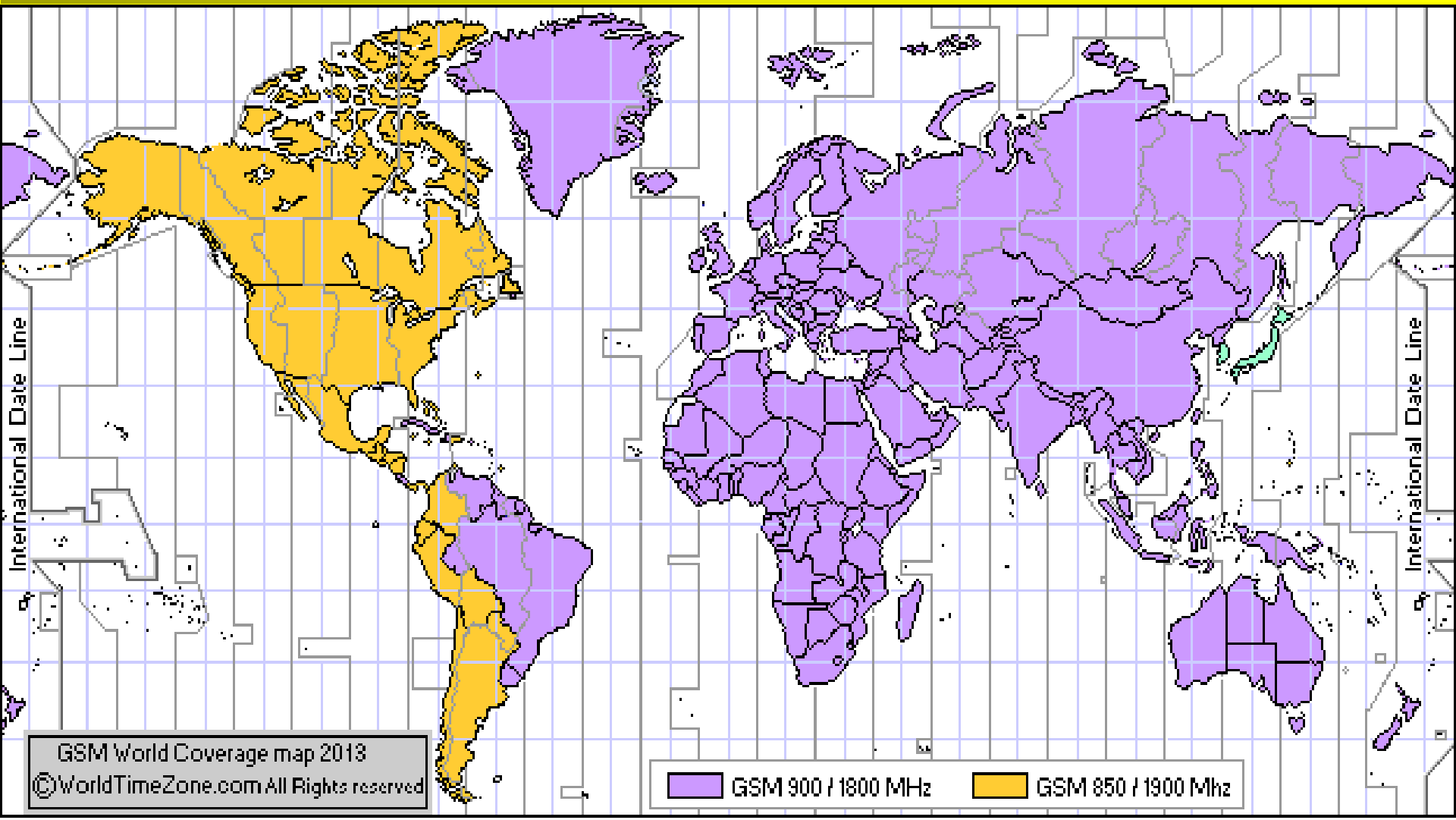
GLOBAL SYSTEM FOR MOBILE COMMUNICATION

ARFCNS, CHANNELS

ECE 426– DIGITAL COMMUNICATION SYSTEMS

Monday, April 13, 2026

GLOBAL GSM FREQUENCY USAGE



EXAMPLE: GSM FREQUENCY ALLOCATION

- Generally, countries with large land mass would prefer to use dual-band frequency allocation where rural areas use the lower and (850 or 900 MHz) and the urban areas use the higher band (1800 or 1900 MHz)

