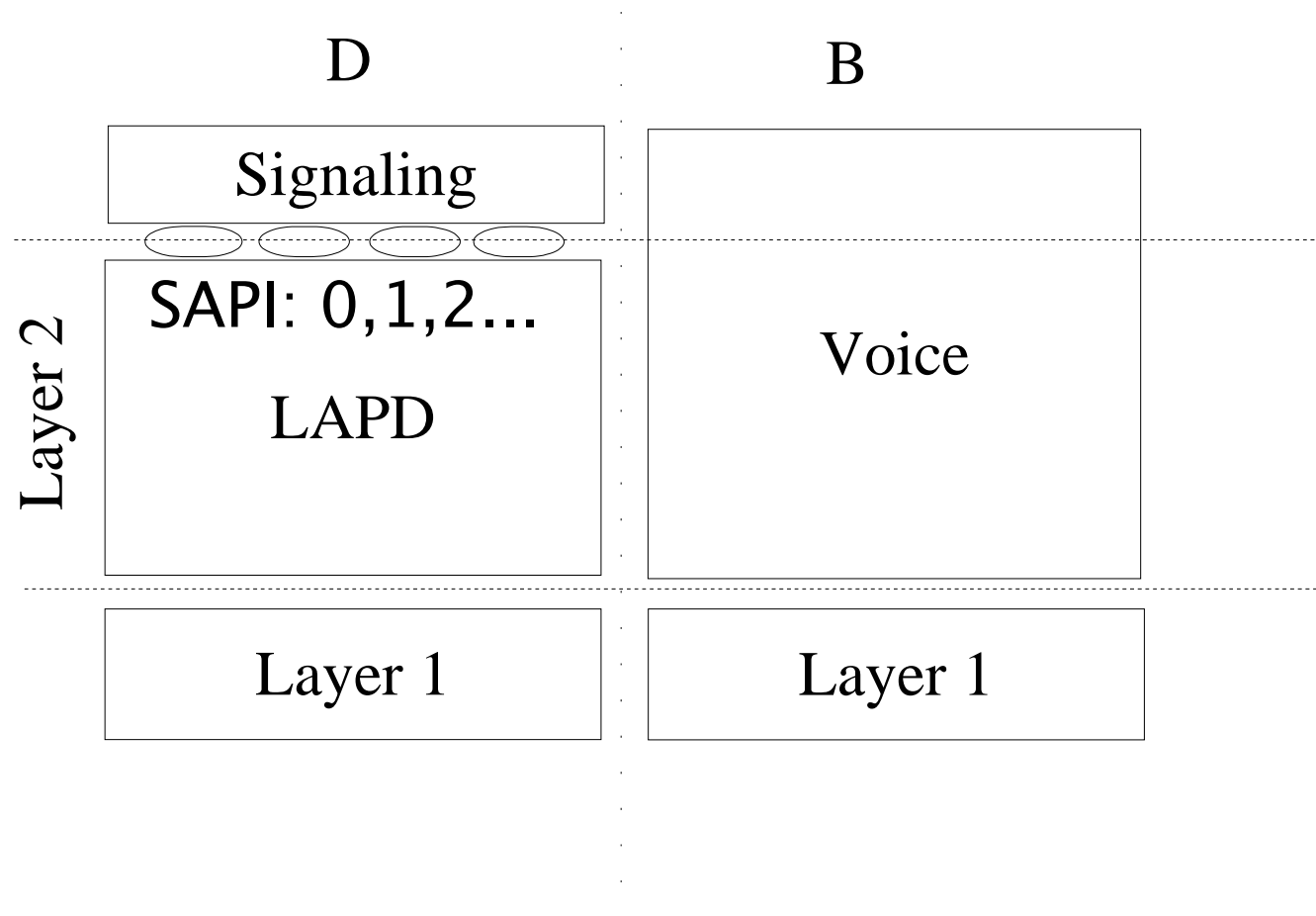


# GSM Network and Services

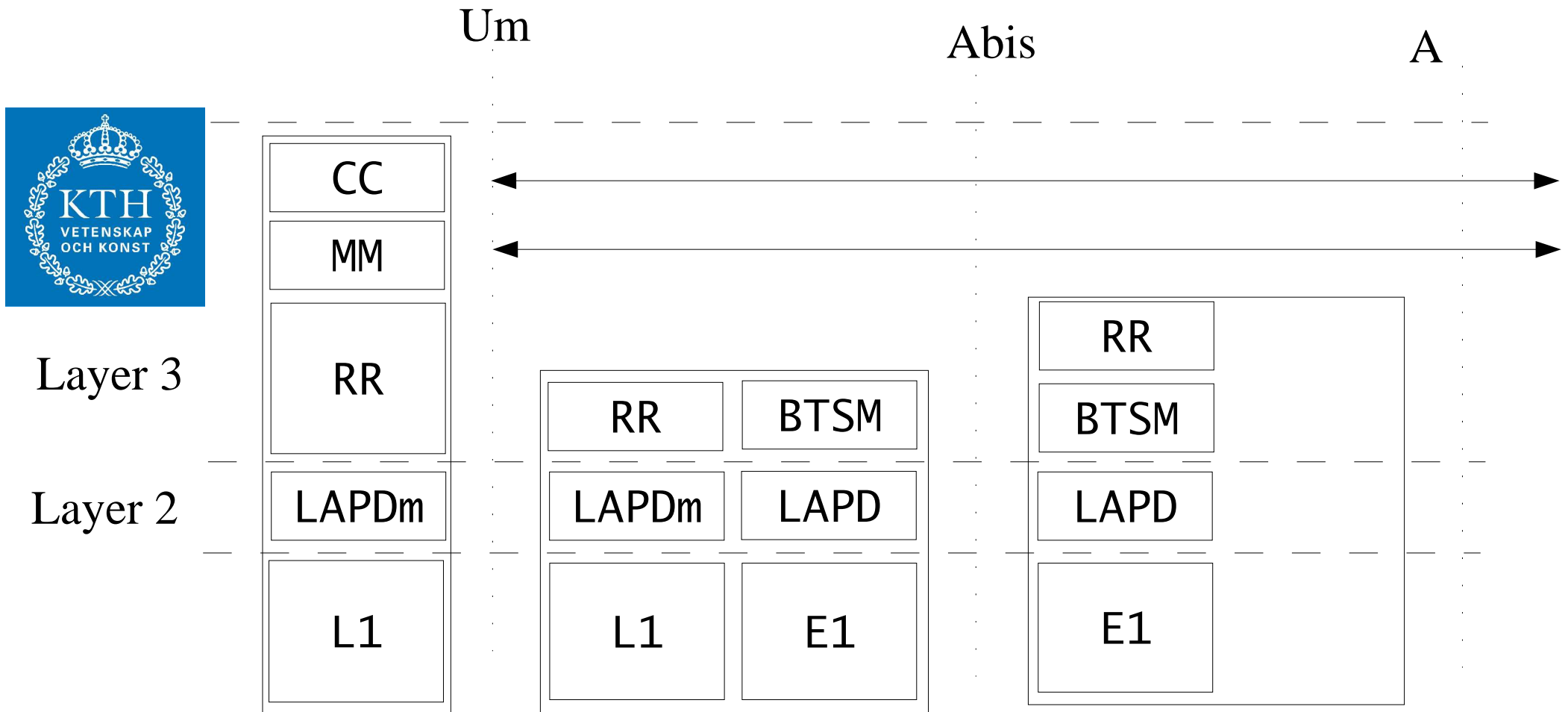


Signaling protocols  
over Um - the air interface

# ISDN



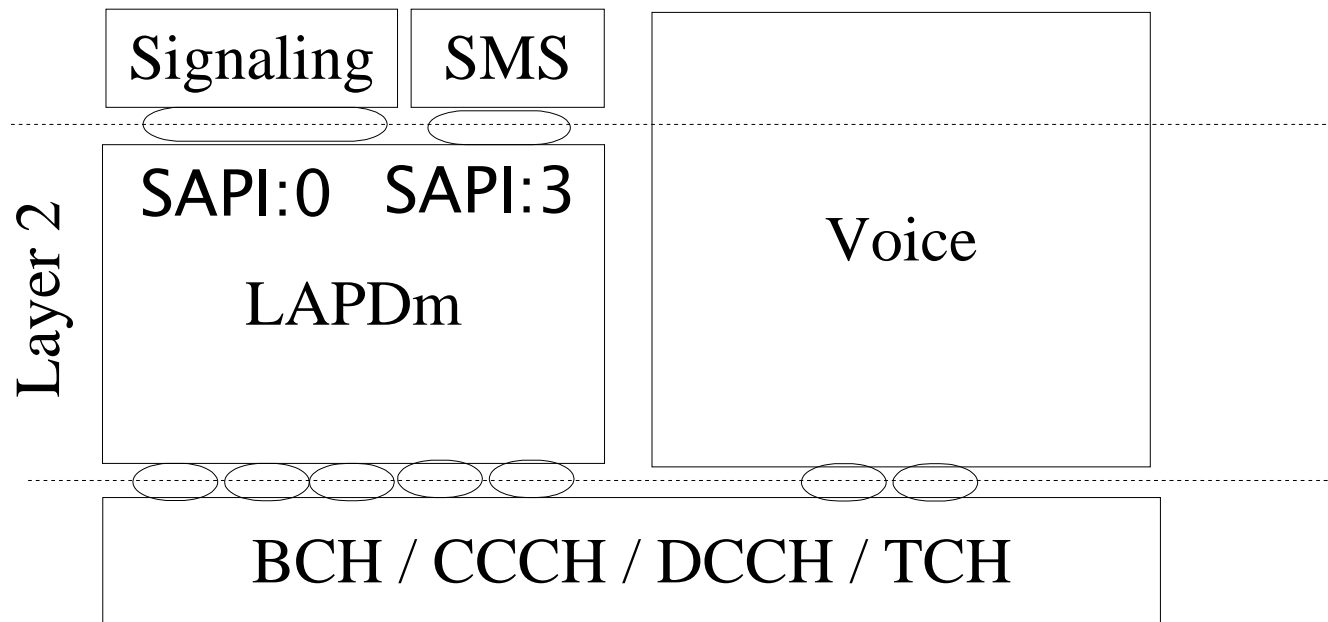
# Signaling protocols MS - BSS



Layer 3

