

Um Interface and Radio Channels

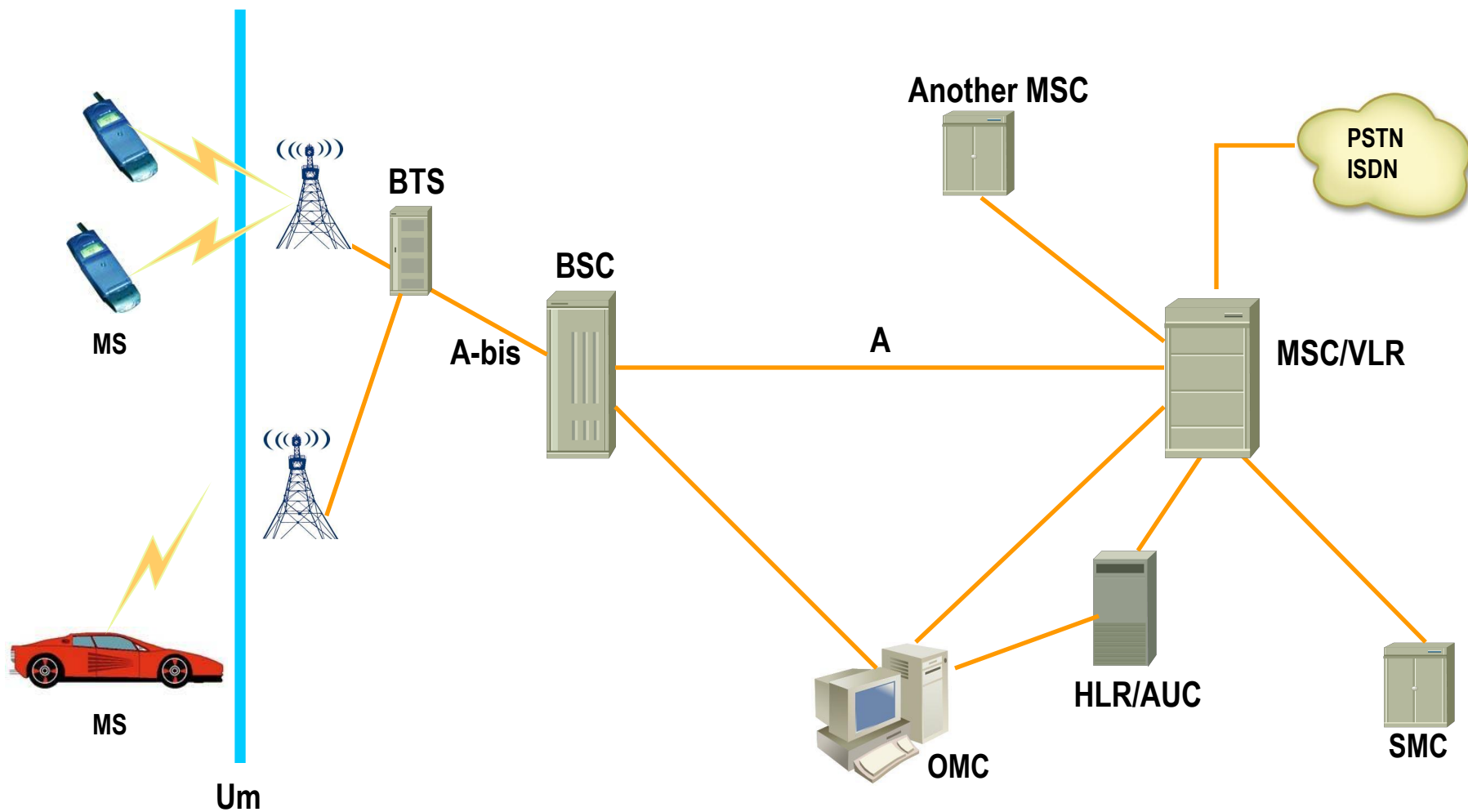
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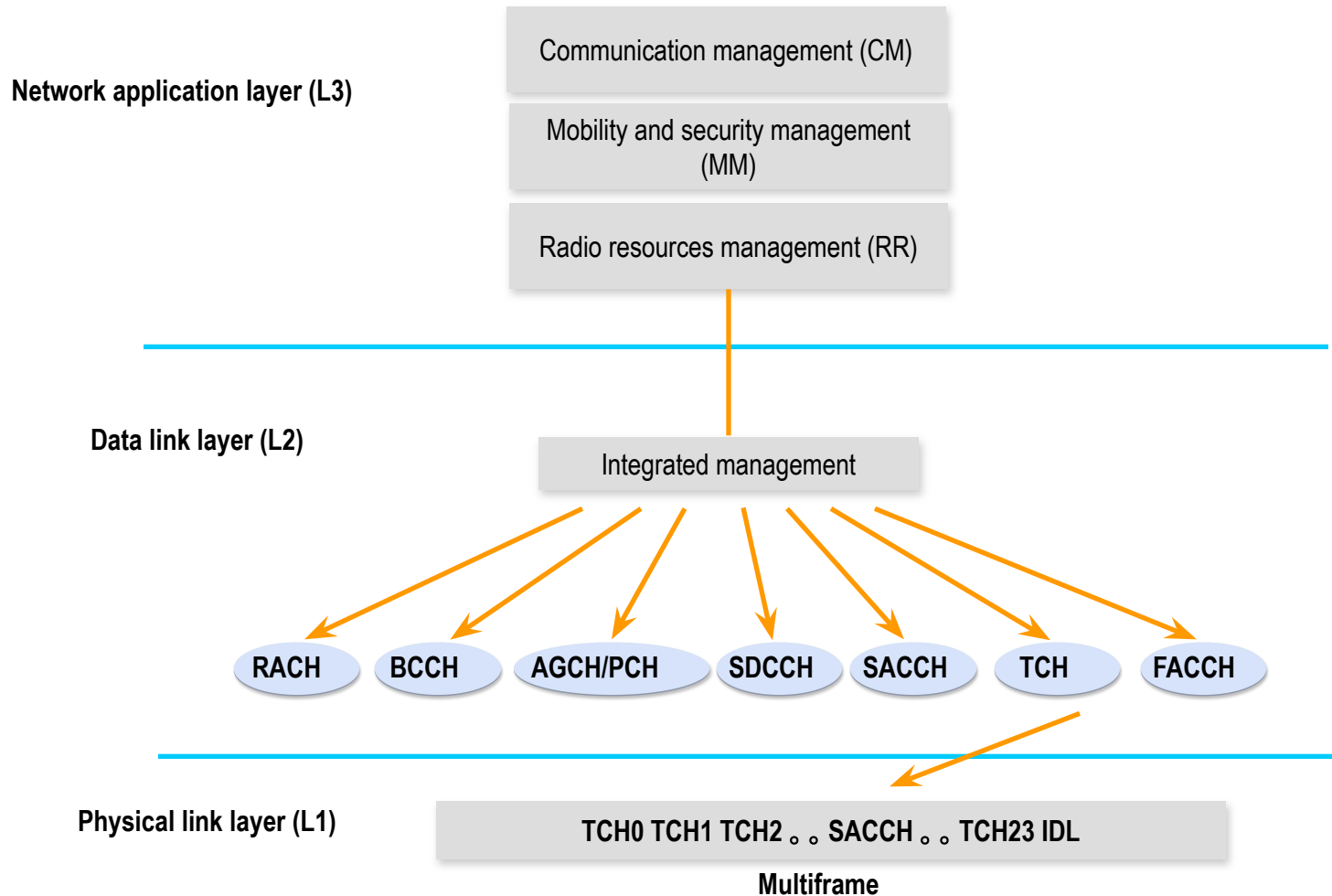
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2. Processing of Voice Signal
3. Radio Channel

