Seminar Datacommunication &
Distributed Systems

Mobility Management in UMTS

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Overview

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2. Mobility in UMTS
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   - 2.2 Handover
3. Mobility in other networks
   - 3.1 GSM
   - 3.2 WLAN – IAPP
   - 3.3 WLAN – Mobile IP

some references

- “On Fundamental Concepts of Mobility for Mobile Communications”, Jun-Zhao Sun, Jaakko Sauvola - University of Oulu, Finland
- „Mobility Management in Mobile Internet“, S. Uskela - Nokia Finland
- UMTS World, http://www.umtsworld.com
- UMTSlink.at, http://umtslink.at, UMTS-Report, http://www.umtsreport.com
- 3GPP TR 23.060 & 25.832
- “Mobility Management: From GPRS to UMTS” Yi-Bing Li, Yieh-Ran Haung,Yuan-Kai Chen, Imrich Chlamtac
- “Handover Control in CDMA Radio Networks” Hongying Yin - Helsinki University of Technology
- “Performance Evaluation of Soft Handover in a Realistic UMTS Network”, Ingo Forkel, Marc Schinnenburg, Bianca Wouters - RWTH (Comnets) / Vodafone NL
- “Inter Access Point Protocol (IAPP)”, ORiNOCO – agere systems
- “Roaming with ORiNOCO/IEEE 802.11”, ORiNOCO – agere systems
- “Ciscos IOS software release 12.1 mainline – ConfiguringMobileIP”, Cisco Systems
- Some more, see workout

Aspects of Mobility 1/2

End-user aspects of Mobility

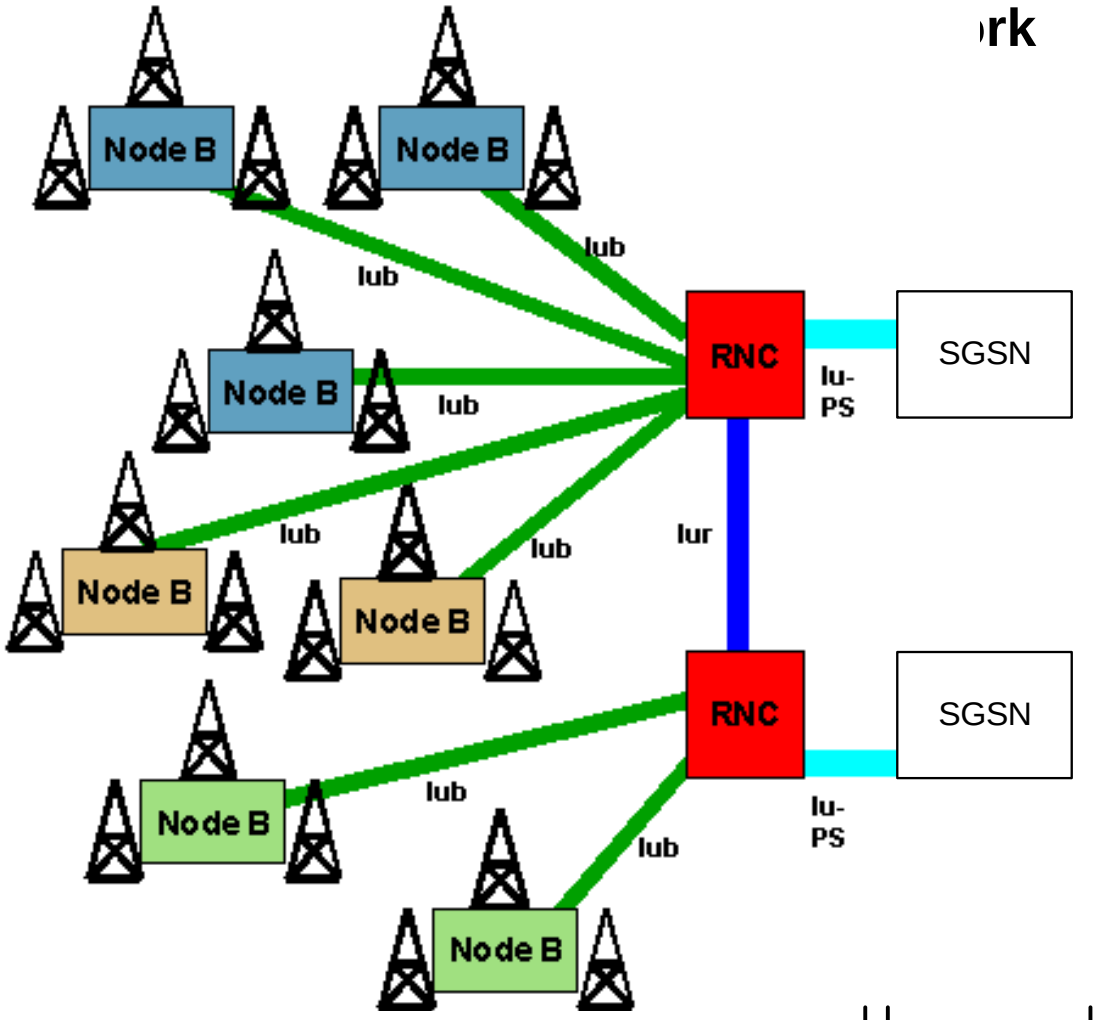
- Static mobility
- Nomadic mobility
- **Continous mobility**
  - **Cellular communication**
  - *Hot Spot communication*
  - Pervasive communication

Mobility Scenarios

- Service mobility
- Network mobiliy
- **Personal mobility**
  - **Personal communication**
  - **Personalising operating environment**
- **Device mobility**

