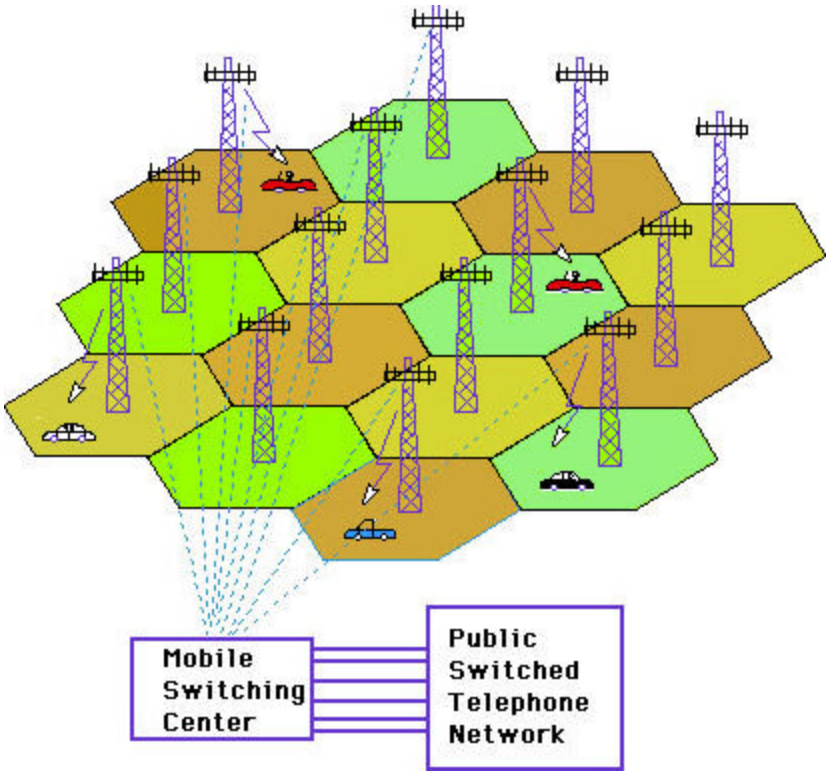
ECECS-611

Microwave Communications

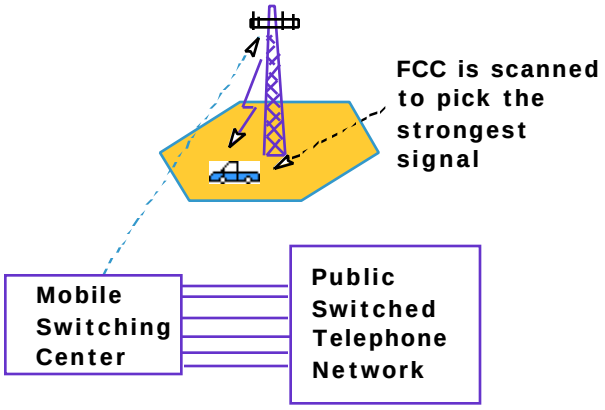
Cellular Telephone Systems[&]



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

How a Cellular Telephone Call is Made

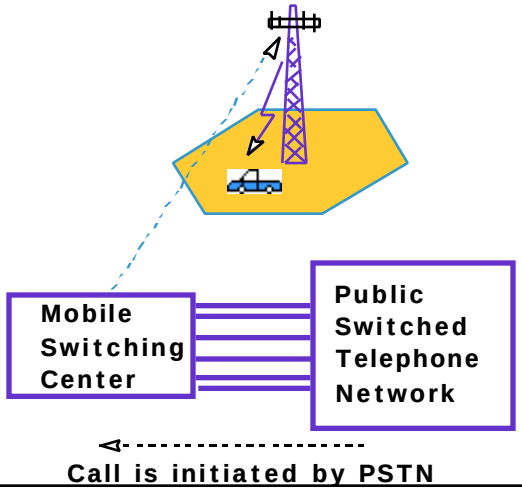
When a cellular mobile phone is turned on and is not yet engaged in a call, scans the group of forward control channels to determine the one with the strongest signal, and then monitors that control channel until the signal drops below a usable level. At this point it again scans the control channels in search of the strongest base station signal.



Since the control channels are standardized and are identical throughout different markets within the country or continent, every phone scans the same channels while idle.

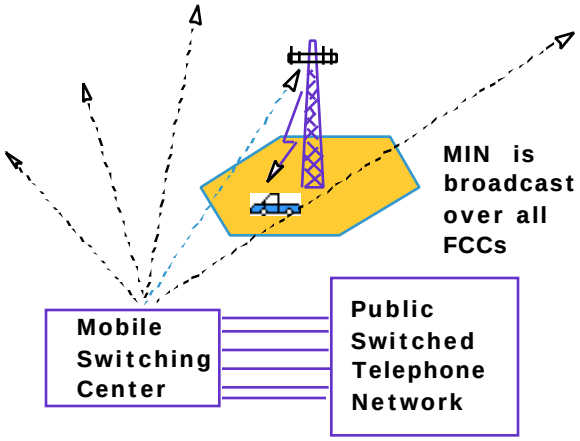
---

1. When a telephone call is placed to a mobile user, the PSTN sends a message to *Mobile Switching Center* (MSC) which dispatches the request to all base stations in the cellular system.