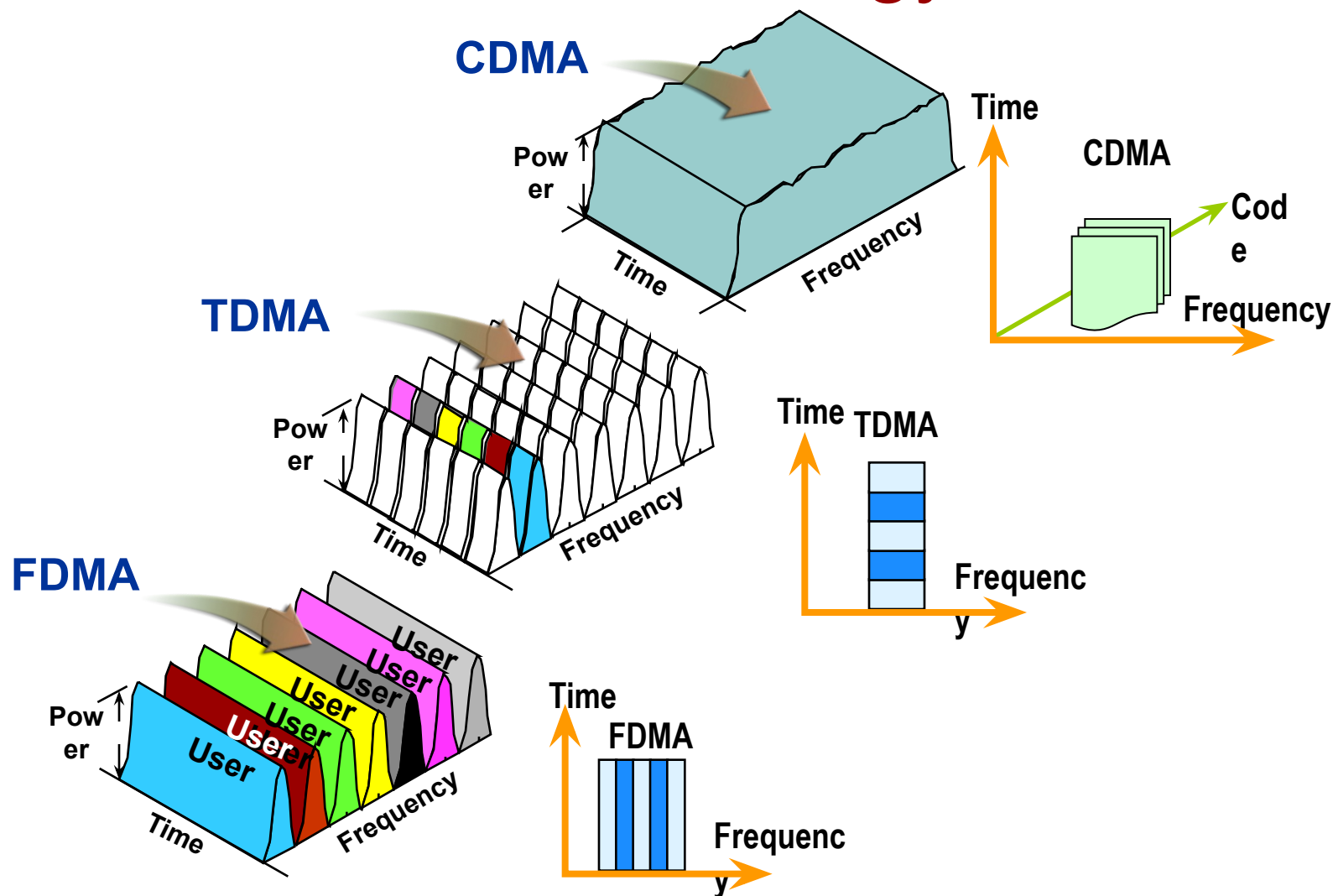
Radio Interface



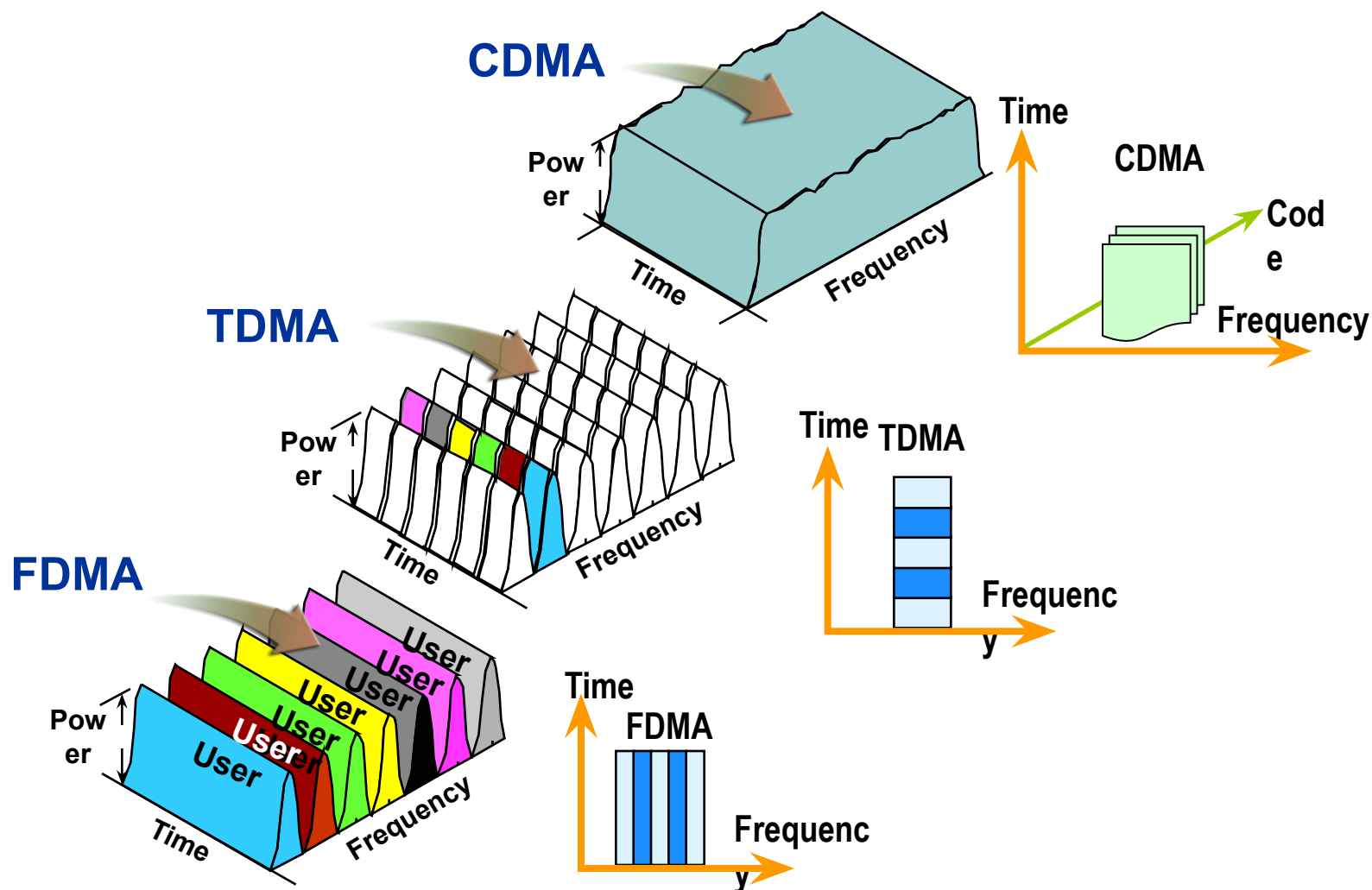
Hierarchical Structure of Um Interface



Radio Access Technology



Radio Access Technology

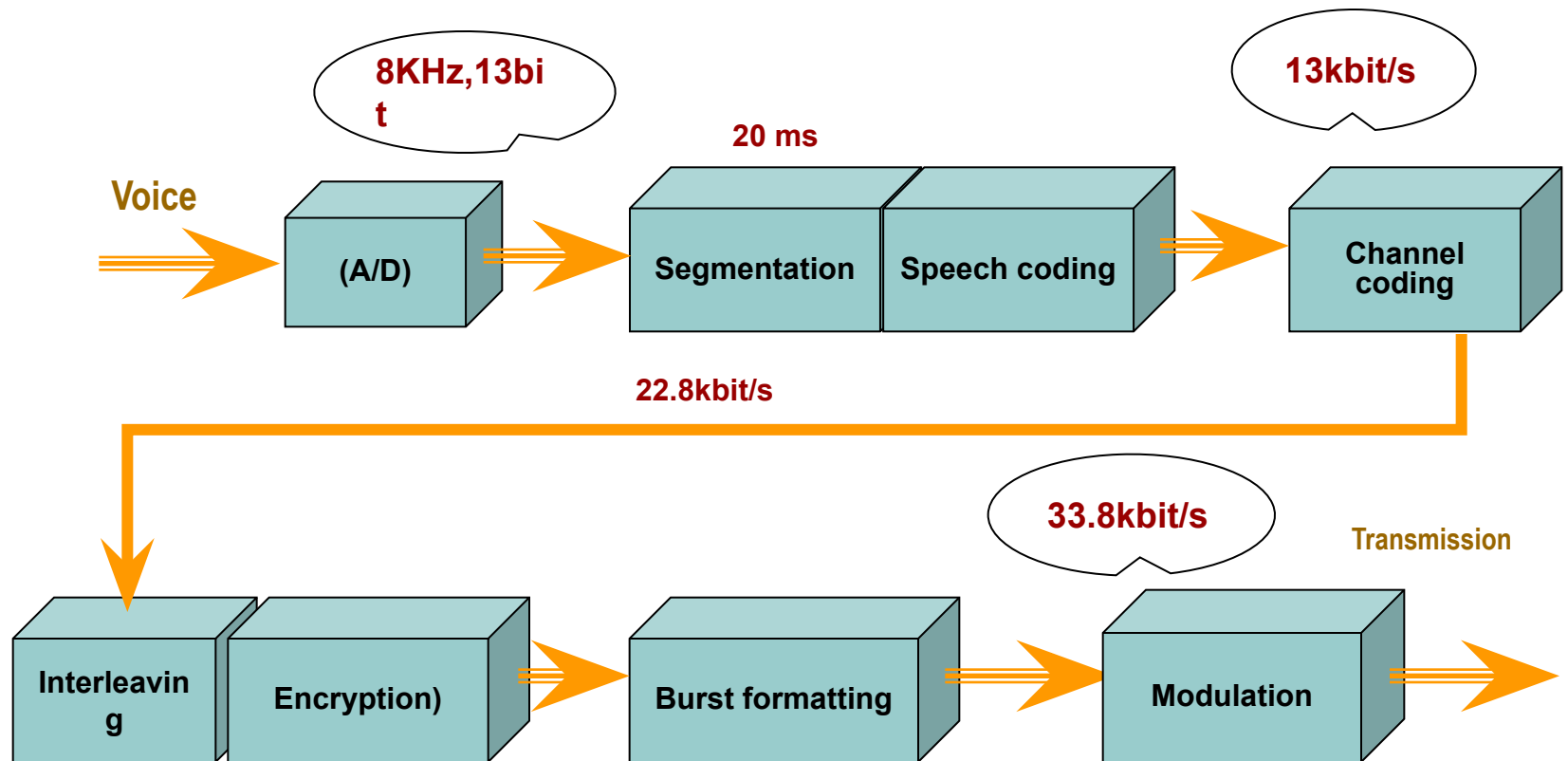




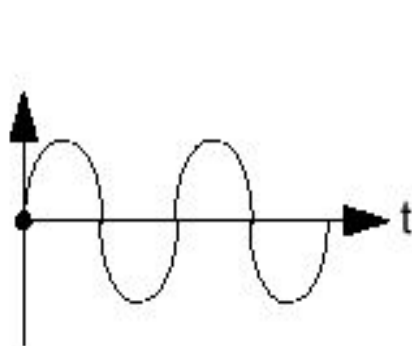
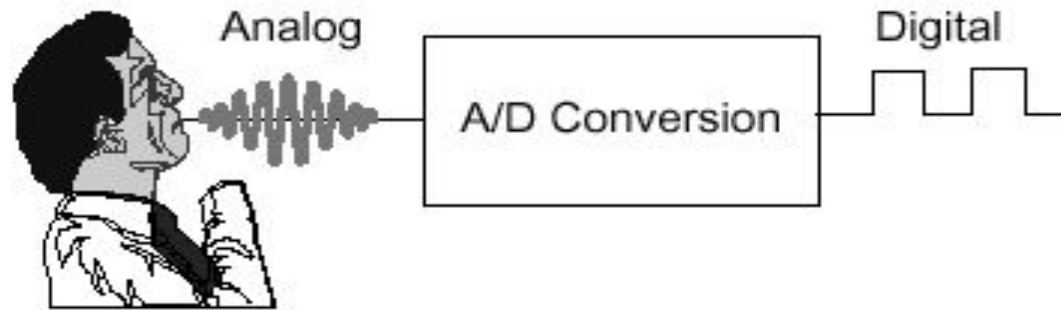
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3. Radio Channel

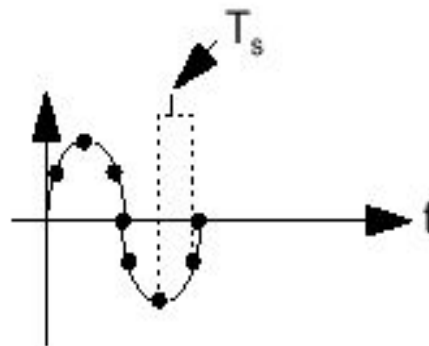
Voice Signal Processing



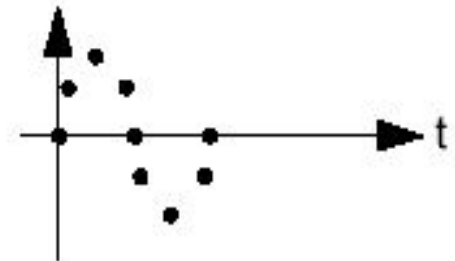
Analog-Digital Conversion



Analogue signal



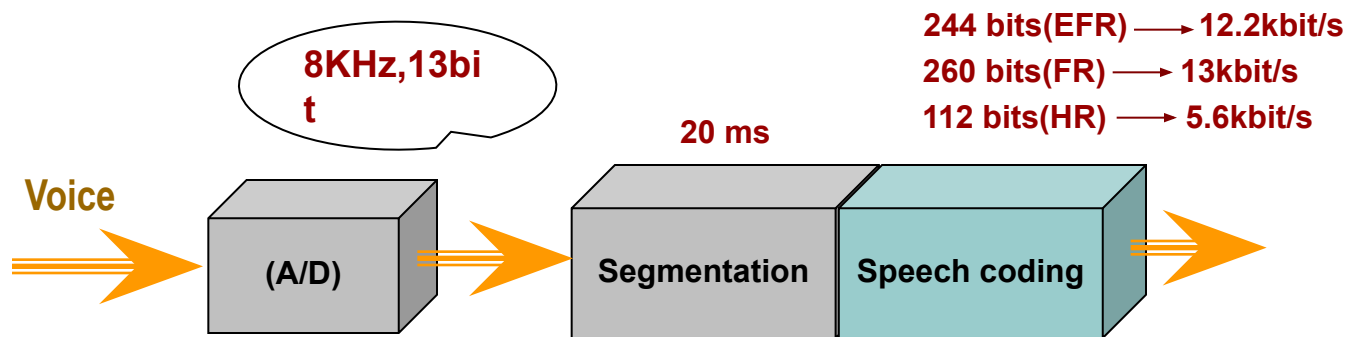
Sampling



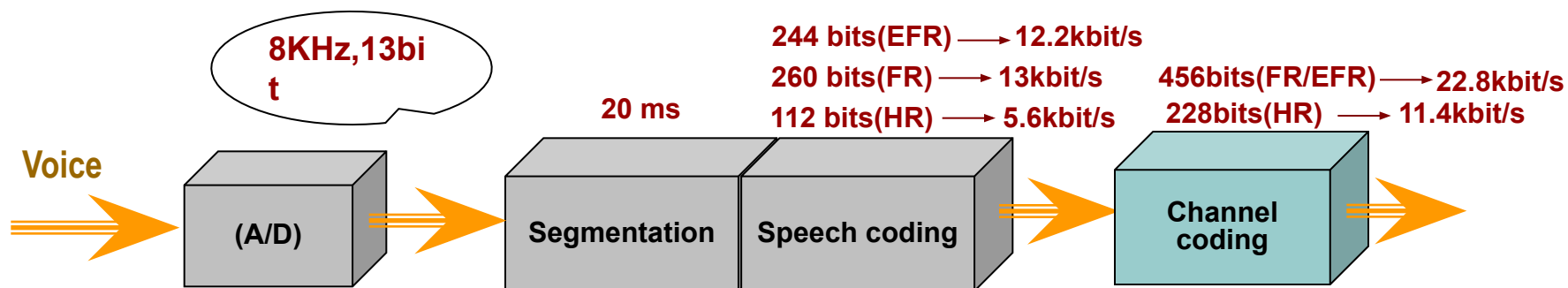
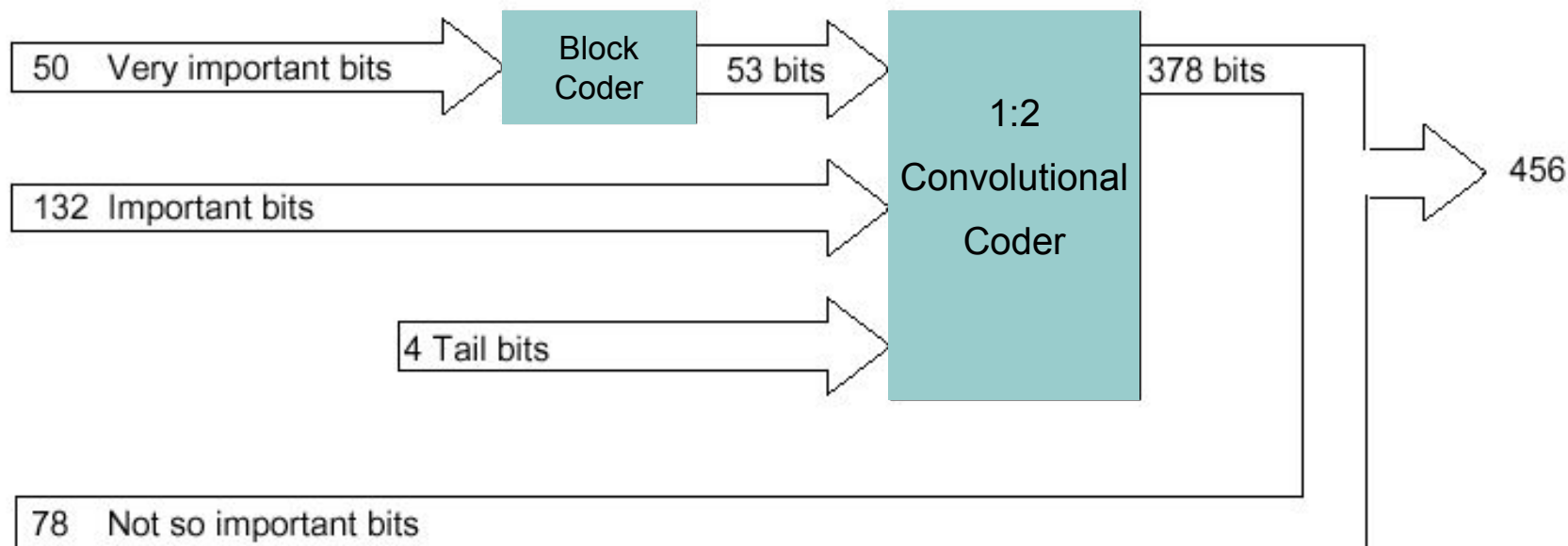
Sampled signal

Speech Coding

- The *Enhance Full Rate* coding mode is called **CELP** (Code Excited Linear Predictive Coding)
- The *Full Rate* coding mode is called **RPE-LTP** (Regular Pulse Excited-Long Term Prediction).
- The *Half Rate* coding mode is called **VCELP** (Vector-Sum Excited Linear Prediction)



Channel Coding



Interleaving

B

1 2 3 4 5 6 7 8 ...

