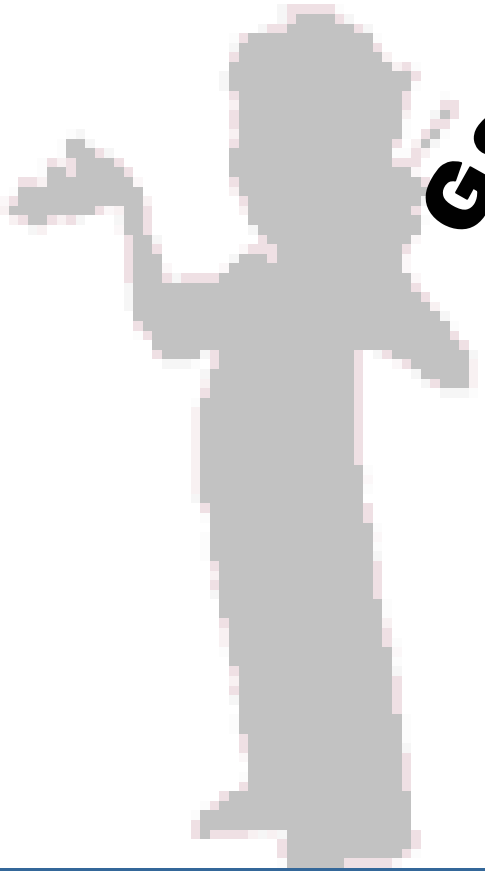
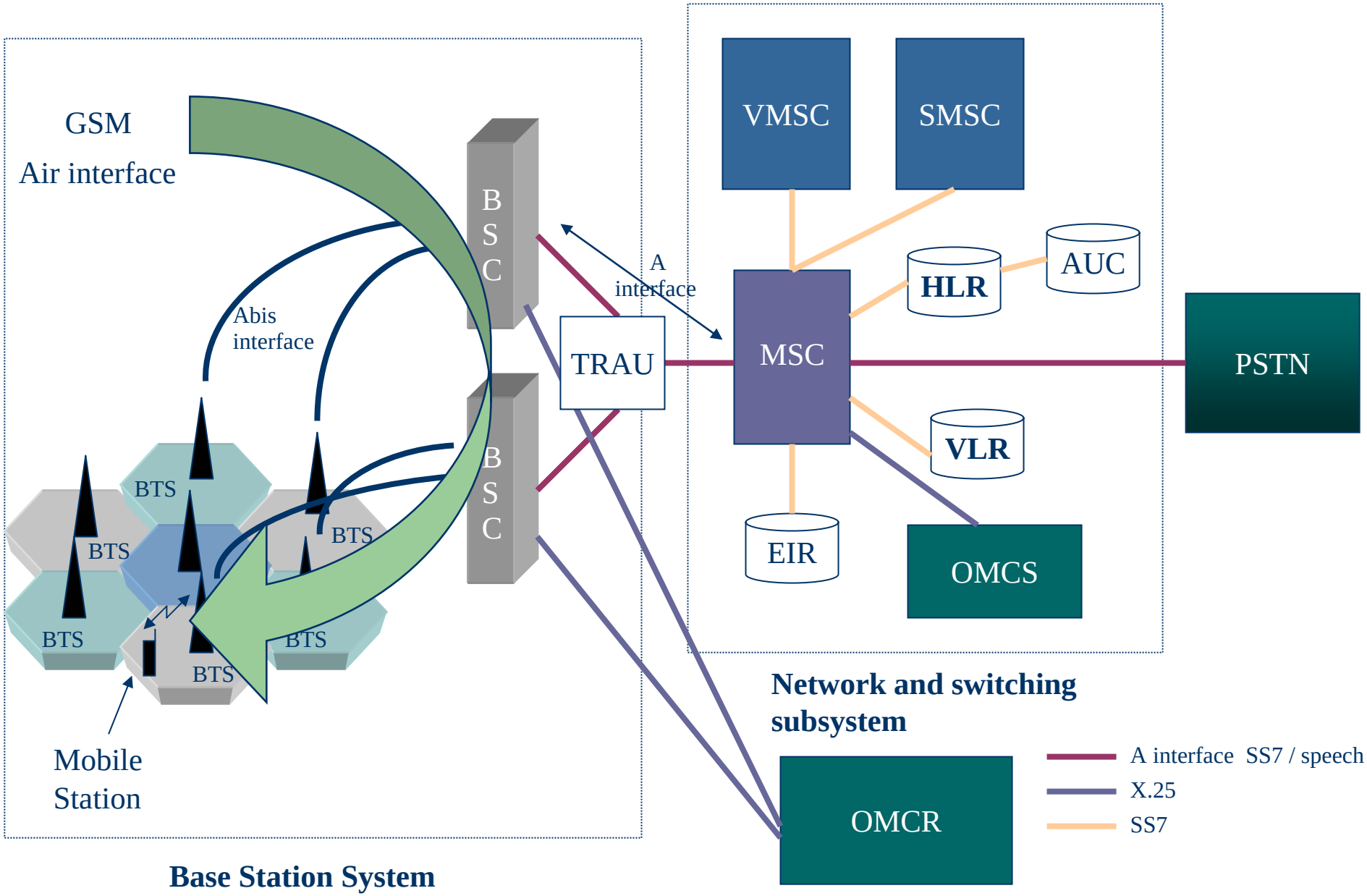
GSM FUNDAMENTALS

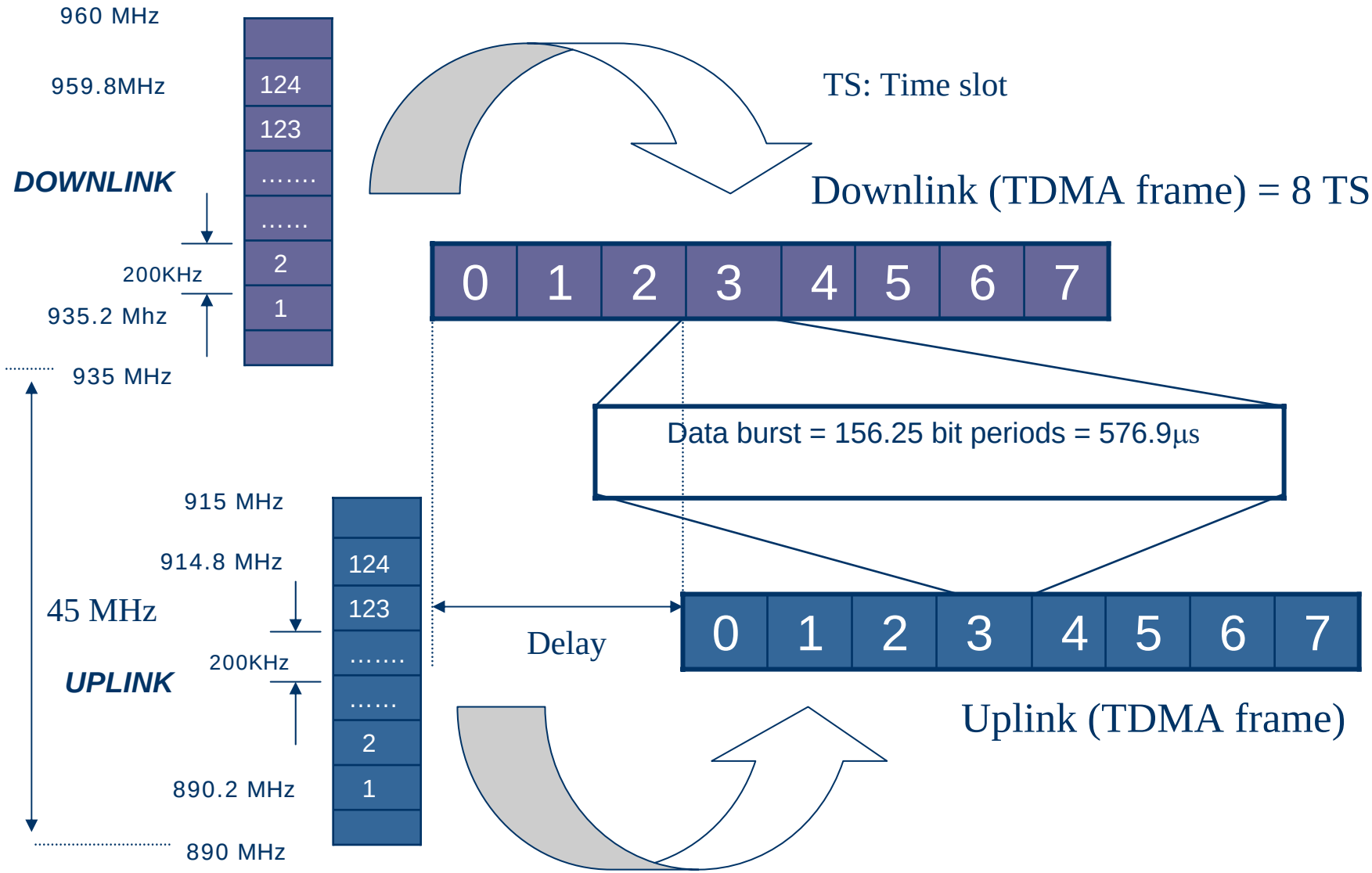


Siddharth Shetty,
Asst. Manager, N/w and Switching dept.
BPL Mobile Communications Limited

