GSM Network and Services

Signaling protocols
over Um - the air interface
ISDN

Layer 2

D

Signaling

SAPI: 0, 1, 2...

LAPD

Layer 1

B

Voice

Layer 1
Signaling protocols MS - BSS
LAPDm

Layer 2

Signaling | SMS

SAPI:0   SAPI:3

LAPDm

BCH / CCCH / DCCH / TCH

Voice
LAPDm

- Provides:
  - Segmentation and reassembly
  - Frame filling; all layer one frames are of fixed length size depending on channel.
  - Unacknowledge mode
  - Acknowledge mode; window size = 1.
Transport of voice

GSM Source Coding (13 kb/s voice)
Transparent data

Unrestricted Digital Information

Layer 1

UDI
Coding
Cipher
Radio

MS

BTS

E1

TRAU
E1

BSC

E1

MSC

E1

IWF

UDI

Coding
Cipher
Radio

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Non-transparent data

Radio Link Protocol

Layer 1

MS

BTS

BSC

MSC

IWF

UDI

RLP

Coding

Cipher

Radio

UDI

RLP

Coding

Cipher

Radio

TRAU

E1

E1

E1

E1

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Circuit switched data

- Circuit switched data, transparent or non-transparent, comes in bitrates up to 14.4 kb/s.
- High Speed Circuit Switched Data (HSCSD) can combine four time slots into one data channel of a maximum of $4 \times 14.4 = 57.6$ kb/s. Operator/terminals often limit this to $3 \times 14.4$ down link and $14.4$ up or $2 \times 14.4$ in both directions.
- GPRS is taking over from HSCSD.
Signaling protocols MS - BSS

Layer 2
- LAPDm
- L1

Layer 3
- CC
- MM
- RR

Um
- RR
- LAPDm
- L1
- BTSM
- LAPD
- E1

Abis
- RR
- BTSM
- LAPD
- E1

A
LAPDm

- UI-frames (Unnumbered Information) are unacknowledged frames used for broadcasting and common control messages (who should acknowledge?). Also used by messages on the SACCH.
- I-frames (information) are acknowledged by the receiver. The window size is set to 1 so we only send one frame at a time. Used by SDCCH and FACCH (handover).
Layer 3 RR/MM/CM
Radio Resource Management

- Administration of frequencies and channels.
- Monitor BCCH and PCH of the current cell.
- Monitor neighboring cells for cell re-selection.
- Request/setup/take down dedicated channels.
- Monitor and report signal quality of dedicated channels.
- Handover (initiated by BSS).
- Encryption/decryption.
Radio Resource Management

• In idle mode: the BSS sends System Information Type 1-4 on the BCCH. This will give the mobile information about current cell and neighbors.

• In dedicated mode: The BSS sends System Information Type 5-6 on the SACCH. The mobile sends measurement reports on the SACCH (TA is piggy-backing on SACCH layer 1 frame)

• Monitoring of neighbors can be done between bursts. Monitoring of BCH can be done in the idle frame.
Mobility Management

- Attach and detach of subscribers (SIM).
- Localization of subscriber (paging)
- Location updating (mobile station is responsible).
- Authentication of subscriber.
- Confidentiality of subscriber – allocating TMSI
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
RR procedures – connection setup

How does the mobile identify himself?

How do we know it's our assignment?
RR procedures – connection setup

MS

Paging Request

Channel Request

Immediate Assignment

|     | LAPDm Connection setup |     |

BSS

PCH

RACH

AGCH

SDCCH

How do we know it's our page?
Do we have to listen all the time?
RR procedures – connection release

Mobile returns to idle state.

Always sent by the BSS.
RR procedures – handover

MS

- Handover Command
- Switch to new Channel
- Handover Access
- Physical Information
- Handover Complete

BSS

FACCH

:\n
(access burst)

How does the new BSS know it's us??
RR procedures – ciphering

From where do we get the keys?
MM procedures – authentication

Authentication is done by encrypting a challenge (RAND) with a shared key (Ki) and sending back the result (SRES)?
MM procedures – confidentiality

- TMSI reallocation Command
- TMSI Reallocation complete

MS | BSS
---|---
SDCCH
MM procedures

- Procedures are divided into:
  - Common: can be performed anytime
  - Specific: one at a time
  - MM Connection Management: requests by CM procedures for establishment of services.
MM procedures – location update

MS

Location Update request

- identification
- authentication
- cipher mode

Location Update Accept

TMSI reallocation complete

BSS

SDCCH
MM procedures – connection management

MS  

CM - Service Request

- identification
- authentication
- cipher mode

BSS

SDCCH

CM – Service Accept
Incomming call

MS

- paging (PCH)
- channel req (RACH)
- assigned (AGCH)
- paging resp (SDCCH)
- auth req and resp (SDCCH)
- cipher setup (SDCCH)
- call setup (SDCCH)
- call connect (FACCH)
- talk (TCH)

BSS