... 452 453 454 455 456

First interleaving:

B0

B1

B2

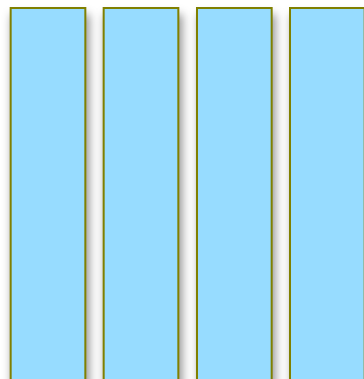
B3

B4

B5

B6

B7



1
9
.
.
.
449

2
10
.
.
.
450

3
11
.
.
.
451

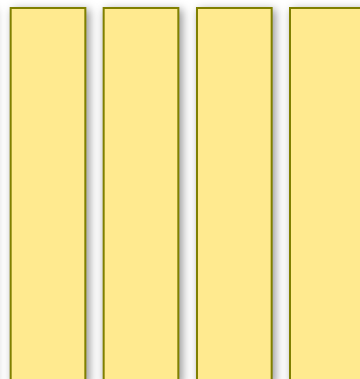
4
12
.
.
.
452

5
13
.
.
.
453

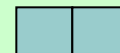
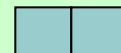
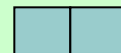
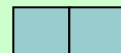
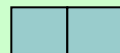
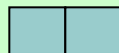
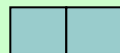
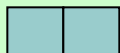
6
14
.
.
.
454

7
15
.
.
.
455

8
16
.
.
.
456



Second interleaving:



{A4,B0}

{A5,B1}

{A6,B2}

{A7,B3}

{B4,C0}

{B5,C1}

{B6,C2}

{B7,C3}

Interleaving

B

1 2 3 4 5 6 7 8 ...

... 452 453 454 455 456

First interleaving:

B0

B1

B2

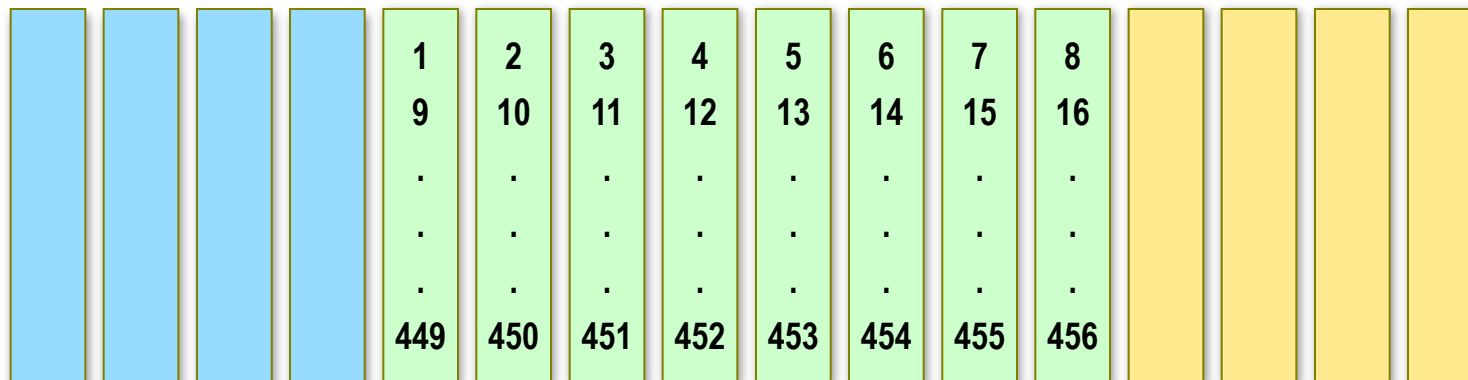
B3

B4

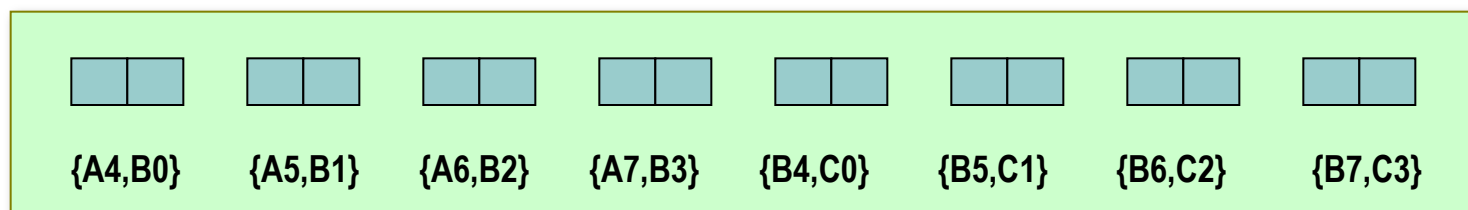
B5

B6

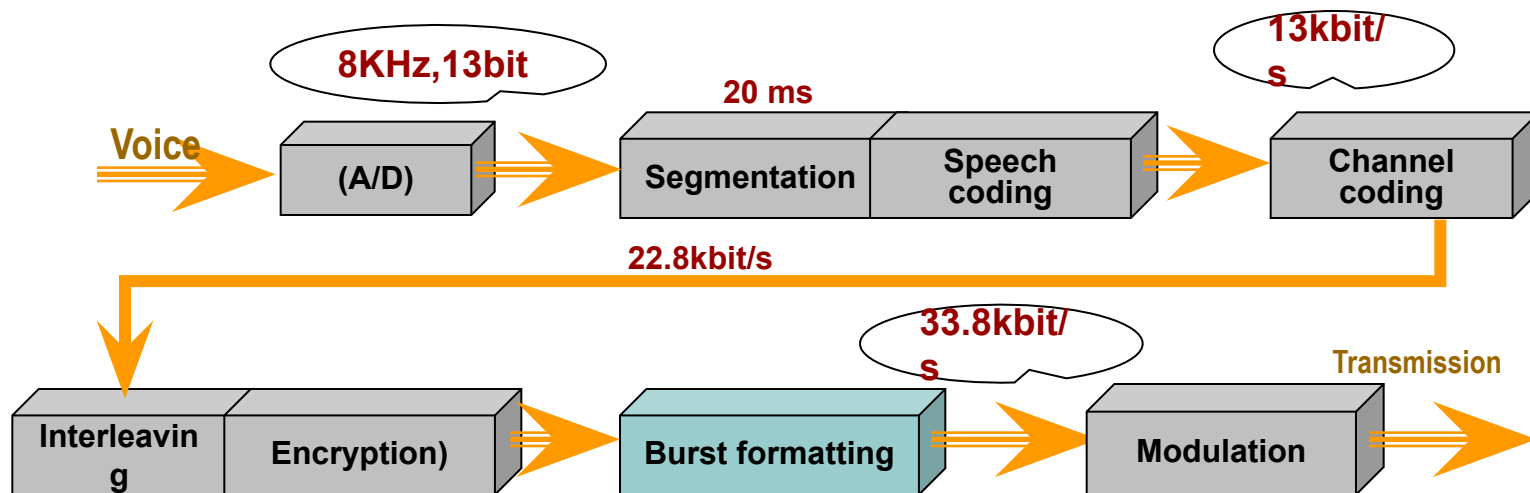
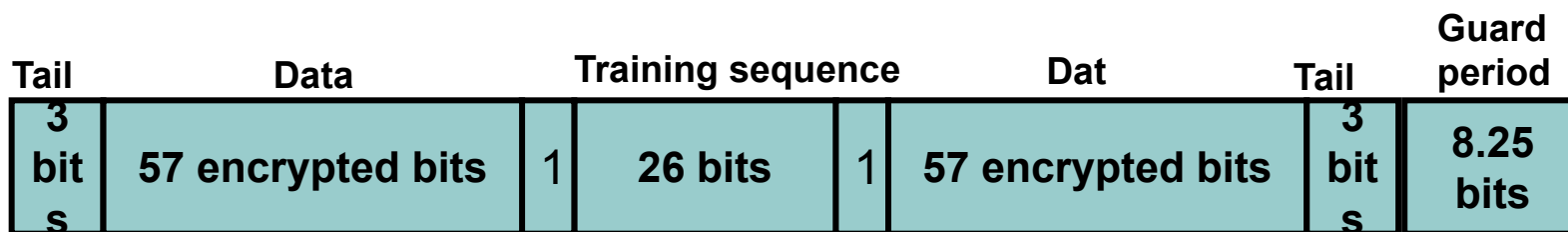
B7



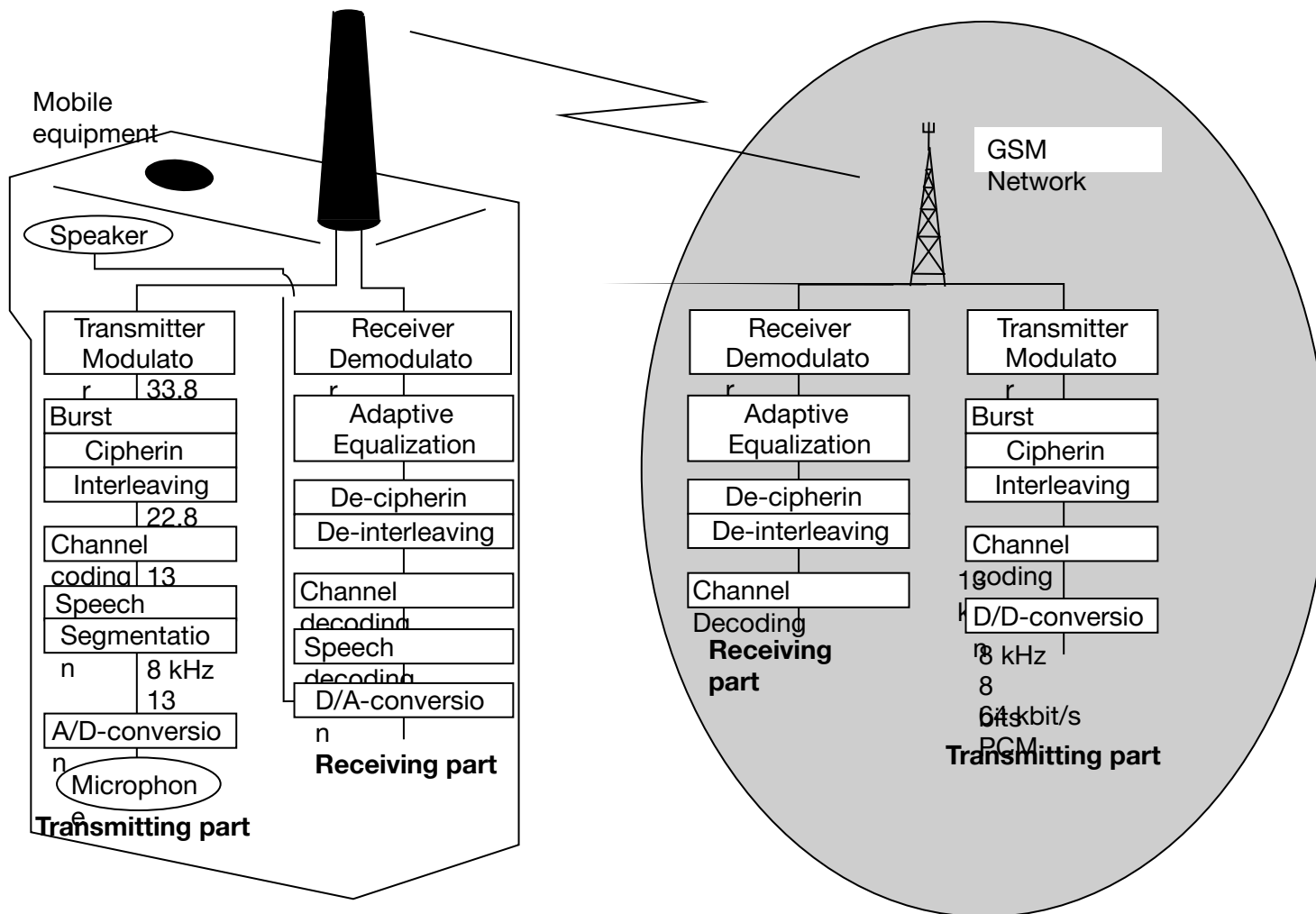
Second interleaving:



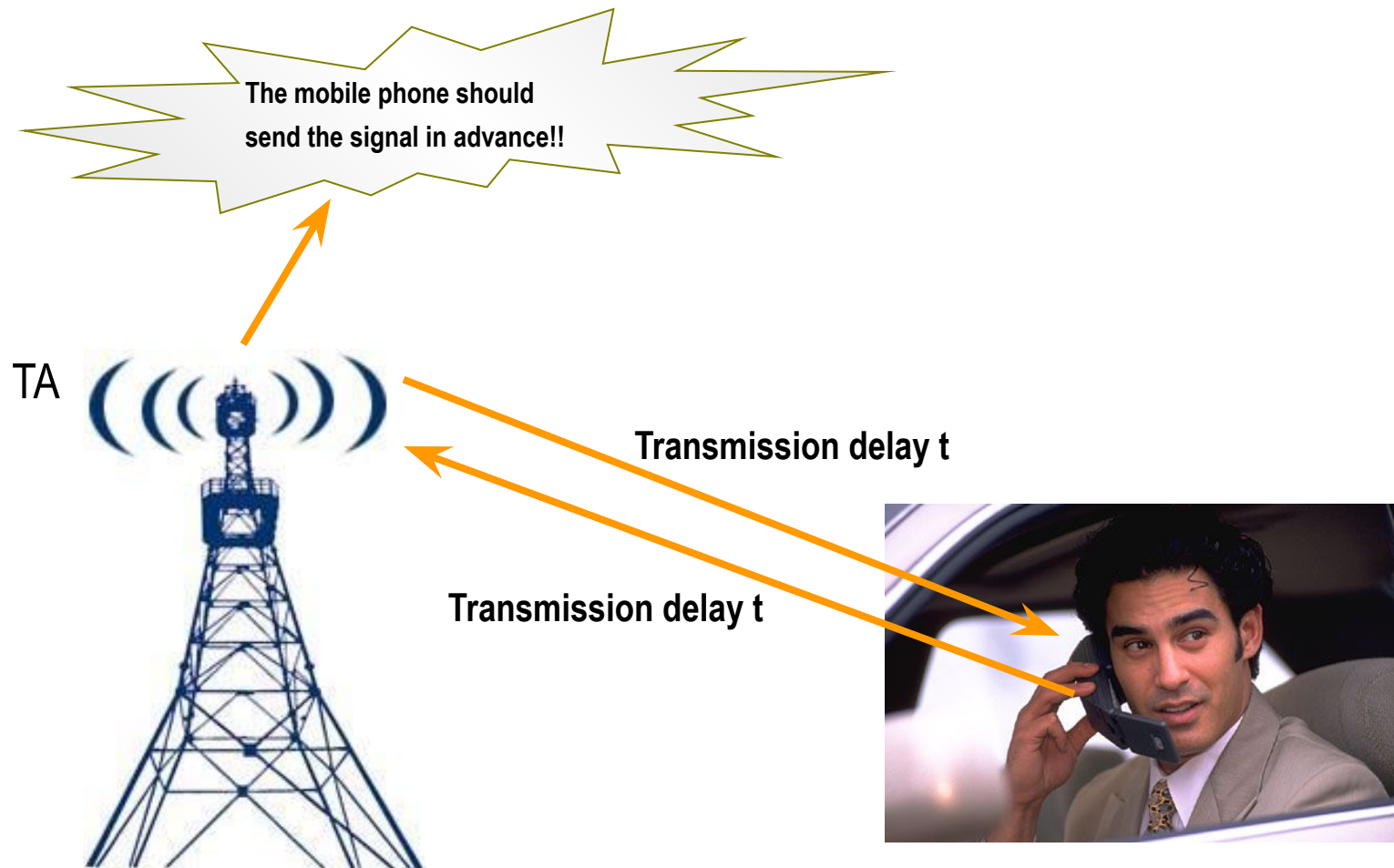
Voice Burst



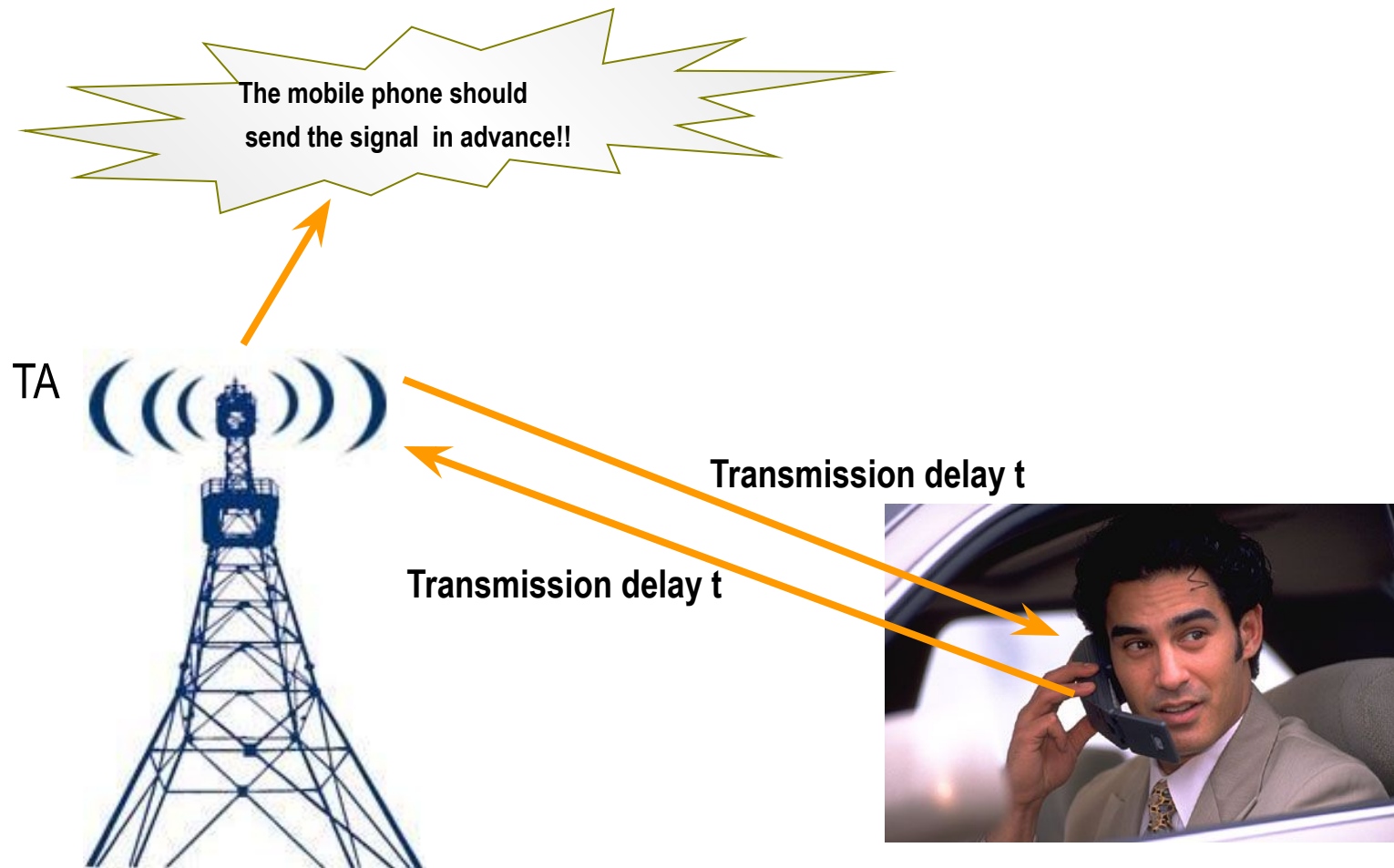
Voice Signal Processing



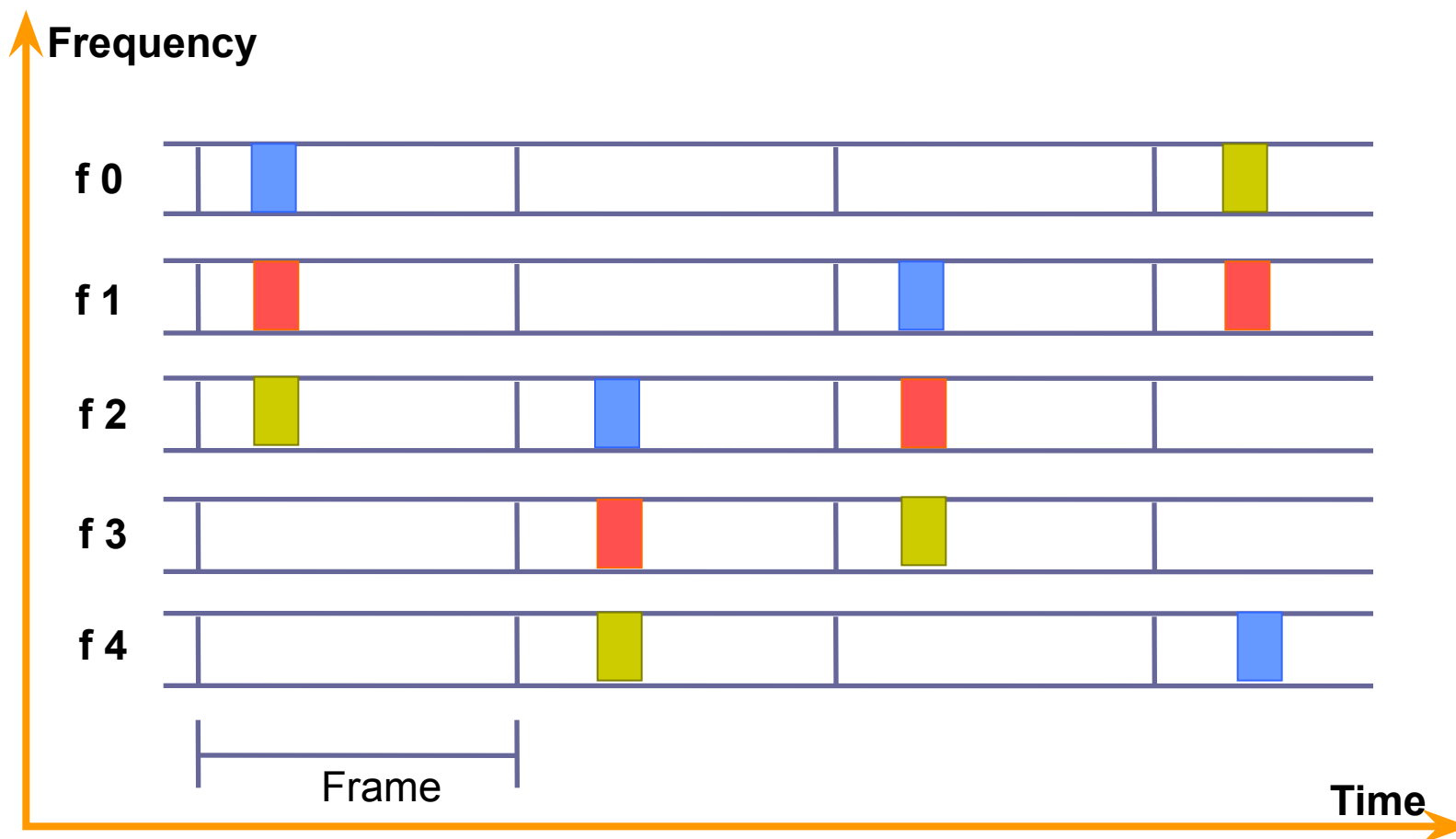
Timing Advance (TA)