GSM Architecture



Fundamentals

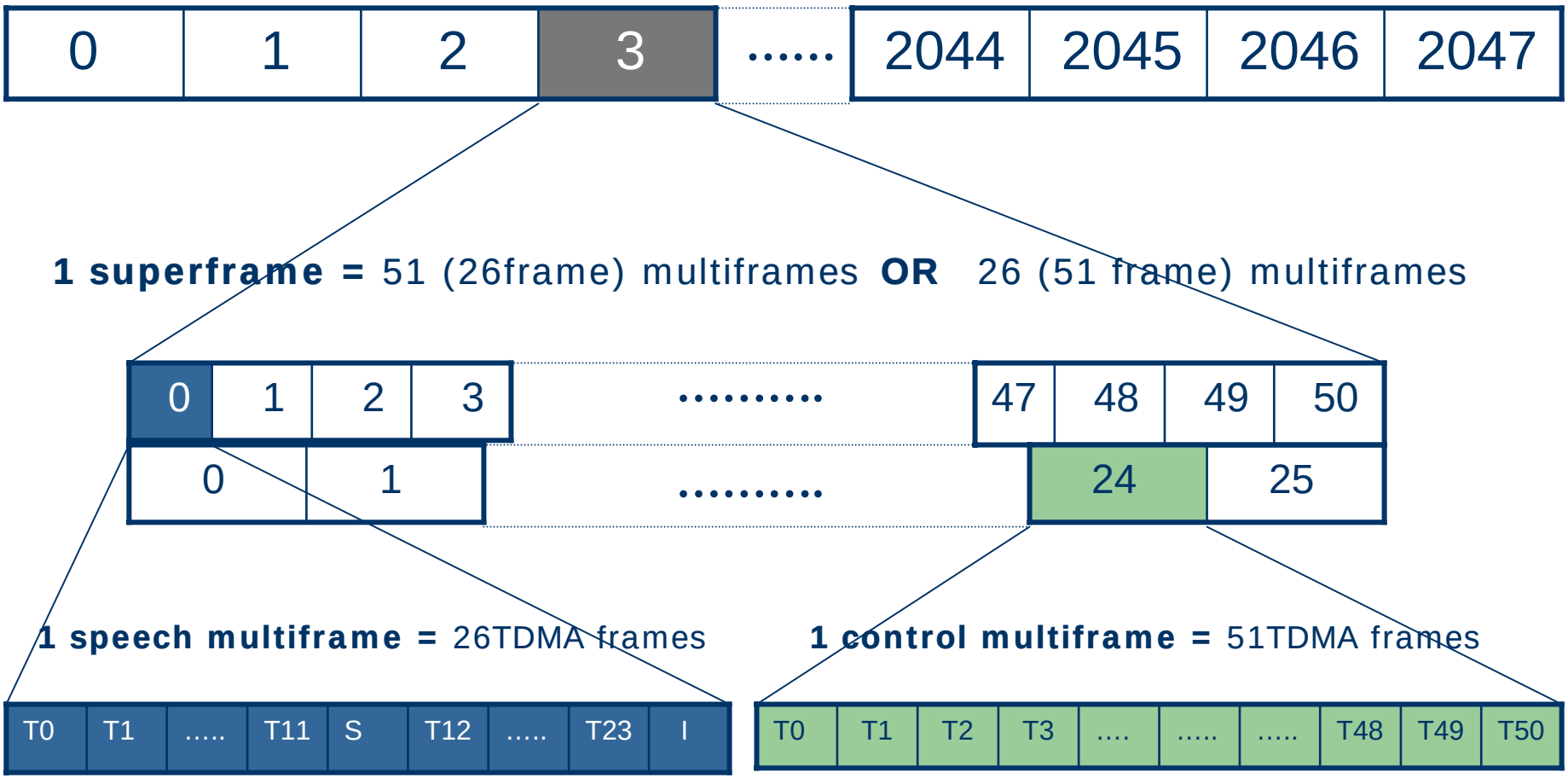


The technology

Therefore **1 TDMA** frame = 156.25 x 8 = 1250 bits
and has a duration of 576.92µs x 8 = 4.615 ms

Frame hierarchy

1 hyperframe = 2048 superframes = 2715648 TDMA frames



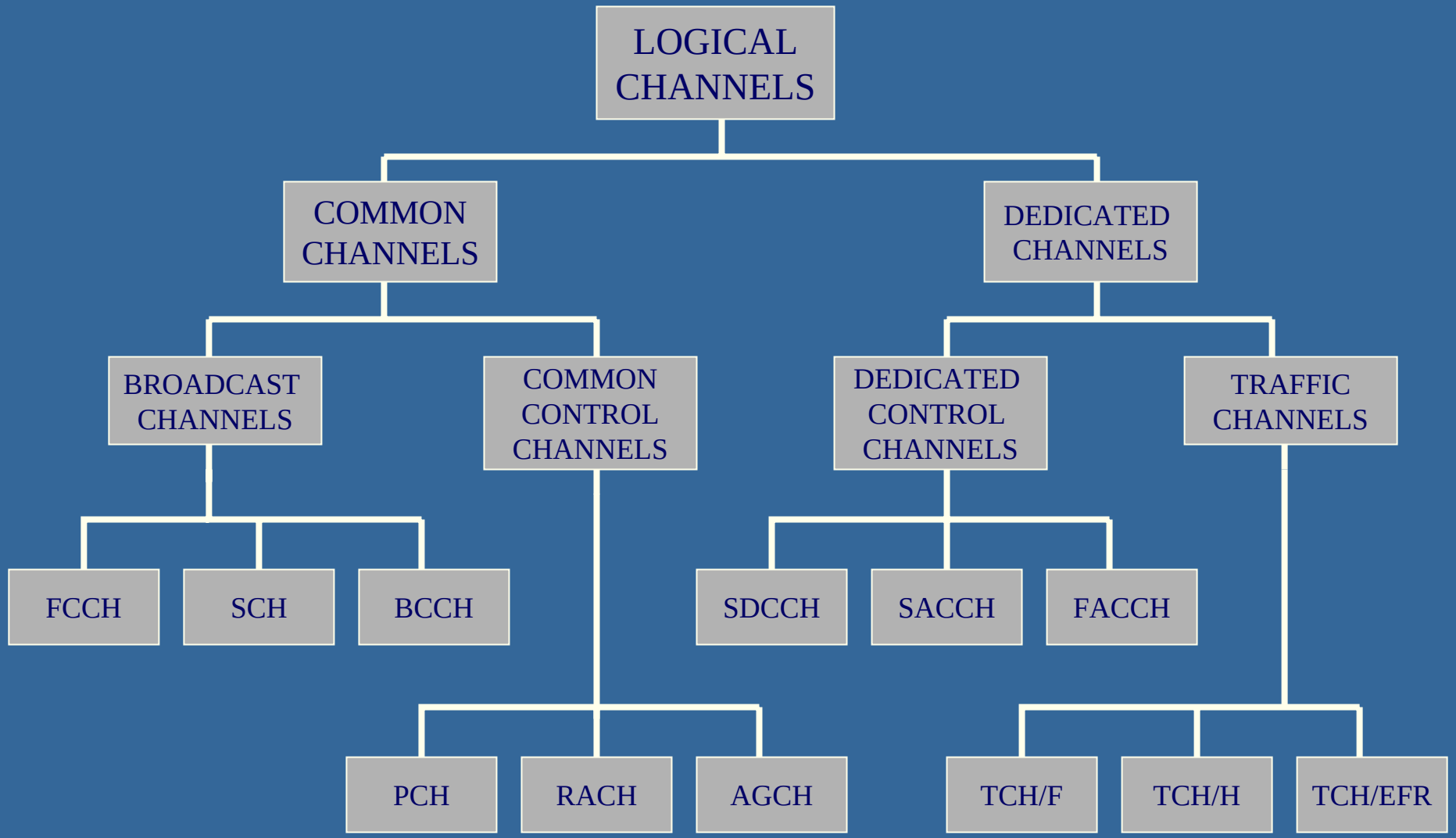
TN=Nth TDMA frame

Channels : differentiating between Physical and Logical channels

Physical channels : The combination of an ARFCN and a time slot defines a physical channel.

Logical channels : These are channels specified by GSM which are mapped on physical channels.

Logical Channels on Air interface



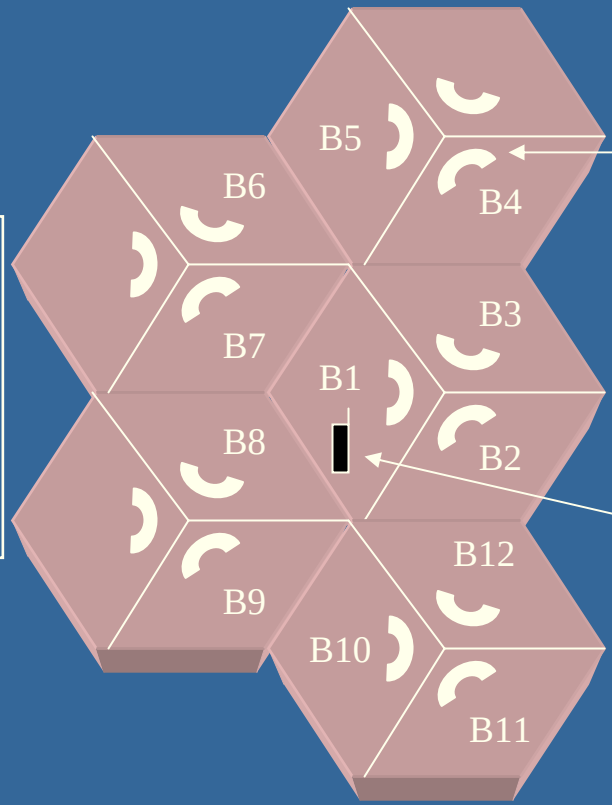
Frequency plan and importance of BCCH

BPL frequency plan:

Broadcast frequencies :

15 Broadcast channels = 48-62

15 Hopping channels = 32-46



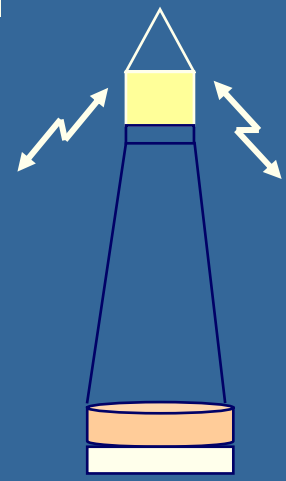
Sectored antennas

MS (monitoring the broadcast radio B1 in ‘idle mode’)

F0	F1	F2	F3	F4	F5		F10	F11			F50
F	S	B	B	B	B	.....	F	S	.....	.....	I

- F,S,B exist in time slot 0 of each frame

What information does Broadcast Control channel (BCCH) contain?



- Serves as a Beacon for the Cell
- Country Code (CC) and the Network Code (NC)
- Location Area Identity (LAI)
- List of neighboring cells which should be monitored by MS
- List of frequencies used in the cell
- Cell identity

Back

Location Updates

Location Updates can be classified into two:

Periodic Location Updates:

This occurs as per the timer set by the network operator. If the MS does not perform this update the MSC marks the MS as ‘Detached’ on the VLR.