COUNTRY	GSM-1	GSM-2	3G
Kenya	900	1800	2100
USA	850	1900	1700, 2100
Zimbabwe	900		2100
UK	900	1800	2100
JAPAN			1700, 2100
SOUTH KOREA			1700, 2100
AUSTRALIA	900	1800	2100, 850, 900

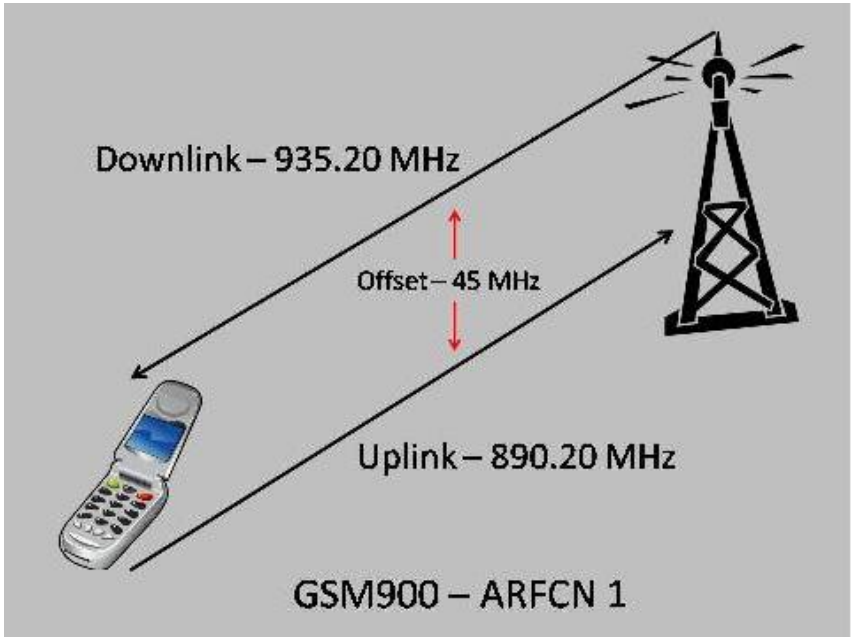
ABSOLUTE RADIO FREQUENCY CHANNEL NUMBER (ARFCN)

1. The ARFCN is a number that describes a pair of frequencies each 200KHz, one uplink and one downlink.

2. The uplink and downlink have a specific offset that varies for each band (Class Discuss..)

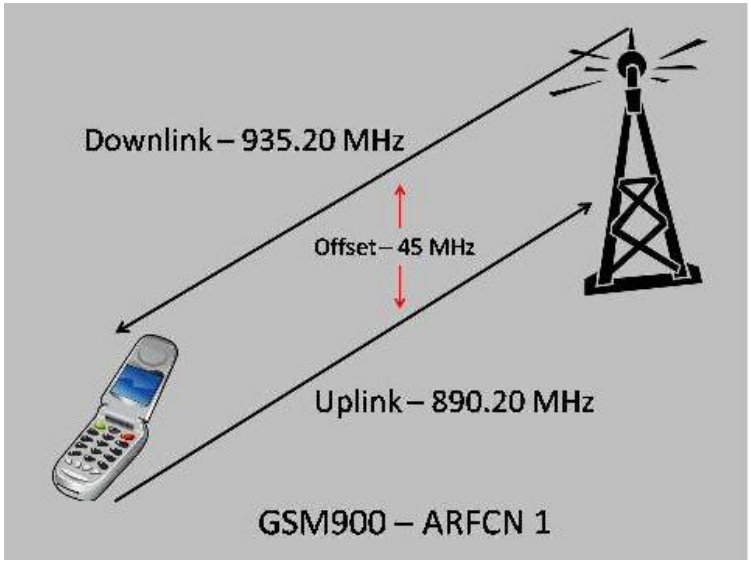
3. The offset is the frequency separation of the uplink from the downlink frequency pairs.

4. Every time the ARFCN increases, the uplink will increase by 200 khz and the downlink also increases by 200 khz.



ABSOLUTE RADIO FREQUENCY CHANNEL NUMBER (ARFCN) (Cont..)

1. Absolute Radio-Frequency Channel Number (ARFCN) is a code that specifies a pair of physical radio carriers used for transmission and reception in a land mobile radio system, one for the uplink signal and one for the downlink signal.