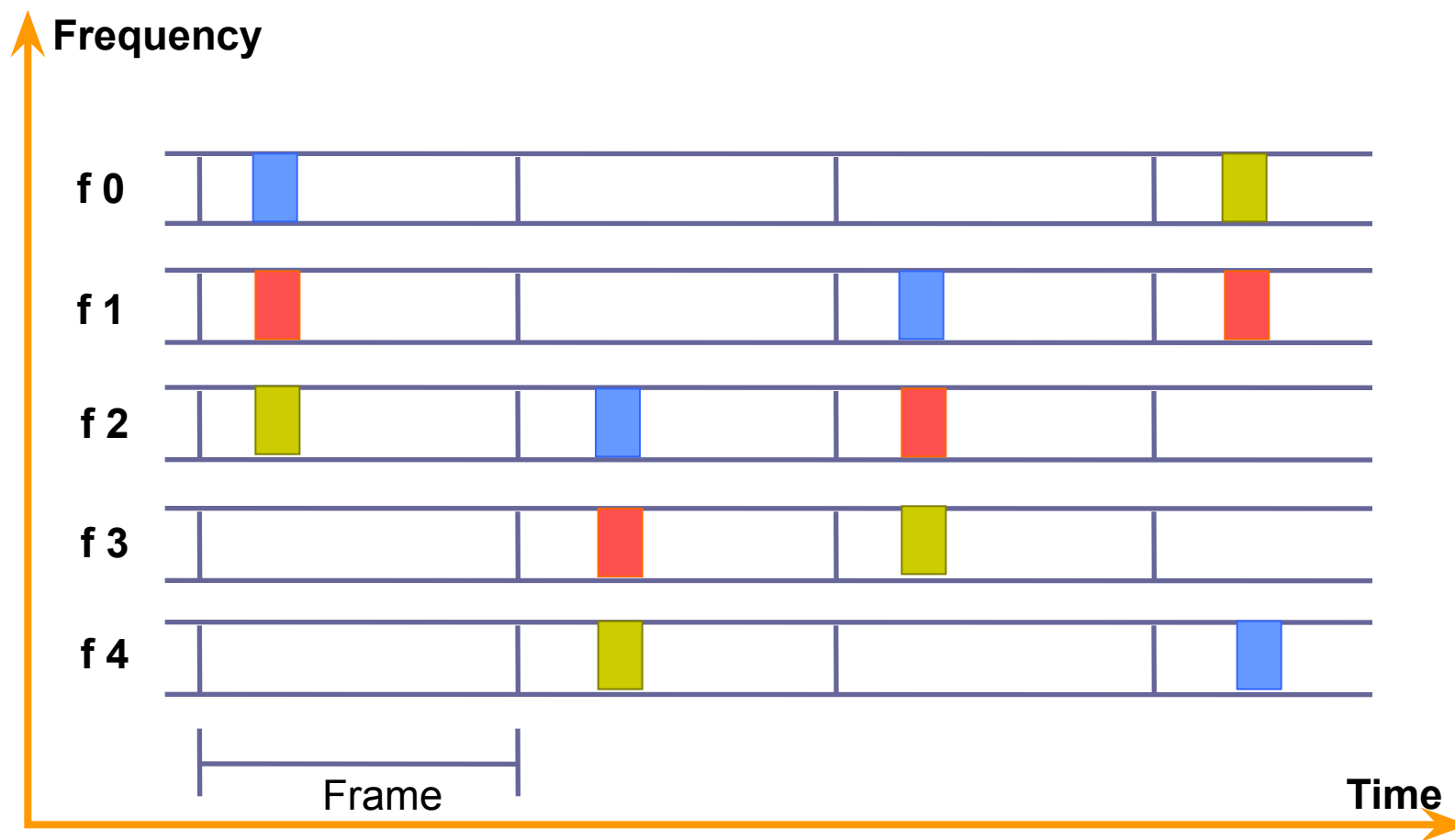
Timing Advance (TA)



Frequency Hopping



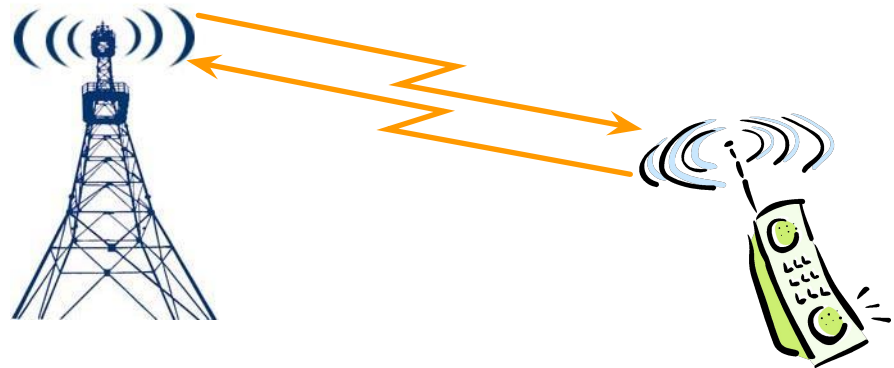
Frequency Hopping



DTX

- DTX: Discontinuous Transmission
 - Shut off the transmission at voice intervals;
 - Only transmit SID frames'
 - The transcoder at the RX terminal produces comfortable noise.
- VAD: Voice Activity Detection
 - Implemented by the transcoder.

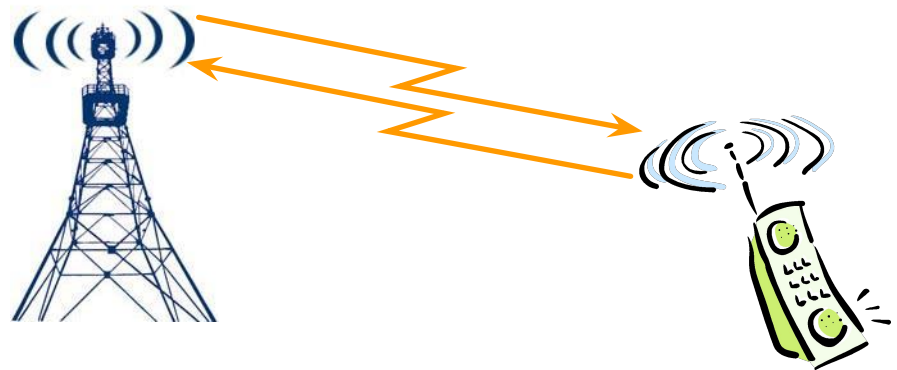
**Prolong battery life and
reduce interference**



DTX

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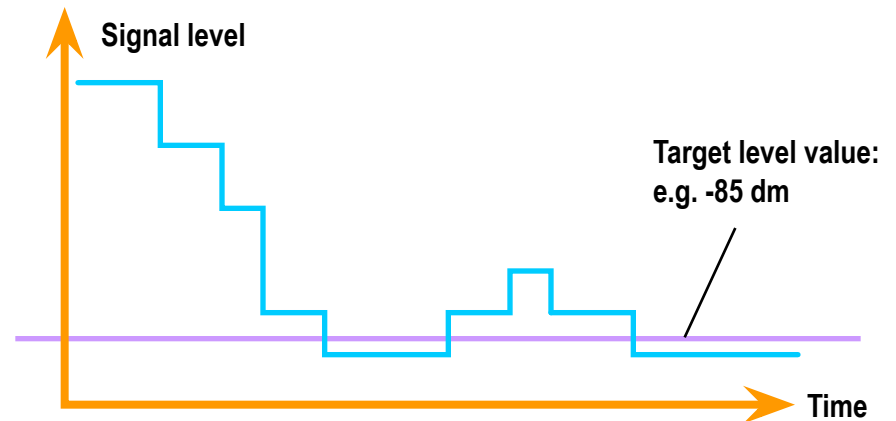
**Prolong battery life and
reduce interference**



Power Control

- Prolong battery life
- Reduce network interference
- Include both uplink power control and downlink power control
- Level and quality are taken into account
- BSC or BTS is the final adjudicator

BCCH Carrier is not involved in power control.

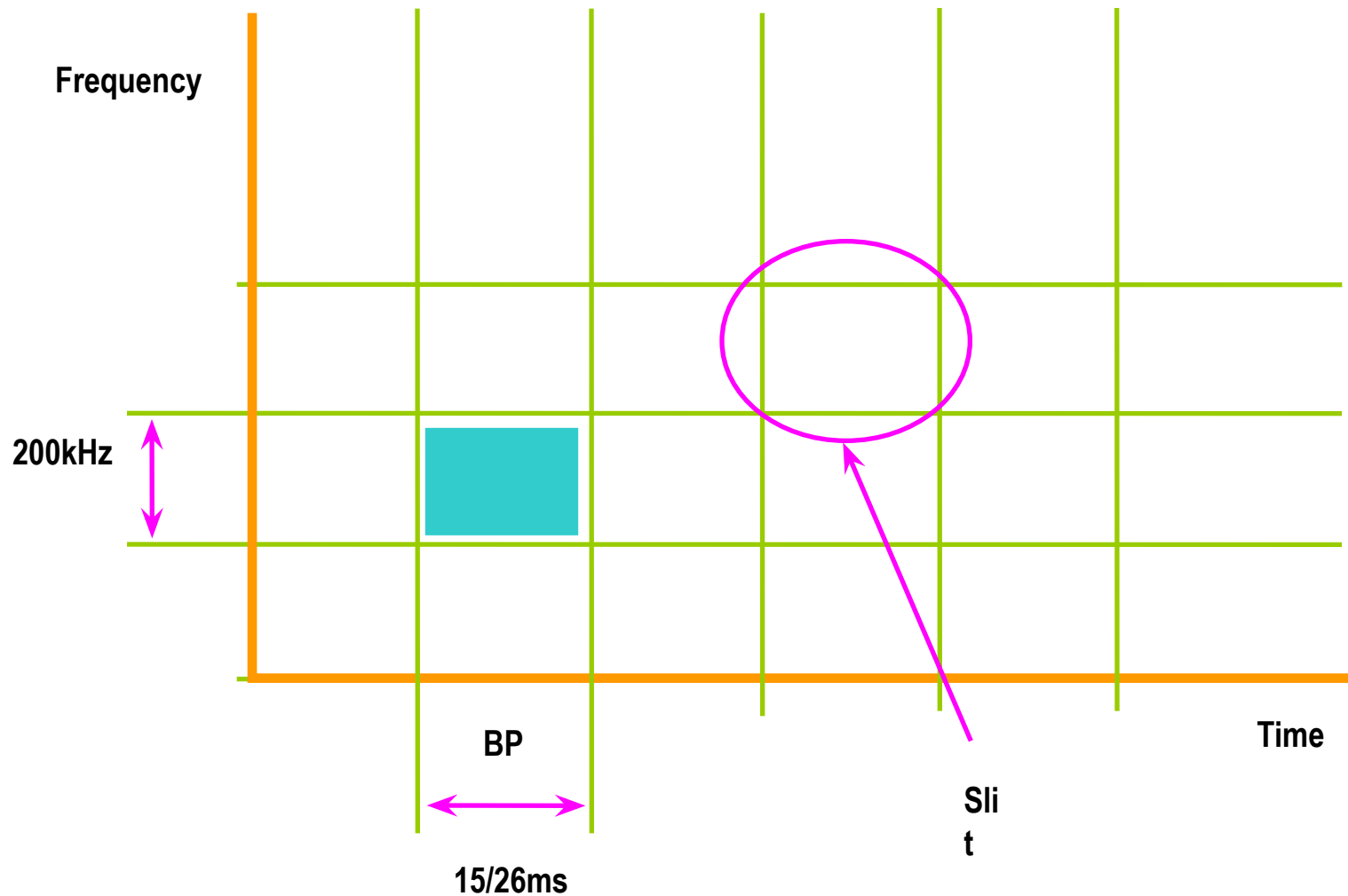




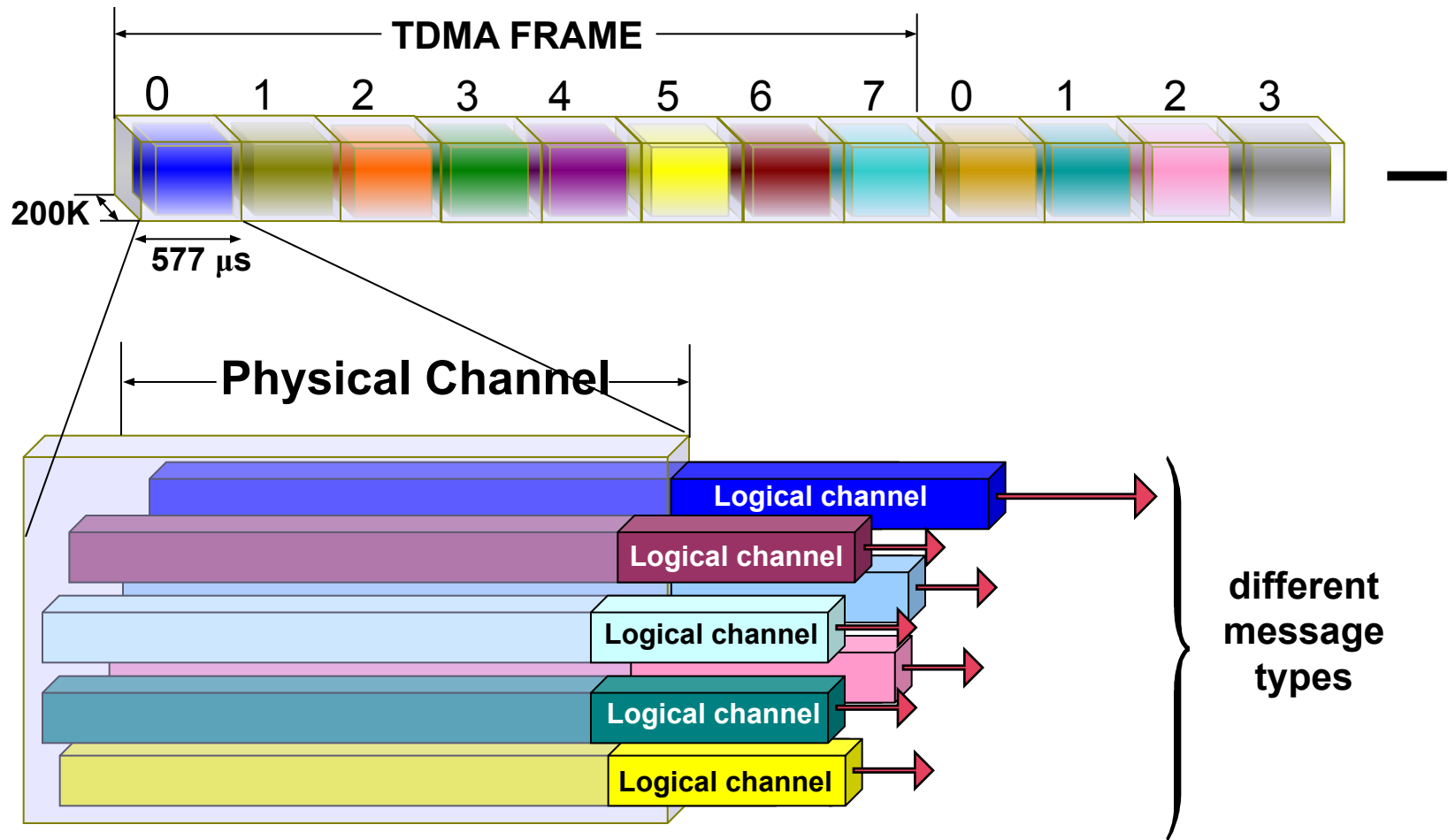
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3. **Radio Channel**