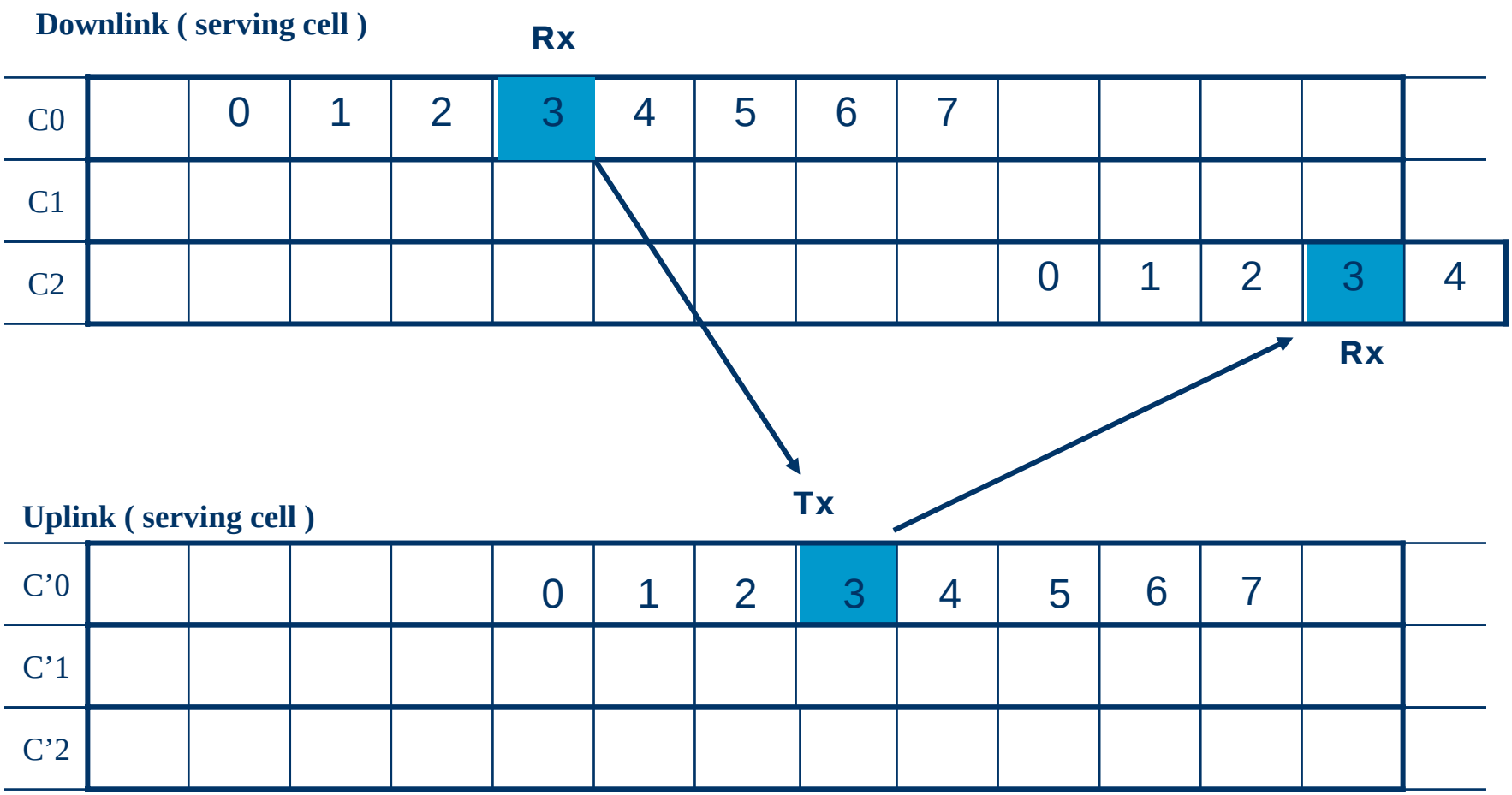
Location Update on a handover:

This occurs if during a handover the MS is moved into a new Location Area Code (LAC).

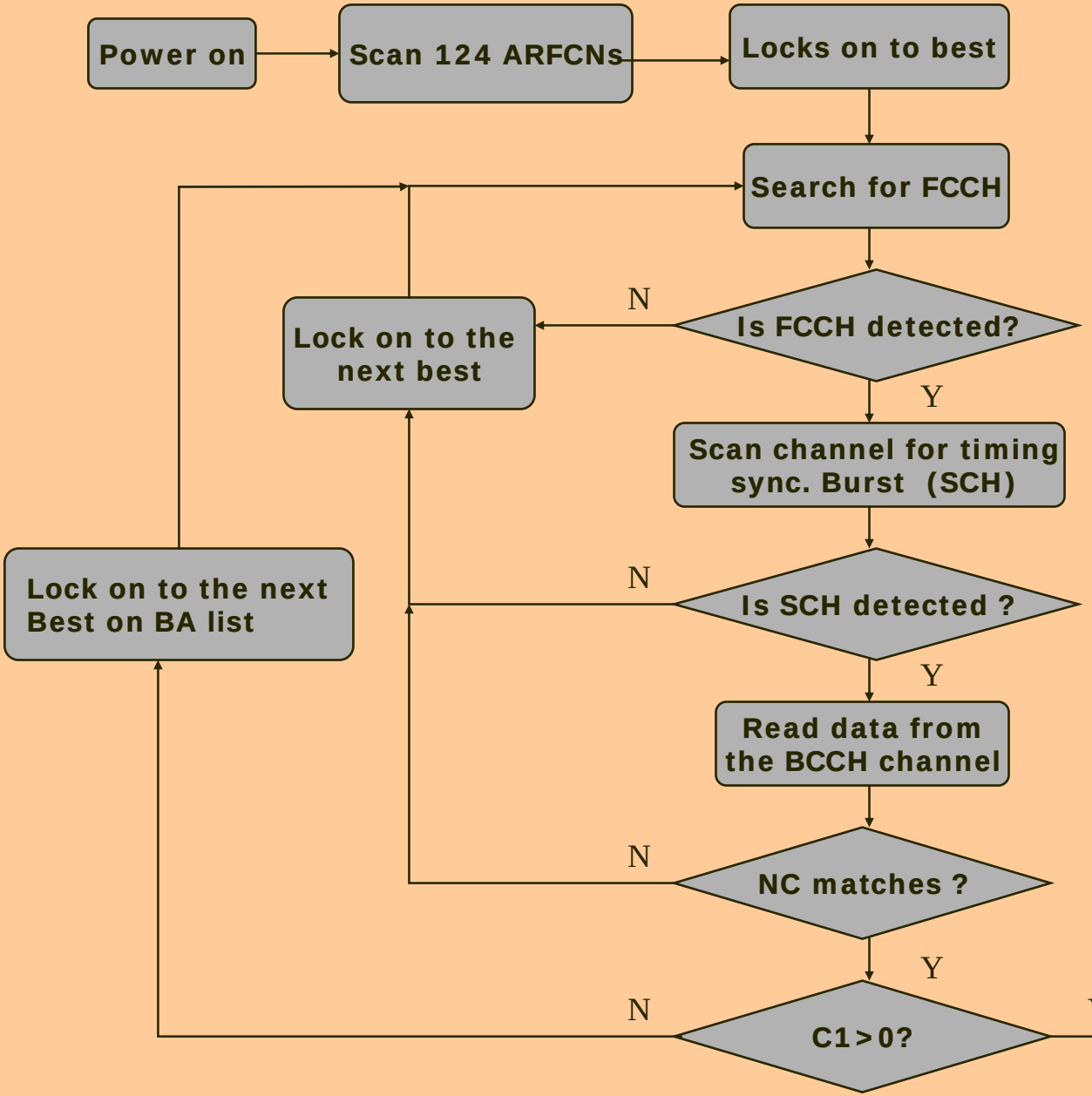
1. The MS is monitoring the BCCH and has all the decoded information stored on the SIM (including the LAC)
2. As soon as the mobile is on a TCH it sends the signal strength indication on the corresponding SACCH
3. The BSC monitors the signal strengths and on analysis sends a ‘handoff request’ on FACCH. The handoff process is completed on the FACCH.
4. After the completion of call, the MS starts monitoring the BCCH again. On finding the LAC (stored on SIM) and that decoded from the BCCH to be different , the MS requests a ‘Location Update’ through SDCCH.

Back

Frequency Hopping



Camp on



C1= A – max (B,0)

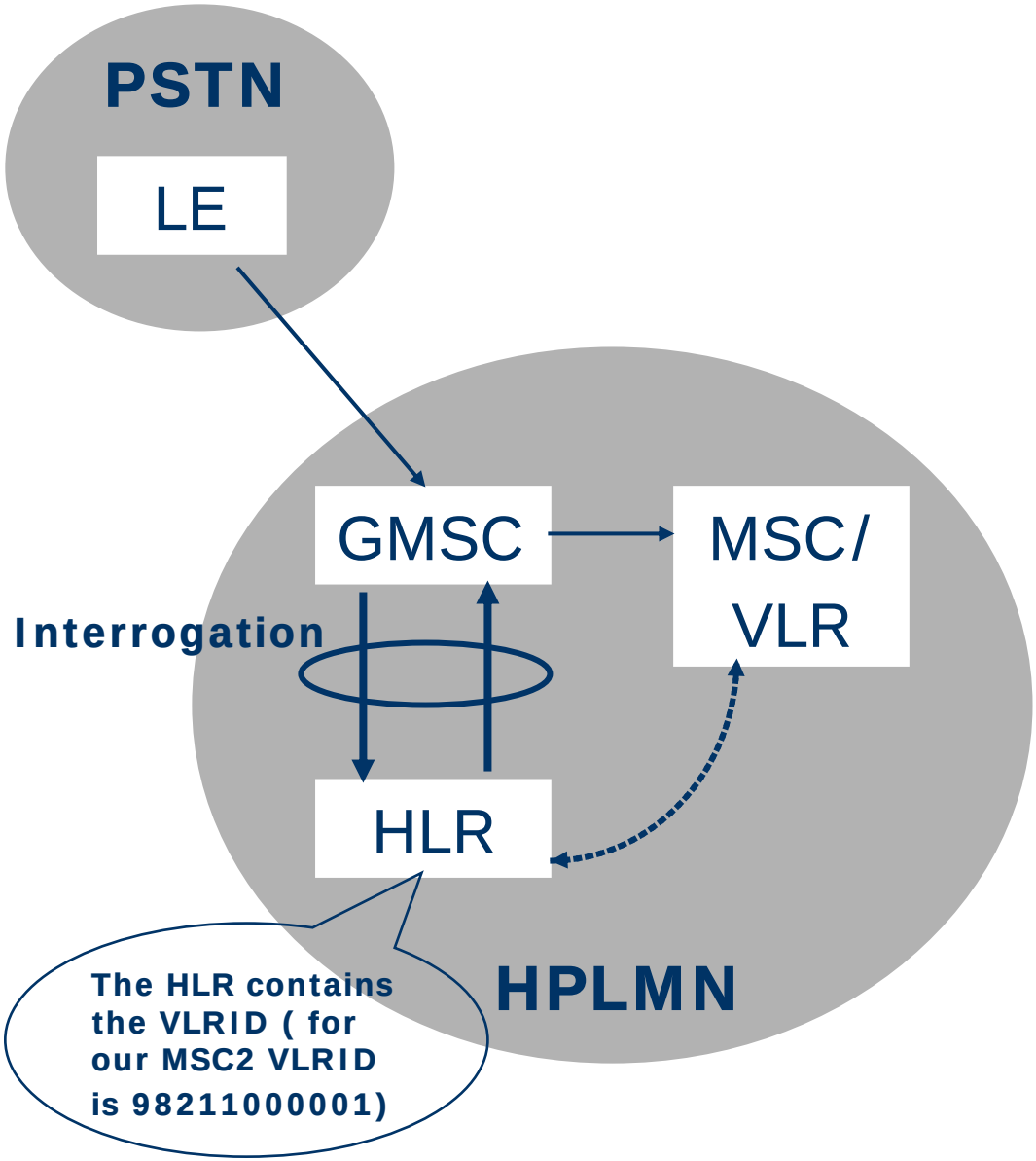
A: Average received signal level – min receive level

