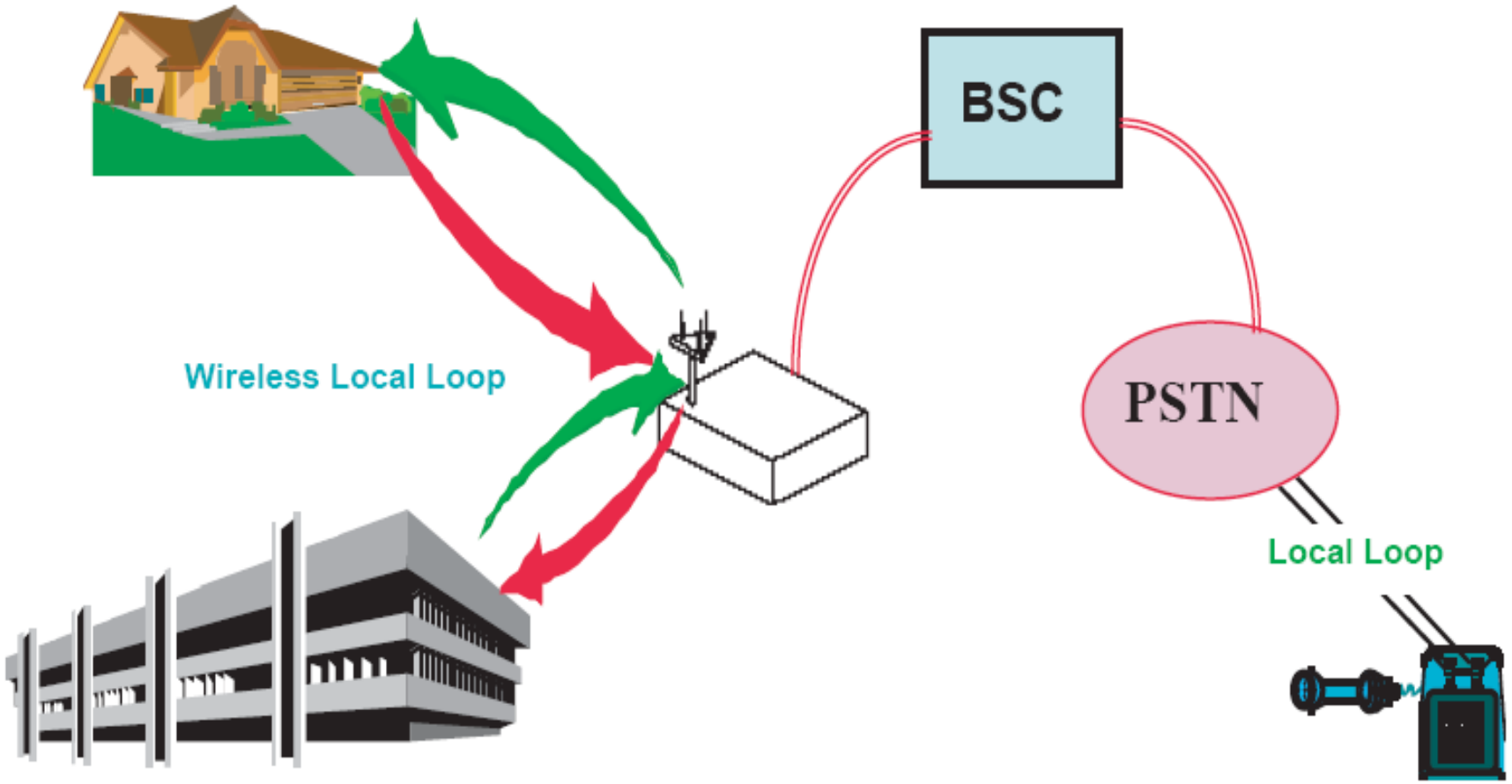
Wireless Local Loop (WLL)

