

# WIRELESS PERSONAL COMMUNICATIONS SYSTEMS

## PAN-EUROPEAN CELLULAR GSM

DAVID GOODMAN  
DEPARTMENT OF ELECTRICAL AND  
COMPUTER ENGINEERING  
POLYTECHNIC UNIVERSITY

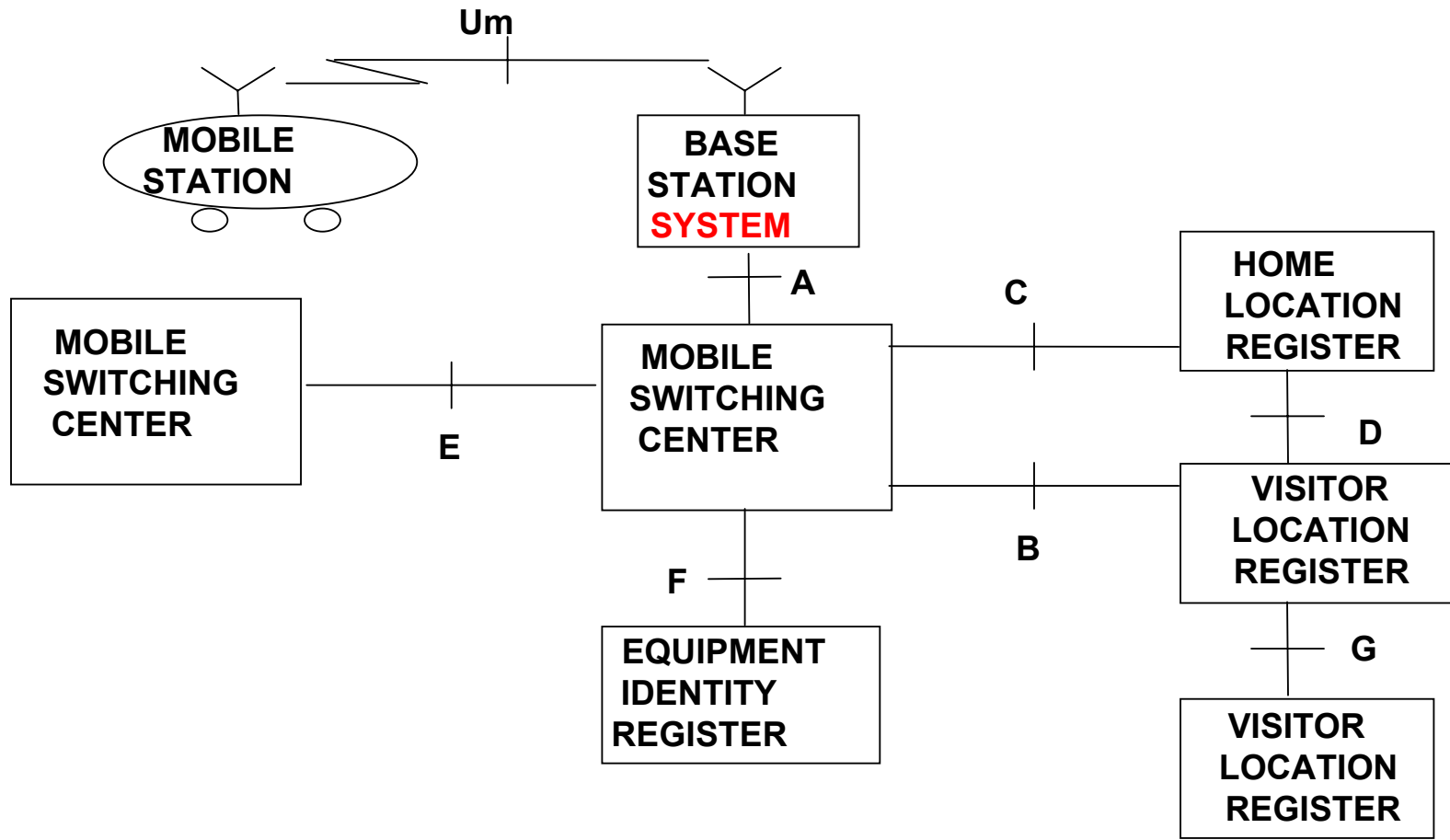
[dgoodman@poly.edu](mailto:dgoodman@poly.edu)

718-260-3221

# GSM highlights

- Open interfaces
- SIM
- ISDN technology
- International roaming
- Slow frequency hopping
- Temporary mobile subscriber identity
- Mobile assisted handover

# GSM Network



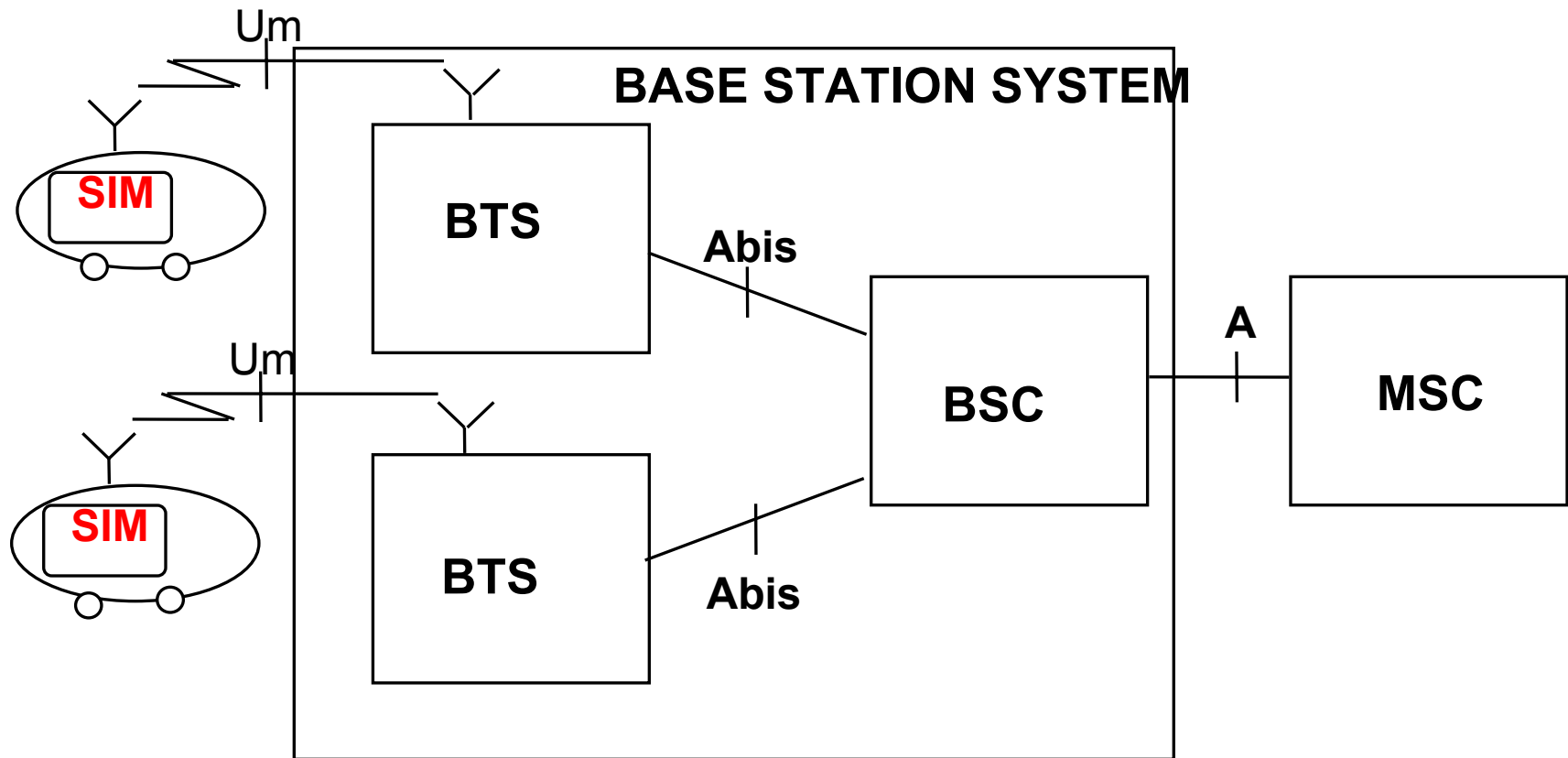
# GSM Identifiers

<u>NOTATION</u>	<u>NAME</u>	<u>SIZE</u>	<u>DESCRIPTION</u>
IMSI	International mobile subscriber identity	15 digits	Directory number assigned by operating company to a subscriber
<b>TMSI</b>	Temporary mobile subscriber identity	32 bits	Assigned by visitor location register to a subscriber
IMEI	International mobile equipment identifier	15 digits	Unique serial number assigned by manufacturer to a terminal