B: Access power – Max. power of mobile

A = positive = Good Downlink path

B=negative= Good Uplink path

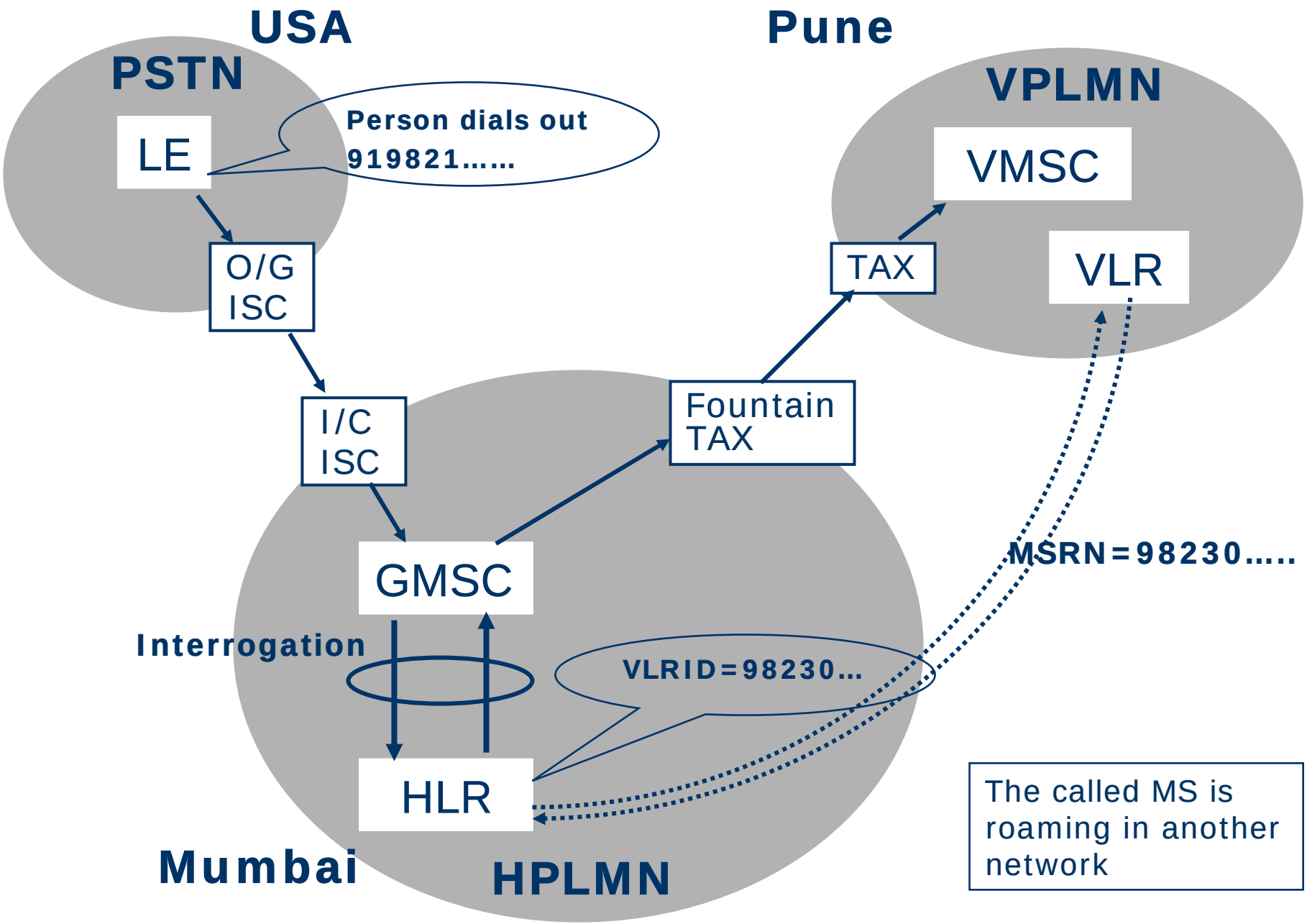
PSTN-MS……1



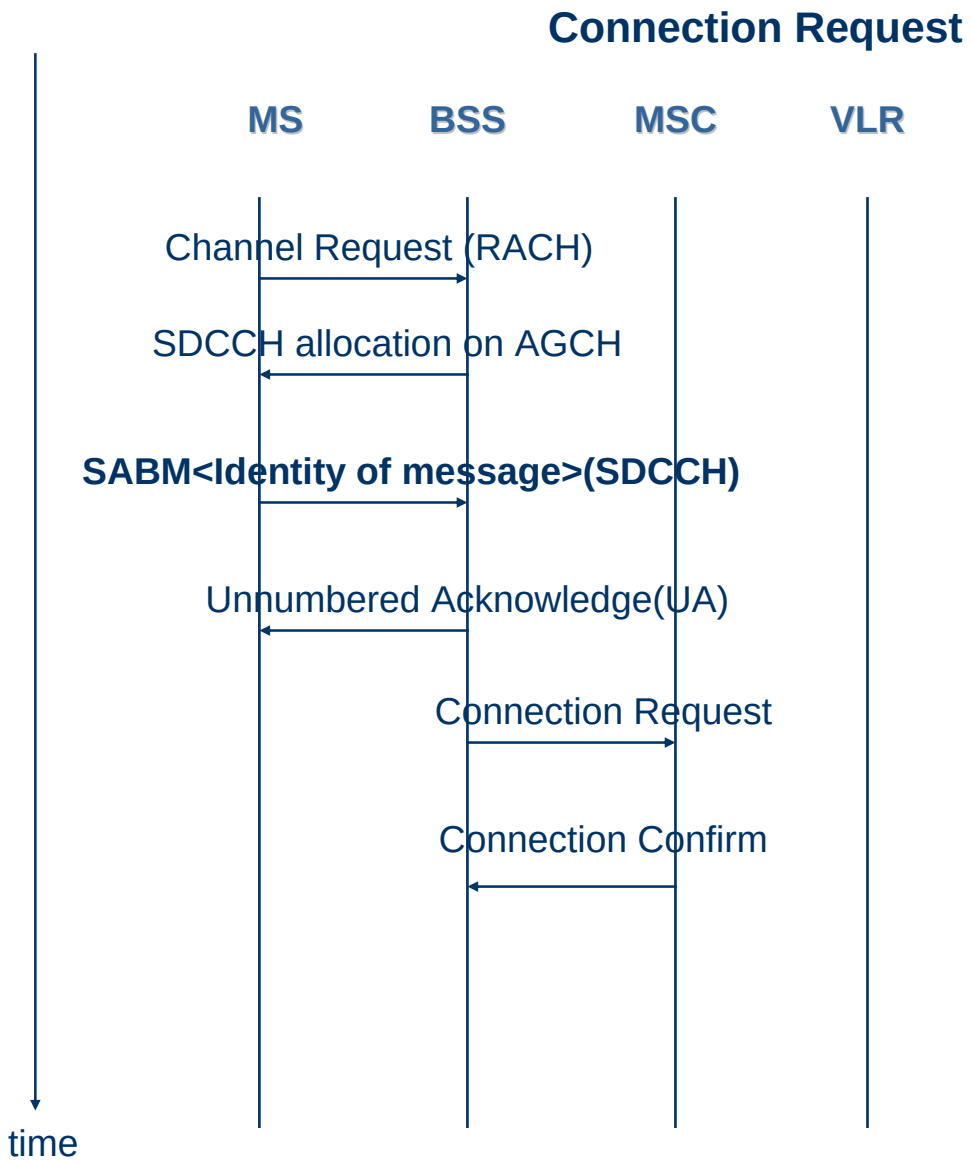
In the case below the called mobile is logged on to the MSC in the HPLMN

1. LE sends MSISDN to the Gateway MSC.
2. The GMSC sends request for routing information to HLR (The HLR has the VLRID stored)
3. The HLR sends a request for MSRN to the respective VLR
4. The VLR then responds with a MSRN
5. The HLR forward this MSRN to the GMSC which uses this MSRN to route the call to the respective VMSC

PSTN-MS……1


USA
PSTN
LE
Person dials out
919821……
O/G
ISC
I/C
ISC
Pune
VPLMN
VMSC
VLR
TAX
Fountain
TAX
GMSC
Interrogation
VLRID=98230…
HLR
MSRN=98230…..
Mumbai
HPLMN
The called MS is roaming in another network