Functions of mobility management

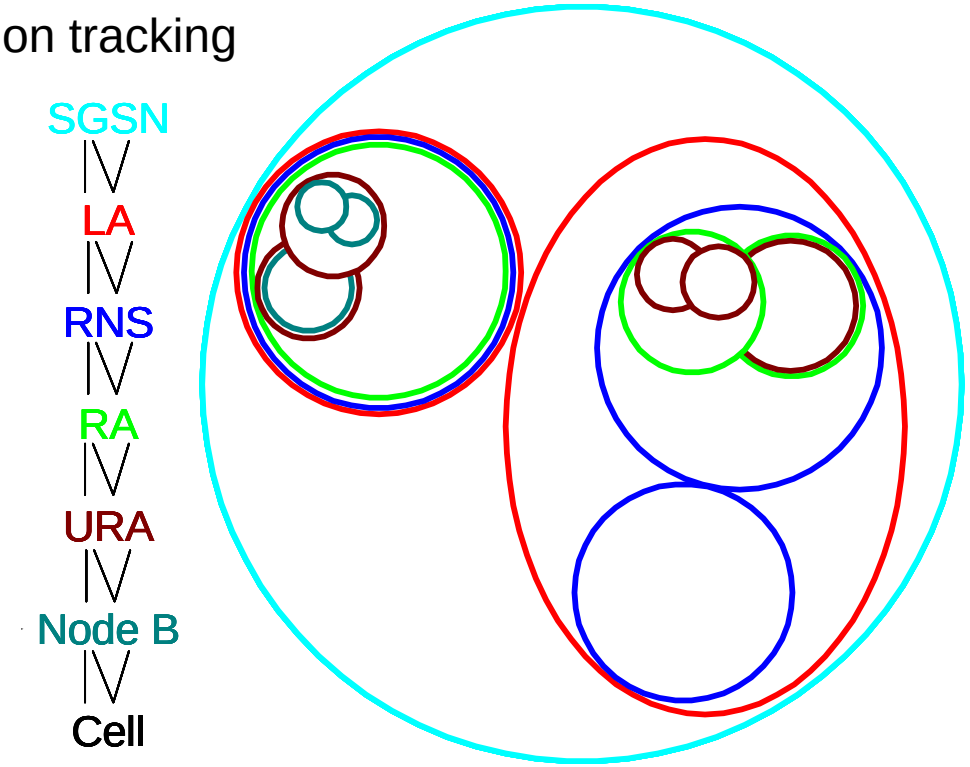
- Registration
  - Informs network which device is used and that it is ready to receive request.
  - Normally combined with authentication.
- Paging
  - In power saving mode only the area a device is located in
  - is known by the network. Paging is used to find the cell a device is located in.
- Location Update
  - Informs the network of new locations of the device.
  - Triggered by movement or timer.
- Handover
  - Keeps link while moving by switching the link from one access point to another.
- Rerouting
  - Optimizes the traffic path by redefining routes after handovers.



UE:	User Equipment
RNC:	Radio Network Controller
RNS:	Radio Network Subsystem (RNC with all connected Node Bs)
Iub:	RNC to Node B interface
Iur:	RNC to RNC interface
Iu-PS:	RNC to CN interface for packet-switched data
UTRAN:	UMTS Terrestrial Radio Access Network
CN:	Core Network
SGSN:	Serving GPRS Support Node
GGSN:	Gateway GPRS Support Node

Mobility in UMTS 2/11 - Introduction

Location tracking

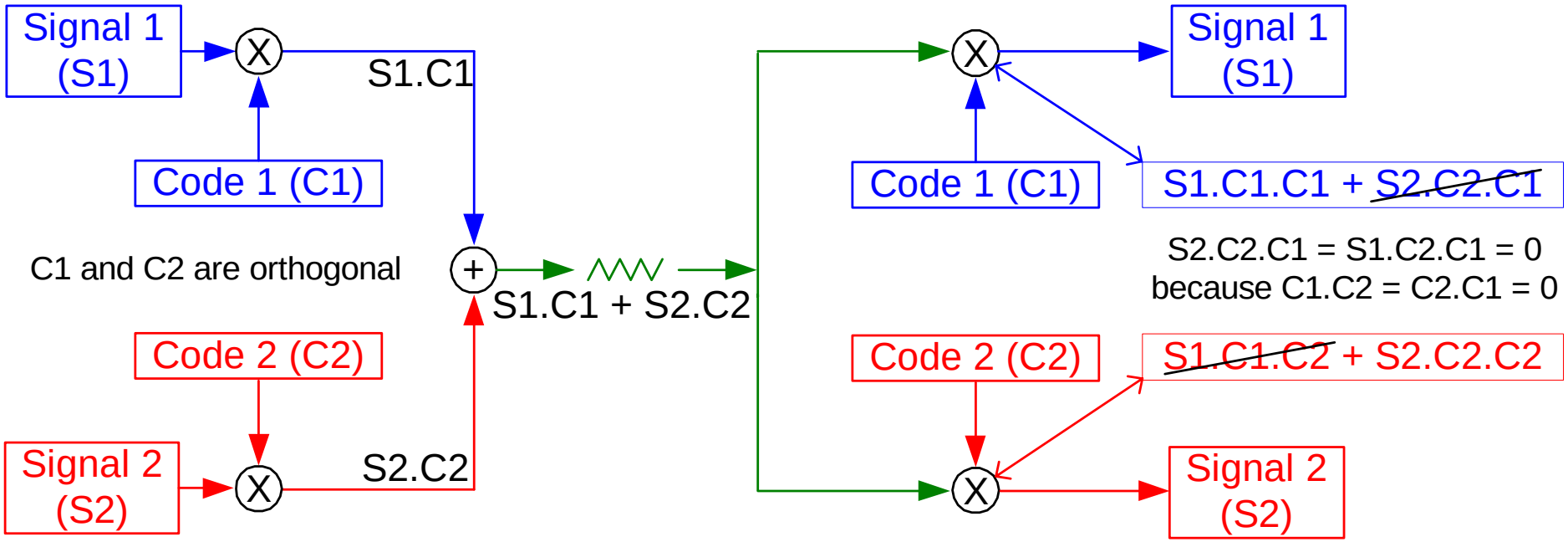


	PMM-connected UTRAN cell connected	PMM-idle UTRAN URA connected	PMM-detached CN (SGSN)
Cell	Yes	No	No
URA	Yes	Yes	No
RA	No	No	Yes