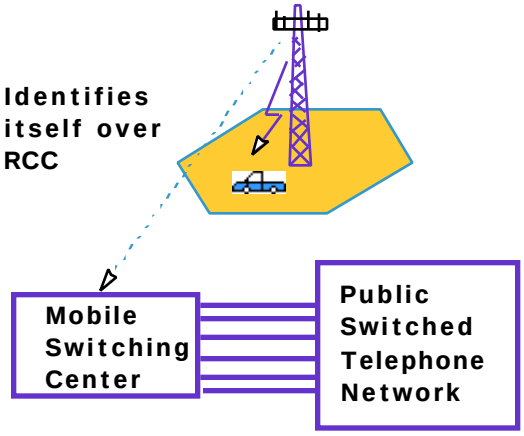


---

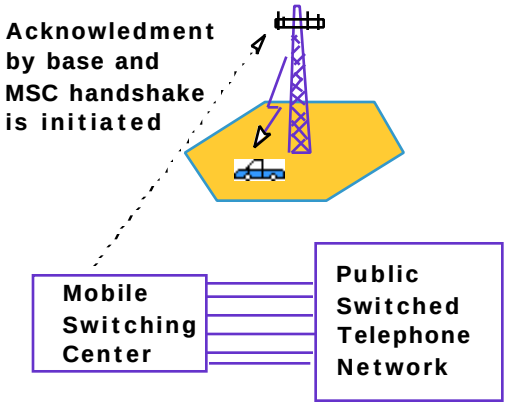
2. The *mobile identification* number (MIN), which is the subscriber's telephone number, is then broadcast as a paging message over all of the *forward control channels* (FCC) throughout the cellular system.



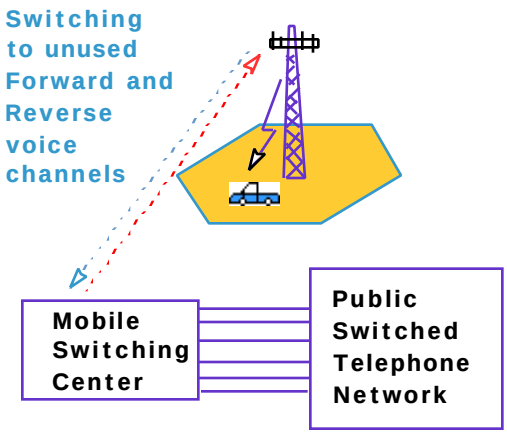
3. The mobile receives the paging message sent by the base station which it monitors, and responds by identifying itself over the *reverse control channel* (RCC).



4.The base station relays the acknowledgment sent by the mobile and informs the MSC of the handshake.

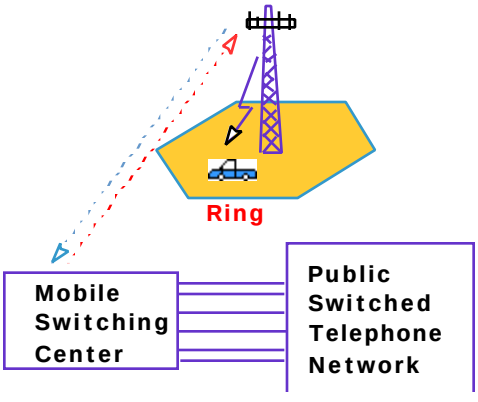


5.Then, the MSC instructs the base station to move the call to an unused voice channel within the cell (typically, between ten to sixty voice channels and just one control channel are used in each cell's base station).



---

6. At this point the base station signals the mobile to change frequencies to an unused forward and reverse voice channel pair, at which point another data message (called an *alert)* is transmitted over the forward voice channel to



instruct the mobile telephone to ring, thereby instructing the mobile user to answer the phone. All of the sequence of events occur within a few seconds and are not noticeable by the user.

7. Once a call is in progress, the MSC adjusts the transmitted power of the mobile and changes the channel of the mobile unit and base stations in order to maintain call quality as the subscriber moves in and out of range of channels so that the mobile unit may be controlled by the base station and the MSC while a call is in progress.

When a mobile originates a call,

1. A call initiation request is sent on the reverse control channel.

2. With this request the mobile unit transmits its telephone number *(MIN)*, *electronic serial* number (ESN), and the telephone number of the called party. (The mobile also transmits a *station class mark* (SCM) which indicates what the maximum transmitter power level is for the particular user.)

3. The cell base station receives this data and sends it to the MSC.

4. The MSC validates the request,

5. Makes connection to the called party through the PSTN, and

6. Instructs the base station and mobile user to move to an unused forward and reverse voice channel pair to allow the conversation to begin.

All cellular systems provide a service called roaming, This allows subscribers to operate in service areas other than the one from which service is subscribed. When a mobile enters a city or geographic area that is different from its home service area, it is registered as a roamer in the new service area. This is accomplished over the FCC, since each roamer is camped on to a FCC at all times. Every several minutes, the MSC issues a global command over each FCC in the system, asking for all mobiles which are previously unregistered to report their MIN and ESN over the RCC. New unregistered mobiles in the system periodically report back their subscriber information upon receiving the registration request, and the MSC then uses the MIN/ESN data to request billing status from the home location register (HLR) for each roaming mobile. If a particular roamer has roaming authorization for billing purposes, the MSC registers the subscriber as a valid roamer. Once registered, roaming mobiles are allowed to receive and place calls from that area, and billing is routed automatically to the subscriber's home service provider.