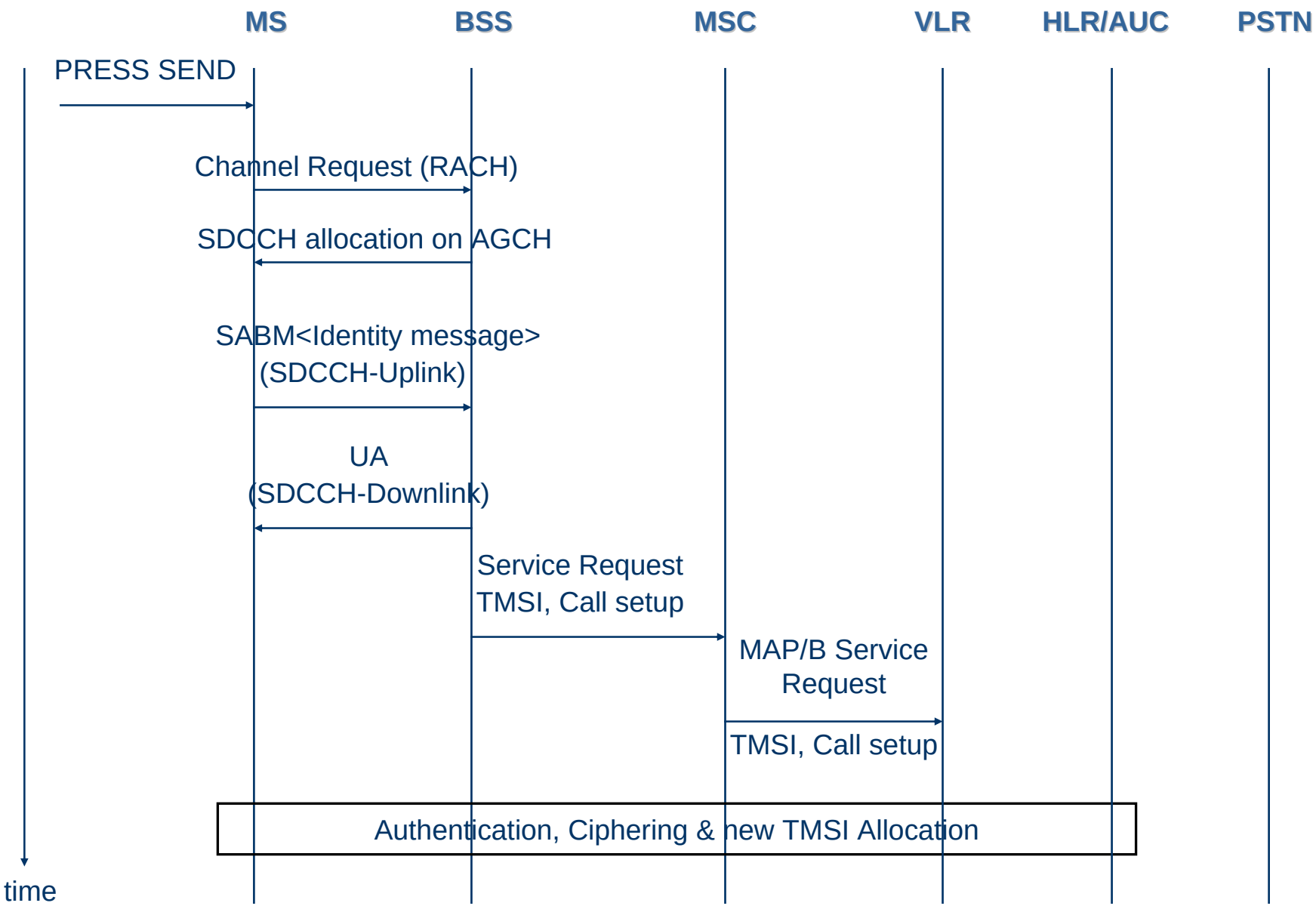
Basic Steps in formation of Call



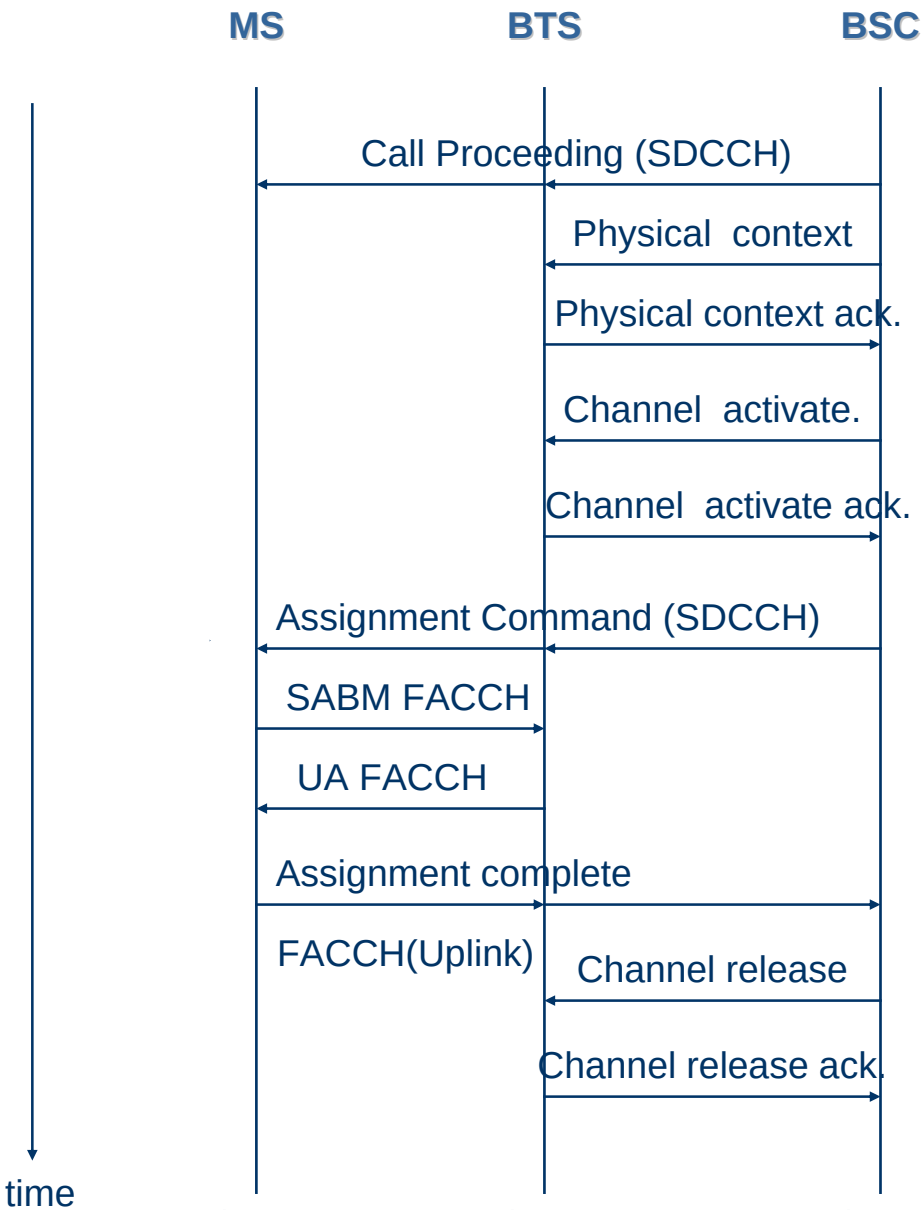
Types of Connection Request

Reason for Access	Initial Message
Paging Response	RIL3-RR paging response
Location Update or IMSI attach	RIL3-MM location updating request
IMSI detach	RIL3-MM IMSI detach
Call setup and supplementary services	RIL3-CC Call control management

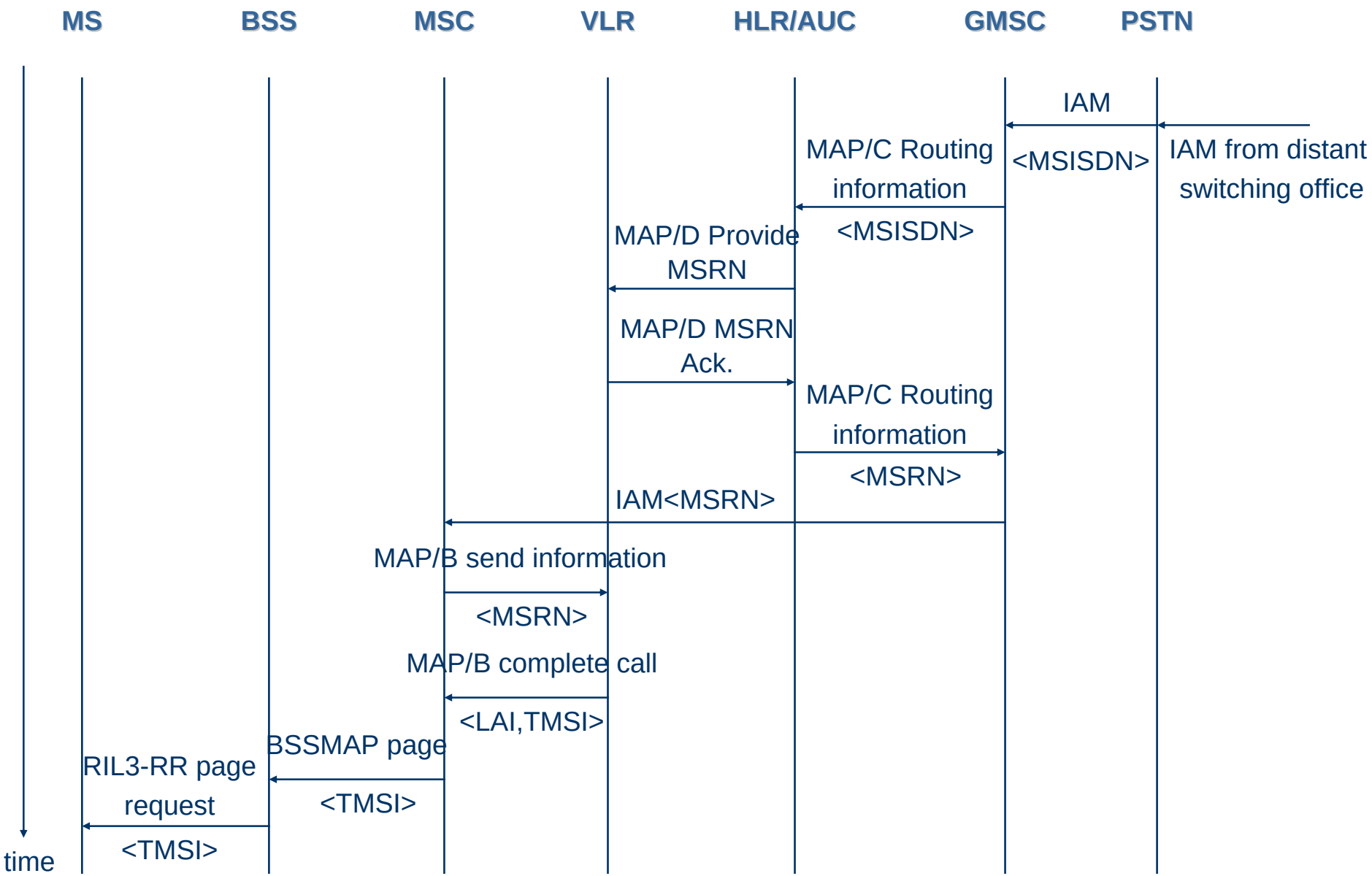
MS-PSTN……1


MS
BSS
MSC
VLR
HLR/AUC
PSTN
PRESS SEND
Channel Request (RACH)
SDCCH allocation on AGCH
SABM<Identity message>
(SDCCH-Uplink)
UA
(SDCCH-Downlink)
Service Request
TMSI, Call setup
MAP/B Service
Request
TMSI, Call setup
Authentication, Ciphering & new TMSI Allocation
time

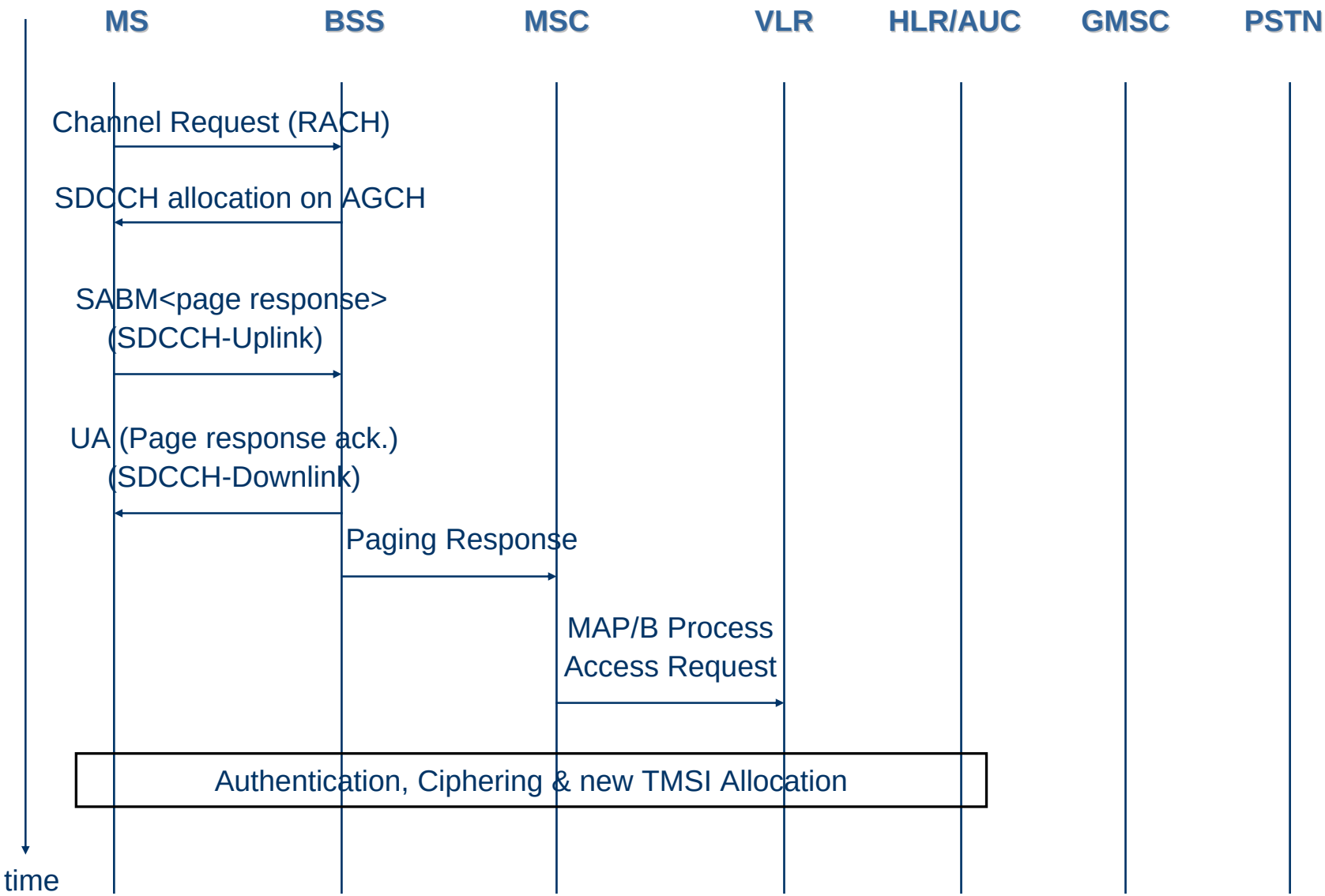
MS-PSTN……2


MS
BTS
BSC
Call Proceeding (SDCCH)
Physical context
Physical context ack.
Channel activate.
Channel activate ack.
Assignment Command (SDCCH)
SABM FACCH
UA FACCH
Assignment complete
FACCH(Uplink)
Channel release
Channel release ack.
time