CN:	Core Network
UTRAN:	UMTS Terrestrial Access Network
SGSN:	Serving GPRS Support Node (*physical device*)
LA:	Location Area, used in CS-domain (*geographical area*)
RNS:	Radio Network Subsystem, RNC with all connected Node Bs (*physical device*)
RA:	Routing Area, used in PS-domain (*geographical area*)
URA:	UTRAN RA, used in PS-domain (*geographical area*)

W-CDMA (Wideband-Code Division Multiple Access)

- W-CDMA technique is used to transmit data over the air
- Unlike in FDMA or TDMA all communicators use the whole frequence spectrum the whole time in parallel
- Codes (channelization- & scramblingcode) are used to distinguish the data sent by the different communicators

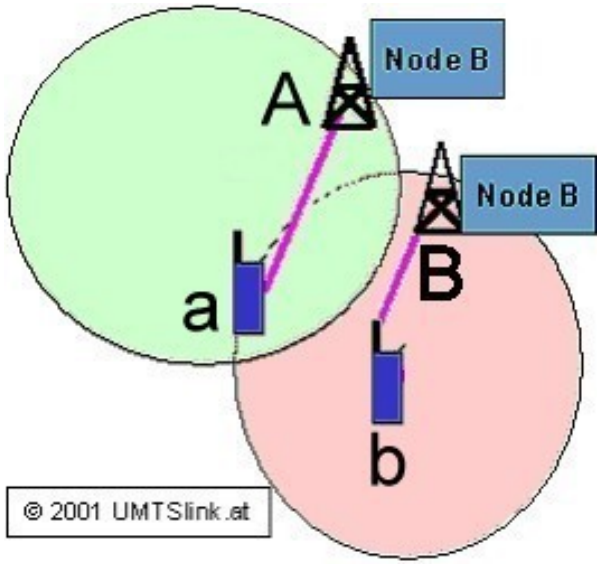


Macro Diversity

Codes used are only almost orthogonal, not enough orthogonal codes available.
Similar codes are used by UEs in different cells to keep codes in a cell most orthogonal.

Example of a problematic situation: Code of UE a and b is quite similar:

1. a & A increase transmission power level, radio signals reach far into neighbour cell
2. b & B are not able to filter out their signals, signal with similar code of a & A is too powerful
3. b & B increase transmission power level, radio signals reach far into neighbour cell
4. a & A are not able to filter out their signals, signal with similar code of b & B is too powerful...



Solution: UE can be connected to several cells at the same time. Transmission errors are corrected by the UTRAN by comparing data received by the different cells. This is called *Macro Diversity*.

In such a case an UE is in a *Soft Handover* situation. This can be a permanent situation.

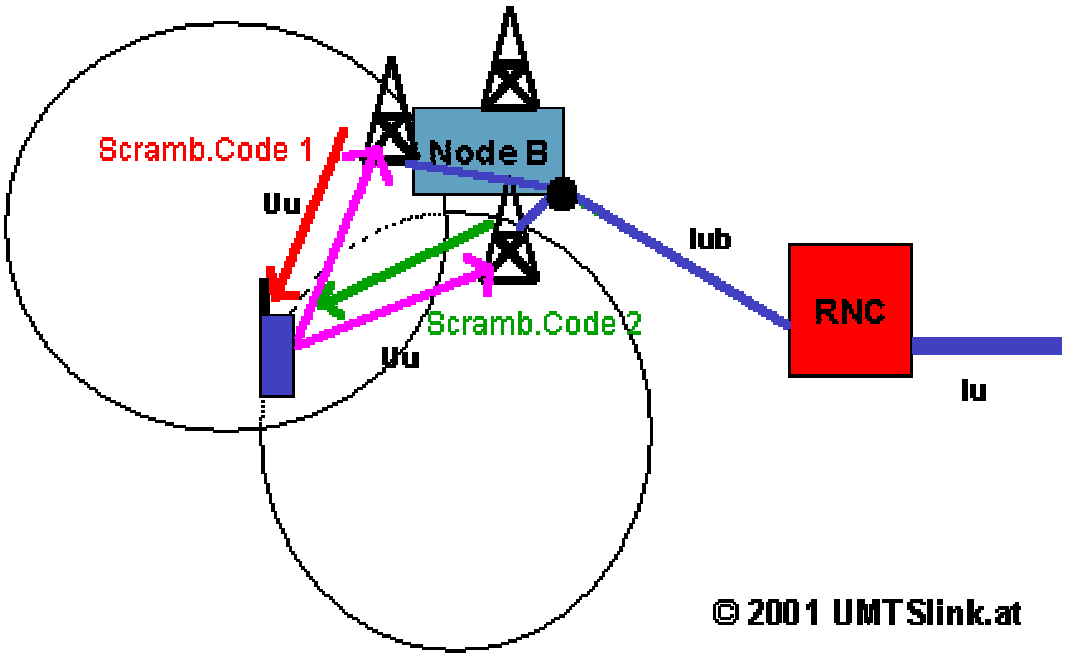
Soft Handover cases

- Depending on the location of the UE, the position of the cells and Node Bs and the internal structure of the network different Soft Handover cases exist:

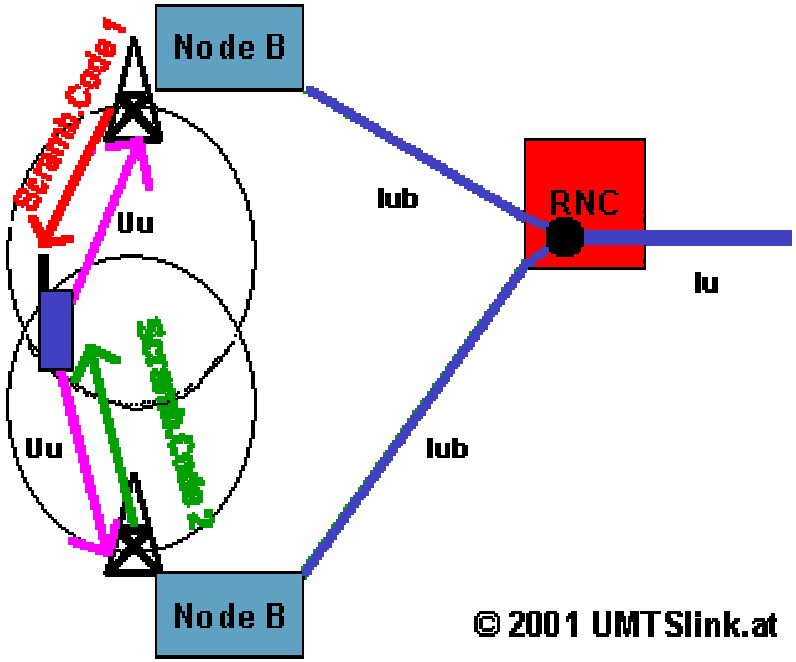
	Softer Handover intra Node B intra RNS intra SGSN	Soft Handover inter Node B intra RNS intra SGSN	Soft handover inter Node B inter RNS intra SGSN	Soft handover inter Node B inter RNS inter SGSN
Cells belong to same Node B	Yes	No	No	No
Node Bs belong to same RNS	-	Yes	No	No
RNSs are served by same SGSN	-	-	Yes	No

Soft Handover cases

1) Softer Handover
(intra Node B/intra RNS/intra SGSN)

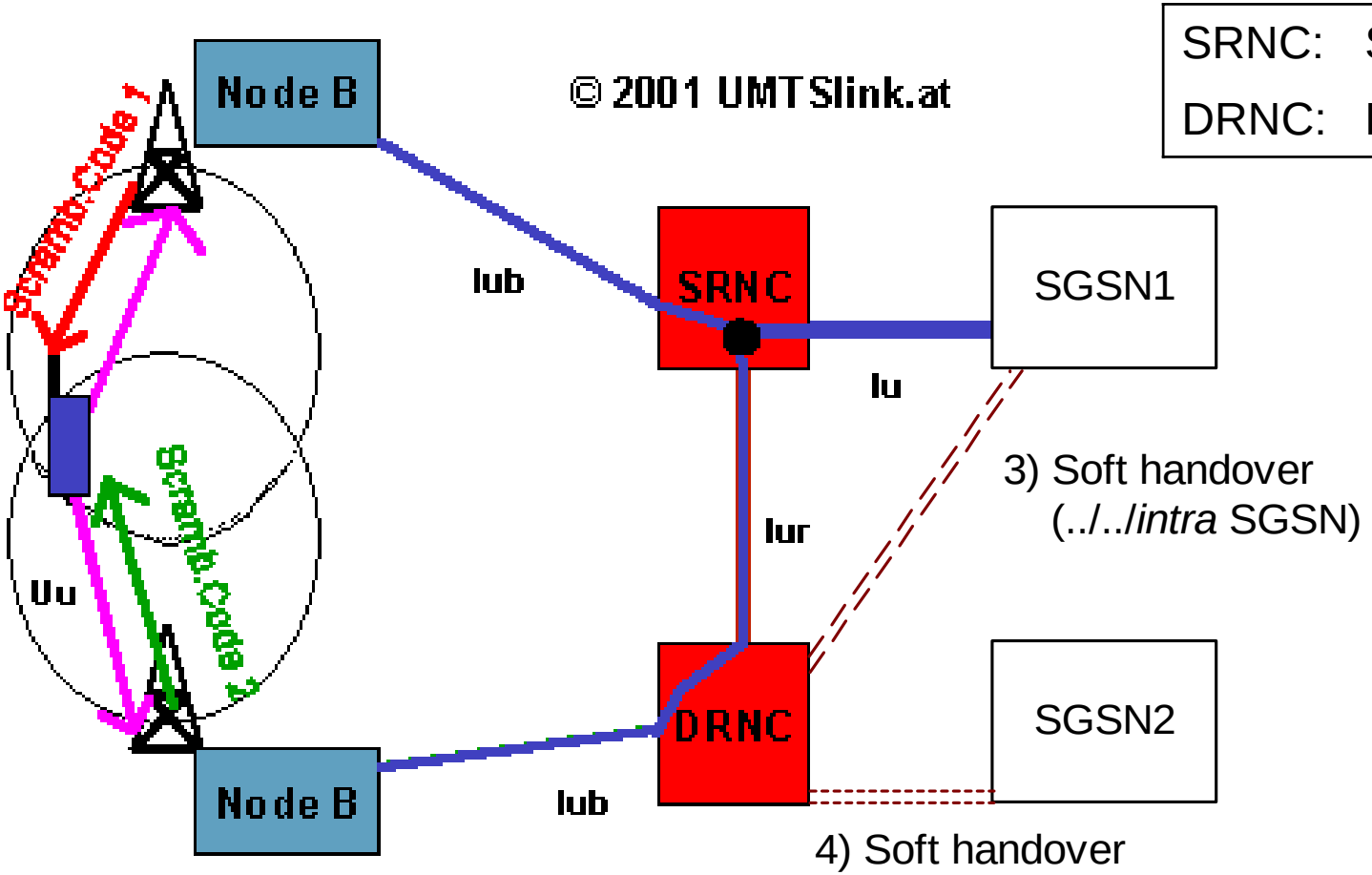


2) Soft Handover
(inter Node B/intra RNS/intra SGSN)