2. A communication channel is defined by selecting a certain ARFCN and a certain time slot within the ARFCN.

GSM BANDS

- Almost all countries in the world use GSM 850, 900 and 1800 Bands
- The exceptions are Tanzania (GSM 450 – trial), Japan and Korea (3G)

REGION 1

	GSM 450	EGSM450	GSM850	GSM900	EGSM900	GSM1800	GSM1900
Uplink Freq. Range	450 to 458 MHz	478 to 486 MHz	824 to 849 MHz	890 to 915 MHz	880 to 915 MHz	1710 to 1785 MHz	1850 to 1910 MHz
Downlink Freq. Range	460 to 468 MHz	488 to 496 MHz	869 to 894 MHz	935 to 960 MHz	925 to 960 MHz	1805 to 1880 MHz	1930 to 1990 MHz
ARFCN	259 to 293	306 to 340	128 to 251	1 to 124	0 to 124 & 975 to 1023	512 to 885	512 to 810
Offset	10 MHz	10 MHz	45 MHz	45 MHz	45 MHz	95 MHz	80 MHz

DUAL/TRI BAND PHONE

1. In North America dual-band and Tri-band Cellular phone indicates that the phone will work in both the 800/850 MHz band and the 1900 MHz band.
2. Dual-mode phones support either analog or digital systems but NOT both in the 800/850 band.
3. Tri-mode phones support both analog and digital on the 800/850 band.
4. The 1900 MHz band is always digital.

DUAL BAND

	GSM 450	EGSM450	GSM850	GSM900	EGSM900	GSM1800	GSM1900
Uplink Freq. Range	450 to 458 MHz	478 to 486 MHz	824 to 849 MHz	890 to 915 MHz	880 to 915 MHz	1710 to 1785 MHz	1850 to 1910 MHz
Downlink Freq. Range	460 to 468 MHz	488 to 496 MHz	869 to 894 MHz	935 to 960 MHz	925 to 960 MHz	1805 to 1880 MHz	1930 to 1990 MHz
ARFCN	259 to 293	306 to 340	128 to 251	1 to 124	0 to 124 & 975 to 1023	512 to 885	512 to 810
Offset	10 MHz	10 MHz	45 MHz	45 MHz	45 MHz	95 MHz	80 MHz

QUAD BAND PHONES

1. A quad-band GSM phone works in four bands i.e 800 and 1900 (for America) and 900MHz and 1800 MHz (Region 1 and 3)
2. A quad-band GSM phone can be used for basic cellular phone service almost anywhere in the world.

	GSM 450	EGSM450	GSM850	GSM900	EGSM900	GSM1800	GSM1900
Uplink Freq. Range	450 to 458 MHz	478 to 486 MHz	824 to 849 MHz	890 to 915 MHz	880 to 915 MHz	1710 to 1785 MHz	1850 to 1910 MHz
Downlink Freq. Range	460 to 468 MHz	488 to 496 MHz	869 to 894 MHz	935 to 960 MHz	925 to 960 MHz	1805 to 1880 MHz	1930 to 1990 MHz
ARFCN	259 to 293	306 to 340	128 to 251	1 to 124	0 to 124 & 975 to 1023	512 to 885	512 to 810
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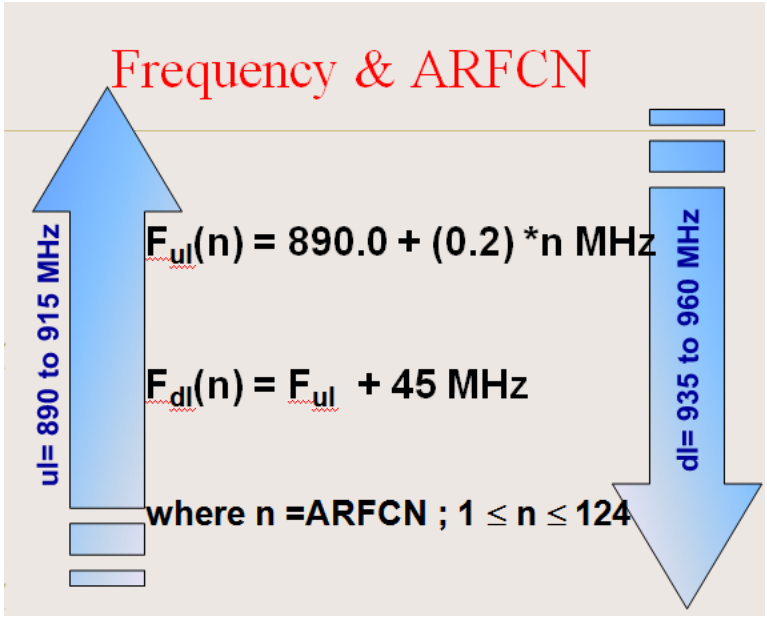
ABSOLUTE RADIO FREQUENCY CHANNEL NUMBER (ARFCN) – 900 MHz BAND