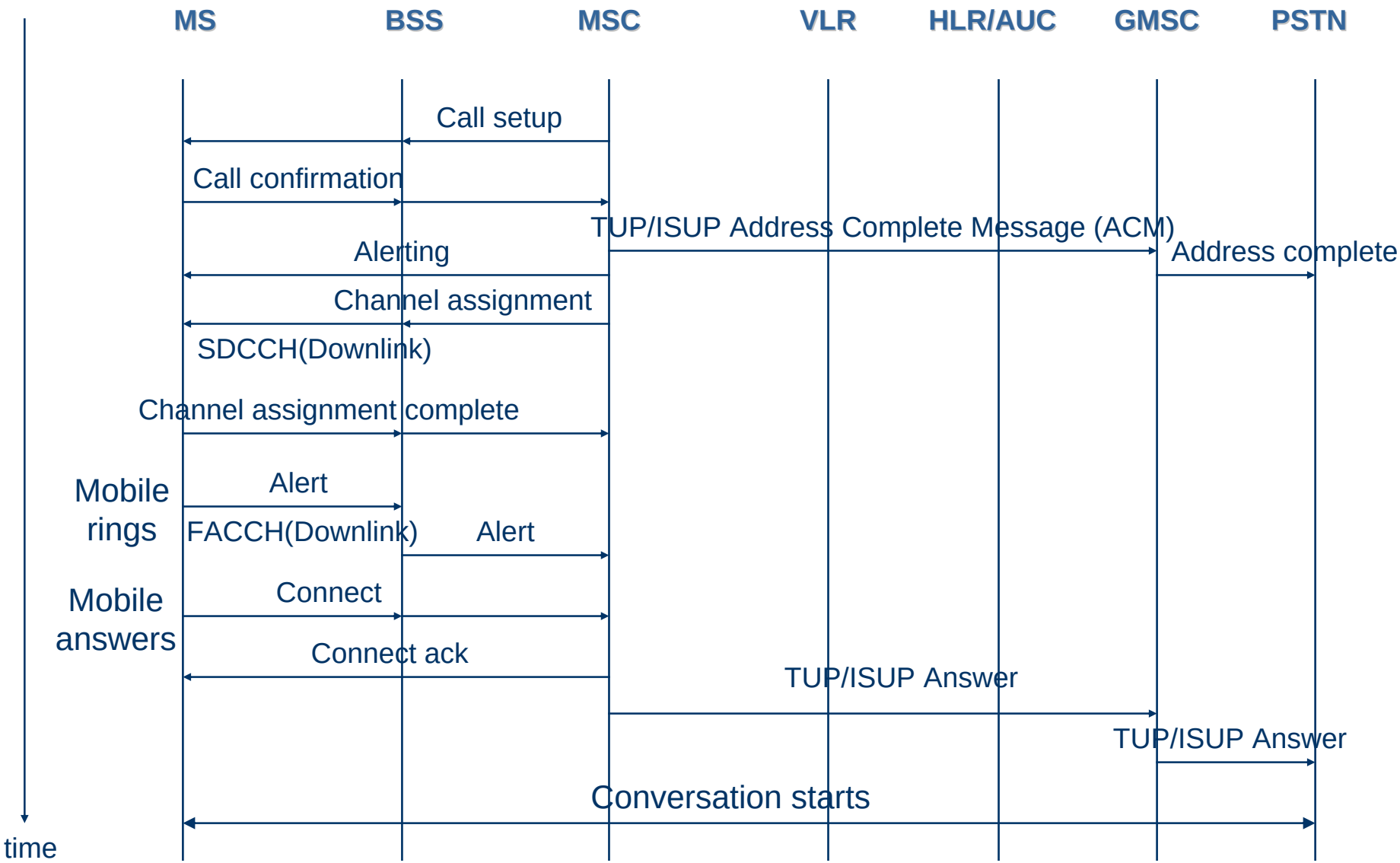
PSTN-MS……1


MS
BSS
MSC
VLR
HLR/AUC
GMSC
PSTN
IAM
<MSISDN>
IAM from distant switching office
MAP/C Routing information
<MSISDN>
MAP/D Provide MSRN
MAP/D MSRN Ack.
MAP/C Routing information
<MSRN>
IAM<MSRN>
MAP/B send information
<MSRN>
MAP/B complete call
<LAI,TMSI>
BSSMAP page
<TMSI>
RIL3-RR page request
<TMSI>
time

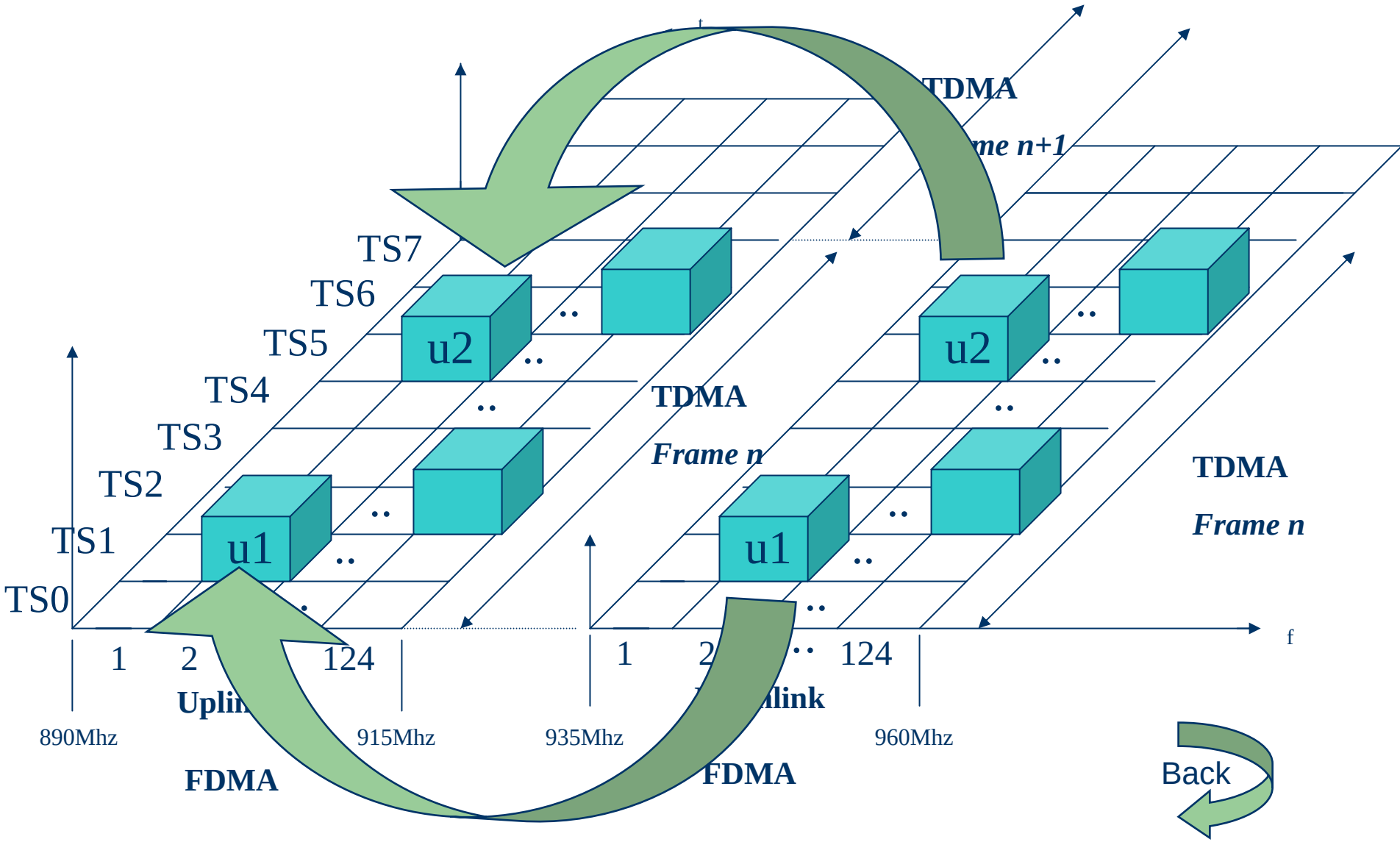
PSTN-MS……2


MS
BSS
MSC
VLR
HLR/AUC
GMSC
PSTN
Channel Request (RACH)
SDCCH allocation on AGCH
SABM<page response>
(SDCCH-Uplink)
UA (Page response ack.)
(SDCCH-Downlink)
Paging Response
MAP/B Process
Access Request
Authentication, Ciphering & new TMSI Allocation
time

PSTN-MS……3


MS
BSS
MSC
VLR
HLR/AUC
GMSC
PSTN
Call setup
Call confirmation
TUP/ISUP Address Complete Message (ACM)
Alerting
Address complete
Channel assignment
SDCCH(Downlink)
Channel assignment complete
Mobile rings
Alert
FACCH(Downlink)
Alert
Mobile answers
Connect
Connect ack
TUP/ISUP Answer
TUP/ISUP Answer
Conversation starts
time