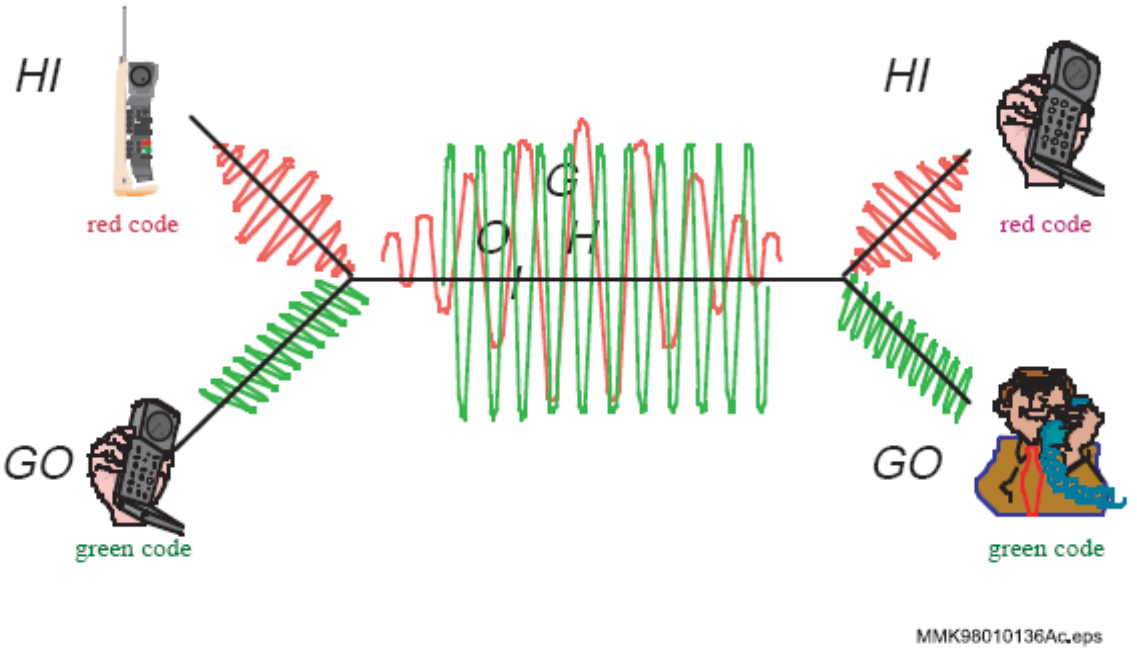


Code Division Multiple Access

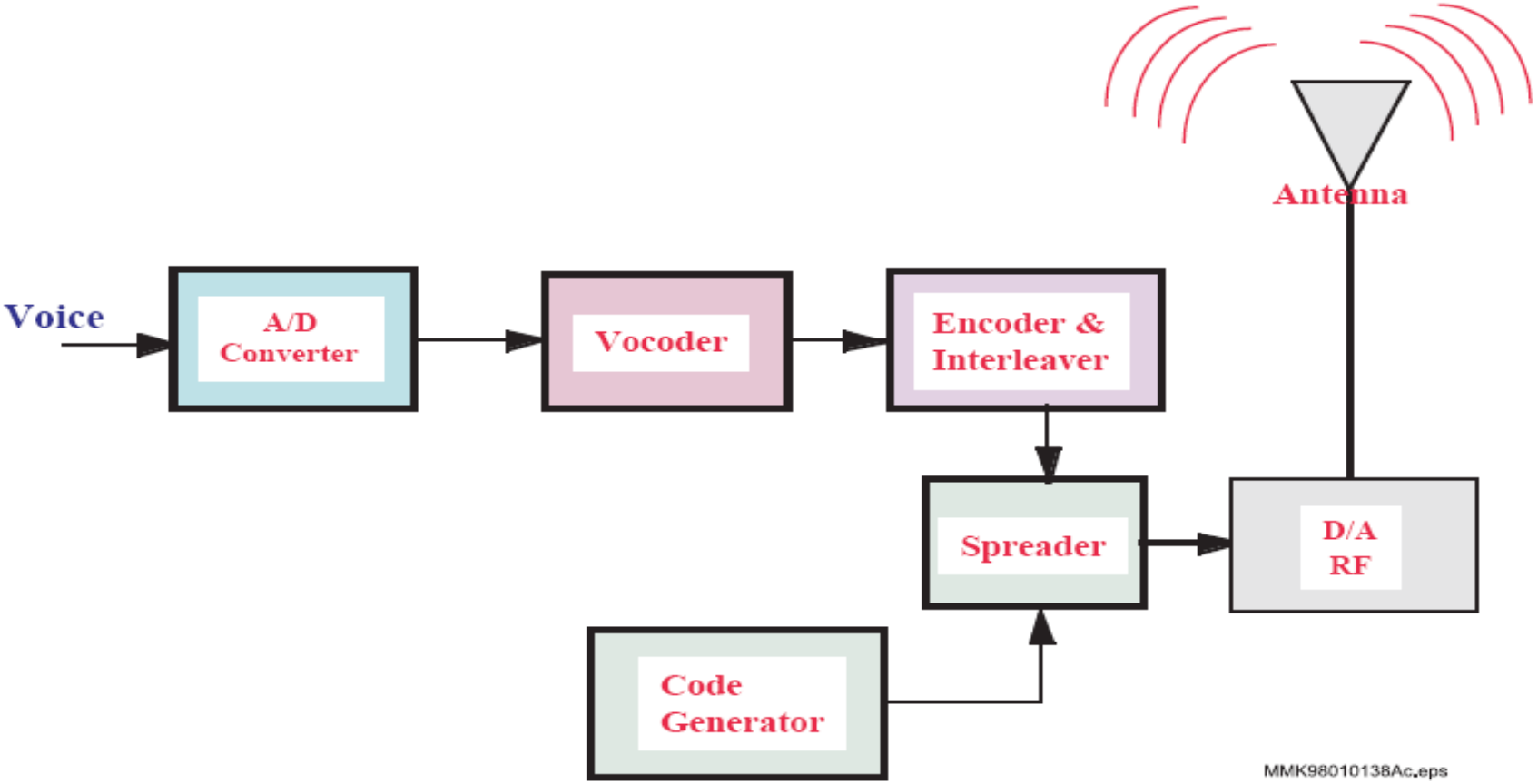
- **Code Division**

  Code Division Multiple Access subscribers share a common channel (frequency).CDMA is a "spread spectrum" technology, allowing many users to occupy the same time and frequency allocations in a given band/space.

  All users are on the **same frequency** at the **same time**, they are divided however by codes.



CDMA System Block Diagram



Steps in Generating a CDMA Signal

- Analog to Digital Conversion (Signal is **digitized**).
- Vocoding (Voice Compression).
- Encoding & Interleaving.
- Channelizing of Signal.
- Conversion from Digital Signal to Radio Frequency(RF) Signal.

Steps in Generating a CDMA Signal

- *Analog to Digital Conversion:-*

  Analog Signal (Voice signal) is converted into Digital Signal by using digital modulation technique i.e.; Pulse Code Modulation (PCM).