Layer 2

# LAPDm



# 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.

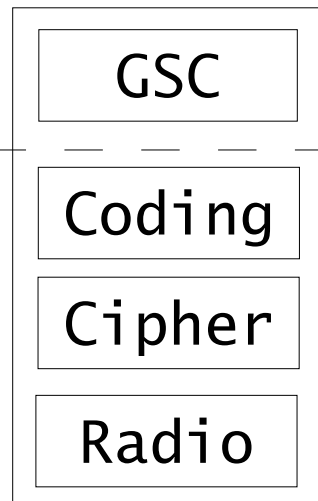


# Transport of voice

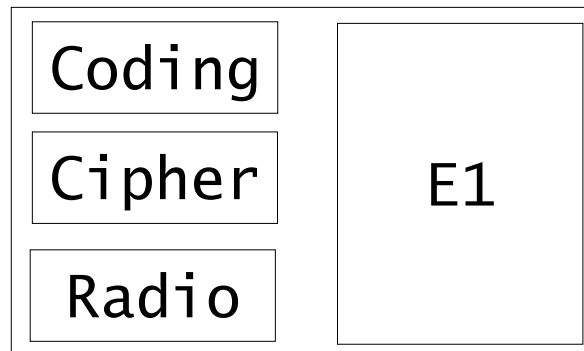
## GSM Source Coding (13 kb/s voice)



