levels: cell, RAN-area, RA
 - RAN – Radio Access Network
 - RA – Routeing Area
- ◆ Mechanisms required for
 - network to know about the Routeing Area of MS
 - RAN to know about the RAN-area or cell of MS

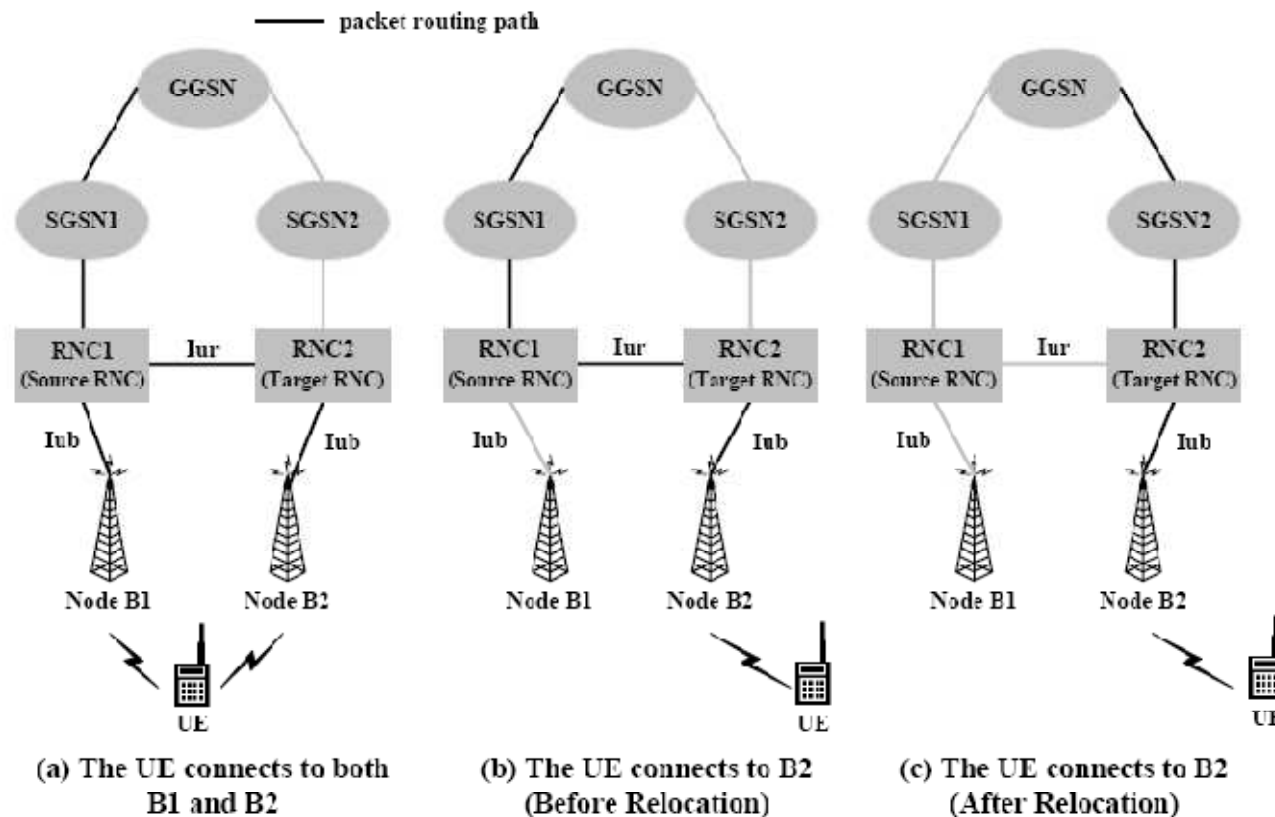
RA Update

MM-3GPP 24

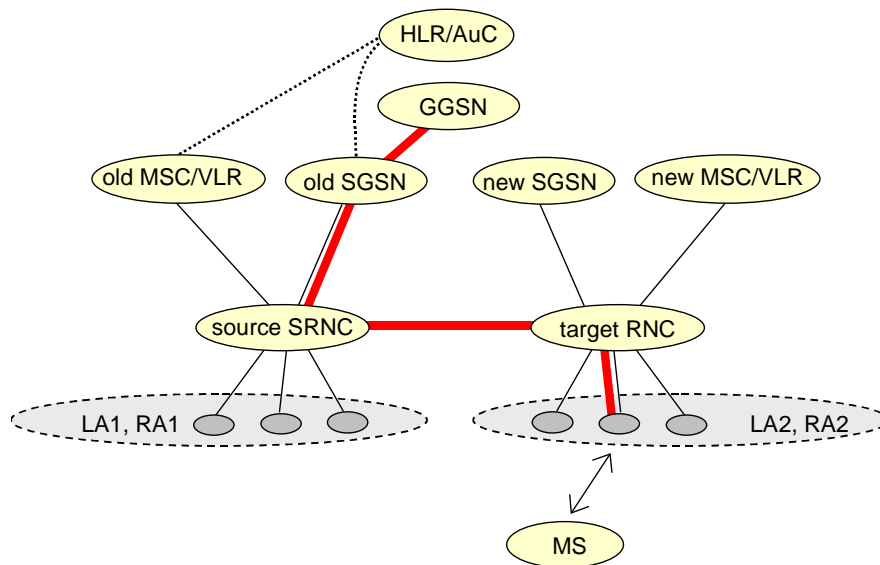


Serving RNS Relocation Procedures

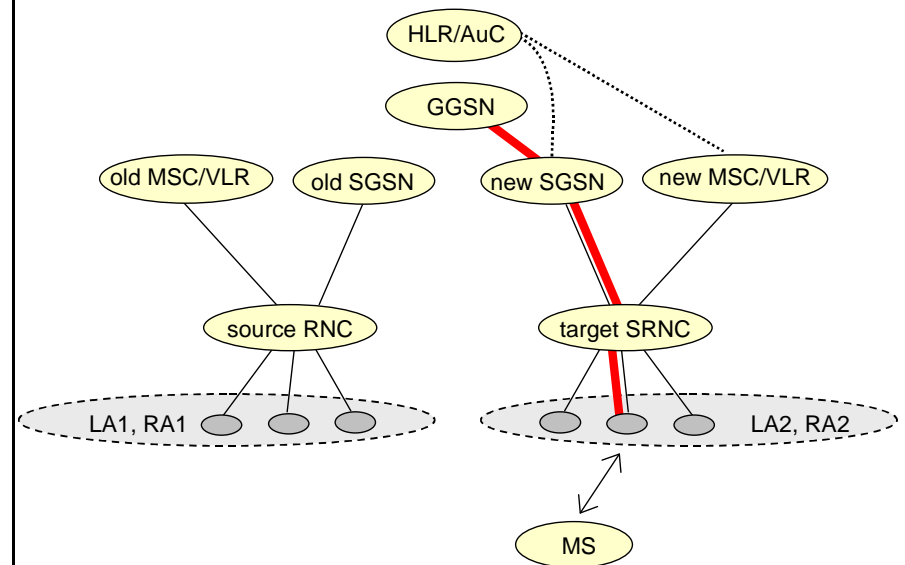
- ♦ Supports movement from serving-RNS to target-RNC
- ♦ Lossless Relocation
- ♦ MS and RNS have to support lossless PDCP
 - » s-RNS forwards GTP-PDUs to t-RNS (received-but-not-yet-transferred)



