UTRAN Procedures

Elementary procedures
- Paging
- RRC connection setup
- Transaction reasoning
- Authentication and security control
- Transaction setup with RAB allocation
- Transaction clearing and RAB release
- RRC connection release

RRM procedures
- Radio link addition and deletion
- Intersystem handover from UMTS to GSM (CS/PS)
- UE state transitions/ bearer reconfiguration

MM procedures -> see MM slides
CM procedures -> see CM slides

References:
- Kaaranen ch. 10 (simple cases discussed here)
- 3GPP TR 25.931 (more complicated cases)
Basic Model of UMTS Network Transactions

A transaction comprises all the elementary procedures required to enable
- the transport of user data (PS or CS mode) or
- the exchange of higher-layer signaling messages (e.g. MM or CM)

1. Paging
2. RRC Connection Establishment
3. Transaction Reasoning (Signaling conn. establishment)
4. Authentication and Security
5. Transaction Setup and RAB Allocation
6. Transaction (user or control plane)
7. Transaction Release and RAB Release
8. RRC Connection Release

- UE indicates the CN the requested service
- Allocation of bearers to support required UMTS bearer service
- Transfer of data
- Release of all bearers to support UMTS bearer service
Paging

Paging type 1:
- UE idle mode (no RRC connection)
- RRC connected modes cell_PCH or URA_PCH

Example: paging for a UE in idle mode
Paging

Paging type 2:
- UE is in RRC connected mode cell_DCH or cell_FACH
- Paging request from another CN domain

Example: paging for a UE in RRC Connected Mode (CELL_DCH or CELL_FACH state)

2 cases:
- UTRAN coordinates the paging request with the existing RRC connection (given example)
- UE coordinates the paging request with the existing RRC connection
RRC Connection Setup

Establishment of a RRC connection in cell_DCH mode

- **Initial Random Access**
  - CCCH (TM)/ RACH: RRC Connection Request
  - RL Setup Request
  - RL Setup Response
  - ALCAP Iub Transport bearer Setup
  - UL/DL Synchronisation
  - CCCH (UM)/ FACH: RRC Connection Setup

- **DCCH (AM)/ DCH: RRC Connection Setup Complete**
  - Addr.: Initial UE ID
  - Establishement of UTRAN DCH resources incl. CAC
  - Addr.: Initial UE ID
  - DCCH established
  - UE capabilities known

**Transaction Reasoning**
- (Signaling conn. establishment)
- Authentication and Security
- Transaction Setup and RAB Allocation
- Transaction (user or control plane)
- Transaction Release and RAB Release
- RRC Connection Release
Initial Random Access

UE addressing
- **CCCH**: UE ID embedded in the RRC message
- **DTCH/DCCH**: UE ID included in MAC header
RRC Connection Setup

Reasons for RRC connection setup:
- Call setup (mobile-originated and mobile-terminated calls)
  - Conversational call
  - Streaming call
  - Interactive call
  - Background call
  - Emergency call
  - Call re-establishment
- Exchange of signaling messages (low/high priority)

RRC connection request message contains, e.g.
- IMSI, TMSI, IMEI
- Location area, routing area identity, etc.
- Other information: e.g. HSDPA/E-DCH UE capability, standards release
1. RRC Connection Establishment

2. DCCH: Initial Direct Transfer

3. Initial UE Message

Payload contains system network message:
Information about the transaction initiated by the UE (IMSI, TMSI, location area, kind of requested transaction)
Authentication and Security Control

Authentication request/response: mutual authentication of UE and network
Security mode command/complete: CN domain indicates to UTRAN and UE the encryption details (method/algorithms and encryption keys)
Transition Setup and RAB Establishment (CS Mode)

RRC Direct Transfer (CC: Setup) → RANAP Direct Transfer (CC: Setup) → RANAP RAB Assignment Request → RANAP RAB Assignment Response → RRC Direct Transfer (CC: Call Proceeding)
Transition Setup and RAB Establishment (PS Mode)

- RRC Direct Transfer
  (SM: Activate PDP Context Request)