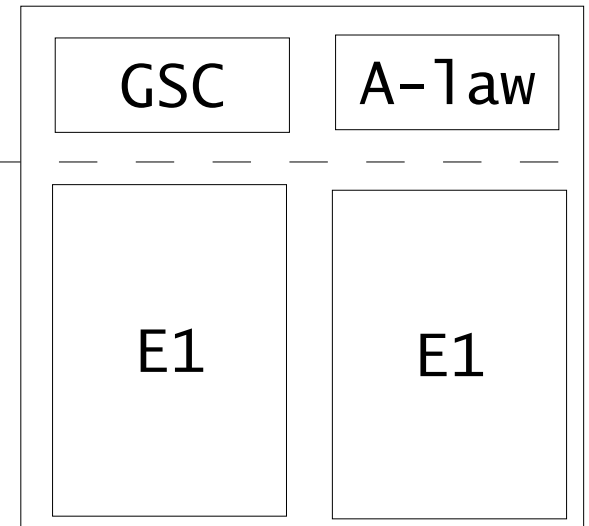
Layer 1



MS



BTS



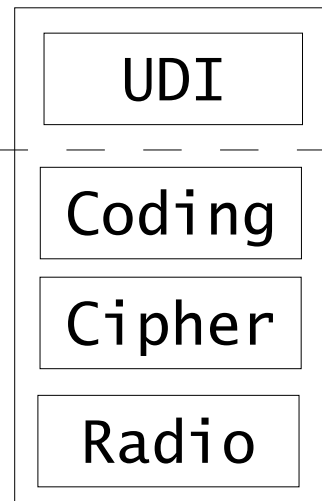
BSC

# Transparent data

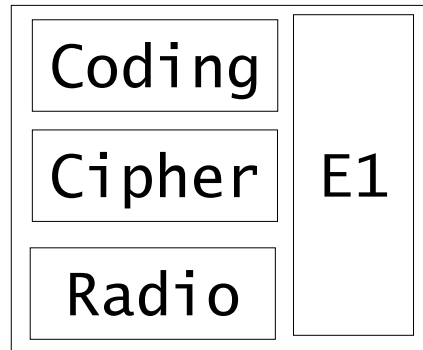
Unrestricted Digital Information



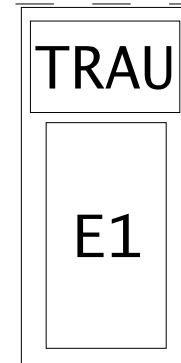
Layer 1



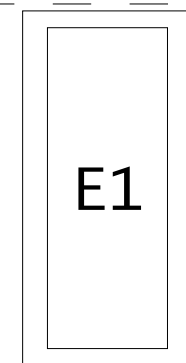
MS



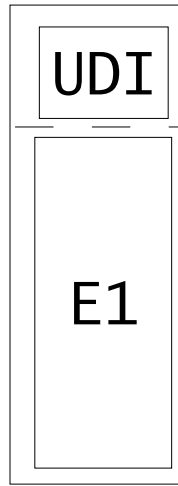