GSM Air interface : FDD/TDMA/FDMA



Speech Multiframe

T: TCH :Traffic channel

S : SACCH : Slow Associated Control channel

T0	T1	…..	T11	S	T12	…..	T23	I

Frame number 0 1 2 …… 12 13 …… 25

Time slots

0	T	T	T	T	T	S	T	T	T	I
1						S				
2						S				
3						S				
4						S				
5						S				
6						S				
7						S				

Control Multiframe

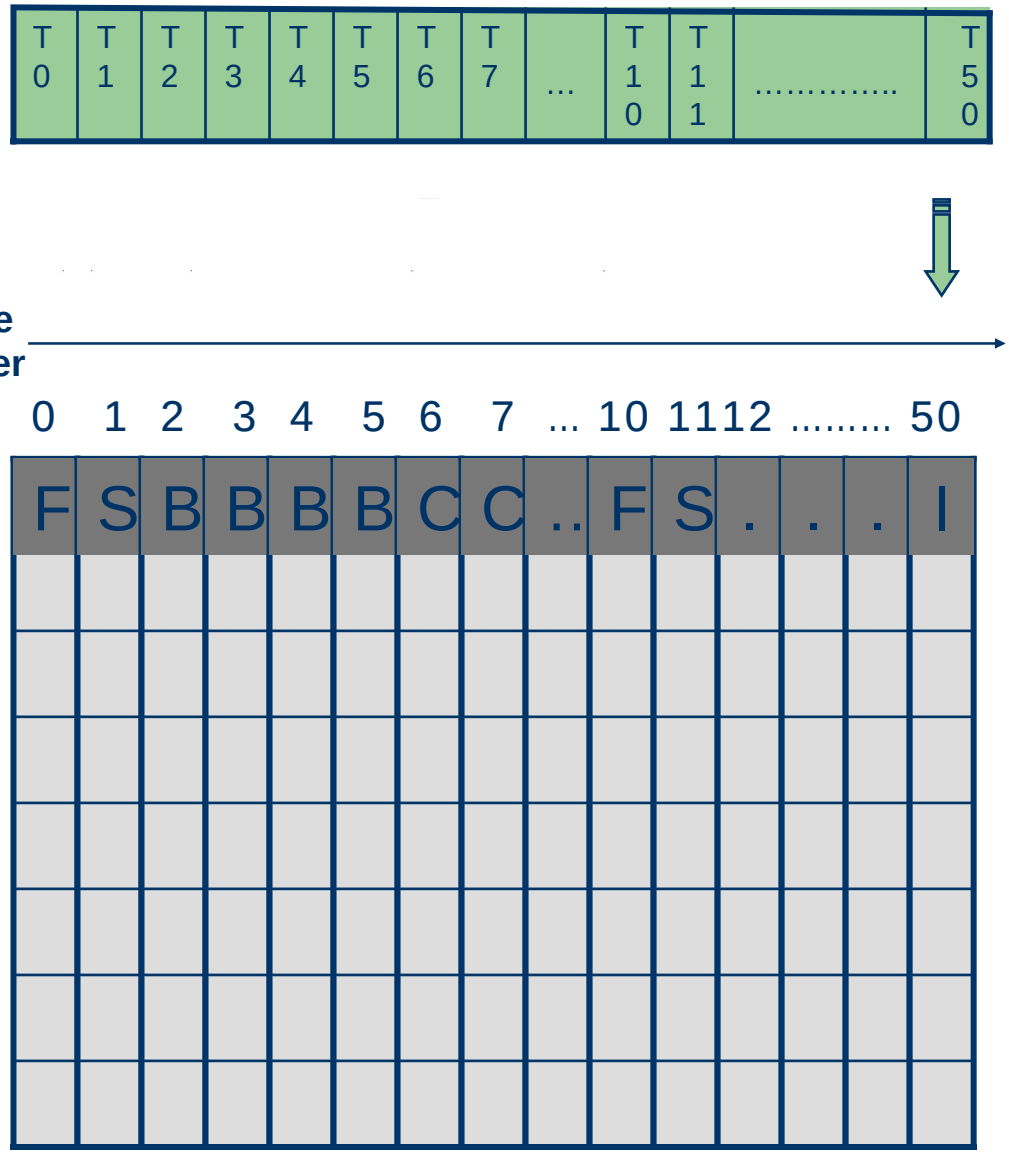
F: FCCH : Frequency Correction channel

S: SCH : Synchronization channel

B: BCCH : Broadcast Control channel

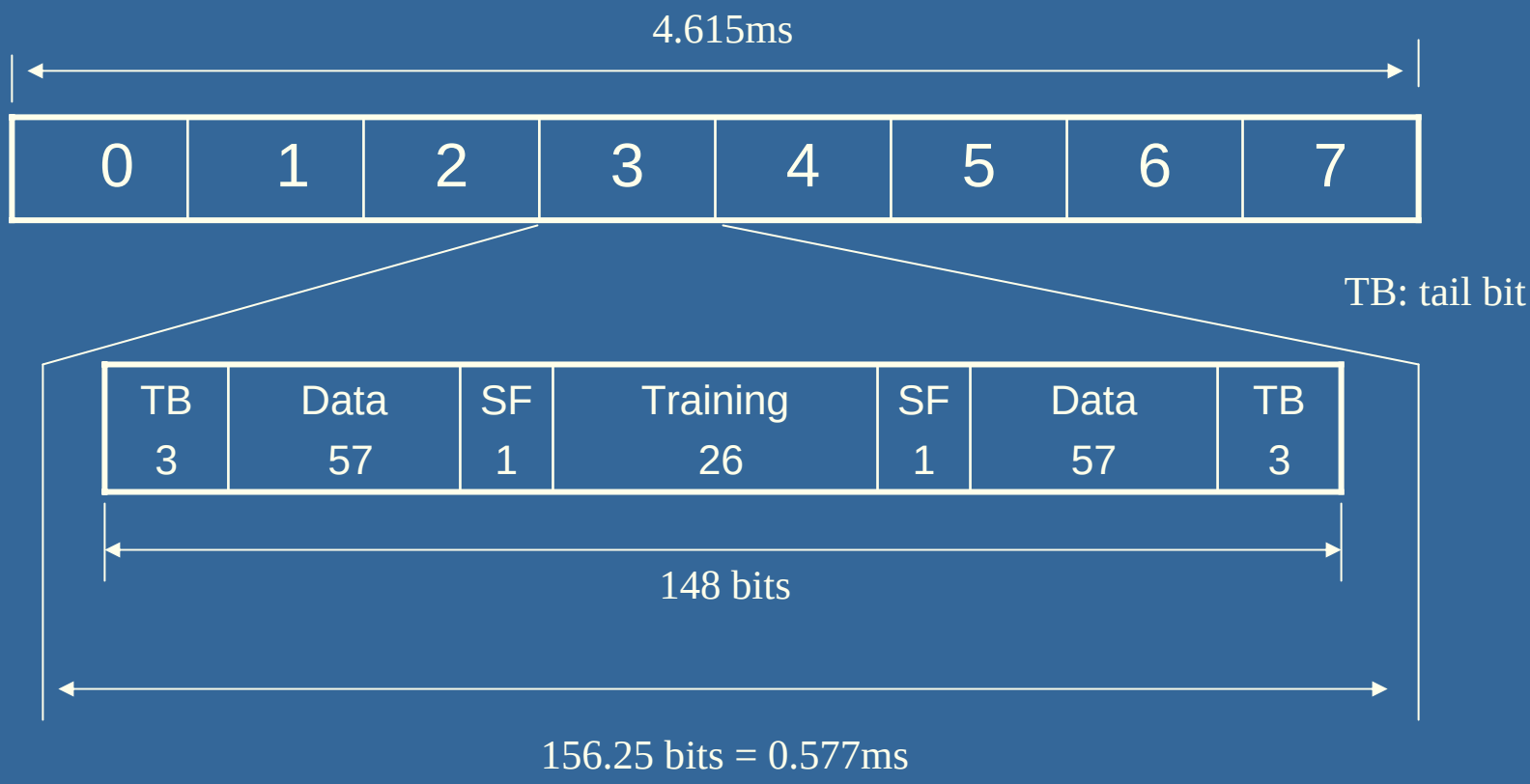
The remaining frames contain : Common Control Channels (CCCH) and Dedicated Controls Channels (DCCH) in TS0

Also FCCH and SCH appear 5 times in a Multiframe



Back

Normal Burst

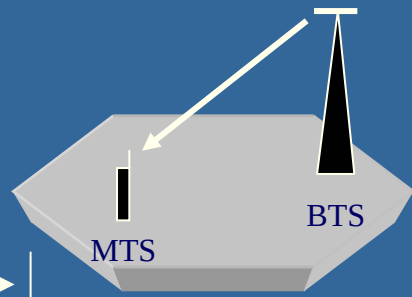


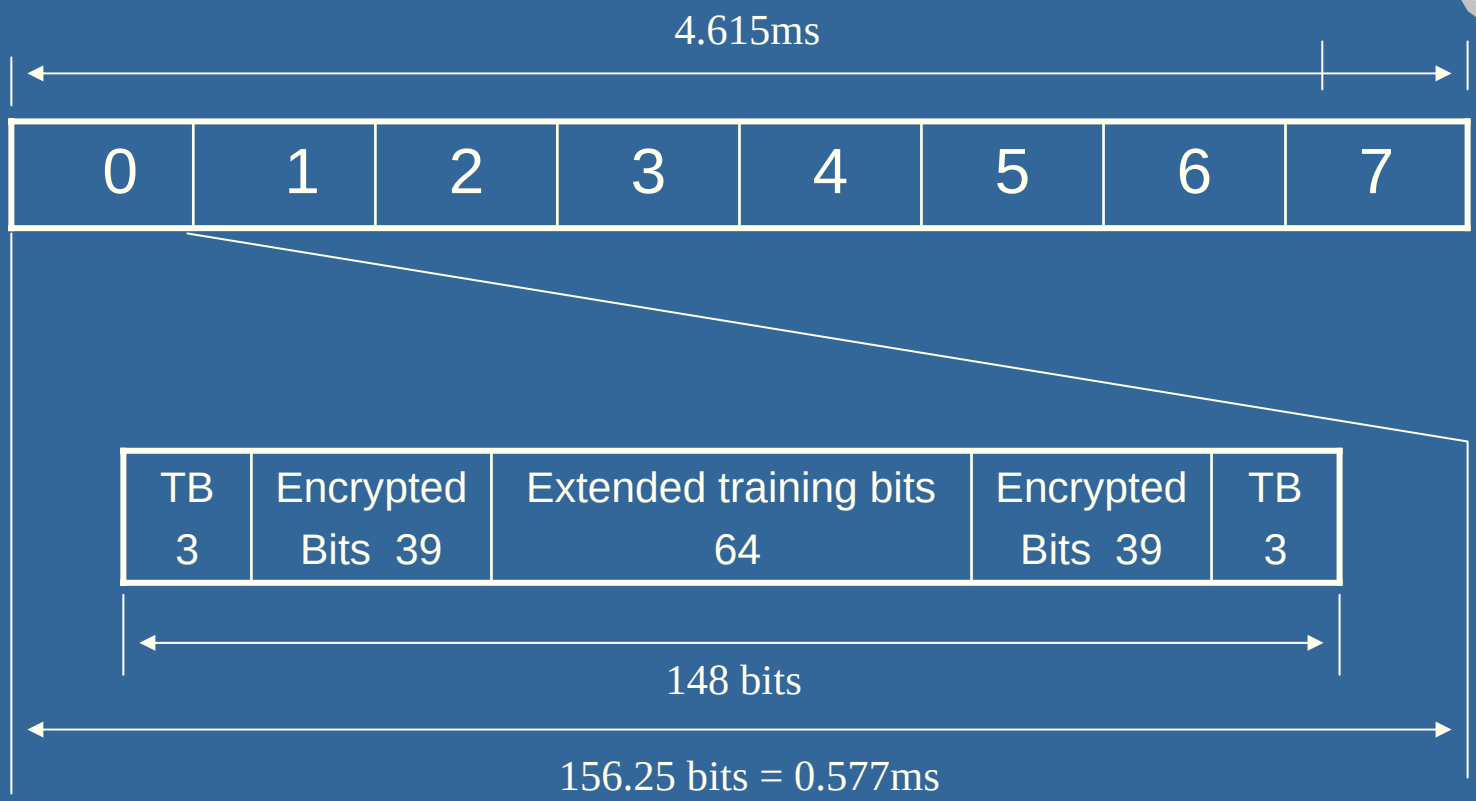
- To carry information on the TCH and all control channels except for RACH, SCH and FCCH
- The two sets of encrypted 57 bits are data or speech …….2