Frame and Channel



Physical Channel of Logical Channel



Burst

- Access burst (AB): Used in MS initial access

Tail bit	Data		Tail bit	Guard interval
8bit	41 synchronous bits	36 encrypted bits	3bit	68.25bit

- Frequency correction burst (FB): Used in frequency synchronization between MS and BTS

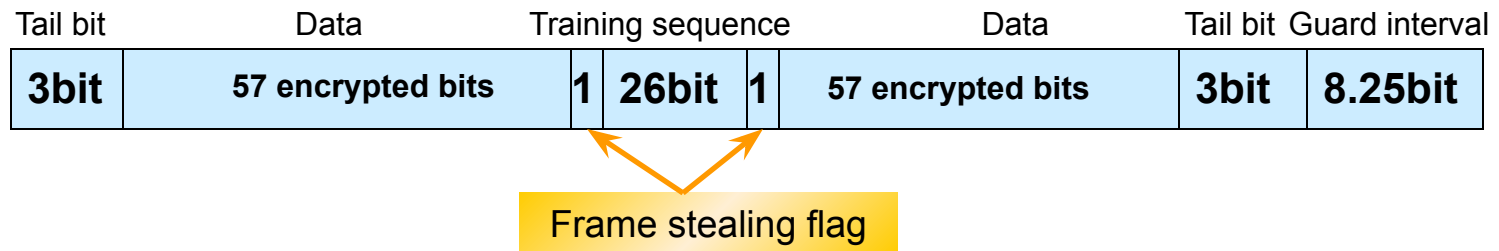
Tail bit	Data		Tail bit	Guard interval
3bit	142bit		3bit	8.25bit

- Synchronous burst (SB): Used in timing synchronization between MS and BTS

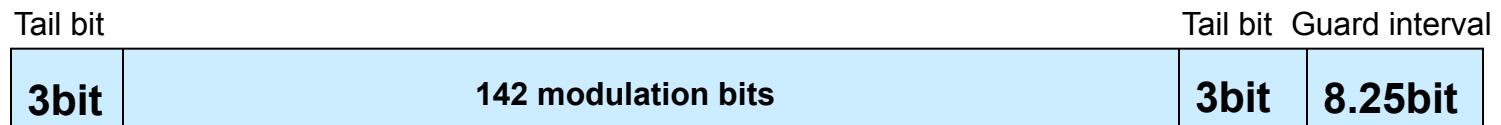
Tail bit	Data		Data	Tail bit	Guard interval
3bit	39 encrypted bits	64 synchronous bits	39 encrypted bits	3bit	8.25bit

Burst

- Normal burst (NB)
 - Used to carry the information of the traffic channel and the control channel except for RACH

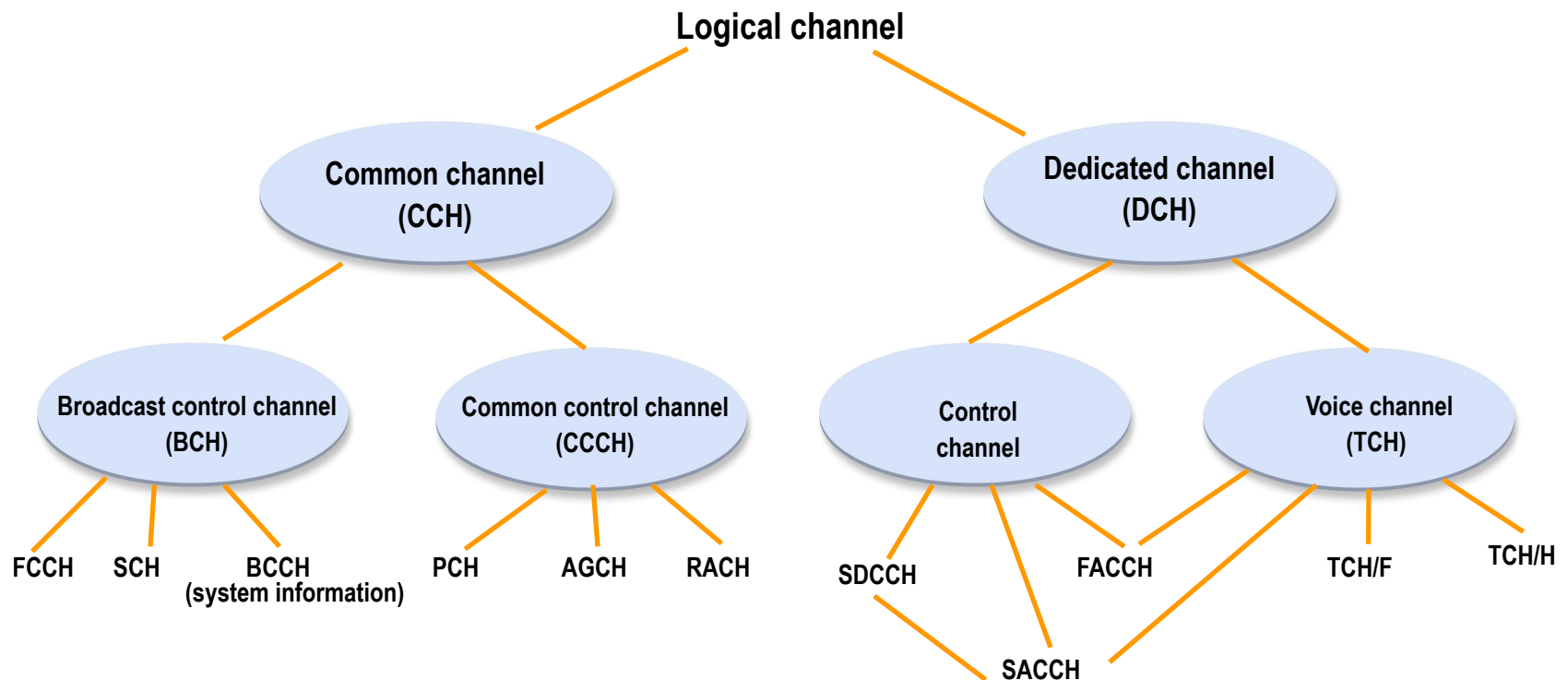


- Dummy burst (DB)
 - Used in transmission of filling frames by BTS at timeslots when there is no information delivered

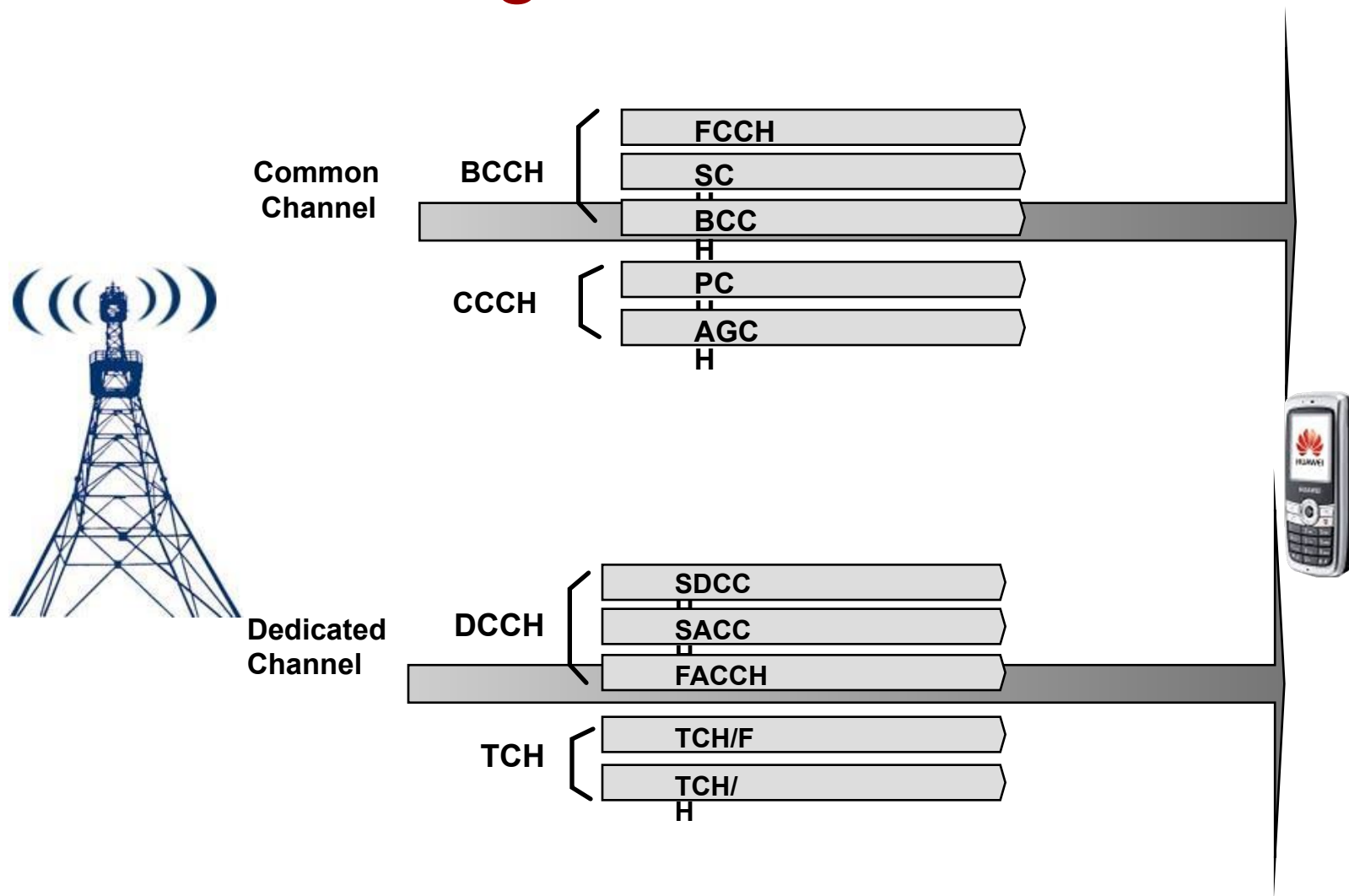


Logical Channel Type

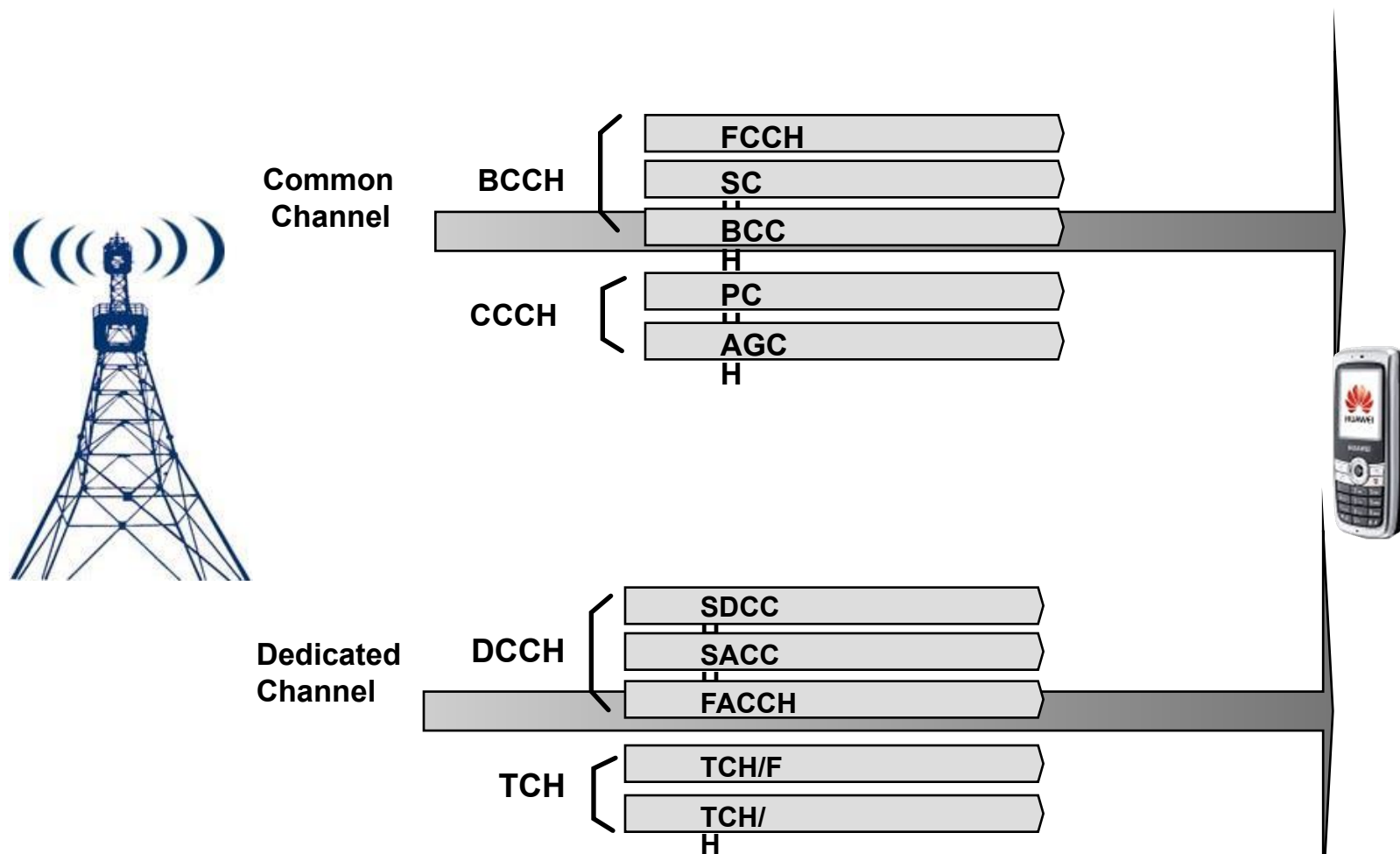
- GSM900 and DCS1800 have the same logical channel category