- A GSM ARFCN has a bandwidth of 200 kHz, which corresponds exactly to the carrier separation.
- The frequency of the ARFCN refers to its center frequency.
- If an ARFCN has a frequency of 914.80 MHz, then it occupies the frequency space from 914.7 MHz to 914.9 MHz (200 kHz total).



ABSOLUTE RADIO FREQUENCY CHANNEL NUMBER (ARFCN)

1. Because of the nature of the modulation method and data rate used in GSM, the actual physical ARFCN bandwidth will be about 135.4 kHz.

2. The unused bandwidth for each ARFCN acts as a buffer with neighbouring ARFCNs to avoid interference.

3. Channel 0 (890.0 MHz) is used as a lower guard band in GSM-900 and is not available for traffic

CALCULATING UP-LINK AND DOWN-LINK FREQUENCIES

- Calculate the uplink and down link frequencies for ARFCN 72 in the GSM 900 Band

Class Work (2 minutes)

ANSWER TO PREVIOUS QUESTION

- Given the ARFCN 72, and we know the offset is 45MHz for the GSM900 band:

  Up = 890.0 + (72 * .2)
  Up = 890.0 + (14.4)
  Up = 904.40 MHz

  Down = Up + Offset
  Down = 904.40 + 45.0
  Down = 949.40 MHz

  The uplink/downlink pair for GSM900 ARFCN72 is 904.40/949.40 (MHz)

ABSOLUTE RADIO FREQUENCY CHANNEL NUMBER (ARFCN) – 1800 MHz BAND

- The 1800 MHz band ranges from 1710 – 1785 MHz uplink and 1805 – 1880 MHz downlink.

- The offset frequency, difference between uplink and downlink is 95 MHz.

- The frequency of the ARFCN refers to its center frequency.

- If an ARFCN has a frequency of 1712.80 MHz, then it occupies the frequency space from 1712.7 MHz to 1712.9 MHz (200 kHz total).

$F(n)_{up} = 1710 + (n-512)*0.2MHz$

$F(n)_{down} = F(n)_{up} + 95\ MHz$

$$512 < n < 885$$

ABSOLUTE RADIO FREQUENCY CHANNEL NUMBER (ARFCN) – EXTENDED GSM BAND

- The extended GSM band ranges from 880– 890 MHz uplink and 925 – 935 MHz downlink.
- The offset frequency, difference between uplink and downlink is 45 MHz.
- The frequency of the ARFCN refers to its center frequency.
- If an ARFCN has a frequency of 885.80 MHz, then it occupies the frequency space from 885.7 MHz to 885.9 MHz (200 kHz total).