BTS



BSC



MSC



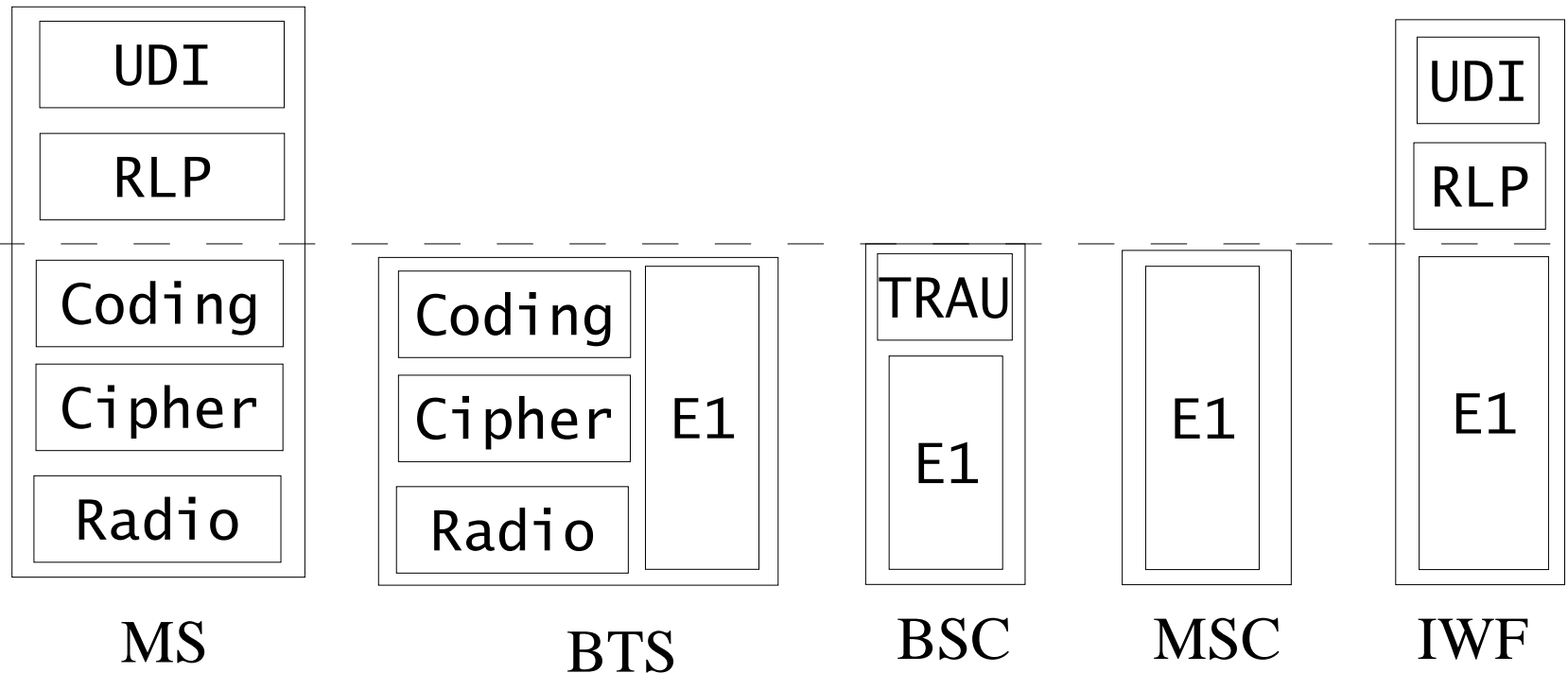
IWF

# Non-transparent data

## Radio Link Protocol



Layer 1



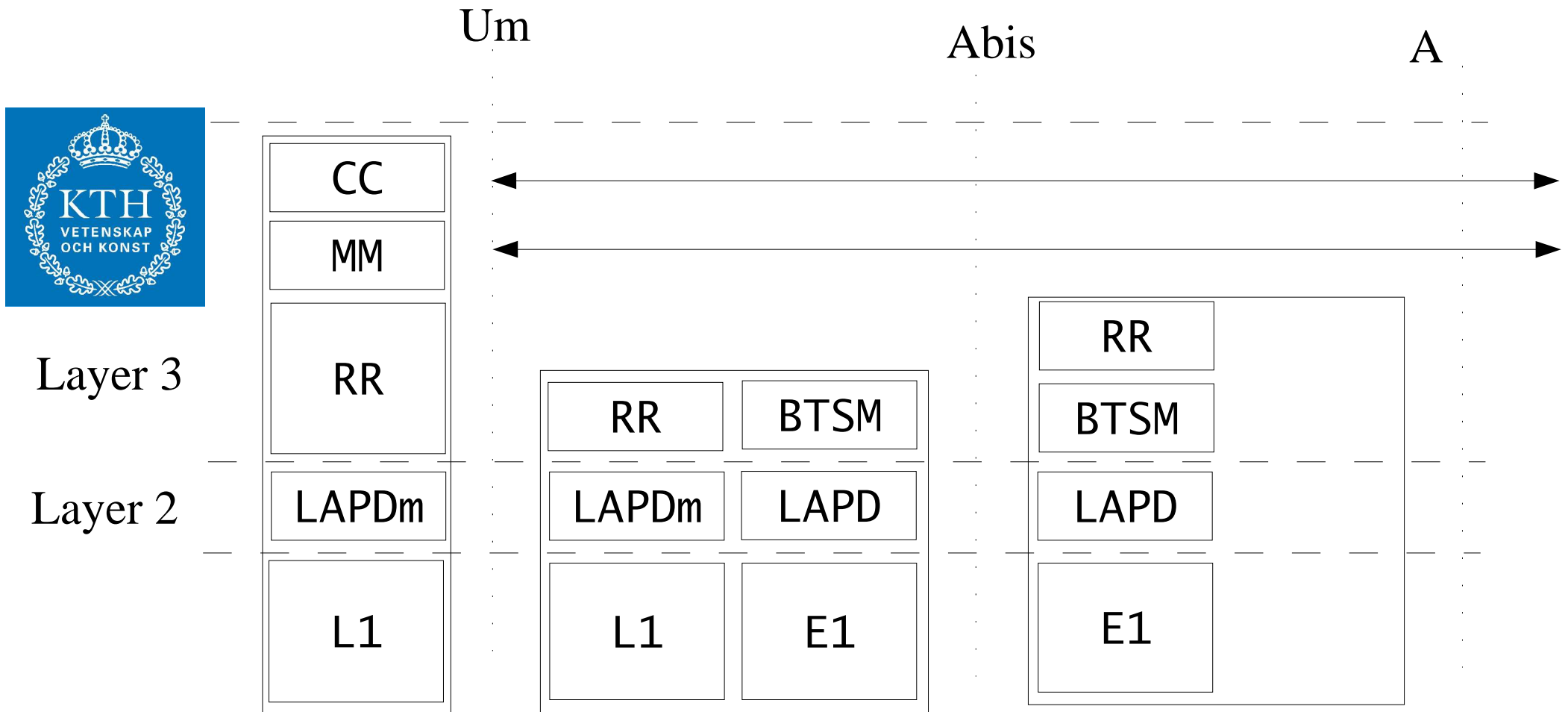




## Circuit switched data

- 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 in to 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.