# GSM Identifiers

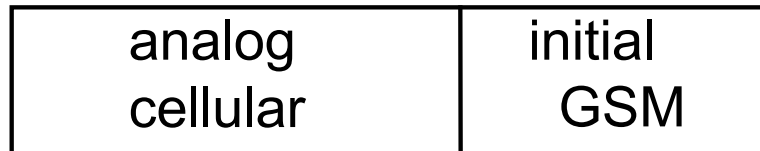
<u>NOTATION</u>	<u>NAME</u>	<u>SIZE</u>	<u>DESCRIPTION</u>
Ki	Authentication key	$\leq 128$ bits	Secret key assigned by operating company to a subscriber
Kc	Cipher key	64 bits	Computed by network and by mobile station.
	Mobile station classmark	32 bits	Indicates properties of a mobile station
BSIC	Base station identity code	6 bits	Assigned by operating company to a base transceiver station
LAI	Location area identity	40 bits	Assigned by operating company to a base station transceiver

# Base station system + SIM



# Original GSM frequency bands

mobile station transmits



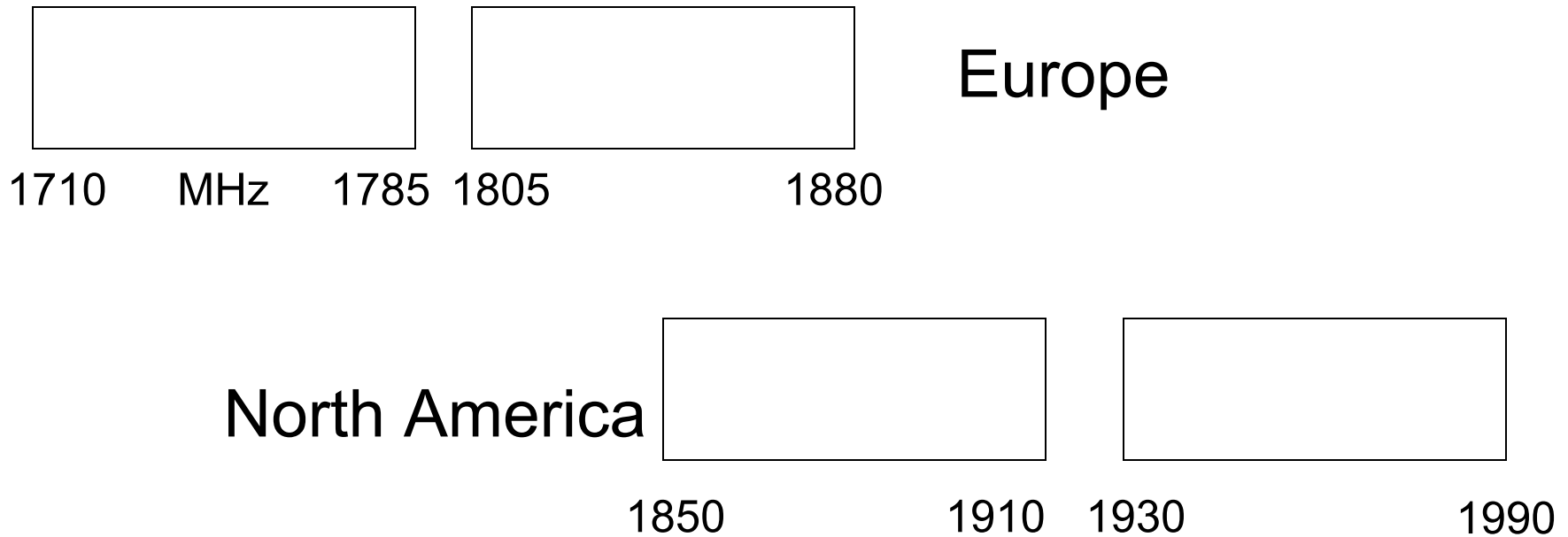
890                  MHz                  905                  915