3) Soft handover
(inter Node B/inter RNS/*intra* SGSN)

4) Soft handover
(inter Node B/inter RNS/*inter* SGSN)



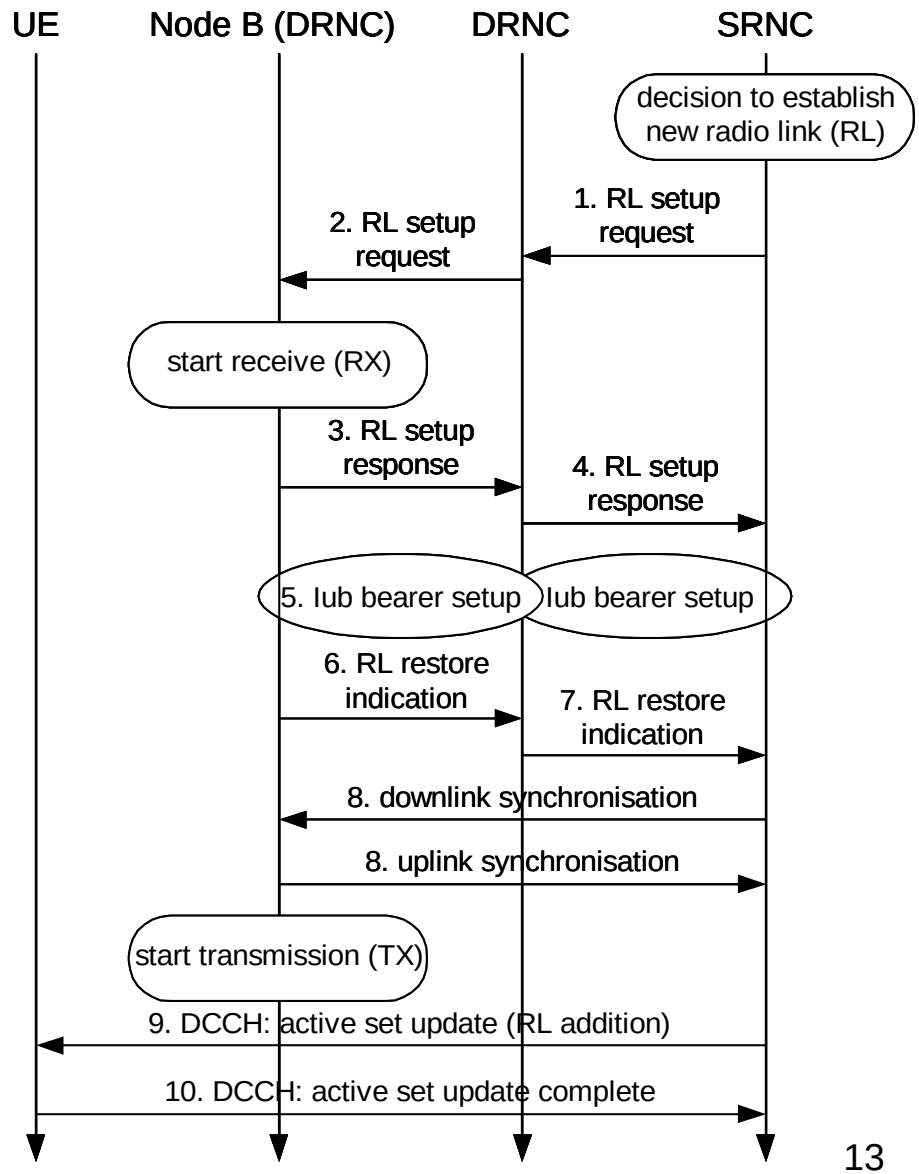
Soft Handover (inter Node B/inter RNS) radio link addition

In case of

- inter Node B/intra RNS and
- intra Node B/intra RNS

soft handover some of the steps are not performed.