- *Vocoding (Voice Compression):-*

  The vocoder is used to compress the digital signal from the Codec (Code/Decode). The vocoder, used in a CDMA system, compresses the voice signal into various data rates. The data rate is dynamically determined by the users speech activity. When we talk, we pause between syllables and words. CDMA takes advantage of these pauses in speech activity.

  The voice is compressed in the vocoder into either one of four rates (Full, 1/2, 1/4, or 1/8 rate). CDMA systems can use either an 8 kbps or 13 kbps vocoder.

  ****The vocoders are located at the BSC and in the phone.***

Steps in Generating a CDMA Signal

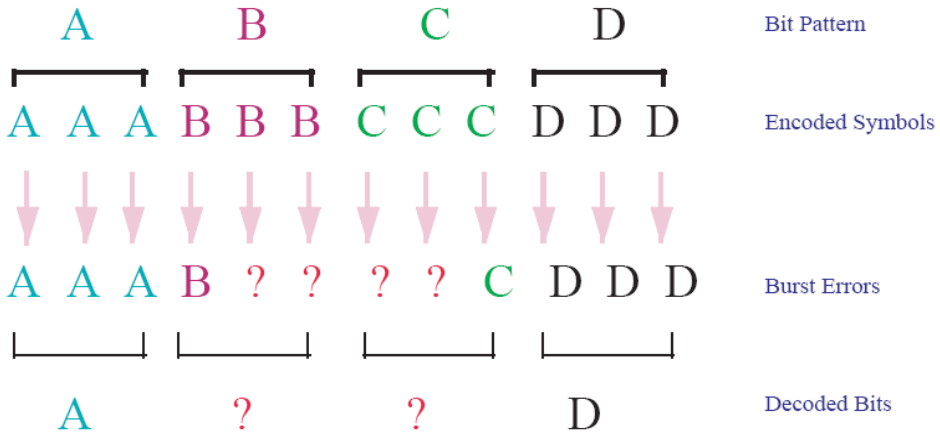
- *Encoding & Interleaving:-*

  Encoding:

  The purpose of the encoder is to build redundancy into the signal.