- The stealing flag indicates whether the burst was stolen for signaling or not
- The 3 tail bits are (0,0,0) and is used as the start/stop pattern for the equalizer
- The GP (guard period of 8.25 is used to prevent overlapping of frames
- The 26 training bits is a known bit sequence for the equalizer to get an estimate of how the channel is affected by interference

Back

Synchronization Burst

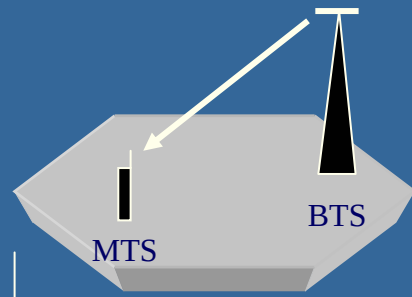


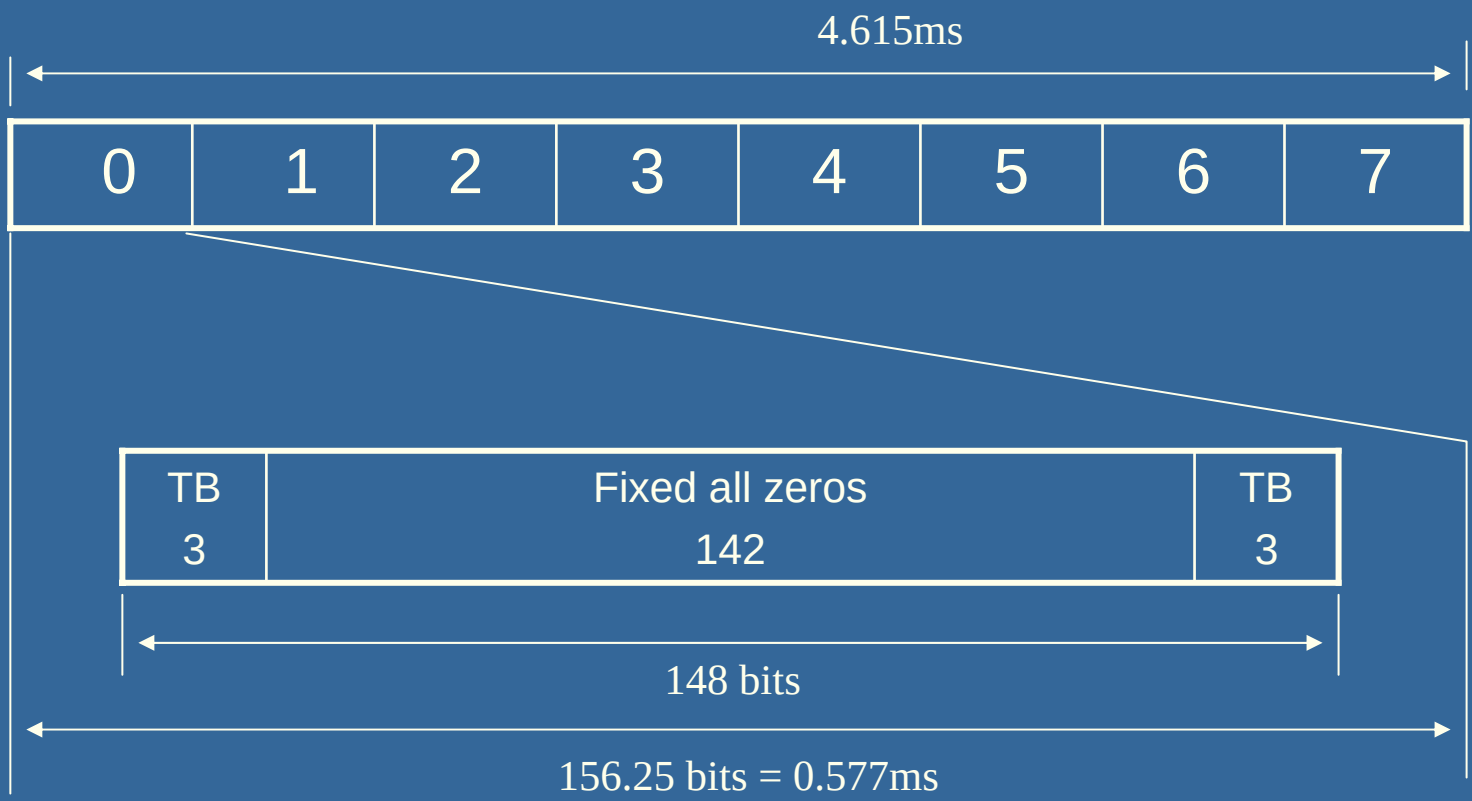


- This burst is used for time synchronization of the mobile
- The long training sequence is a synchronization sequence
- The encrypted 78 bits carry the information of the TDMA frame number and the BSIC

Back

Frequency Correction Burst

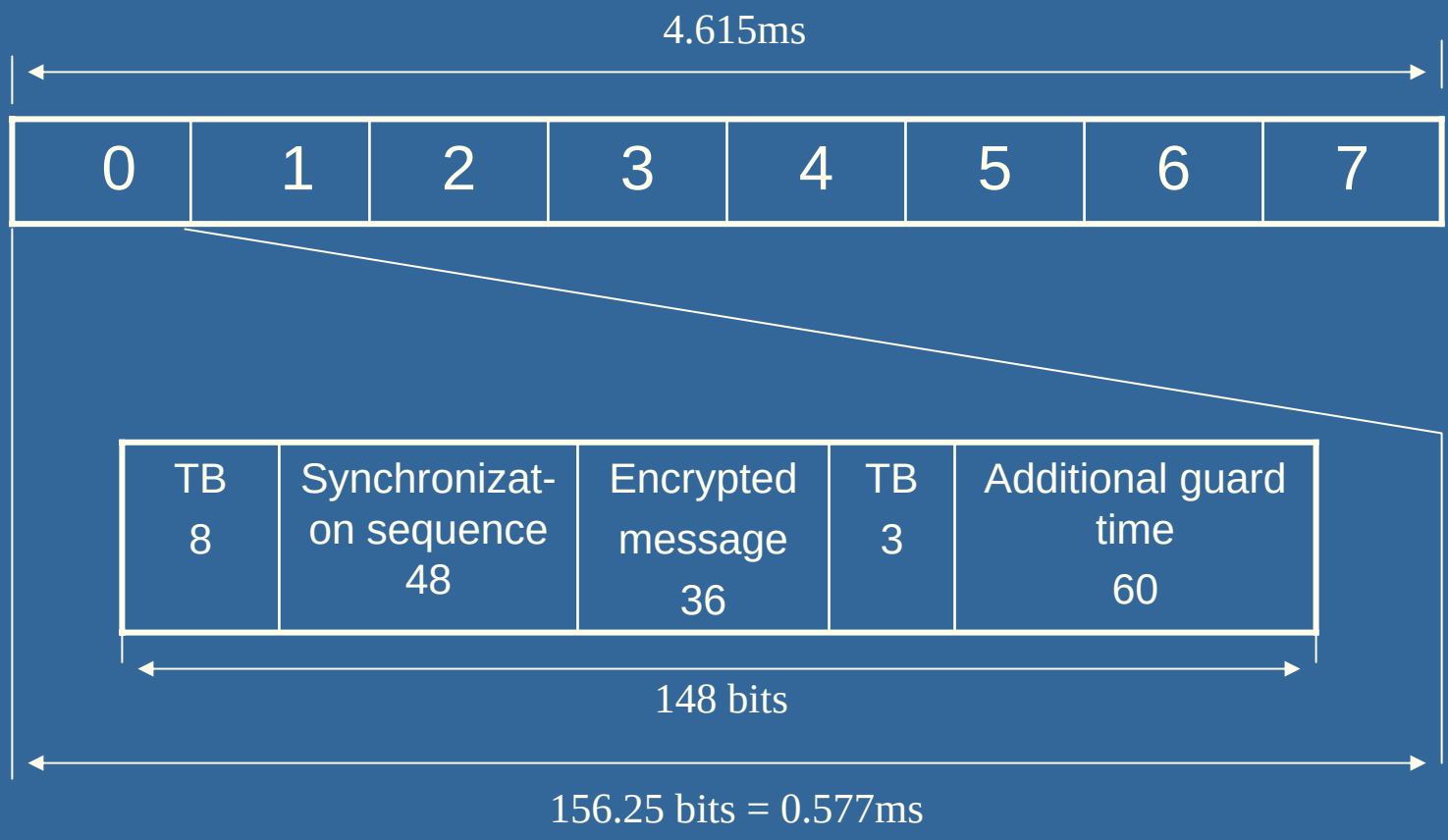




- This burst is used for frequency synchronization of the mobile
- The sequence of fixed zeros is equivalent to an unmodulated carrier with a specific offset

Back

Access Burst

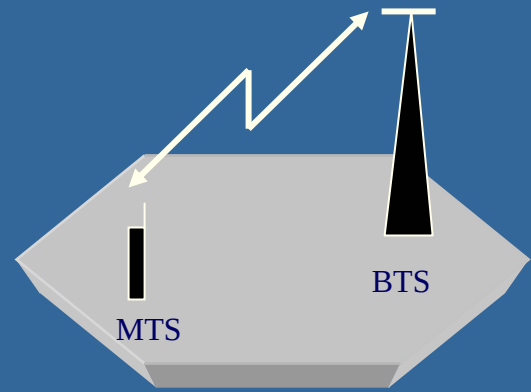


•The random access burst has a longer guard period since the mobile does not know the timing advance when it randomly accesses the system

Back

What function does Stand-Alone Dedicated Control channel (SDCCH) serve?

- Used by MS for call setup
- Authentication
- Location Updating
- Short message service (SMS)



(***Bi-directional***)

Back

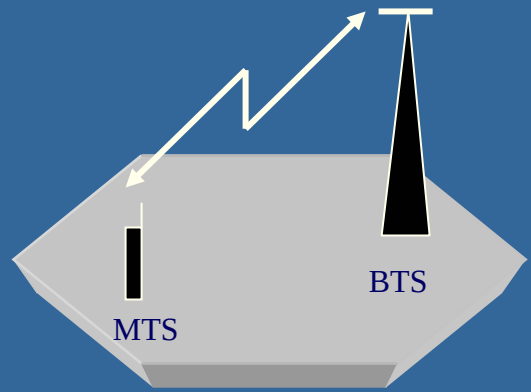
A Slow Associated Control channel (SACCH) is associated with both a TCH and a SDCCH

DOWNLINK:

- Power control
- Timing Advance information

UPLINK

- Receive Signal Strength Indicator
- Quality reports



(***Bi-directional***)

Back

Frequency Hopping