SRNC:	Serving RNC
DRNC:	Drift RNC
RL:	radio link
DCCH:	Dedicated Control Channel

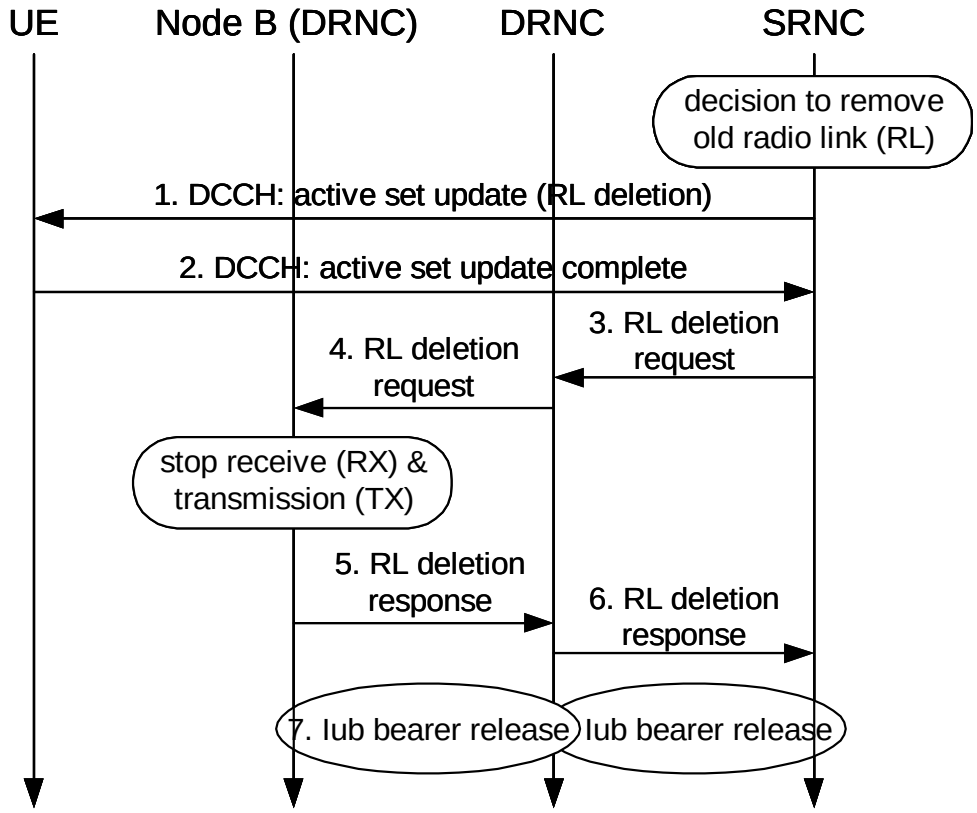


Soft Handover (inter Node B/inter RNS)
radio link deletion

In case of

- inter Node B/intra RNS and
- intra Node B/intra RNS

soft handover some of the steps are not performed.

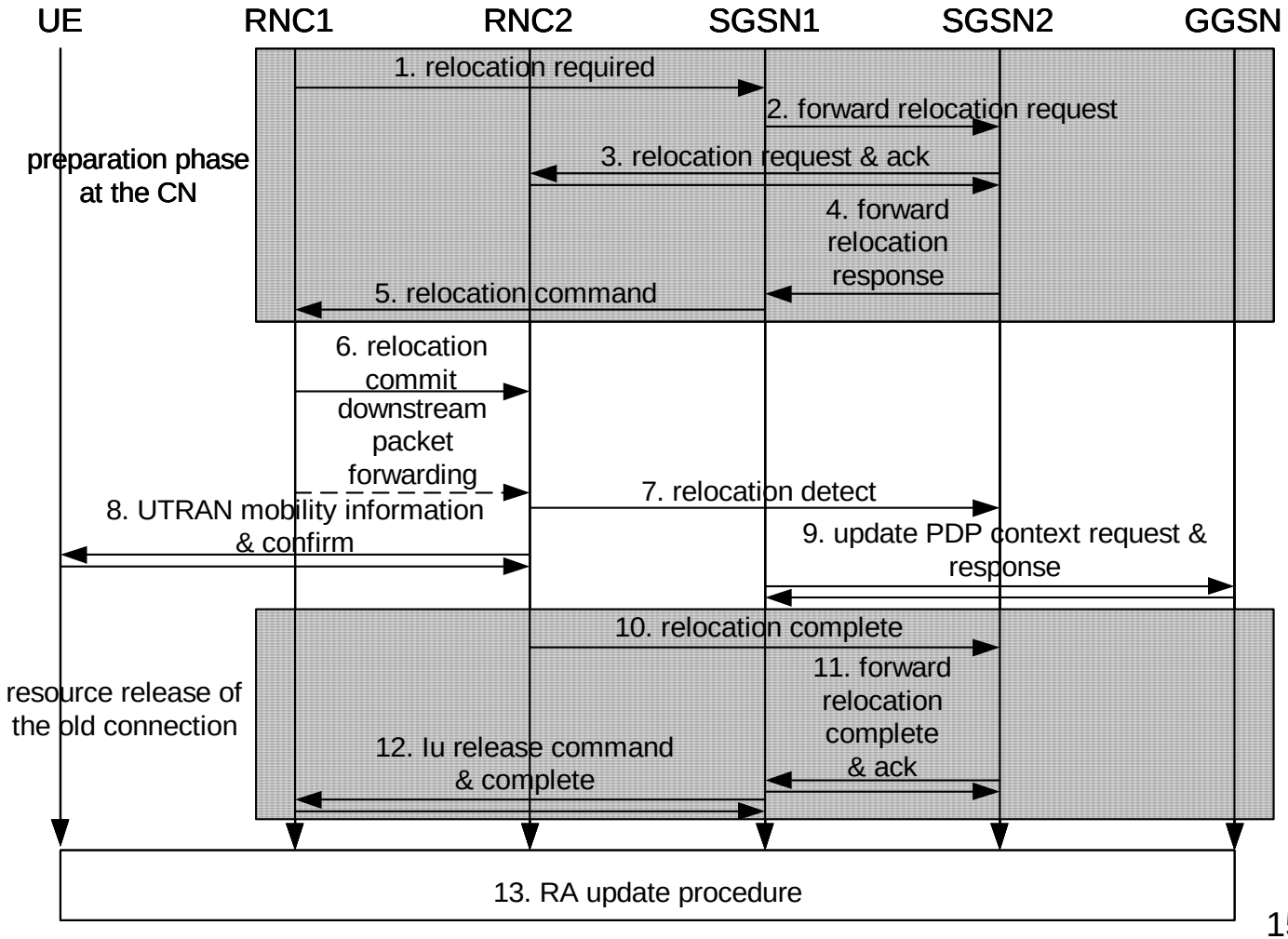


SRNC:	Serving RNC
DRNC:	Drift RNC
RL:	Radio Link
DCCH:	Dedicated Control Channel

Soft Handover (../inter RNS/inter SGSN) - SRNC and SGSN relocation

in ../inter RNS/intra SGSN case some steps not performed

PDP:	Packet Data Protocol
RA:	Routing Area
SGSN:	Serving GPRS Support Node
GGSN:	Gateway GPRS Support Node



Advantages & Disadvantages of Macro Diversity & Soft Handover

+ speech quality

  Good speech quality because of seamless handover & good error correction methods.