  Redundancy is the number of bits used to transmit a message minus the number of bits of actual information in the message.

  Example: A simple coding scheme is shown in this example. The digital message consists of four bits (A,B,C,D) of vocoded data. Each of the bits is repeated (encoded) 3 times. These encoded bits are called symbols.



  Decoding at the receiver uses a majority logic rule (two out of three wins). If an error occurs the redundancy can help recover the lost information.

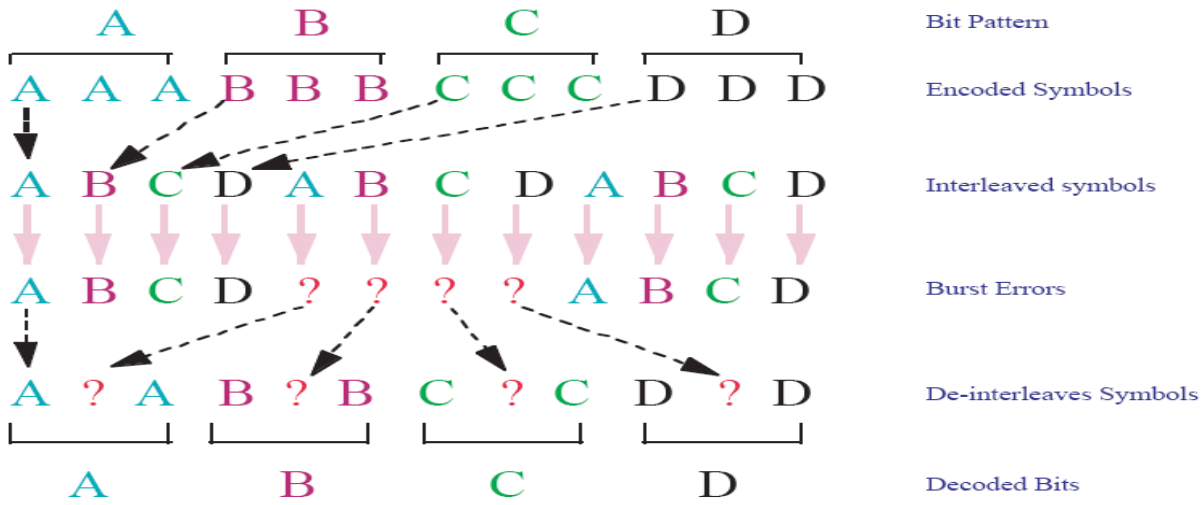
Steps in Generating a CDMA Signal

- *Encoding & Interleaving:-*

Interleaving:

Interleaving is a simple, but powerful, method of reducing the effects of burst errors and recovering bits when burst errors occur.

Example: In this example the symbols from each group are interleaved in a pattern that the receiver knows.



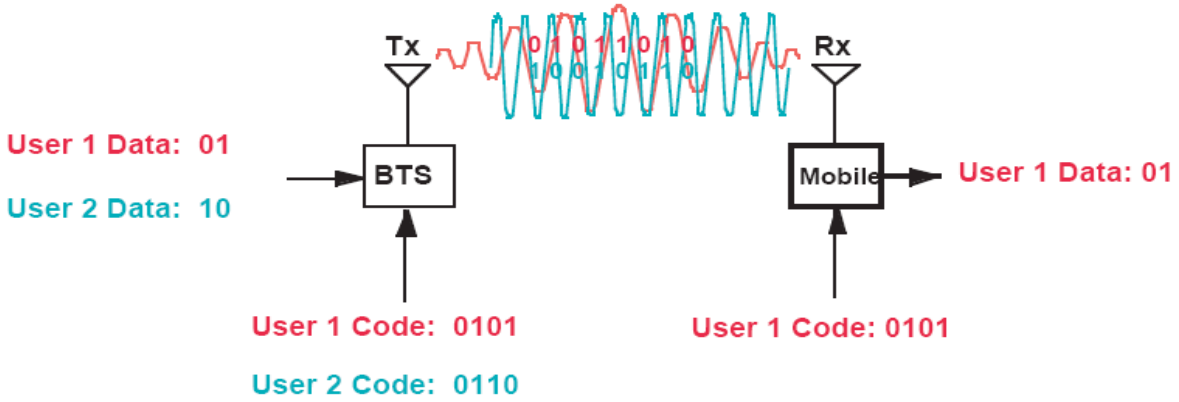
Deinterleaving at the receiver will spread any burst errors that occur during transmission and make it simpler to decode.