base station transmits

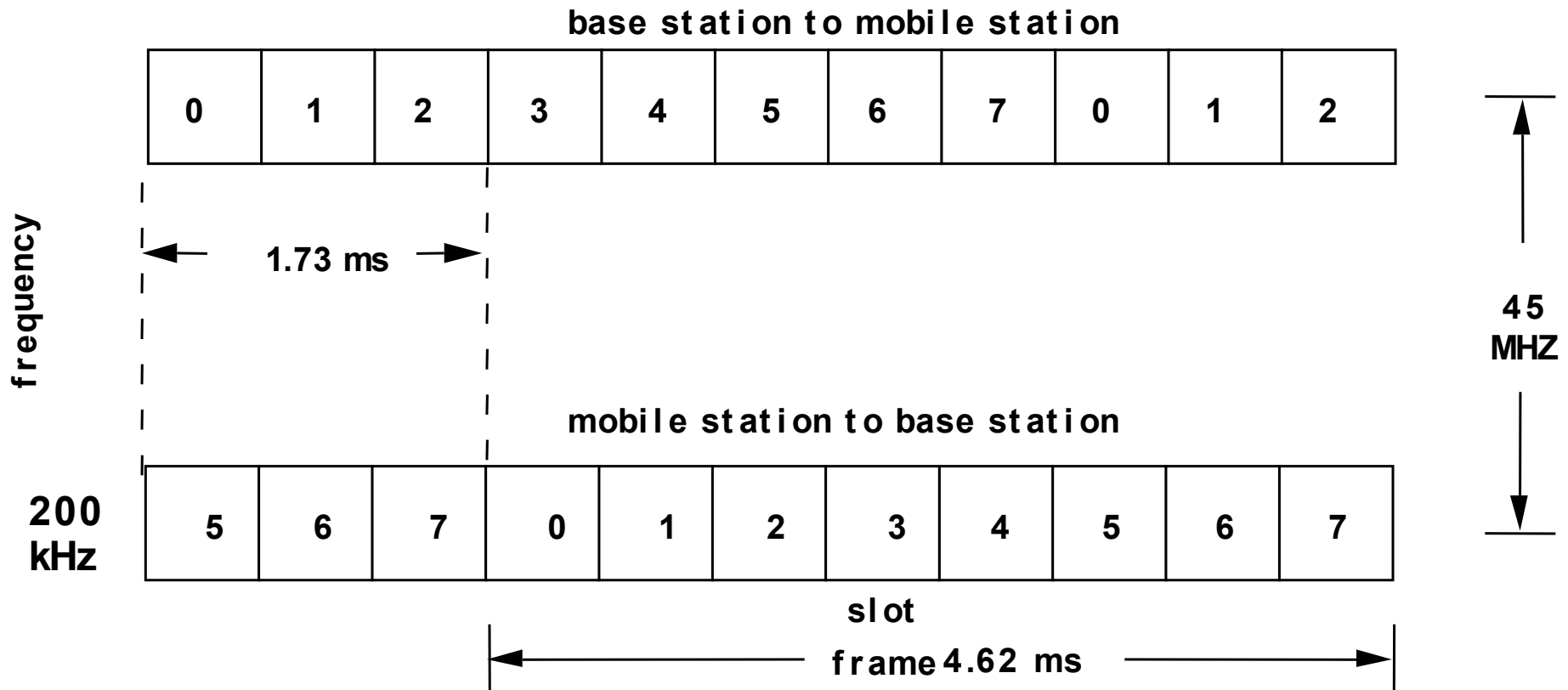


935    950    960

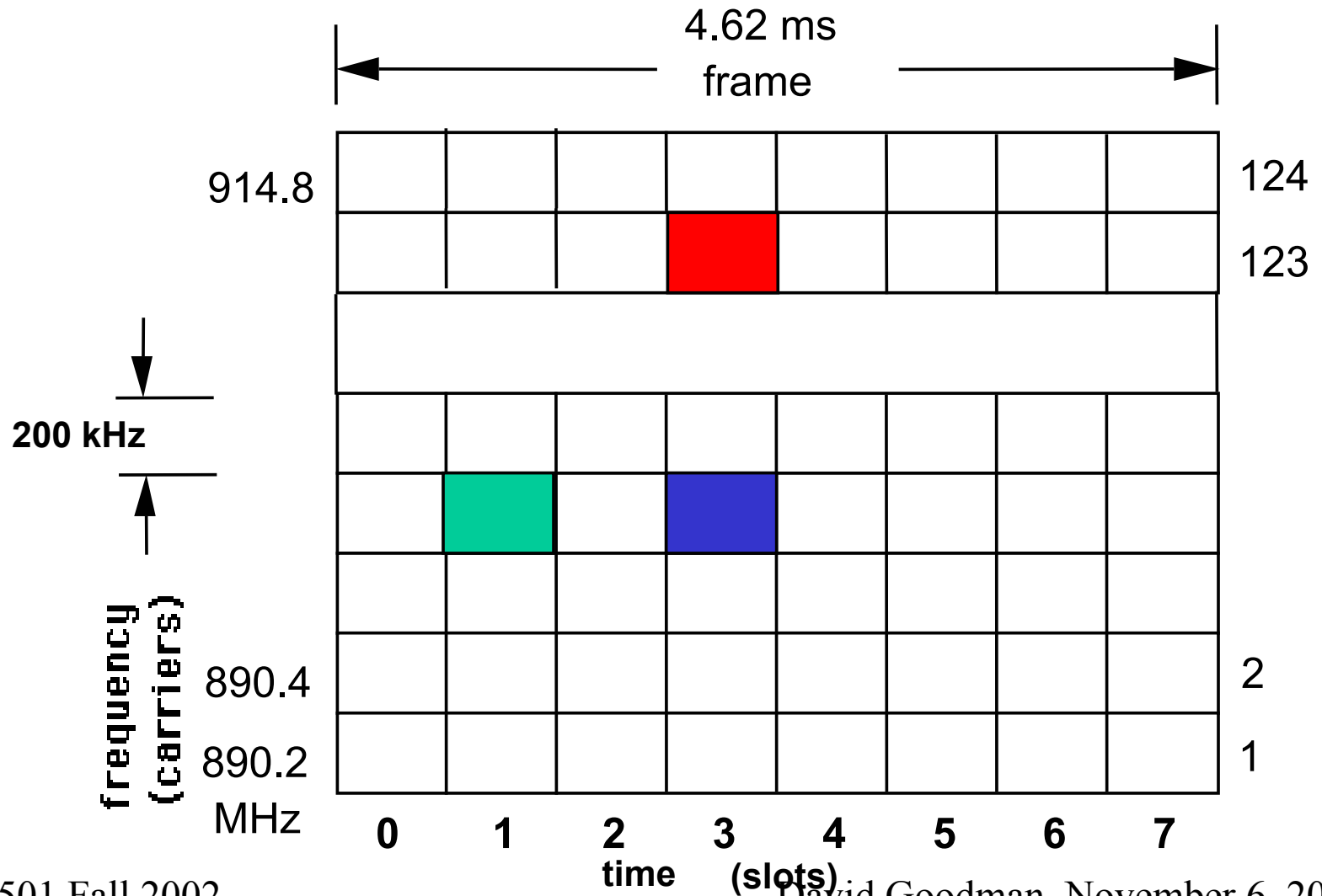
# PCS/PCN Frequency bands



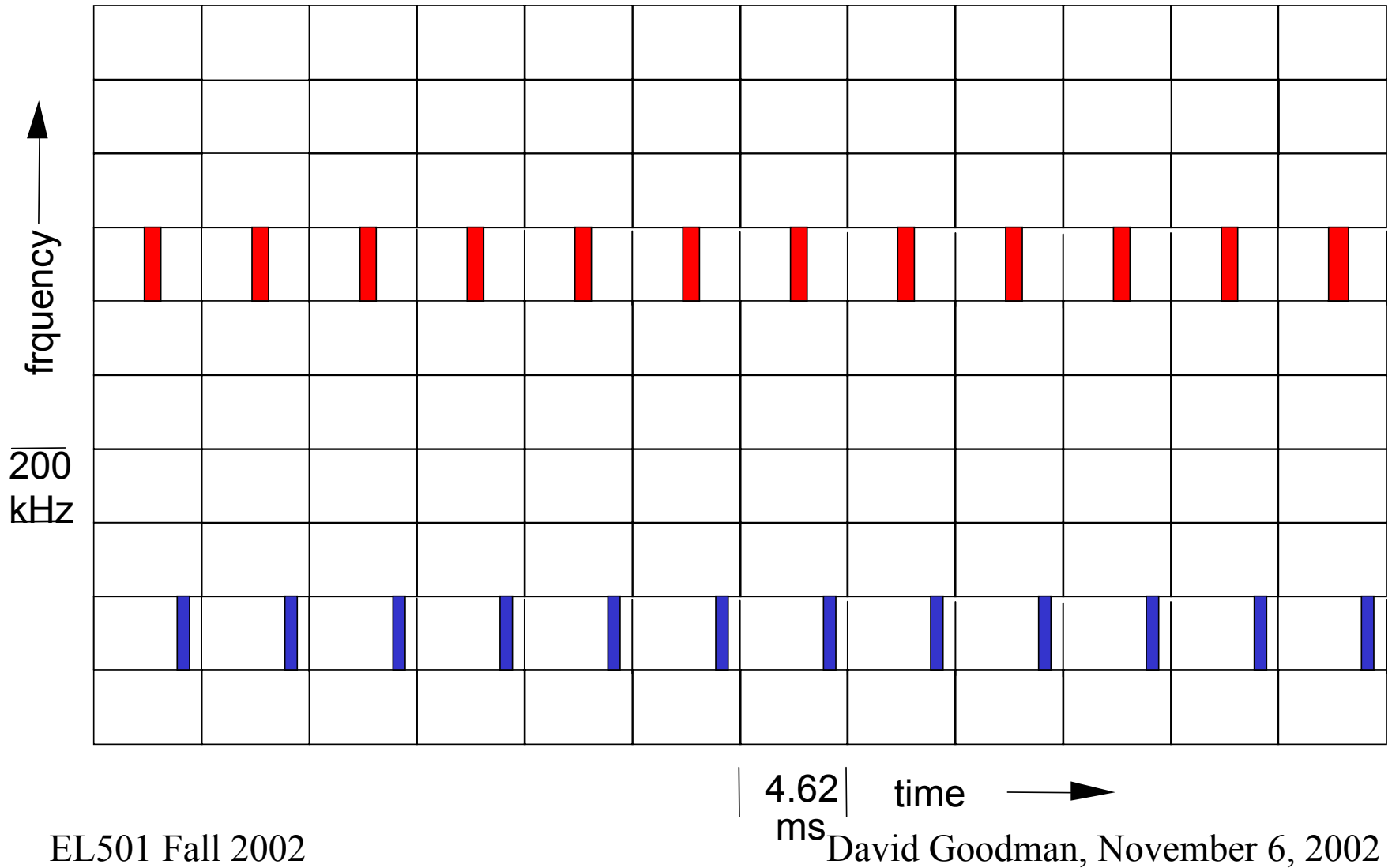
# Carriers, time slots, and frames



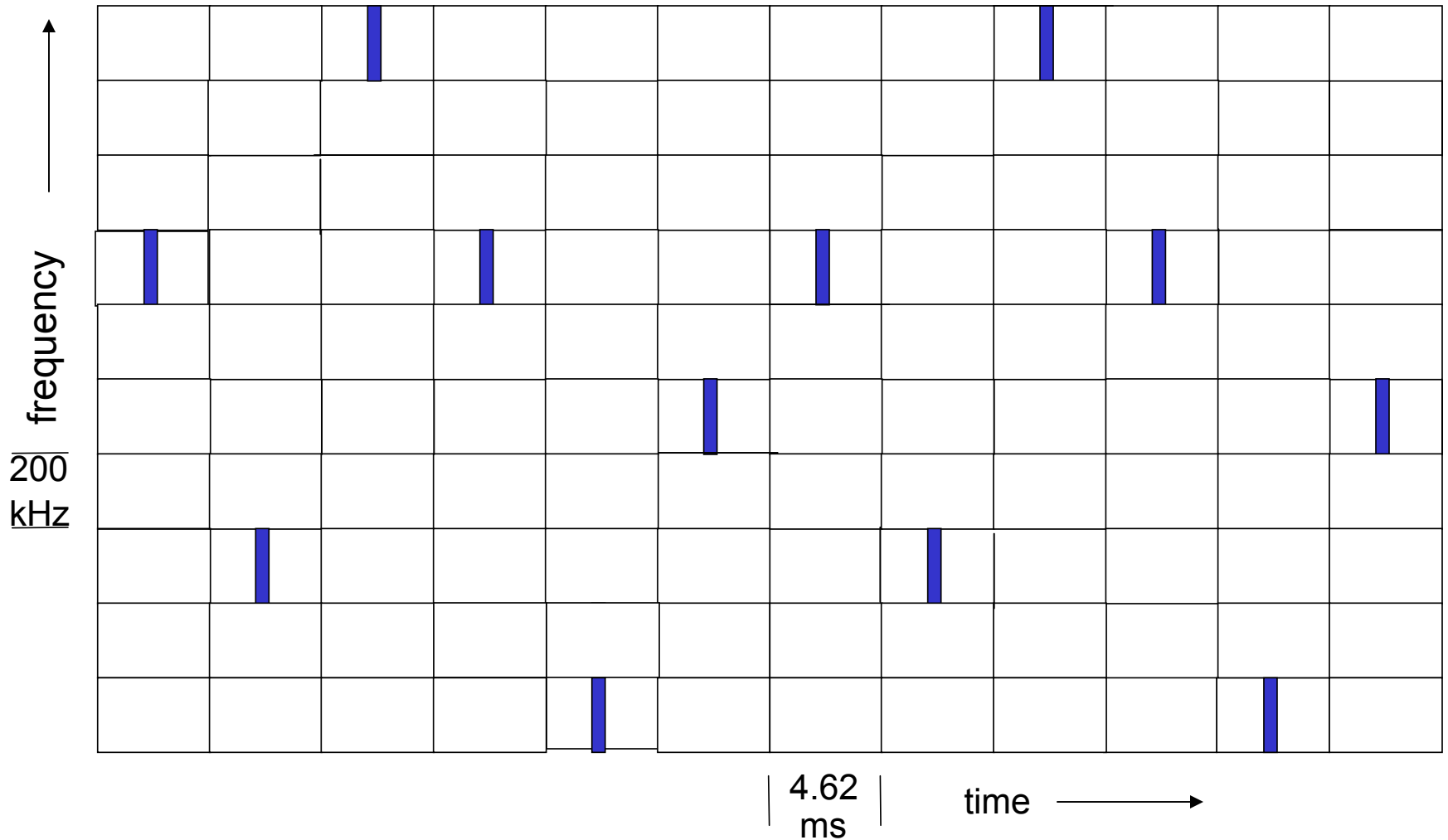
