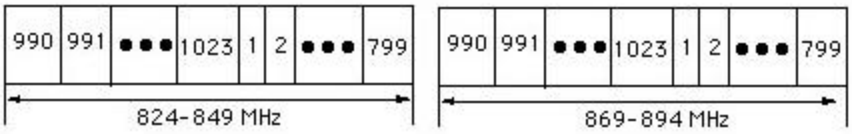
ECECS-611

Microwave Communications

Cellular Telephone Systems[&]



Channel Number	Center Frequency (MHz)
Reverse Channel	
I < N < 799	**0.03ON + 825.0**
990<N<1023	**0.030(N-1023)+825.0**
Forward Channel	
I< N < 799	**0.03ON + 870.0**
990<N<1023	**0.030(N-1023)+870.0**

(Channels 800-989 are unused)

Frequency spectrum allocations for US cellular radio service.

Digital Communication System (DCS) 1.85-1.99 GHz.

Voice transmission from the base station to mobiles are *called forward voice channels (FVC)*

Voice transmission from mobiles to the base station are called *reverse voice channels (RVC)*.

The two channels responsible for initiating mobile calls are *the forward control channels (FCC) and reverse control channels (RCC).*

[&] From: Wireless Communications, Principles and Practice T.S.Rapport, IEEE Press, 1996

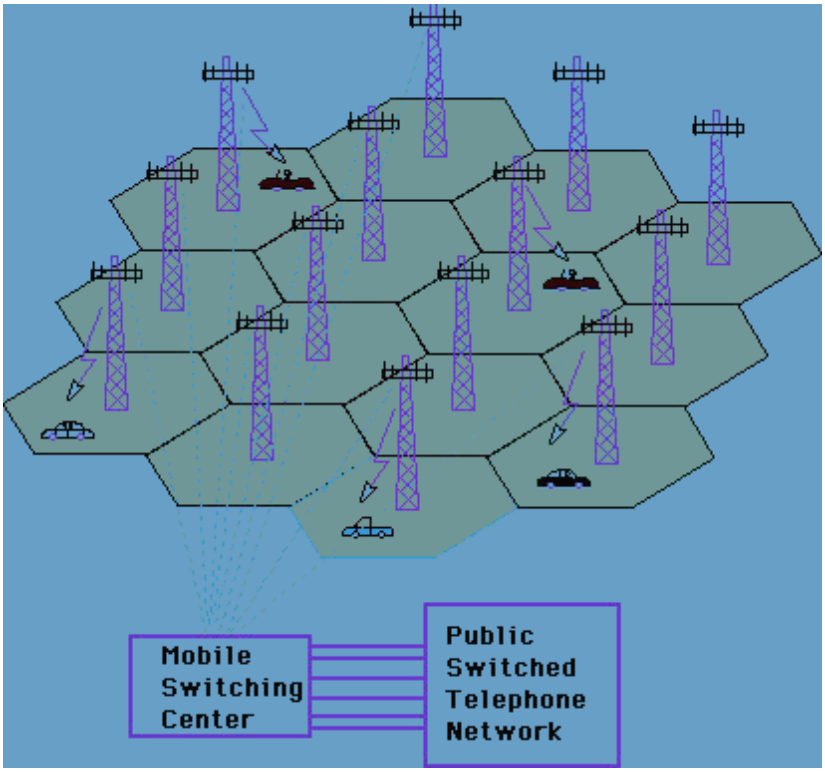


Figure I Cellular System. The towers represent base stations which provide access between the mobile users and the Mobile Switching Center (MSC)