**** The Encoder & interleaver is located at the BTS and in the phone.***

Steps in Generating a CDMA Signal

- *Channelizing of Signal:-*

  The encoded voice data is encoded using a code that will separate it from other encoded voice data. This process, known as channelization, will spread the encoded symbols over the entire bandwidth of the CDMA channel.



Coding Types:

* Walsh Codes:
  => **Orthogonal** (Walsh) codes are used on the **forward link** to channelize users.
  => 64 Walsh codes are there.
* Pseudorandom Noise (PN) Codes:
  => **Pseudorandom noise (PN)** code is used on the **reverse link** to channelize users.
  => yields about 4.4 trillion codes.

Steps in Generating a CDMA Signal

- *Conversion from Digital Signal to Radio Frequency(RF) Signal :-*

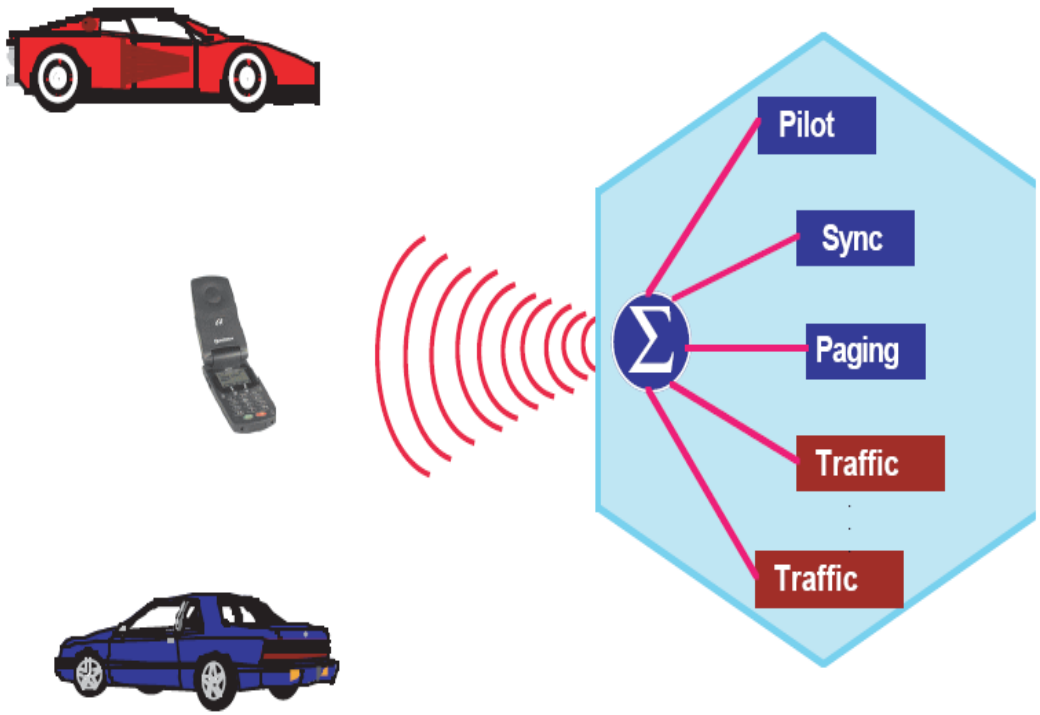
  The channelized data from all calls will be combined into a **one** signal that is converted to an analog RF signal which is transmitted over the air.