# Physical channels



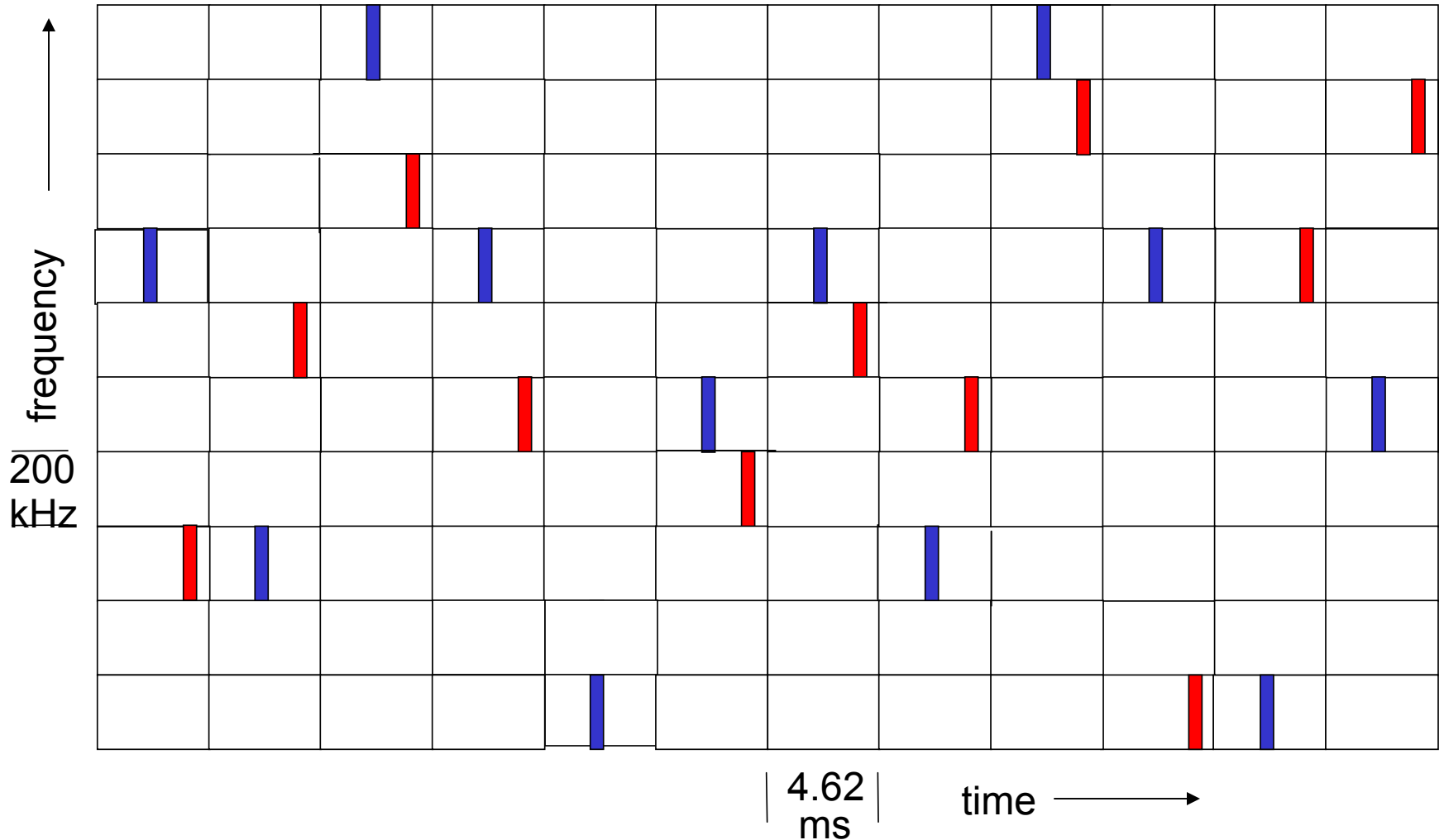
# Conventional carriers



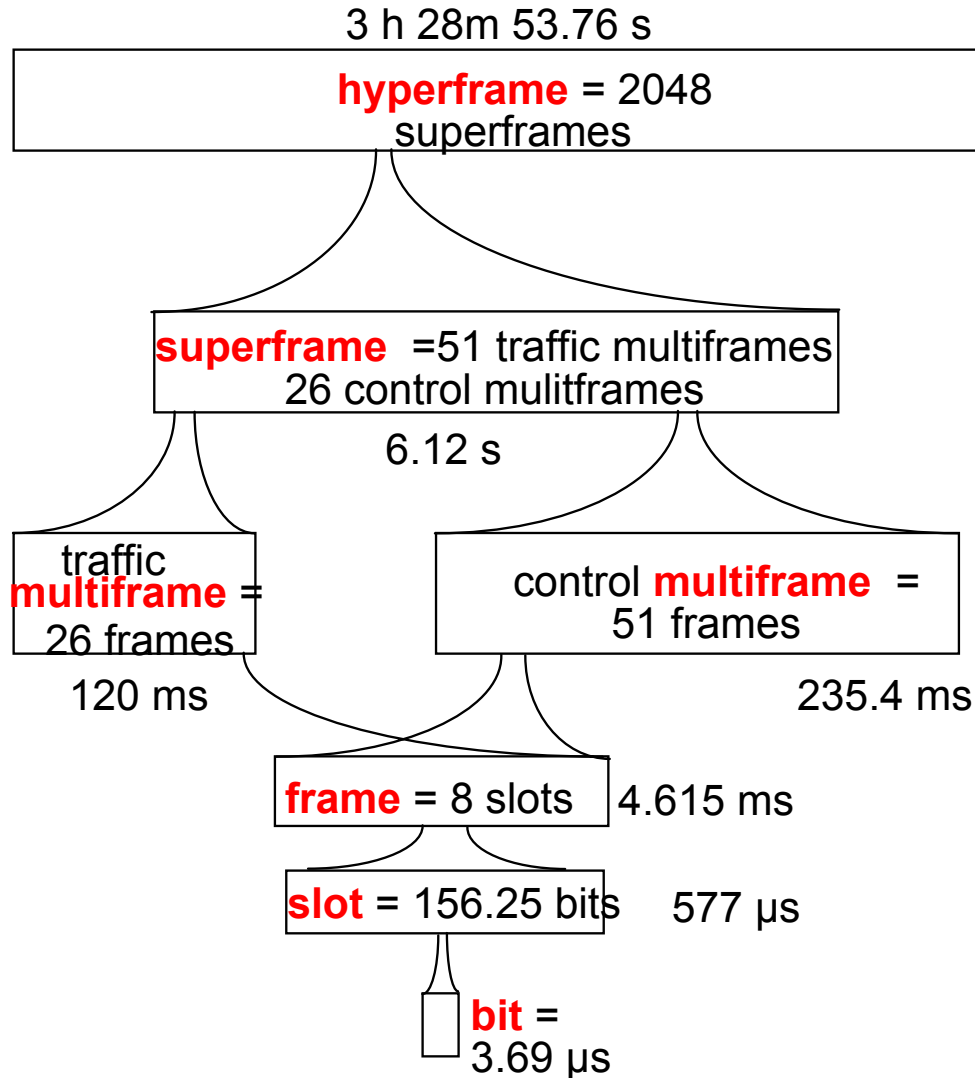
# Frequency hopped carrier



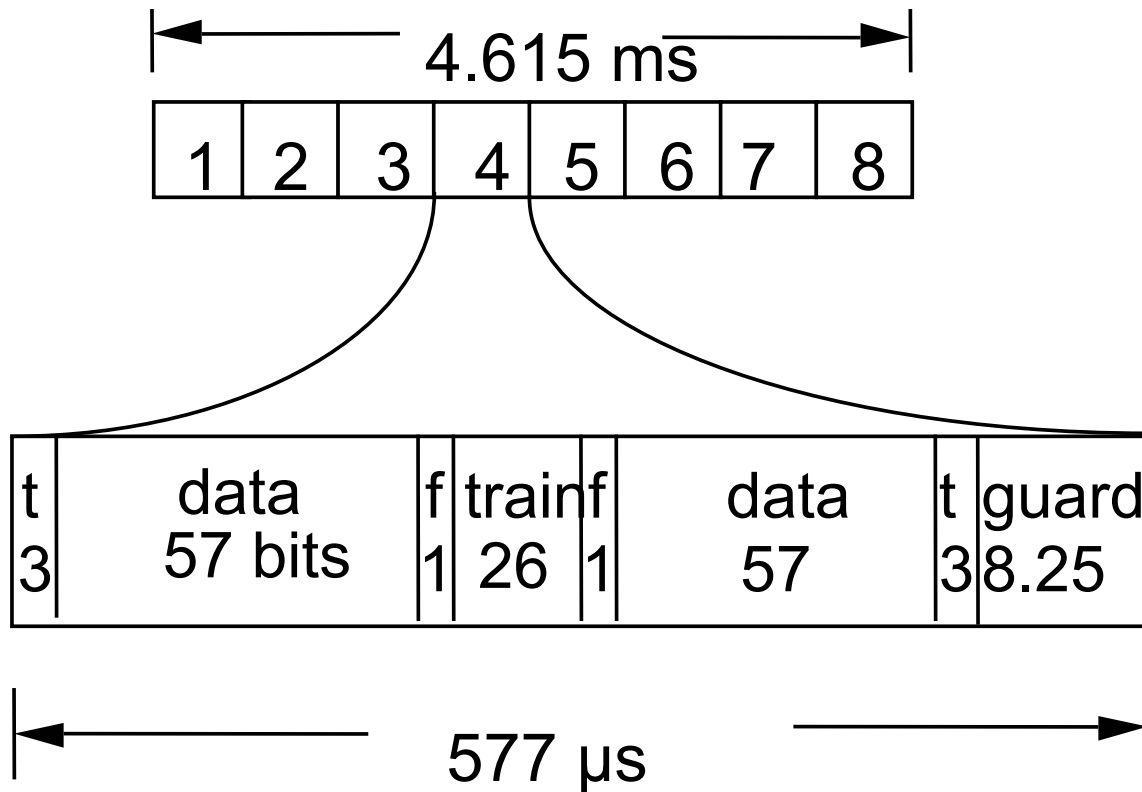
# Two FH carriers



# Timing



# Normal burst



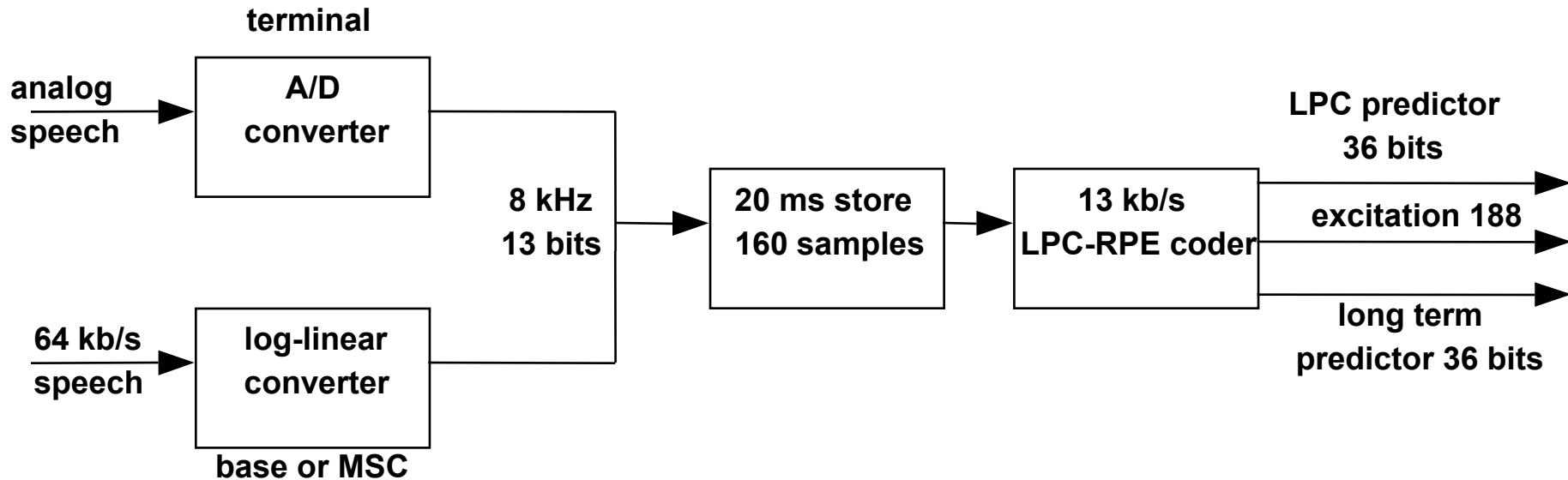