- RRC: Radio Bearer Setup

- Radio Bearer Establishment

- RRC: Radio Bearer Setup Complete

- RRC Direct Transfer
  (SM: Activate PDP Context Accept)

- RANAP Direct Transfer
  (SM: Activate PDP Context Request)

- RANAP RAB Assignment Request

- RANAP RAB Assignment Response

- RANAP Direct Transfer
  (SM: Activate PDP Context Accept)

⇒ see next slide for details
Example: Synchronised establishment of a RAB on DCH
Transaction Release and RAB Release (CS Mode)

Note: signaling connection and RRC connection remains
Transaction Release and Iu Release (CS Mode)

Note: signaling connection and RRC connection are released
Note: signaling connection and RRC connection remain
Transaction Release and Iu Release (PS Mode)

Note: signaling connection and RRC connection are released
RRC Connection Release

RRC: Connection Release

RRC: Connection Release Complete

NBAP: RL Deletion

NBAP: RL Deletion Response

lub Bearer Release
RRC Connection Release (involving DRNC)

Example: RRC connection release of a dedicated channel in soft HO mode with DRNC
Soft Handover – Radio Link Addition

- **UE** starts Rx on new radio link
- **Target Node B** starts Rx
- **DRNC** sends Radio Link Add/Setup Request
- **UE** sends Radio Link Add/Setup Response
- **SRNC** sends Radio Link Add/Setup Response
- **Target Node B** is ready
- **UE** starts Tx
- **DRNC** sends ALCAP Iub Data Transport bearer Setup
- **Target Node B** sends Radio Link Restore Indication
- **SRNC** sends Radio Link Restore Indication
- **UE** sends Active Set Update (Radio Link Addition)
- **DRNC** sends Active Set Update Complete
- **SRNC** sends Measurement Control

**Unsynchronized addition**
Soft Handover – Radio Link Deletion

UE stops Rx on old radio link

Active Set Update (Radio Link Deletion)

Active Set Update Complete

Measurement Control

Radio Link Deletion Request

Radio Link Deletion Response

stop Rx & Tx

UE

Node B

DRNC

SRNC

RNC Decides to delete an existing Radio Link

E.g. new neighbour cell list

Free-up resources of old NodeB

ALCAP Iub Data Transport bearer Release

ALCAP Iur bearer Release

Unsynchronized deletion
SRNS Relocation (CS)
UE RRC Connected States – Traffic Perspective

- **Cell_DCH**
  - Dedicated Traffic and Control carried over DCH
- **Cell_FACH**
  - Dedicated Traffic and Control carried over RACH/FACH
- **URA_PCH**
  - No air interface resources required, “dormant” RB
  - UE receives paging on UTRAN Routing Area (URA) basis rather than standard routing area (RA); URA usually in the order of 10 cells
URA_PCH to CELL_DCH/CELL_FACH Transition

Unsynchronised procedure with CRNC = SRNC
CELL_FACH to CELL_DCH Transition

Unsynchronised procedure with CRNC = SRNC
CELL_DCH to URA_PCH/CELL_FACH Transition

Unsynchronised procedure with CRNC = SRNC
Dynamic Bearer Reconfiguration

- **UE**: Cell DCH
- **Node B (Drift RNS)**
- **Node B (Serving RNS)**
- **DRNC**: Radio Link Reconfiguration Prepare
- **SRNC**: RNC Decides to change the rate of the UE

- **Radio Link Reconfiguration Prepare**
- **Radio Link Reconfiguration Ready**
- **Radio Link Reconfiguration Commit** ($T_{Activation}$)
- **Transport Channel Reconfiguration** (DCCH, AM, $T_{Activation}$)

- **Transport Channel Reconfiguration Complete** (DCCH, AM)
- **ALCAP Iub Data Transport bearer Setup**
- **ALCAP Iub Data Transport bearer Release**
- **ALCAP Iur bearer Setup**
- **ALCAP Iur bearer Release**

- **Activation Time $T_{Activation}$**
- **UE & Node-B reconfigured to the new rates**

**Synchronised DCH modify w/o transport bearer reconfiguration**