+ lower radio transmission level

  Because of W-CDMA more transmission errors can be corrected even at lower transmission levels.

+ power saving

  Transmitting at low radio transmission levels saves power.

+ frequency planning and network expansion

  New cells can be added easily, detailed frequency planning is not needed.

- costs of computation

  Error correction in soft handover situation cost computation power.

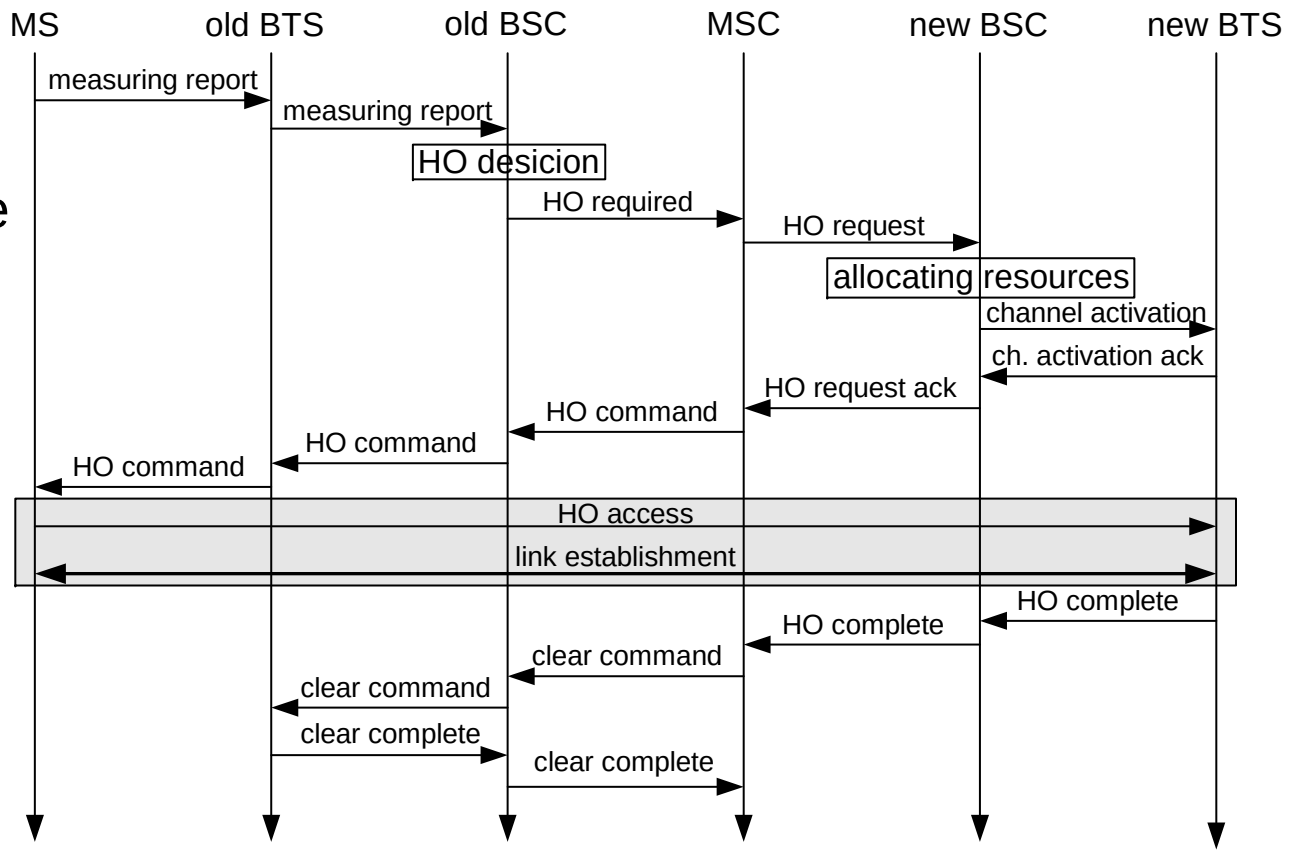
- complex to implement

  The different soft handover scenarios are quite complex to implement.

Handover in GSM

- frequency change at every handover (hard handover)
- connections are switched, only one connection possible

HO:	Handover
MS:	Mobile Station (UE)
BTS:	Base Transceiver Station (similar to Node B)
BSC:	Base Station Controller (similar to RNC)
MSC:	Mobile Switching Center (similar to SGSN for PS-domain in UMTS)