t: tail bits      f: flag      train: equalizer training sequence

# Traffic channels

Full rate	TCH/F	24 slots per multiframe
Half rate	TCH/H	12 slots per multiframe

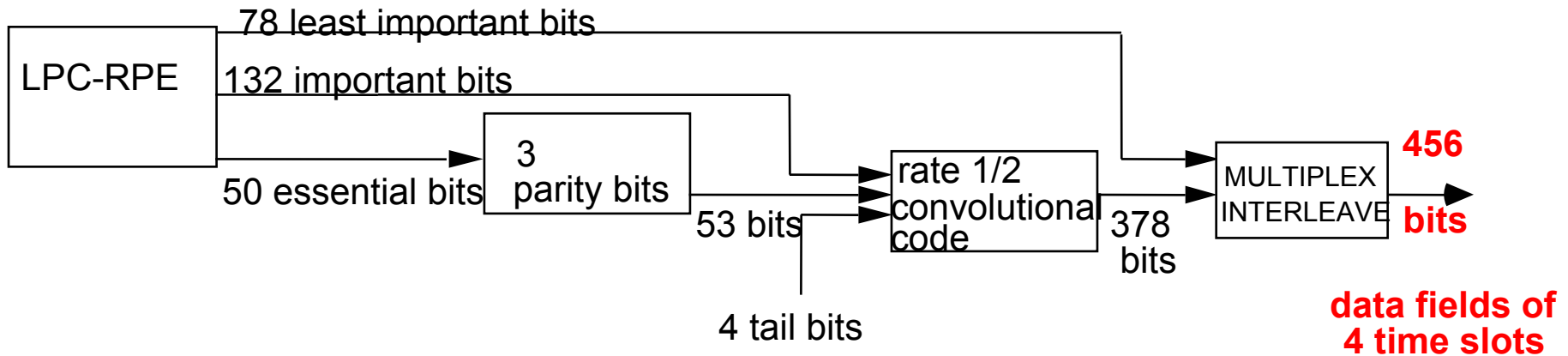


# GSM speech coding LPC/RPE



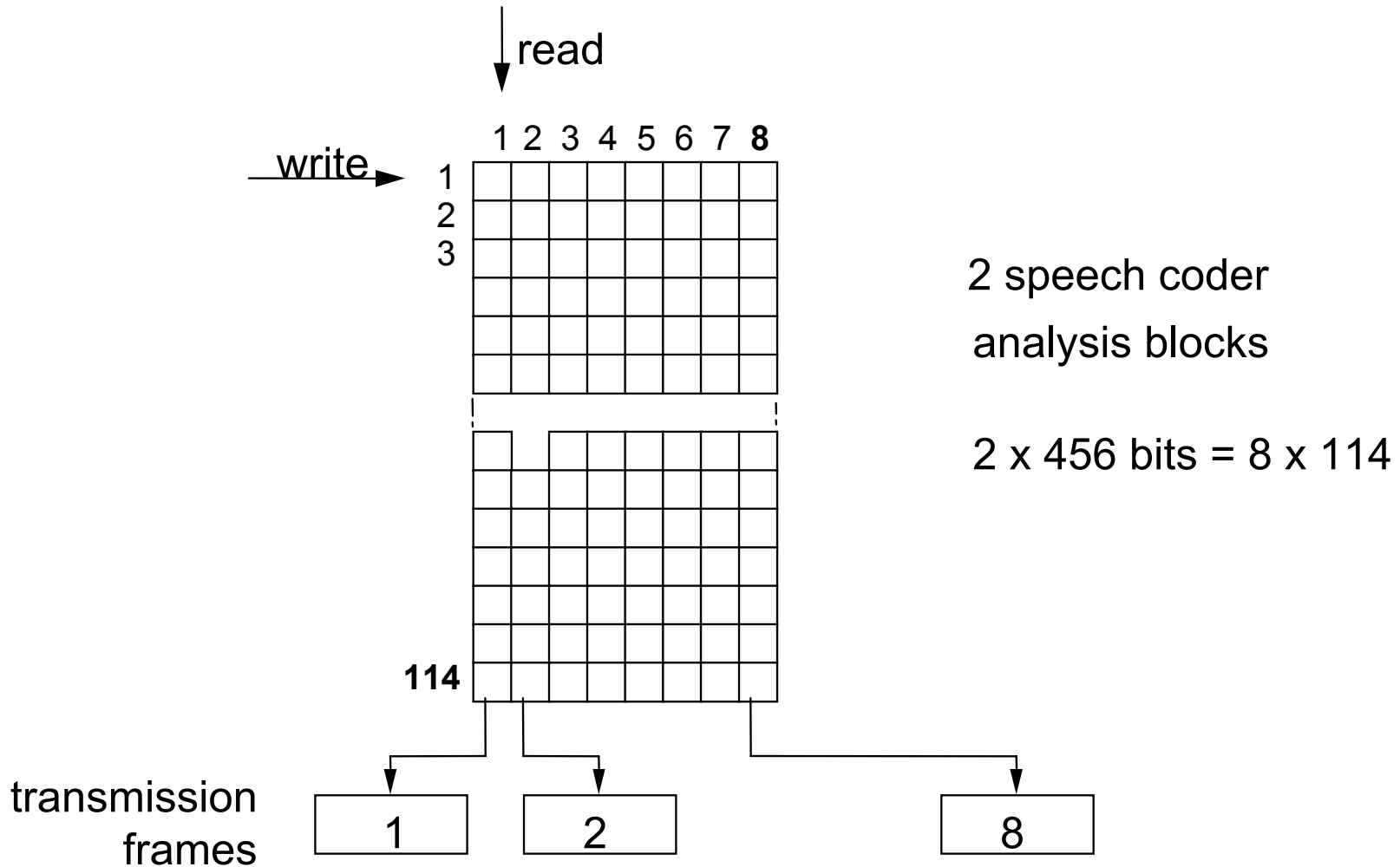
**260 bits/20 ms = 13 kb/s  
compression**