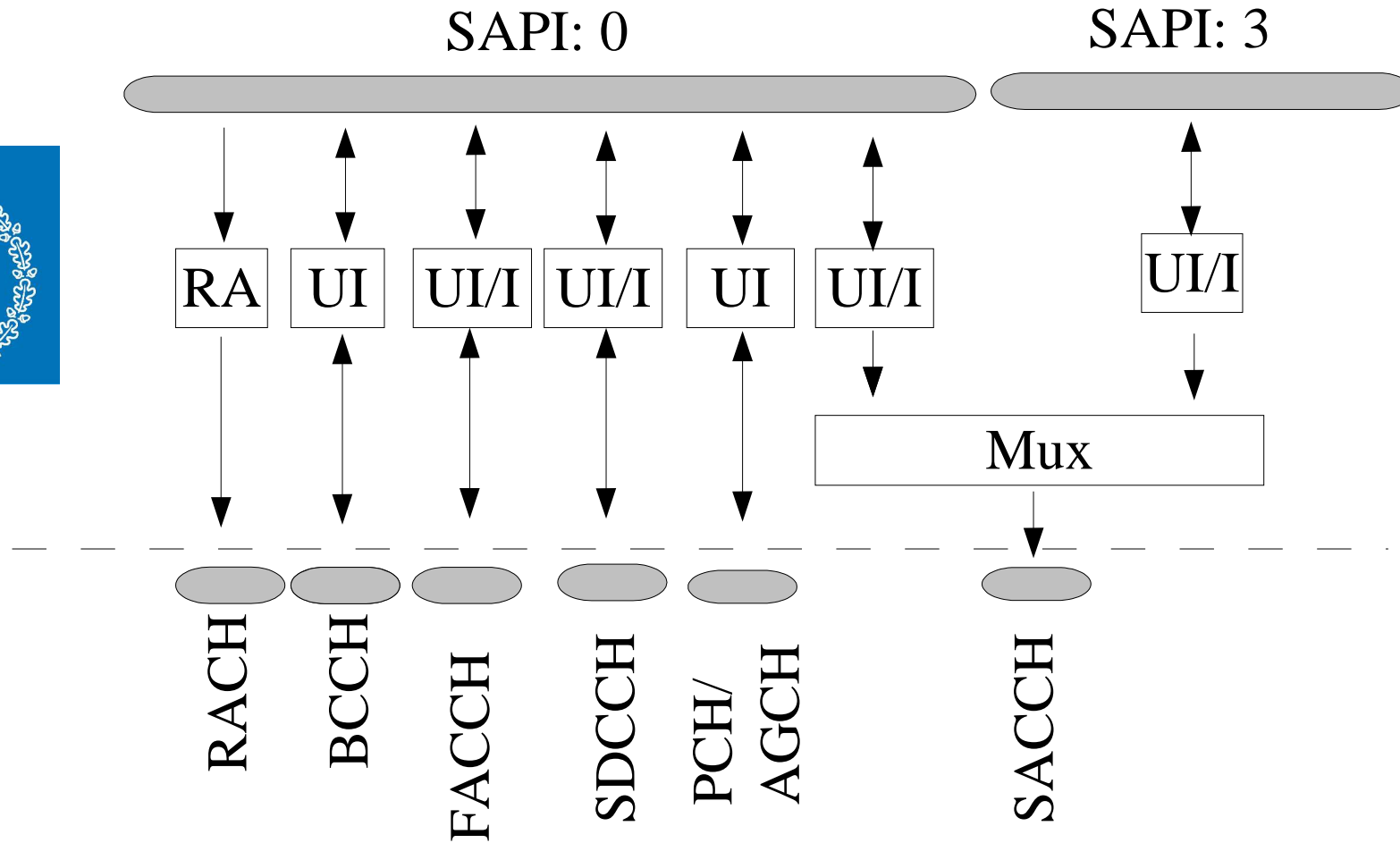
# Signaling protocols MS - BSS



Layer 3

Layer 2

# LAPDm

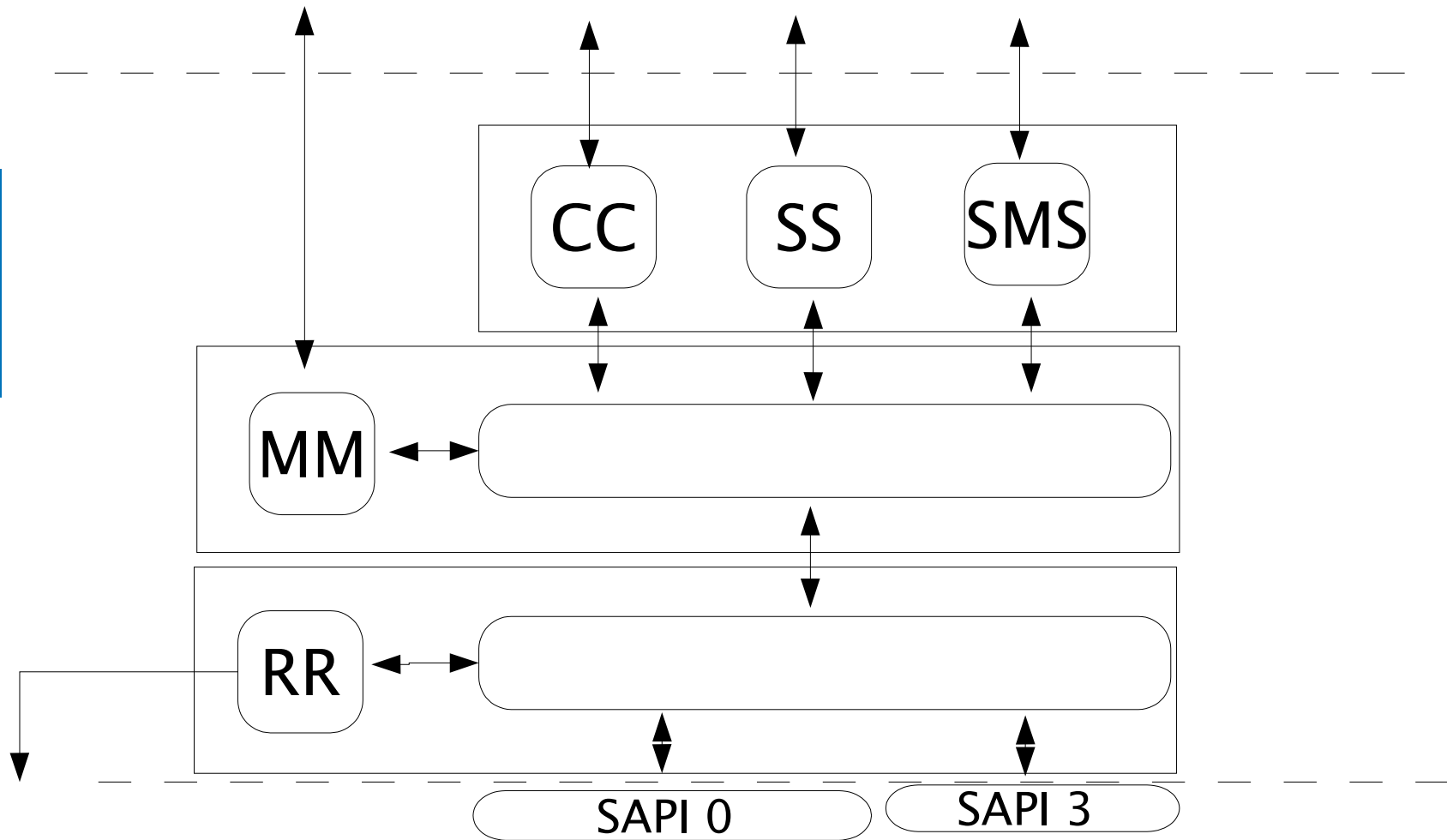


# LAPDm



- 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

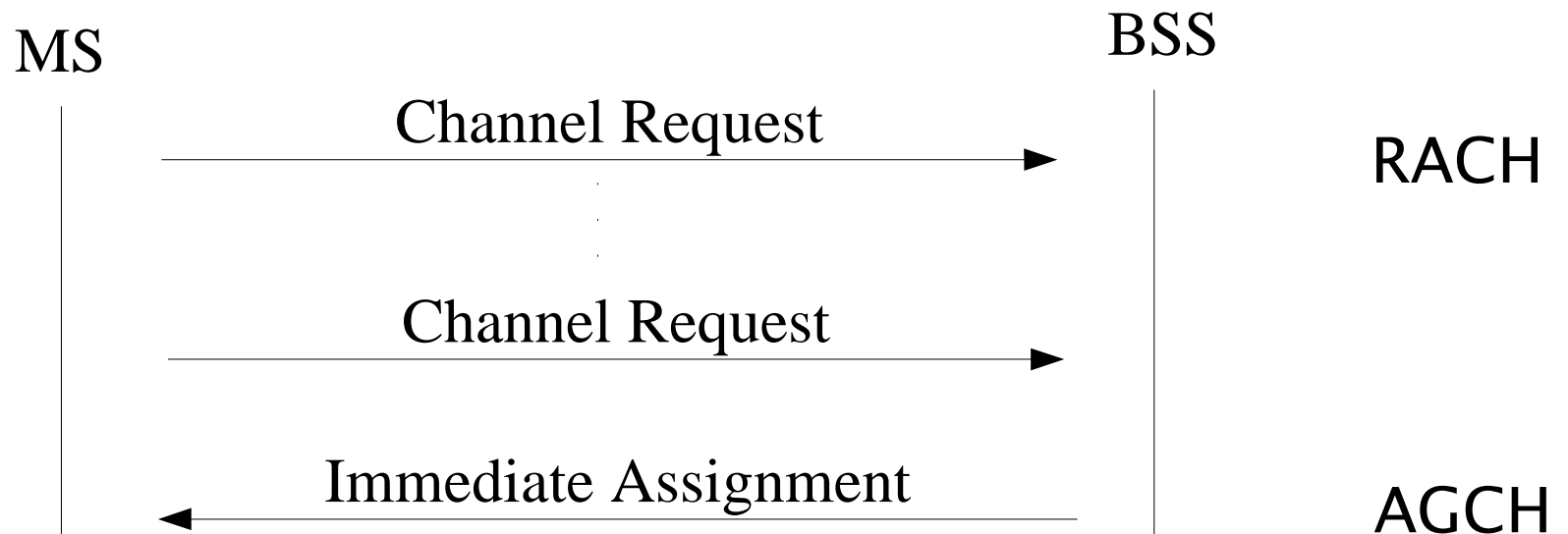