WLAN

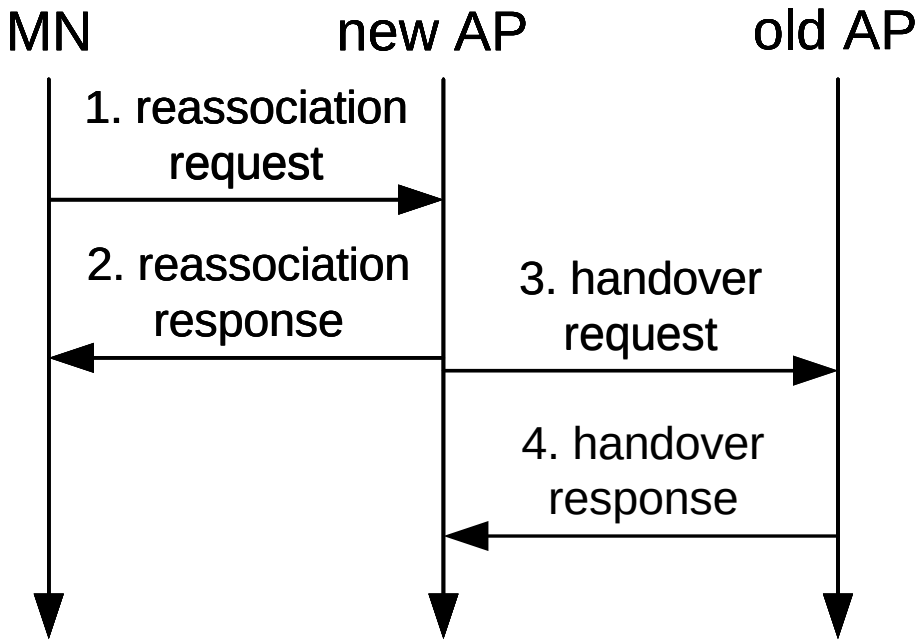
- WLANs consists of access points (APs), each covers an area around it
- APs are connected to fixed IP-network
- Mobile node (MN) usually gets an IP e.g. via DHCP from its current AP
- Two different techniques are used to roam between APs:

1. Inter Access Point Protocol (IAPP) (IEEE 802.11f draft 5)
   - Layer 2 handover mechanism
   - all APs must belong to the same IP-subnet
   - MNs keep their IP-address even when moving to another AP
2. Mobile IP (RFC 2002, 3344 and more for IPv4)
   - IP address of the MN changes while moving
   - APs can belong to different IP-subnets
   - general approach to solve mobility problems in IP networks, not specific for WLANs

WLAN – IAPP

- each AP maintains a BSSID-to-IP table containing informations of all APs in the IP-subnet
- To update and build BSSID-to-IP tables new APs announce themself by multicasting to the other APs while starting, other APs reply to this

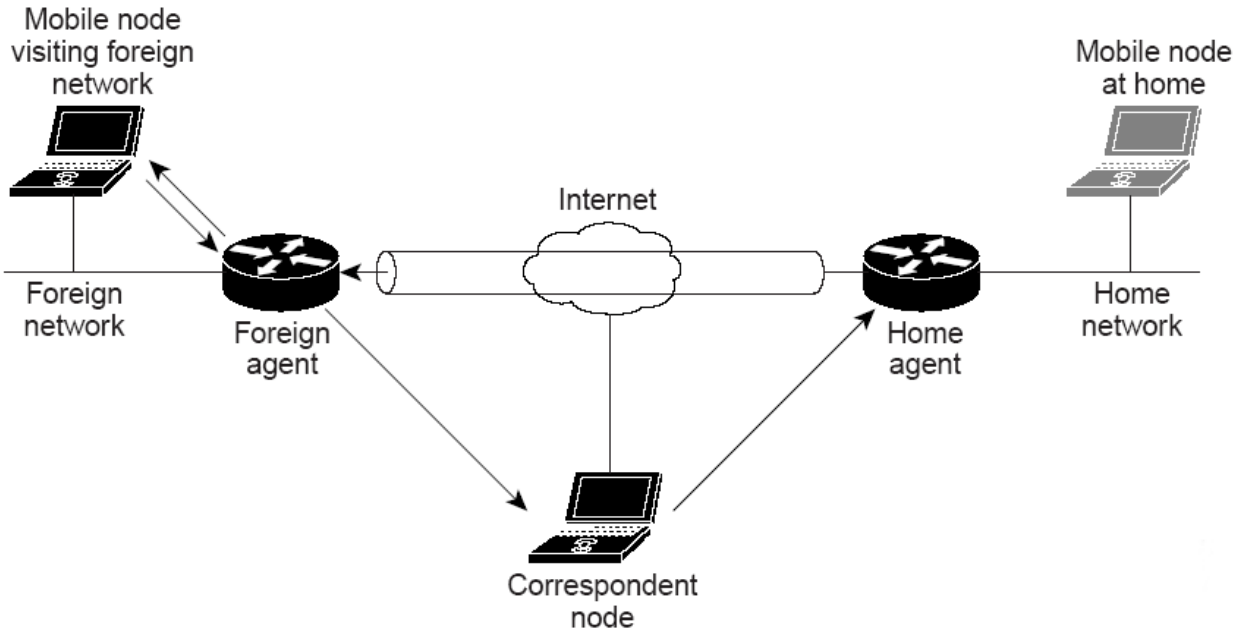
MN moves to a new AP:



WLAN – Mobile IP

Mobile IP works with 3 components:

- Home Agent (HA)
  Router located in the home network of MN. Forwards packets for MN to the network MN is located in.
- Foreign Agent (FA)
  Assigns care-of-address to MN and forwards packets from HA to MN.
- Mobile Node (MN)
  MN can be reached at its home address even while moving. Registers with current care-of-address at its HA (if located in foreign network).



Traffic is routed in a triangular manner.

Conclusion

- *UMTS*
  - Soft handover is used because with W-CDMA technique frequencies are used by all communicators at the same time
  - Macro Diversity prevents problems with interferences
  - Soft Handover situations can be quite or even as long as the active connection
- *GSM*
  - Only hard handovers are supported because the frequence has to be changed
- *WLAN*
  - Two possible techniques exist to provide mobility
  - Moblity is more roaming than handover,
    only MN decides and performs a switch to another AP