# GSM channel coding

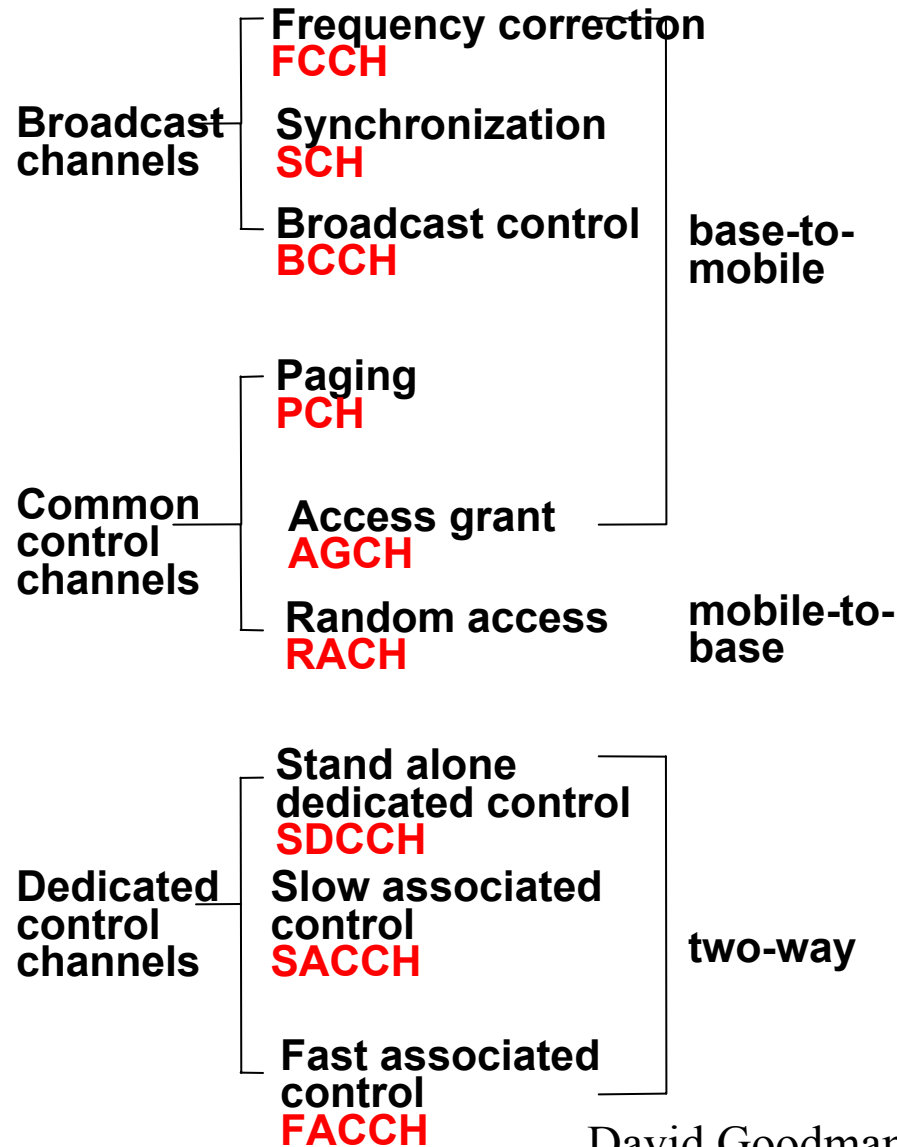


**456 bits/20 ms = 22.8 kb/s  
transmission**

# Speech interleaving



# Signaling channels



# Control multiframe (51 frames)

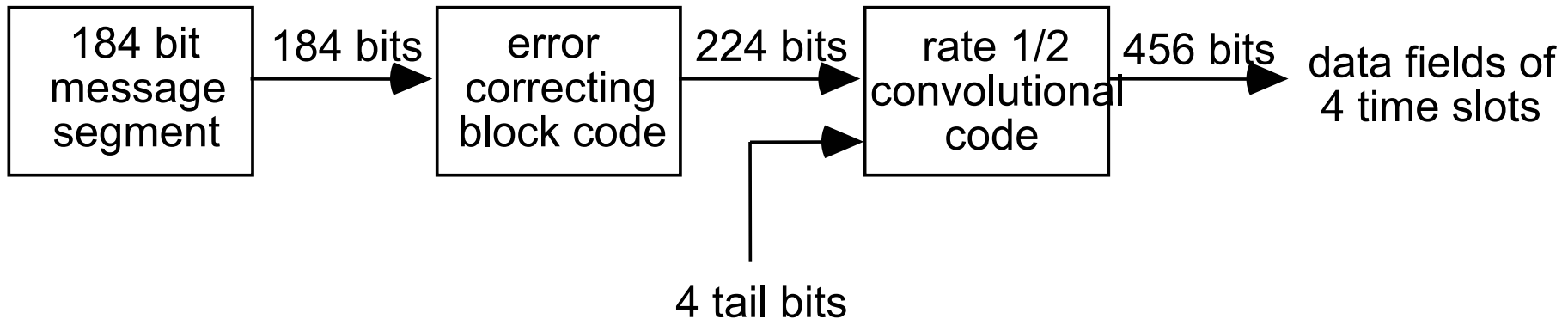
235.4 ms

FSBBBBPPPP FSPPPPPPPP FSPPPPPPPP FSPPPPPPPP FSPPPPPPPP X

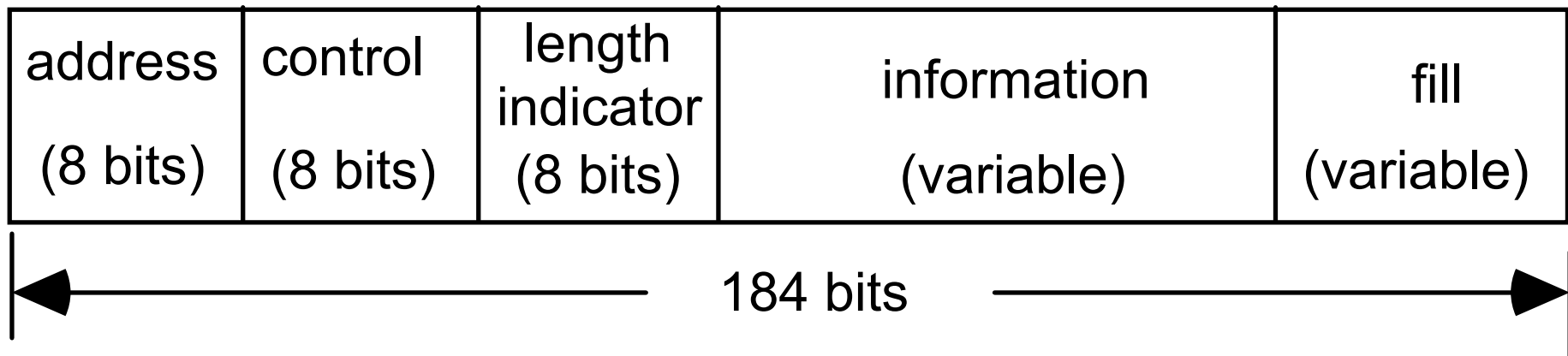
F: FCCH frame S: SCH frame B: BCCH frame P: PAGCH frame X: idle frame