Serving RNS Relocation Procedure

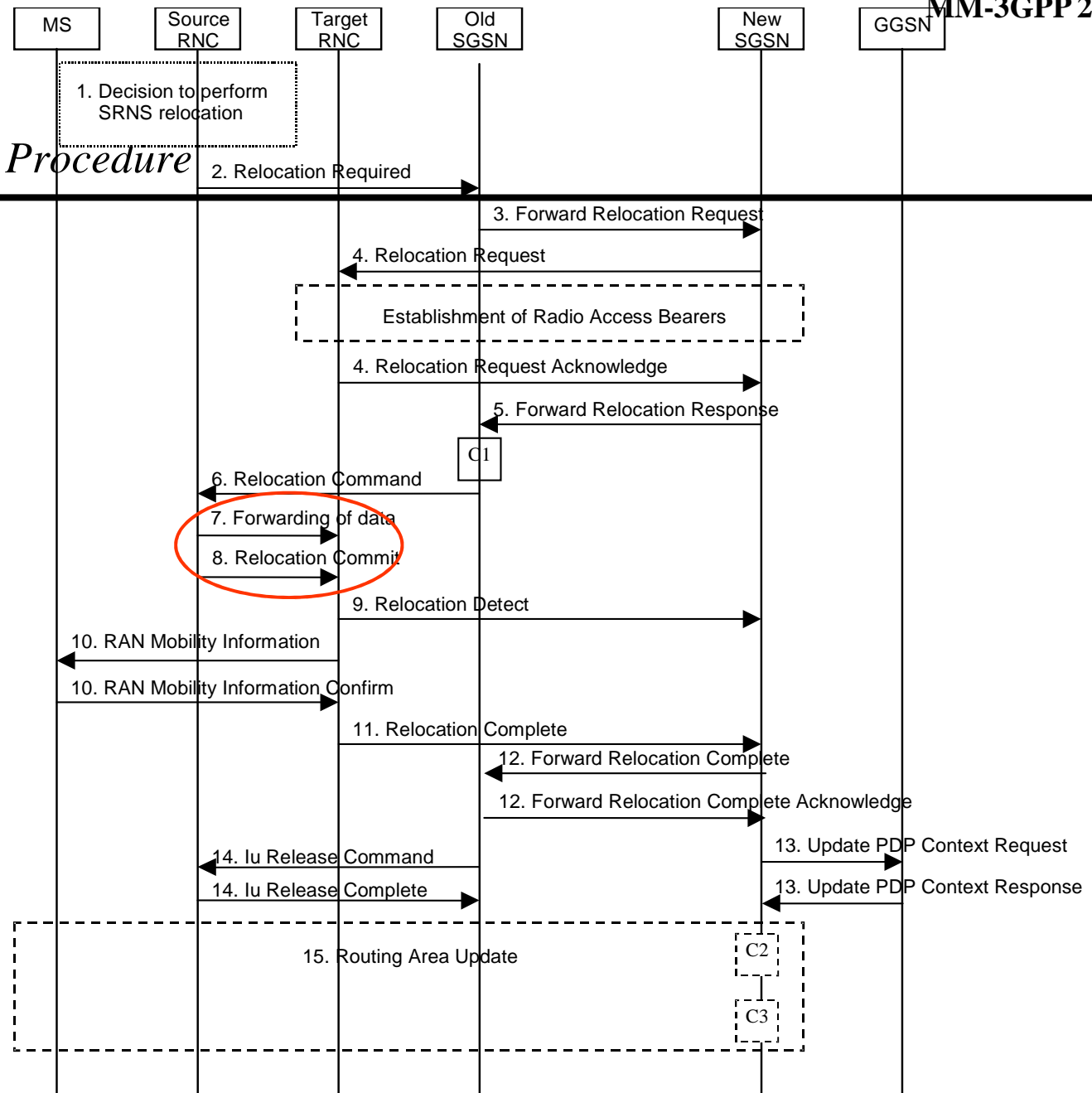


*Before SRNS Relocation and
Routing Area Update*

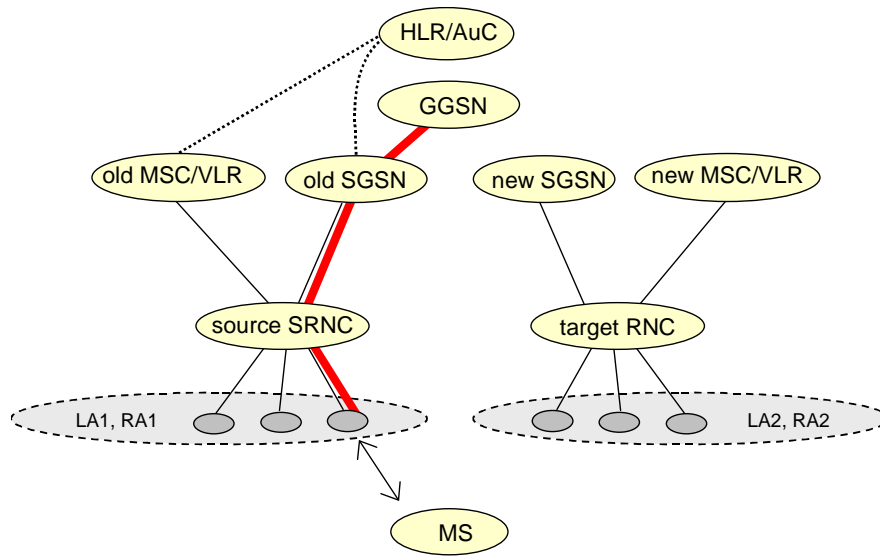


*After SRNS Relocation and
Routing Area Update*

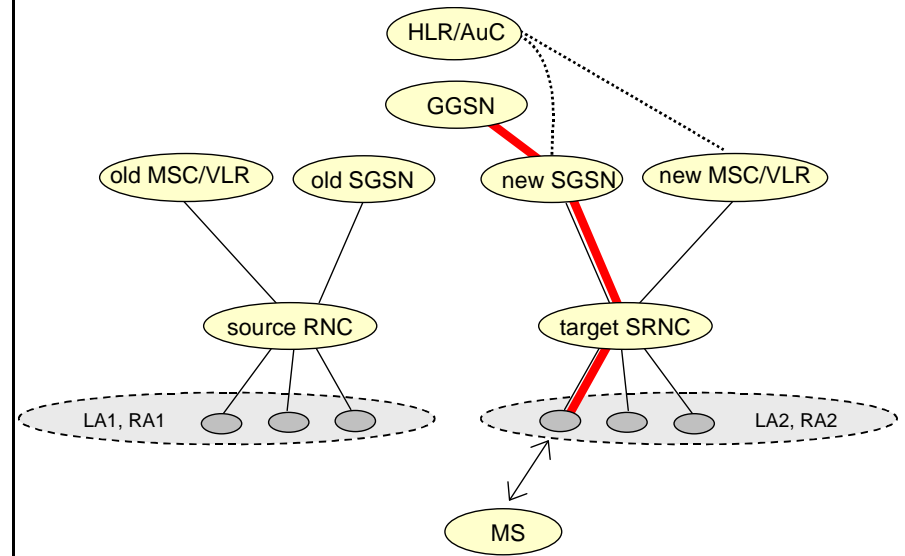
SRNS Relocation Procedure



Combined Hard Handover and SRNS Relocation Procedure



*Before Combined Hard Handover and
SRNS Relocation and Routeing Area Update*



*After Combined Hard Handover and
SRNS Relocation and Routeing Area Update*

Combined Hard Handover and SRNS Relocation Procedure