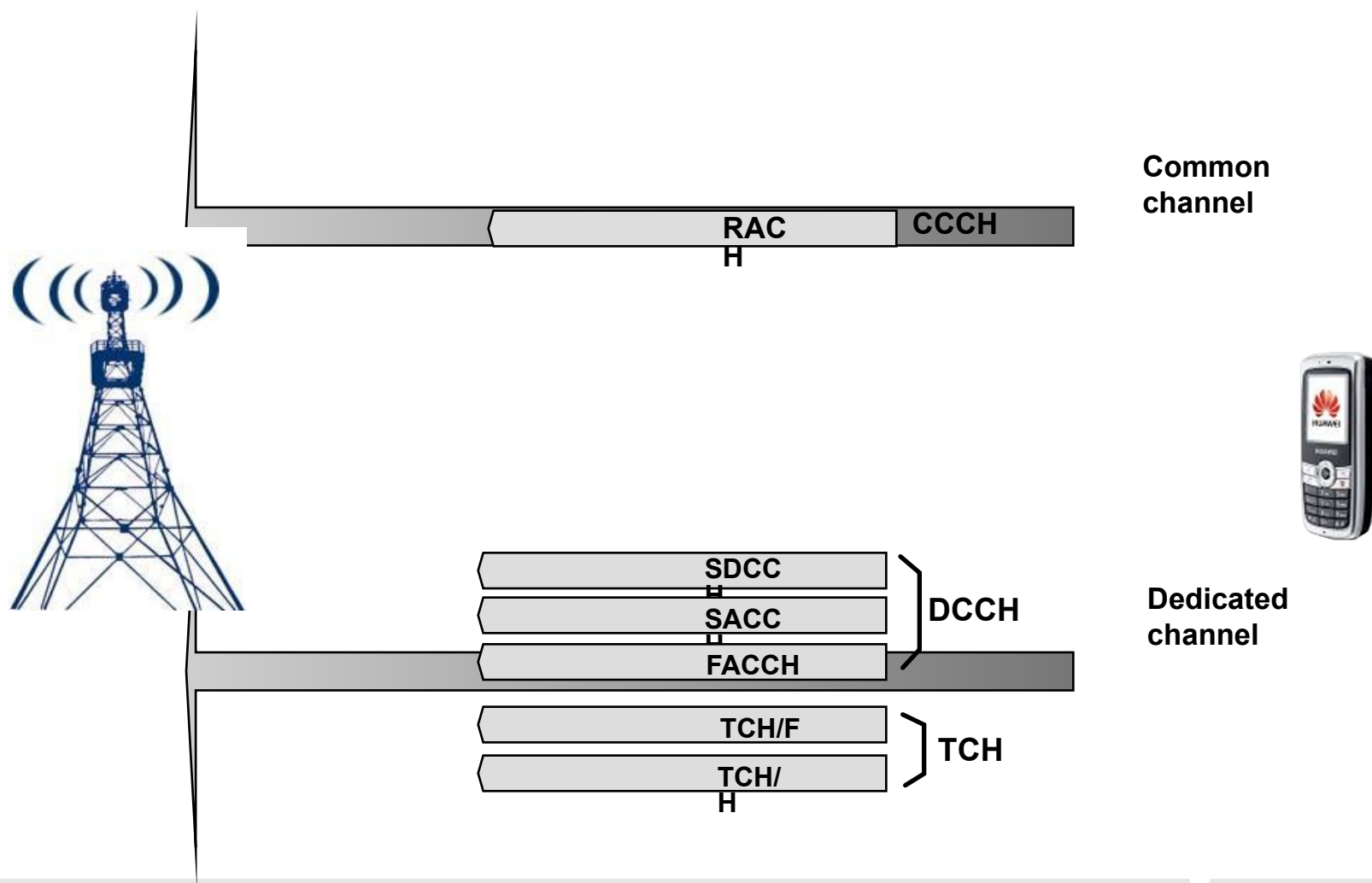
Downlink Logical Channel



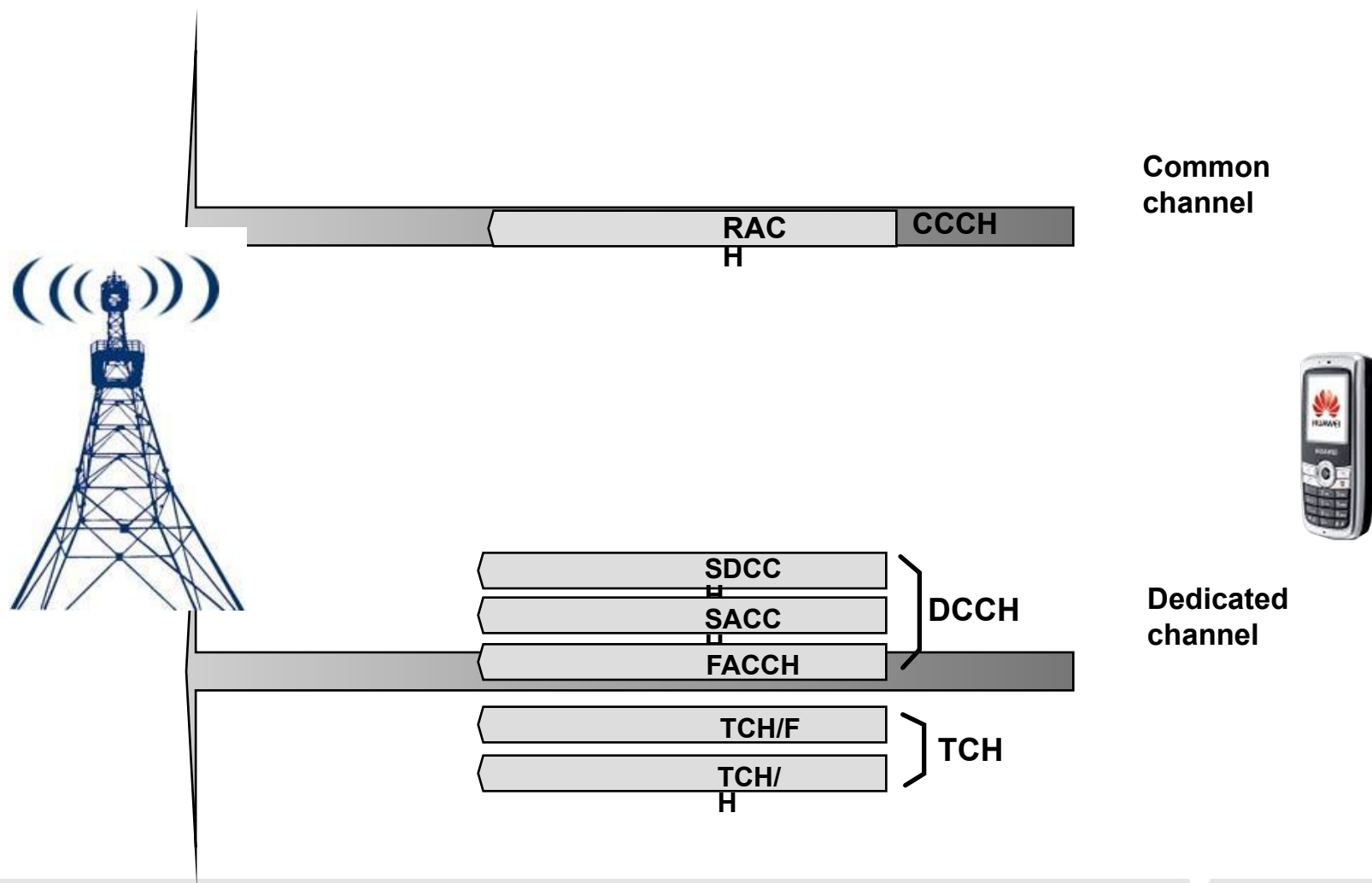
Downlink Logical Channel



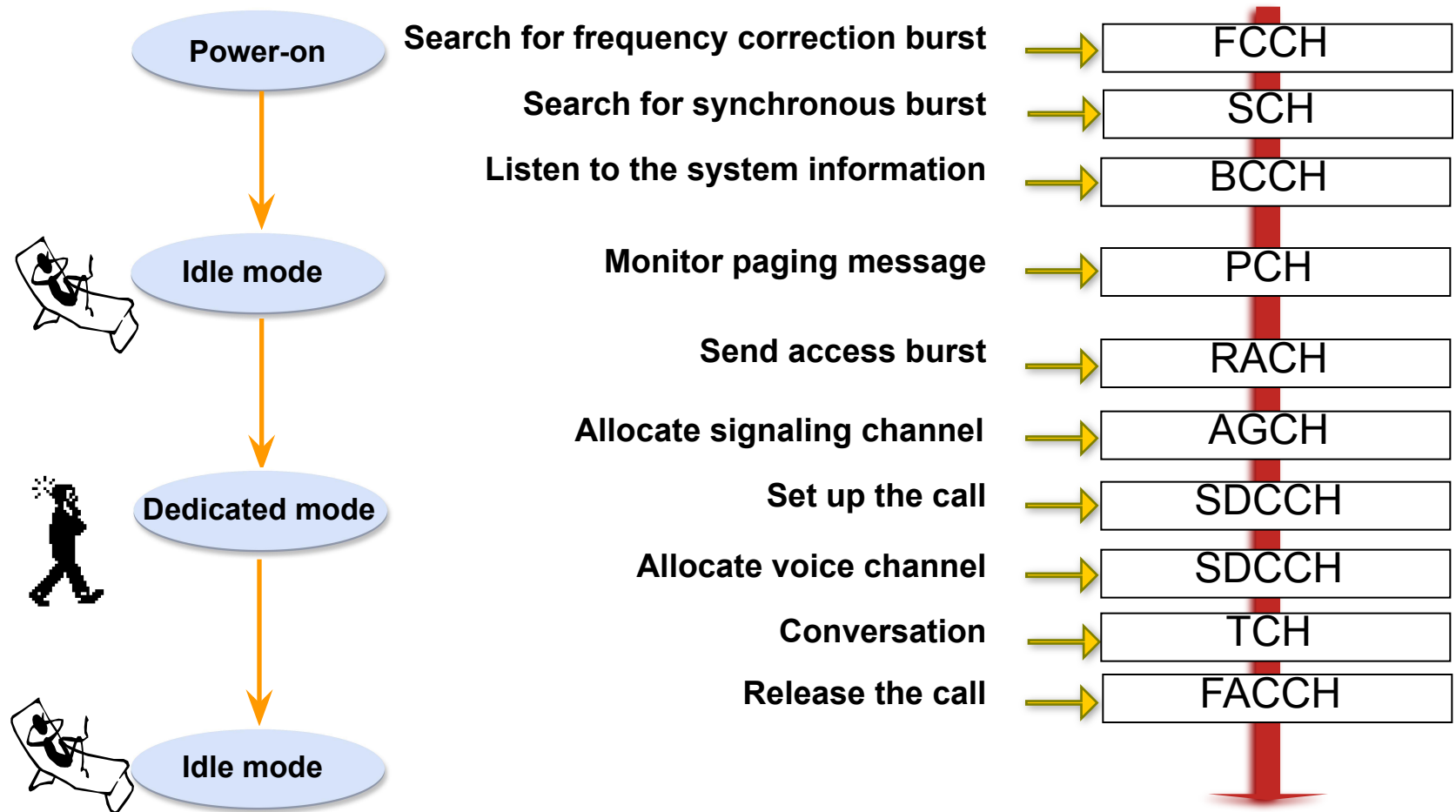
Uplink Logical Channel



Uplink Logical Channel



Use of Logical Channels



Physical Combination of Logical Channel

26-frame multi-frame

TCH/F+FACCH/F+SACCH/F (full-rate TCH)

TCH/H+FACCH/H+SACCH/H (half-rate TCH)

51-frames multi-frame

FCCH+SCH+BCCH+CCCH (main BCCH)

FCCH+SCH+BCCH+CCCH+SDCCH/4+SACCH/4 (combined BCCH)

BCCH+CCCH (extended BCCH)

SDCCH/8+SACCH/8 (main SDCCH)