# Control channel coding

BCCH, SDCCH, FACH, SACH, AGCH, PCH



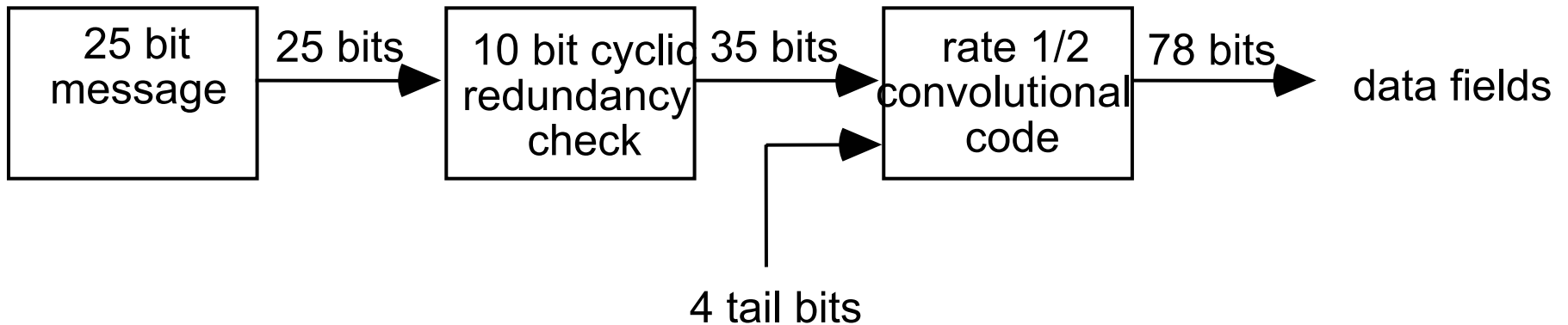
# Message format



# Synch channel burst

t	data	train	data	t	guard
3	39 bits	64	39	3	8.25

# Synchronization message

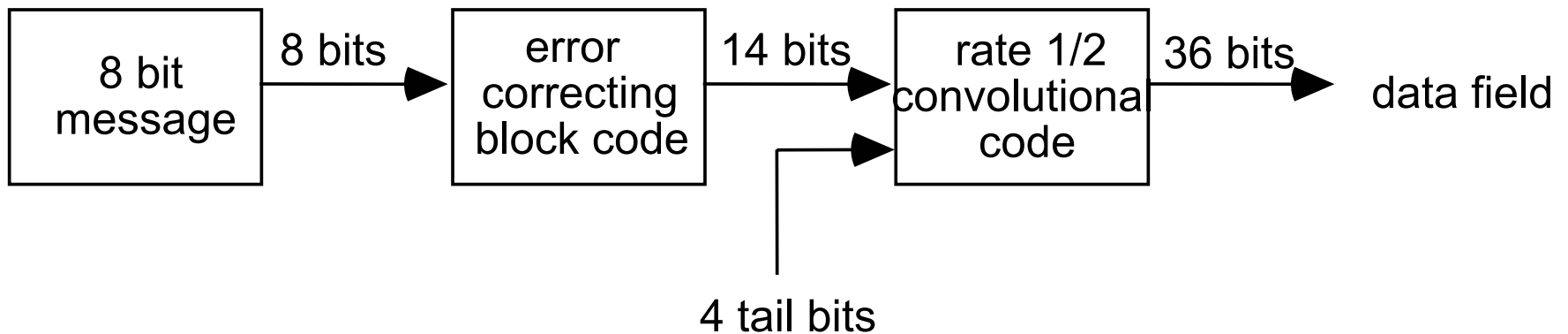


# Random access burst

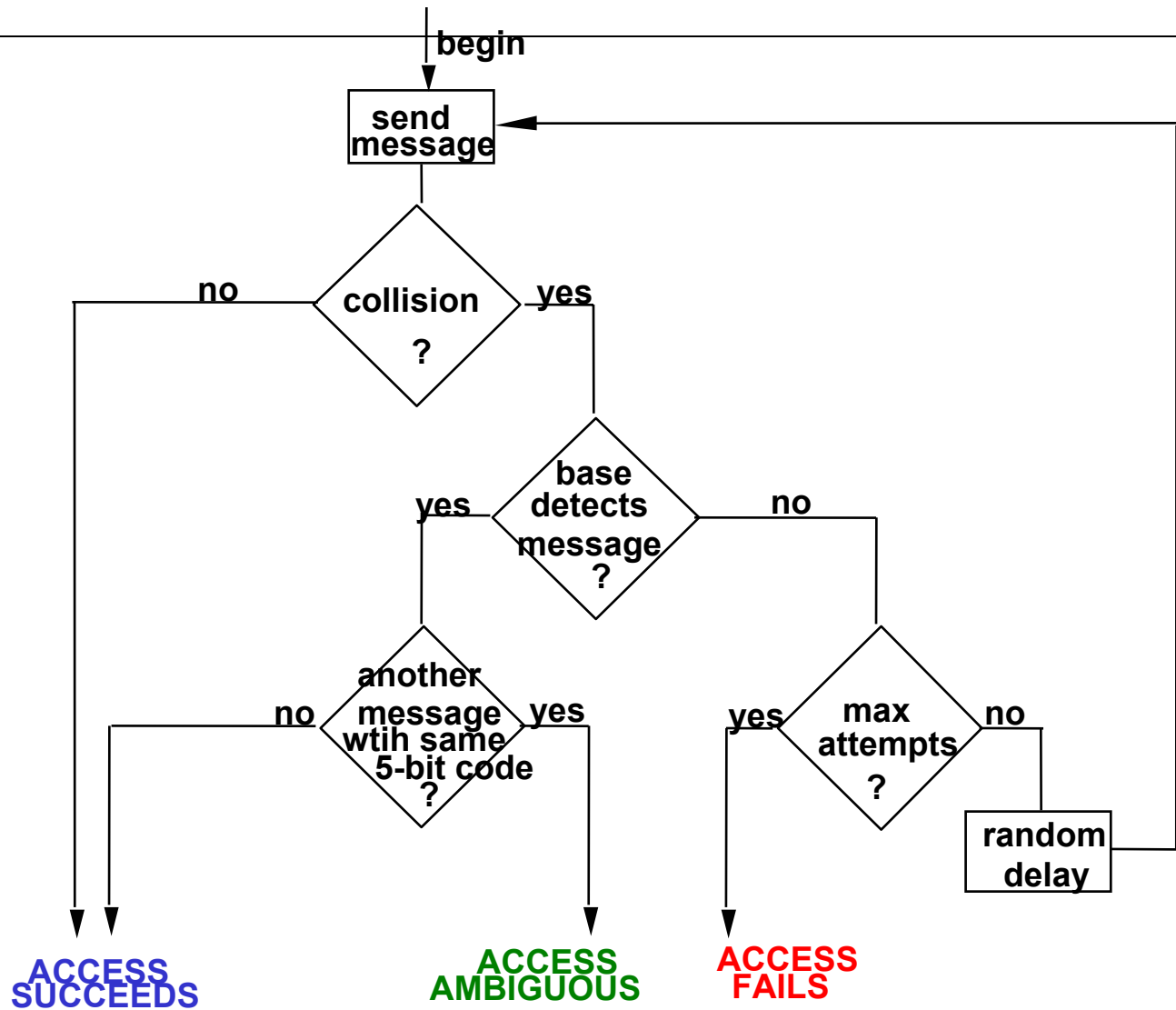
t	train	data	t	guard
7	41 bits	36	3	69.25