# Connection Management



- 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

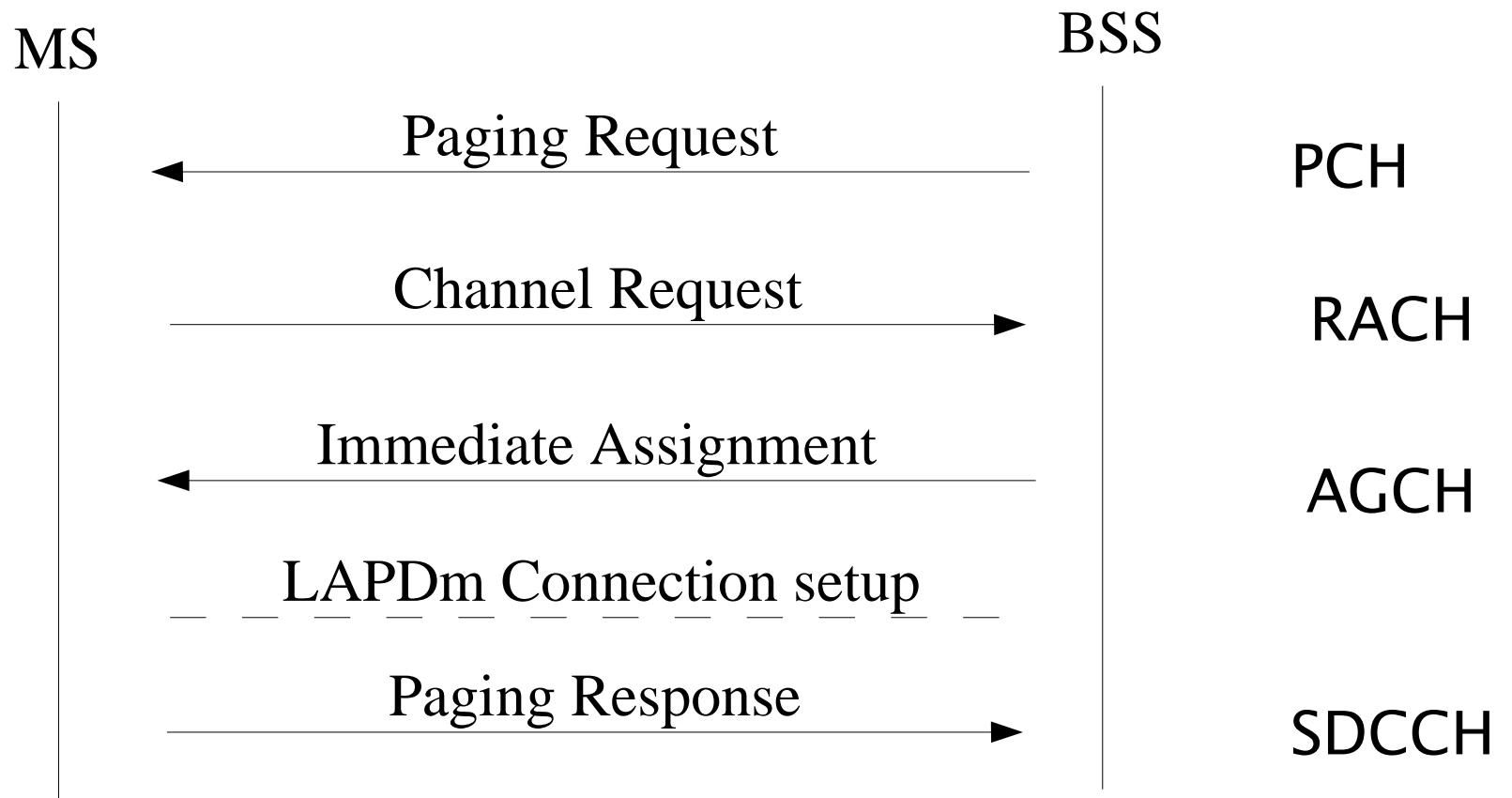
# RR procedures – connection setup



How does the mobile identify himself?

How do we know it's our assignment?

# RR procedures – connection setup



How do we know it's our page?

Do we have to listen all the time?

# RR procedures – connection release



MS

BSS

← Connection Release

SDCCH

LAPDm Connection release

Mobile returns to idle state.