Structure of Main BCCH

1 multi-frame (51TDMA Frames) 235.38ms Downlink																		
Group	Group1				Group2				Group3,4 (same as Group2)	Grpup5								
Channel	F	S	BX4	CX4	F	S	CX4	CX4		F	S	CX4	CX4	I				
Frame Number	0	1	2-5	6-9	10	11	12-15	16-19	20-39	40	41	42-45	46-49	50				
1 multi-frame (51TDMA Frames) 235.38ms Uplink																		
Channel	R	R	R	R	R	R	R	R	R	R	R	R	R	R.....R	R	R	R	R
Frame Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13-46	47	48	49	50

F:FCCH; S:SCH; B:BCCH; C:CCCH; R:RACH; I:IDLE

Structure of Combined BCCH

1 multi-frame (51TDMA Frames) 235.38ms Downlink																					
Group	Group1				Group2				Group3				Group4				Grpup5				
Channel	F	S	B× 4	C× 4	F	S	C× 4	C× 4	F	S	D0 ×4	D1 ×4	F	S	D2 ×4	D3 ×4	F	S	A0 ×4	A1 ×4	I
Channel	F	S	B× 4	C× 4	F	S	C× 4	C× 4	F	S	D0 ×4	D1 ×4	F	S	D2 ×4	D3 ×4	F	S	A2 ×4	A3 ×4	I
Frame Number	0	1	2-5	6-9	10	11	12- 15	16- 19	20	21	22- 25	26- 29	30	31	32- 35	36- 39	40	41	42- 45	46- 49	50

1 multi-frame (51TDMA Frames) 235.38ms Uplink											
Channel	D3×4	R	R	A2×4	A3×4	R.....R	D0×4	D1×4	R	R	D2×4
Channel	D0×4	R	R	A0×4	A1×4	R.....R	D0×4	D1×4	R	R	D2×4
Frame Number	0-3	4	5	6-9	10-13	14-36	37-40	41-44	45	46	47-50

F:FCCH; S:SCH; B:BCCH; C:CCCH; D:SDCCH ;A:SACCH; R:RACH; I:IDLE

Structure of Logical Channel Combination Frame-Main SDCCH

1 multi-frame (51TDMA Frames) 235.38ms Downlink															
Channel	D0× 4	D1× 4	D2× 4	D3× 4	D4× 4	D5× 4	D6× 4	D7× 4	A0× 4	A1× 4	A2× 4	A3× 4	I	I	I
Channel	D0× 4	D1× 4	D2× 4	D3× 4	D4× 4	D5× 4	D6× 4	D7× 4	A4× 4	A5× 4	A6× 4	A7× 4	I	I	I
Frame Number	0-3	4-7	8-11	12-1 5	16-1 9	20-2 3	24-2 7	28-3 1	32-3 5	36-3 9	40-4 3	44-4 7	48	49	50

1 multi-frame (51TDMA Frames) 235.38ms Uplink															
Channel	A5× 4	A6× 4	A7× 4	I	I	I	D0× 4	D1 ×4	D2× 4	D3× 4	D4× 4	D5× 4	D6× 4	D7× 4	A0× 4
Channel	A1× 4	A2× 4	A3× 4	I	I	I	D0× 4	D1 ×4	D2× 4	D3× 4	D4× 4	D5× 4	D6× 4	D7× 4	A4× 4
Frame Number	0-3	4-7	8-11	12	13	14	15-1 8	19- 22	23-2 6	27-3 0	31-3 4	35-3 8	39-4 2	43-4 6	47-5 0

D:SDCCH; A:SACCH; I:IDLE

Structure of Logical Channel Combination Frame-TCH

Case of one full rate TCH

1 multi-frame (26TDMA Frames) 120ms

Channel	T	T	T	T	T	T	T...T	A	T,,,T	T	T	T	T	T	T	I
Frame Number	0	1	2	3	4	5	6...11	12	13...18	19	20	21	22	23	24	25

Case of two half rate TCHs

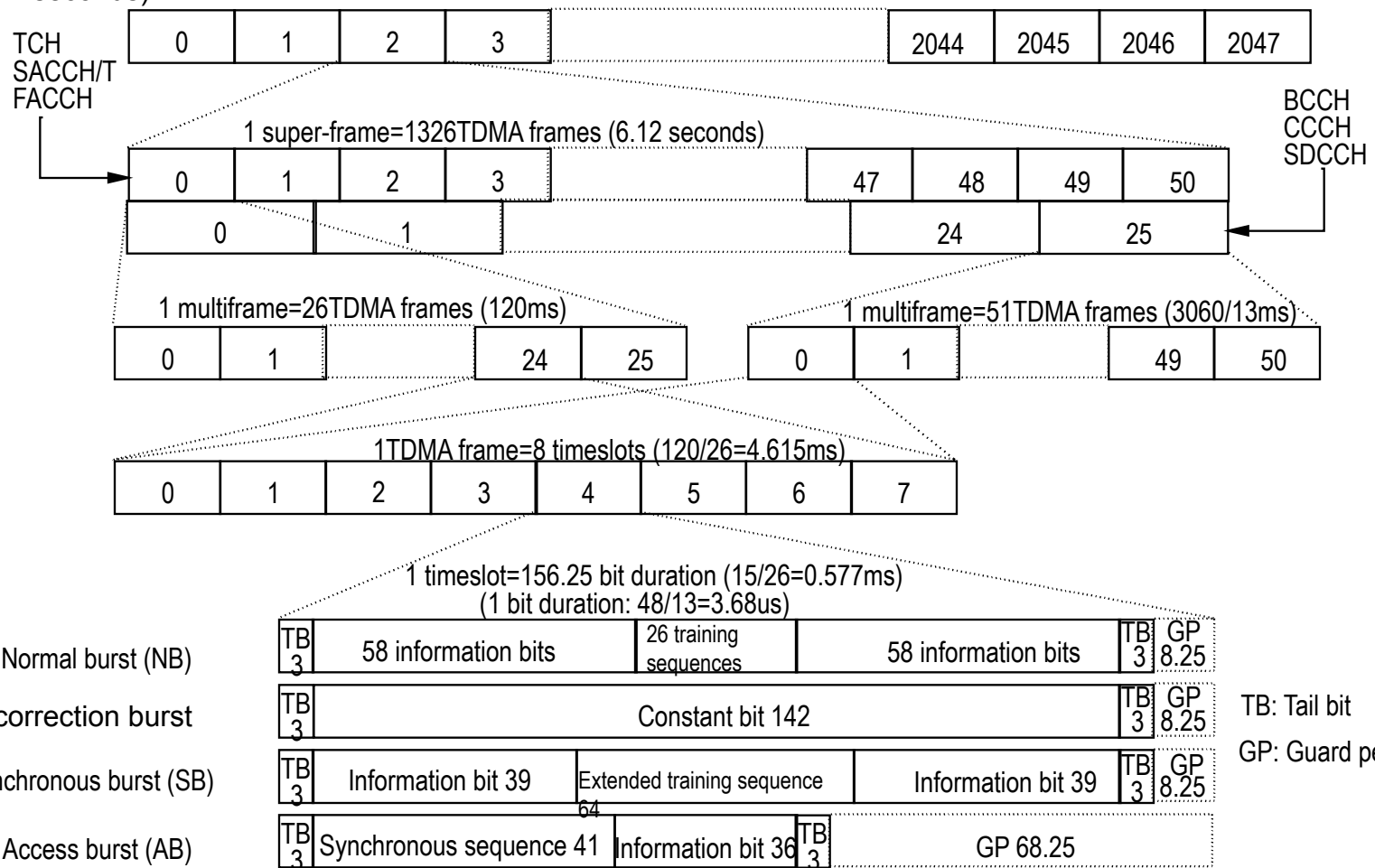
1 multi-frame (26TDMA Frames) 120ms

Channel	T	t	T	t	T	t	T...t	A	T,,,t	T	t	T	t	T	t	a
Frame Number	0	1	2	3	4	5	6...11	12	13...18	19	20	21	22	23	24	25

T:TCH;A:SACCH; I:IDLE

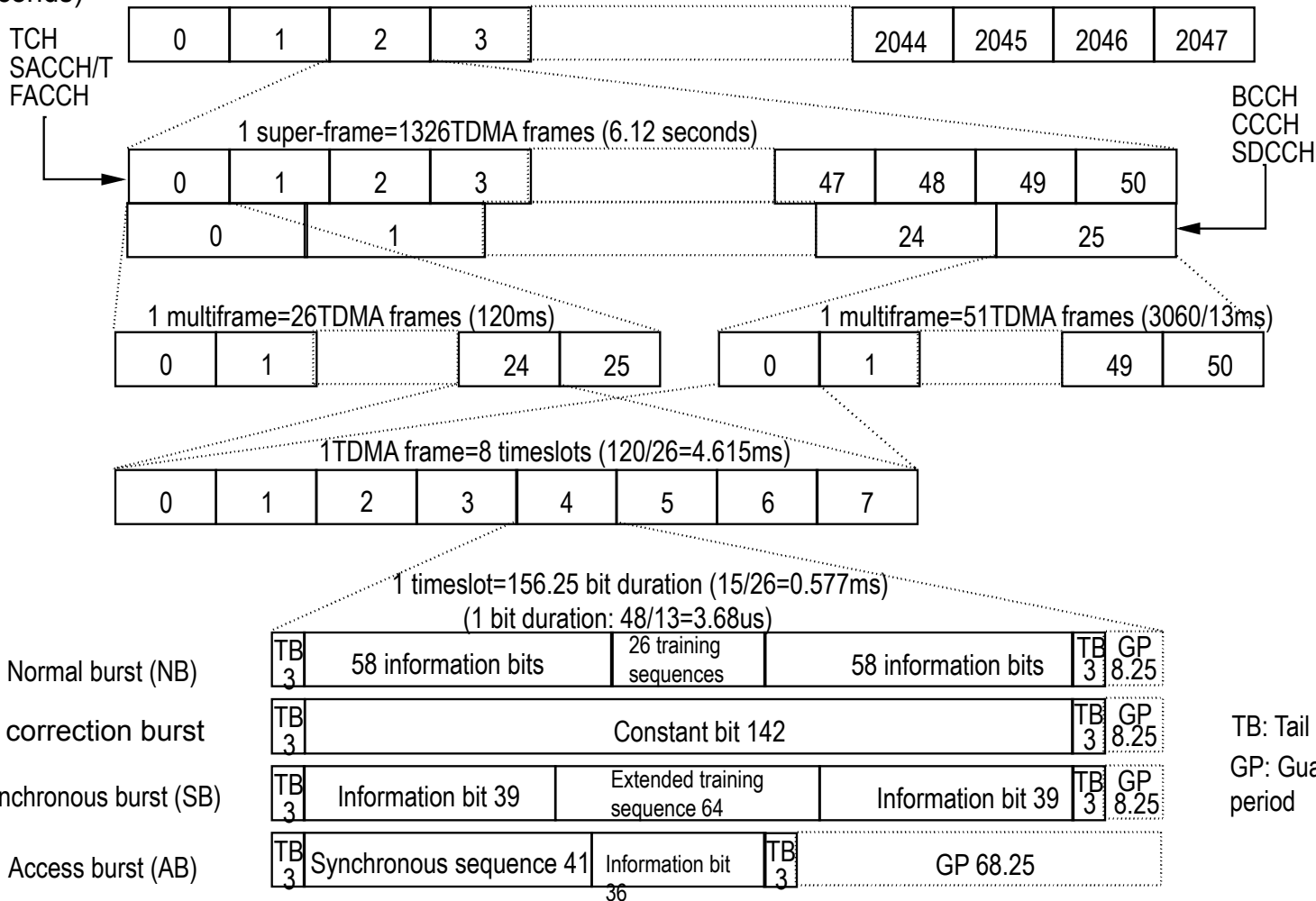
Frame

1 hyper frame=2048 super-frames=2715648 TDMA frames (3 hours, 28 minutes, 53 seconds and 760 milliseconds)

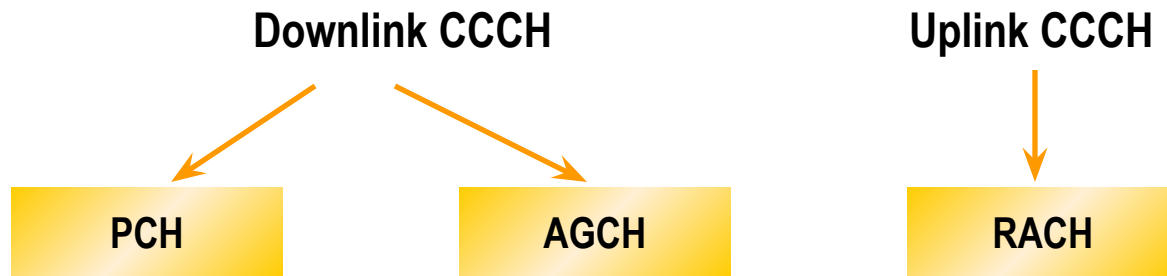


Frame

1 hyper frame=2048 super-frames=2715648 TDMA frames (3 hours, 28 minutes, 53 seconds and 760 milliseconds)



Configuration of Common Control Channel



How to determine the total CCCH resources of the cell? How to allocate AGCH and PCH reasonably?



Summary

- In this course, we have learned:
 - Processing of Voice Signal
 - Radio Channel in Um Interface
 - Key Technical in Um Interface

Thank

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