t: tail bits

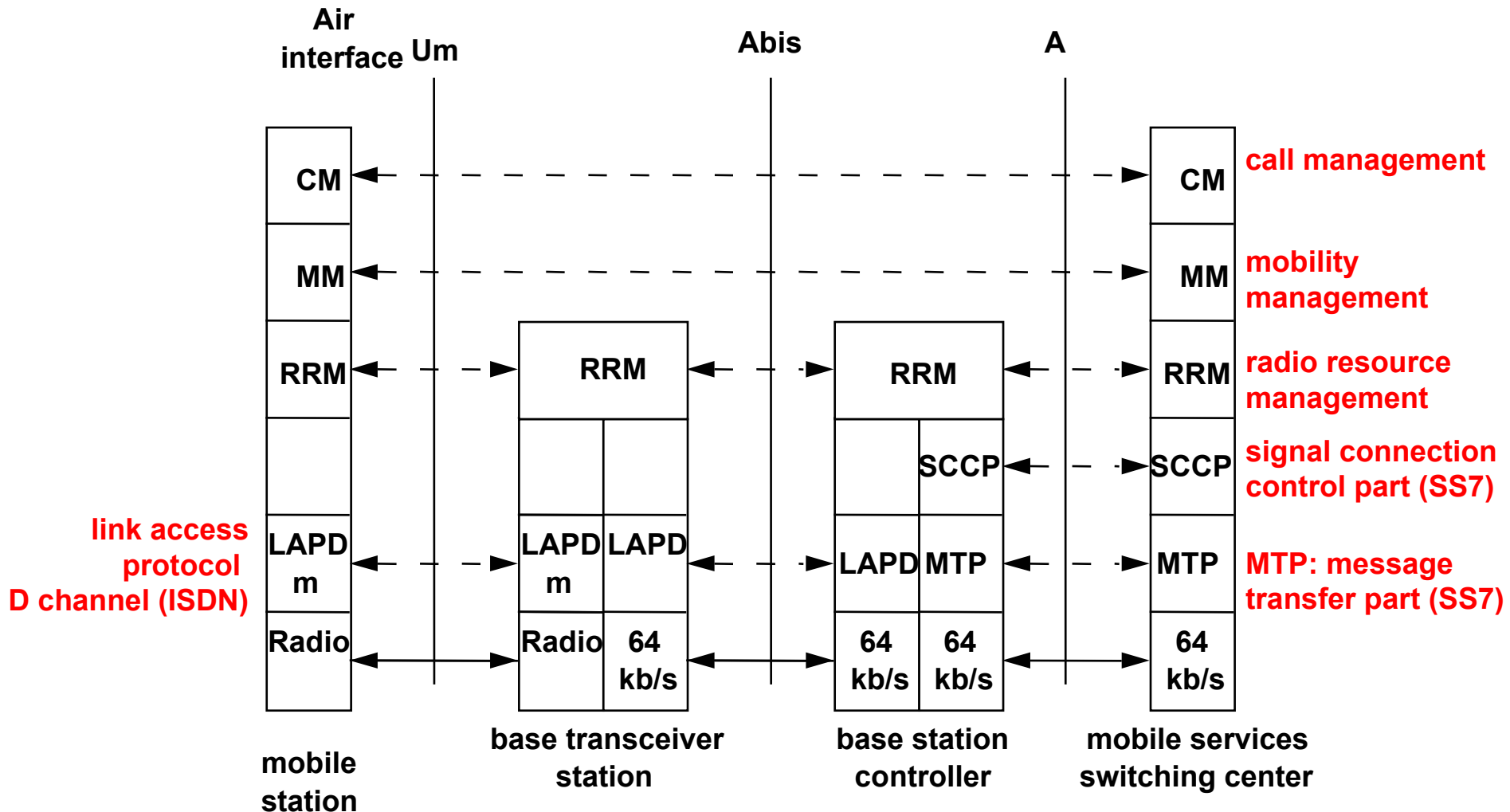
# RACH message



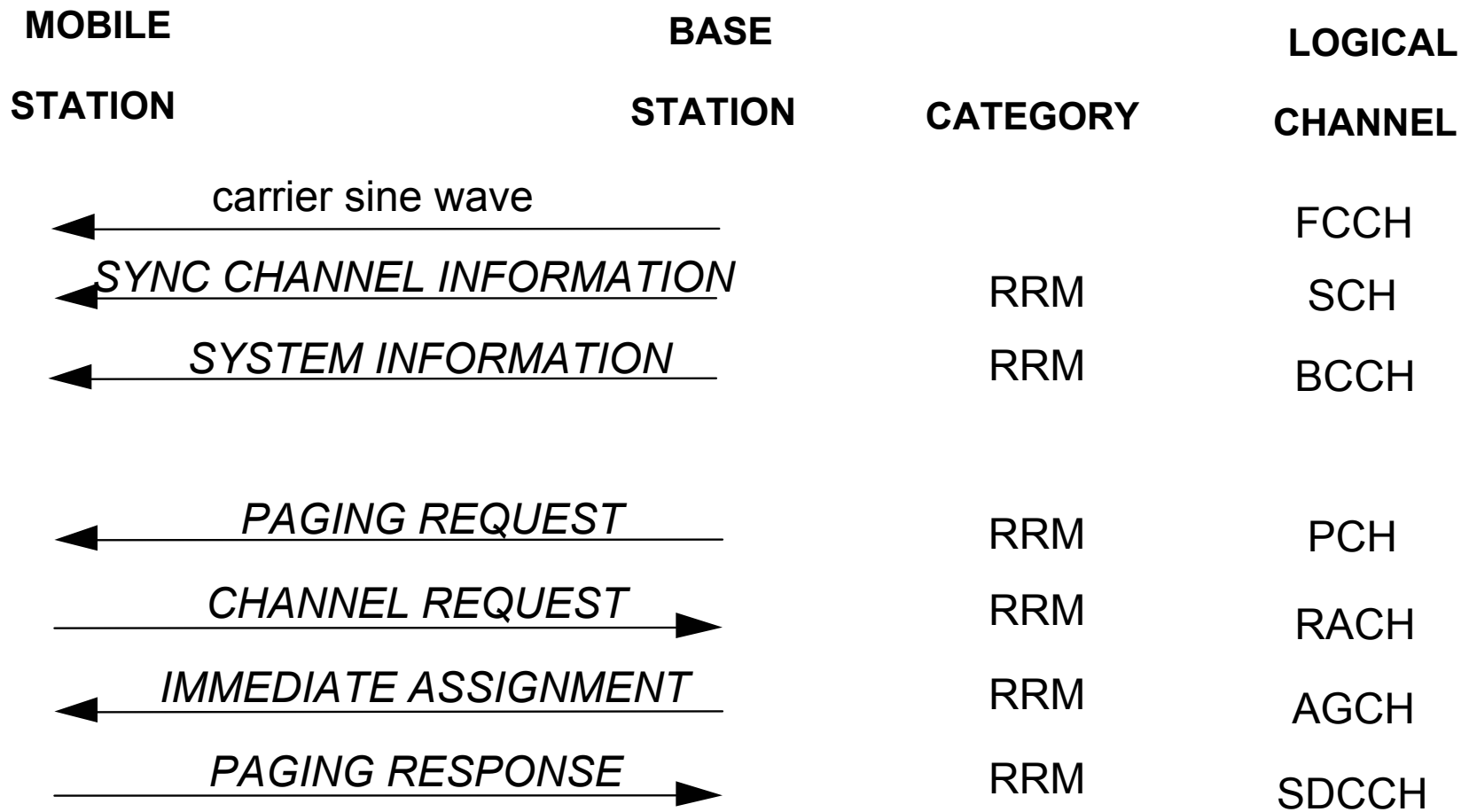
# Access protocol



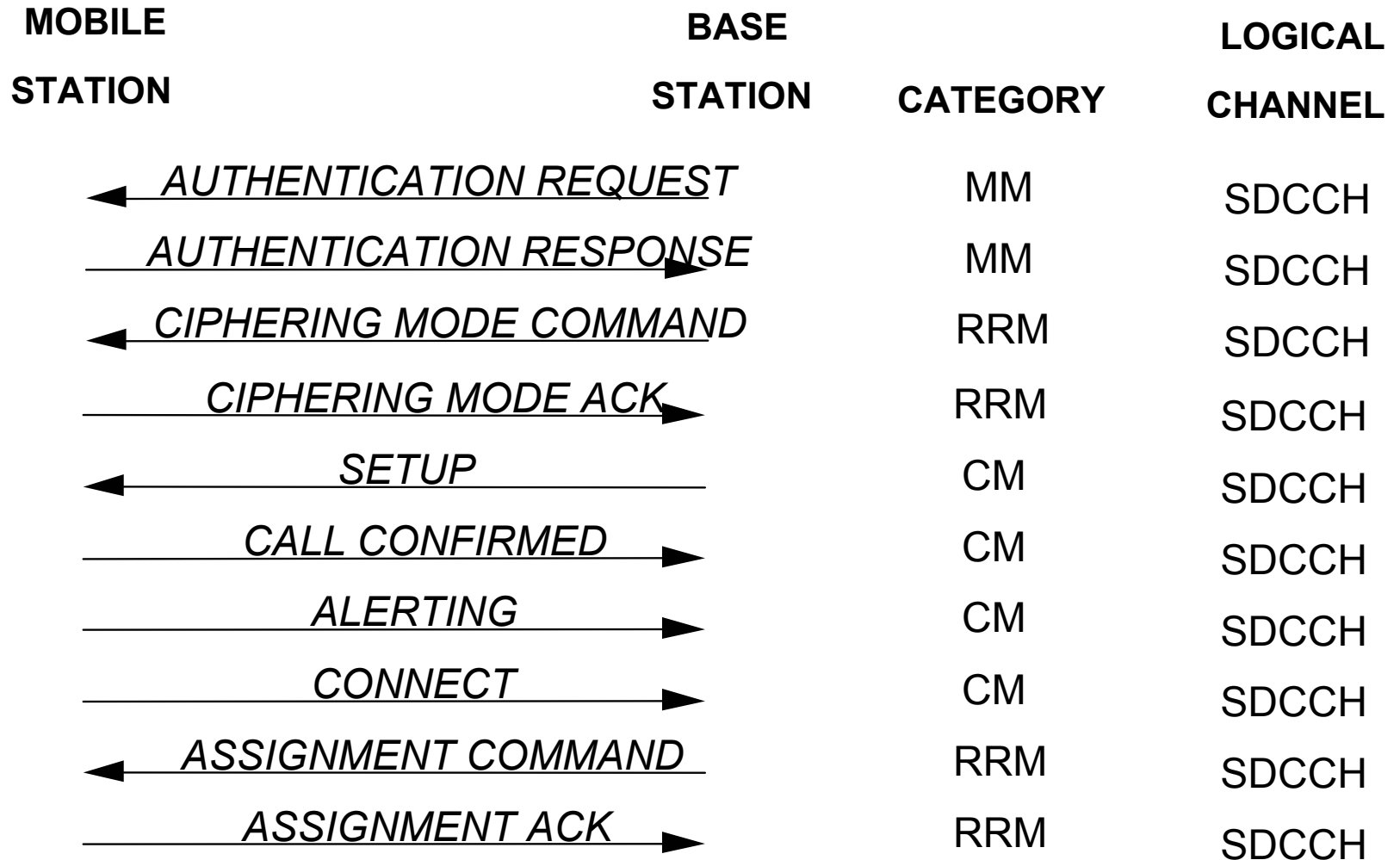
# Signaling protocols



# Call to a GSM phone



# Call to a GSM phone (2)



# Connection and end of call