$$F(n)_{up} = 880 + (n-975)*0.2MHz$$

$$F(n)_{down} = F(n)_{up} + 45\ MHz$$

$$975 < n < 1023$$

FROM ARFCN TO TIME SLOTS

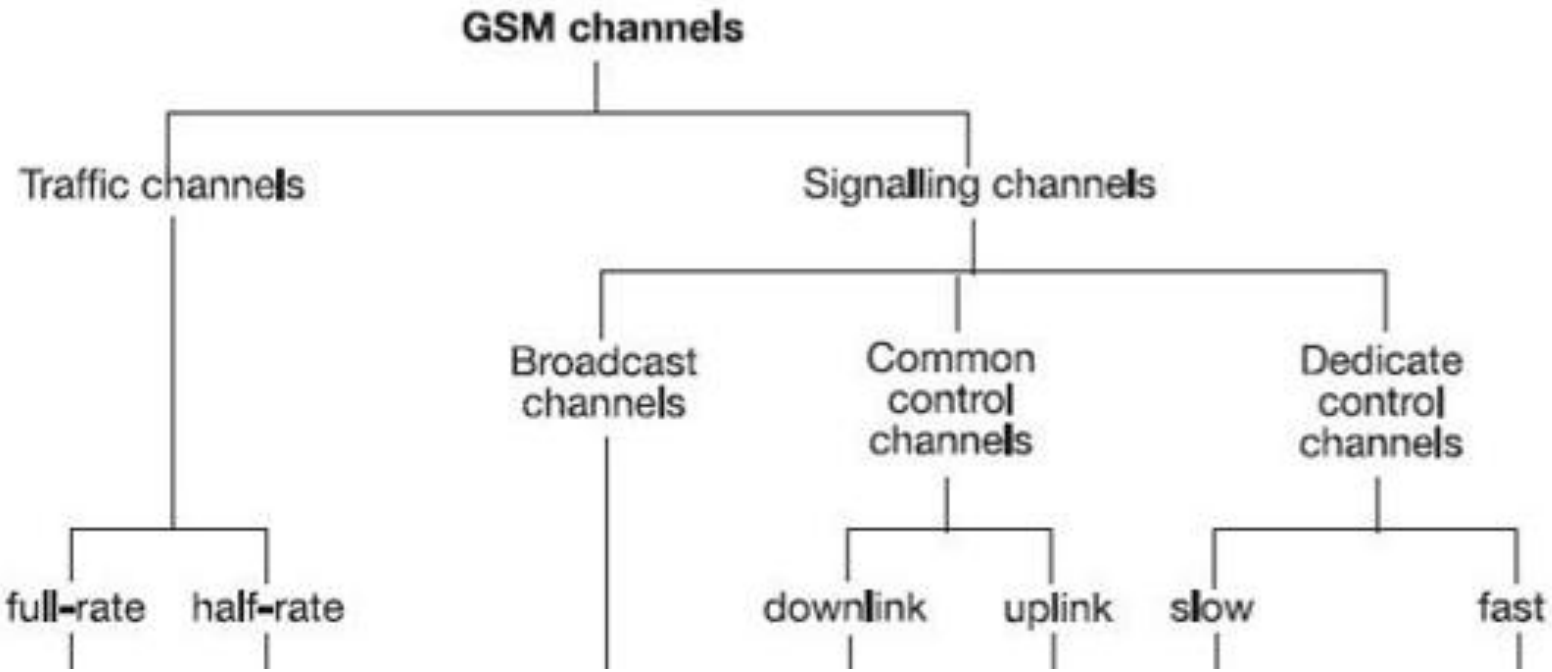
- Each ARFCN is divided into 8 time slots.
-

  Time slots are categorized into logical channels.

  Logical channels can be thought of as just different types of data that is transmitted only on certain frames in a certain timeslot.

  Different time slots will carry different logical channels, depending on the structure the BSS uses.

LOGICAL GSM CHANNELS



BROADCAST CHANNELS (BCCH)

(*Downlink Only*)

1. Broadcast information of the serving cell (System Information).
2. Transmitted on timeslot zero of BCCH carrier.
3. BCCH is read by idle mobile at least once every 30 secs.

GSM CHANNELS

SCH (Synchronization Channels)

- *Downlink Only*
- Carries information for frame synchronization.
- Contains frame number and BSIC (Base Station Identity Code).

GSM CHANNELS

Random Access Channel (RACH)

Uplink only

1. Used by the MS when making its first access to the Network.
2. The reason for access could be initiation of a call or a page response.

GSM CHANNELS

Access Grant Channel - AGCH

Downlink only

1. Used for acknowledgement of the access attempt sent on Random Access Channel (RACH).
2. Used by the BTS to assign a signaling channel upon successful decoding of access bursts.

GSM CHANNELS

Paging Channel (PCH)

Downlink only

1. The network will page the MS ,if there is a incoming call or a short Message.
2. PCH contains the MS identity number, the IMSI or TMSI.

GSM CHANNELS

- **Stand-alone Dedicated Control Channel - SDCCH**

Uplink and Downlink

- Used for call setup, authentication, ciphering location update and SMS.

GSM CHANNELS

FCCH (Frequency Correction Channels)

- *Downlink Only*
- Used to synchronize MS to the BTS frequency.

SYNCHRONIZATION CHANNEL (SCH)

- Used by the MS to learn the Base Station Information Code (BSIC) as well as the TDMA frame number (FN).
- This lets the MS know what TDMA frame they are on within the hyperframe.

CELL BROADCAST CHANNEL (CBCH)

Cell Broadcast Channel (CBCH)

1. Used to broadcast specific information to network subscribers; such as weather, traffic, sports, stocks, etc.
2. Messages are normally public service type messages or announcements.
3. The mobile is NOT able to acknowledge any of CBCH messages