****At Reception side Reverse Process is done***

Forward Link Channels in CDMA

On the forward link there are 4 channels used to transmit control and voice data to the mobile. These code channels are:

- Pilot Channel
- Synchronize Channel
- Paging Channel
- Traffic Channel



Forward Link Channels in CDMA

Code Channels

A channel is a stream of data designated for a specific use or person and is separated by a code. A channel may be voice data or overhead control data.

Forward Link Code channels in CDMA are:

- *Pilot Channel:-*

  The pilot channel is constantly transmitted by the BTS. The mobile uses the pilot signal to acquire the system. After the mobile has acquired the system the pilot is used for signal strength measurement. The strength of the pilot is used to determine the power required for mobile transmit.

  The pilot contains no information but it is the strongest signal on the forward link, containing at least 20% of the total power on the forward link.

- *Synchronize Channel:-*

  The sync channel is constantly transmitted by BTS providing critical timing information to the mobile. The mobile will decode the sync channel message during the power up sequence. Once the mobile is synchronized with the base station the synchronize channel is ignored.

Forward Link Channels in CDMA

- *Paging Channel:-*

  The paging channel is used to transmit overhead information (i.e. commands and pages) to the mobile. When a call is being set up the commands and traffic channel assignment are sent on the paging channel. Once a traffic channel is established the paging channel is ignored by the mobile.
  CDMA uses up to 7 Paging channels.

- *Forward Traffic Channel:-*

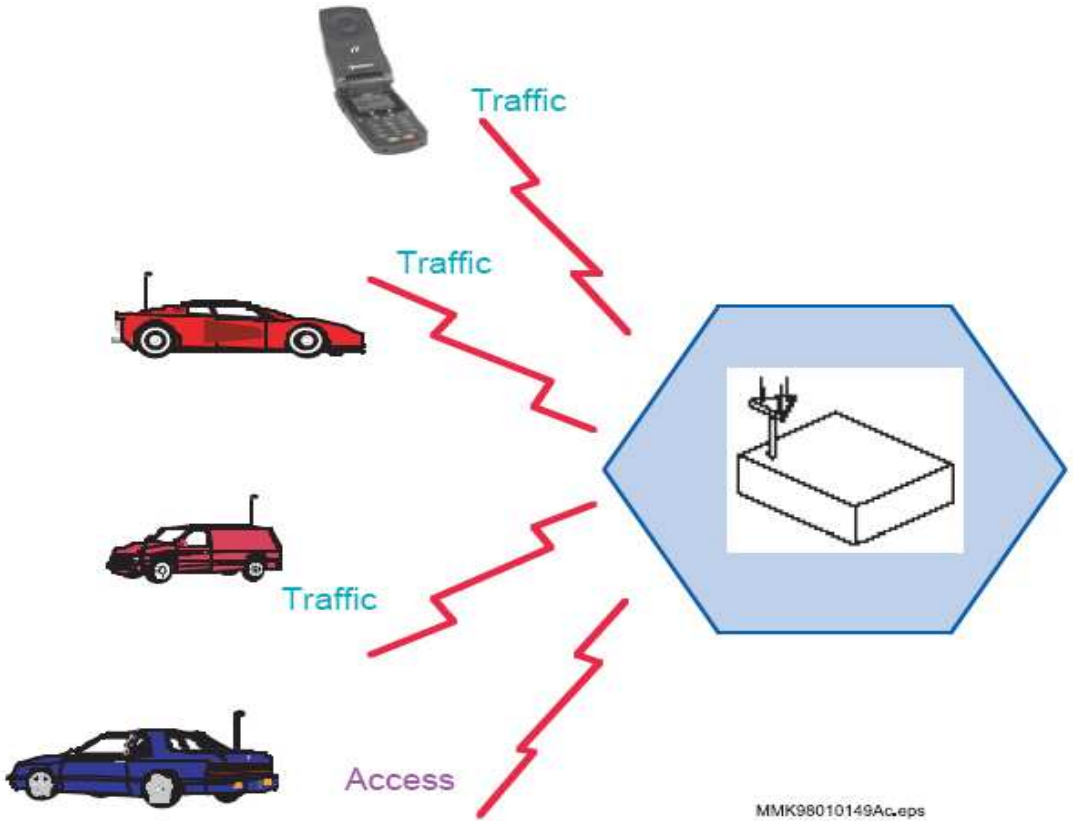
  The forward traffic channel is used when there is a call. Voice data and control overhead information, normally sent on the paging channel, are transmitted to the mobile on the traffic channel.
  CDMA uses 55 and 61 forward Traffic channels.