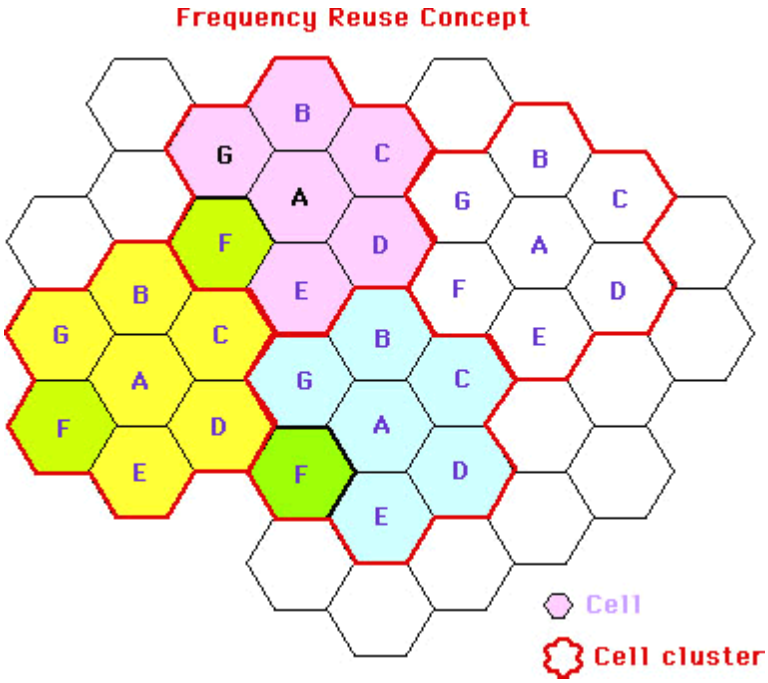


Figure 2. Cells within the same letter use the same set of frequencies. A cell cluster is outlined in bold and is replicated over a coverage area. In this example, the cluster size, N, is equal to seven, and the frequency reuse factor is 1/7 since each cell contains one-seventh of the total available channels.

Example 1

Cellular systems rely on the frequency reuse concept, which requires that the forward control channels (FCCS) in neighboring cells be different. By defining a relatively small number of FCCs as part of the common air interface, cellular phones can be manufactured by many companies which can rapidly scan all of the possible FCCs to determine the strongest channel at any time. Once finding the strongest signal the cellular phone receiver stays "camped" to the particular FCC. By broadcasting the same setup data on all FCCs at the same time, the MSC is able to signal all subscribers within the cellular system and can be certain that any mobile will be signaled when it receives a call via the PSTN.

Example 2.
If the total of 33 MHz of bandwidth is allocated to a particular FDD cellular telephone system which uses two 25 kHz simplex channels to provide full duplex voice and control channels, compute the number of channels available per cell if a system uses (a) 4-cell reuse, (b) 7-cell reuse (c) 12-cell reuse. If I MHz of the allocated spectrum is dedicated to control channels, determine an equitable distribution of control channels and voice channels in each cell for each of the three systems.

Solution to Example 2

Given Total bandwidth = 33 MHz. Channel bandwidth = 25 kHz x 2 simplex channels = 50 kHz/duplex channel. Total available channels = 33,000/50 = 660 channels

(a) For N = 4,
total number of channels available per cell = 660/4= 1 65 channels
(b) For N = 7,
total number of channels available per cell = 660/7= 95 channels
(c) For N = 12,
total number of channels available per cell 660/12 = 55 channels.

A I MHz spectrum for control channels implies that there are 1000/50 = 20 control channels out of the 660 channels available.

To evenly distribute the control and voice channels, simply allocate the same number of channels in each cell wherever possible.

Here, the 660 channels must be evenly distributed to each cell within the cluster. In practice, only the 640 voice channels would be allocated, since the control channels are allocated separately as I per cell.

(a) For N = 4, we can have 5 control channels and 160 voice channels per cell. In practice, however, each cell only needs a single control channel (the control channels have a greater reuse distance than the voice channels). Thus, one control channel and 160 voice channels would be assigned to each cell.

(b) For N = 7, 4 cells with 3 control channels and 92 voice channels, 2 cells with 3 control channels and 90 voice channels, and I cell with 2 control channels and 92 voice channels could be allocated. In practice, however, each cell would have one control channel, four cells would have 91 voice channels, and three cells would have 92 voice channels.

(c) For N = 12, we can have 8 cells with 2 control channels and 53 voice channels, and 4 cells with 1control channel and 54 voice channels each. In an actual system, each cell

would have 1 control channel, 8 cells would have 53 voice channels, and 4 cells would have 54 voice channels.