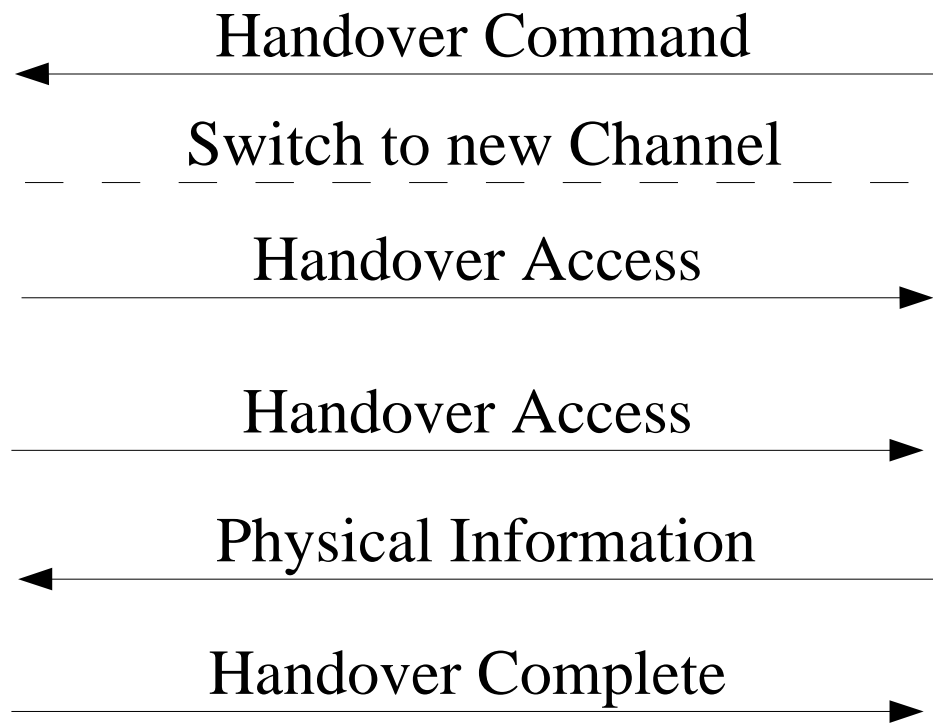
Always sent by the BSS.

# RR procedures – handover



MS

BSS



FACCH  
:

(access burst)

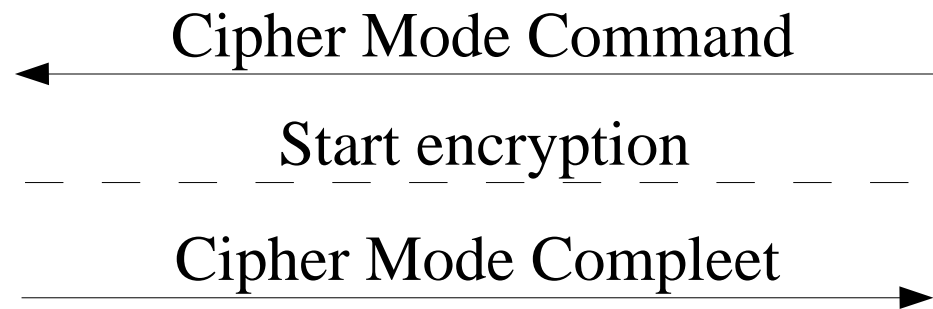
How does the new BSS know it's us??

# RR procedures – ciphering



MS

BSS



SDCCH  
:

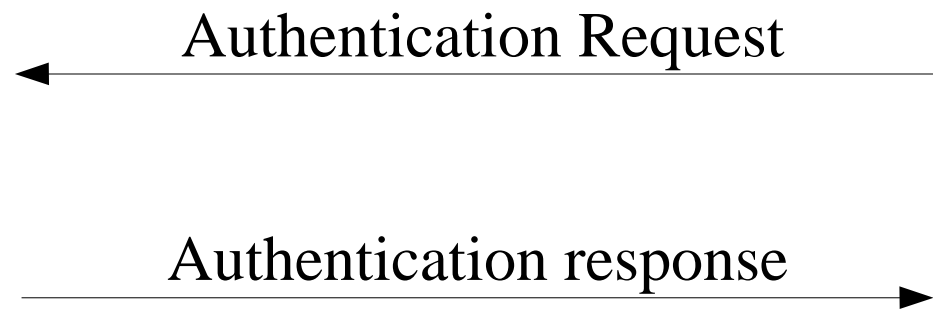
From where do we get the keys?

# MM procedures – authentication



MS

BSS



SDCCH

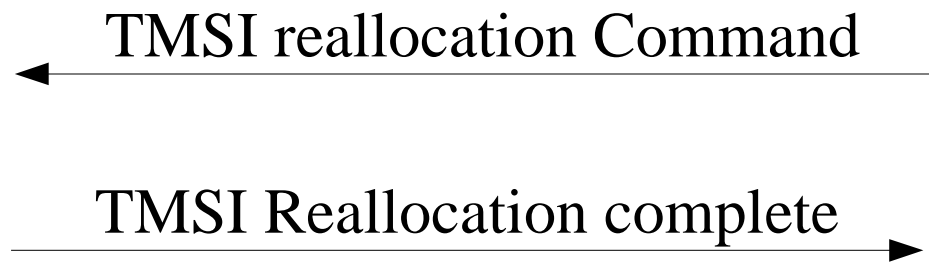
Authentication is done by encrypting a challenge (RAND) with a shared key ( $K_i$ ) and sending back the result (SRES)?

# MM procedures – confidentiality



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

BSS

Location Update request

identification

authentication

cipher mode

Location Update Accept

TMSI reallocation complete

SDCCH

# MM procedures – connection management



MS

BSS

CM - Service Request

identification

authentication

cipher mode

CM – Service Accept

SDCCH

# Incomming call