*__Once the call is completed, mobile tunes back to Paging channel for commands and pages.__

Reverse Link Channels in CDMA

On the reverse link there are 2 types of channels used to transmit control and voice data to the mobile. These channels are:

- Access Channel
- Traffic Channel



Reverse Link Channels in CDMA

- *Access Channel:-*

  The access channel is used by the mobile when not assigned to a traffic channel. The access channel is used by the mobile to:

  * Register with the network,
  * Originate calls,
  * Respond to pages and commands from the base station,
  * Transmit overhead messages to the base station.

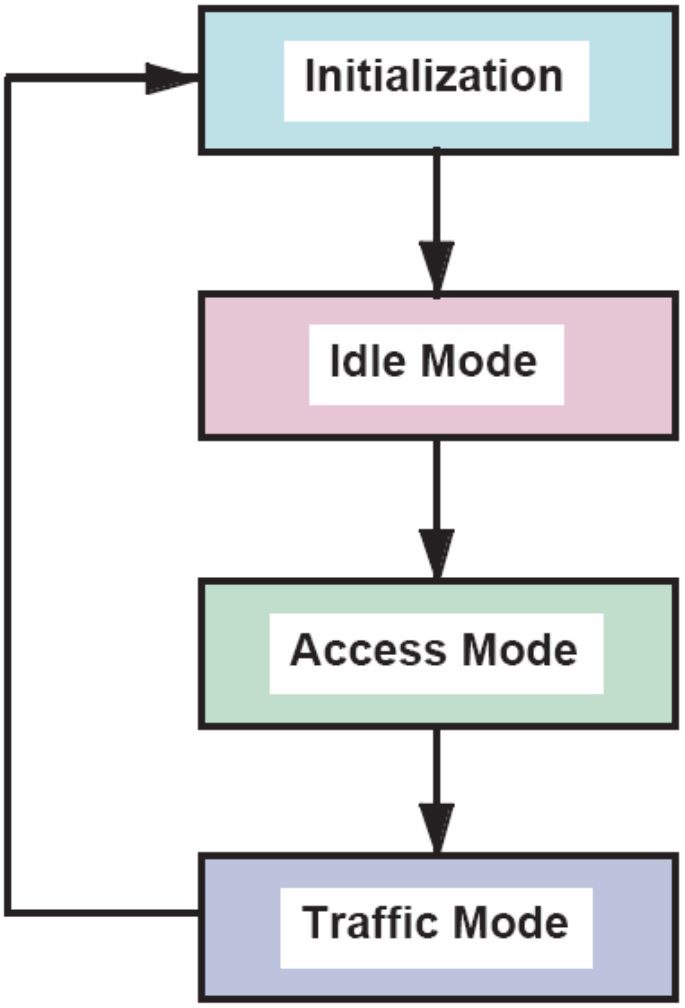
- *Reverse Traffic Channel:-*

  The reverse traffic channel is used when there is a call. Voice data and control overhead information, normally sent on the access channel, are transmitted to the base station (BTS) on this channel.

Call Processing in CDMA

There are 4 Call Processing modes in CDMA:

- Initializing Mode
- Idle Mode
- Access Mode
- Traffic Mode



Call Processing in CDMA

- *Initialization Mode:-*
  - Mobile acquires system via Pilot code channel.
  - Mobile synchronizes with system via Sync code channel.

- *Idle Mode:-*
  - Mobile and base station communicate over Access and Paging code Channels when NOT involved in a call.
  - Mobile obtains overhead information via the Paging code channel.

- *Access Mode:-*
  - Mobile accesses the network via the Access code channel

- *Traffic Mode:-*

Land to mobile call

- When a call for a mobile is placed the mobile will receive a page on the Paging channel.
- The mobile responds on the Access channel and Traffic channels are established.

Mobile to land call

- When a call is placed from a mobile the call is placed using the Access channel.
- The base station responds on the Paging channel and Traffic channels are established.