4.4.Time Division Multiple Access (TDMA)

Time Division Multiple Access (TDMA) systems divide the radio spectrum into time slots, and in each slot only one user is allowed to either transmit or receive as shown in figure 2.1.3.

Each user occupies a cyclically repeating time slot.

A channel may be thought of as particular time slot that re occurs every frame, where N time slots comprise a frame.

TDMA systems transmit data in a buffer-and-burst method, the transmission for any user is non continuous.

Digital data and digital modulation must be used with TDMA.

Frame consists of a number of slots (information message), together with a preamble, and tail bits as shown in figure 2.1.4.

Preamble contains the address and synchronization information that both the base station and the subscribers use to identify each other.

Guard times allow synchronization of the receivers between different slots and frames.

In TDMA/ TDD, half of the time slots in the frame information message would be used for the forward link channels and half would be used for reverse link channels.

In TDMA/ FDD systems, an identical or similar frame structure would be used solely for either forward or reverse transmission, but the carrier frequencies would be different for the forward and reverse links.

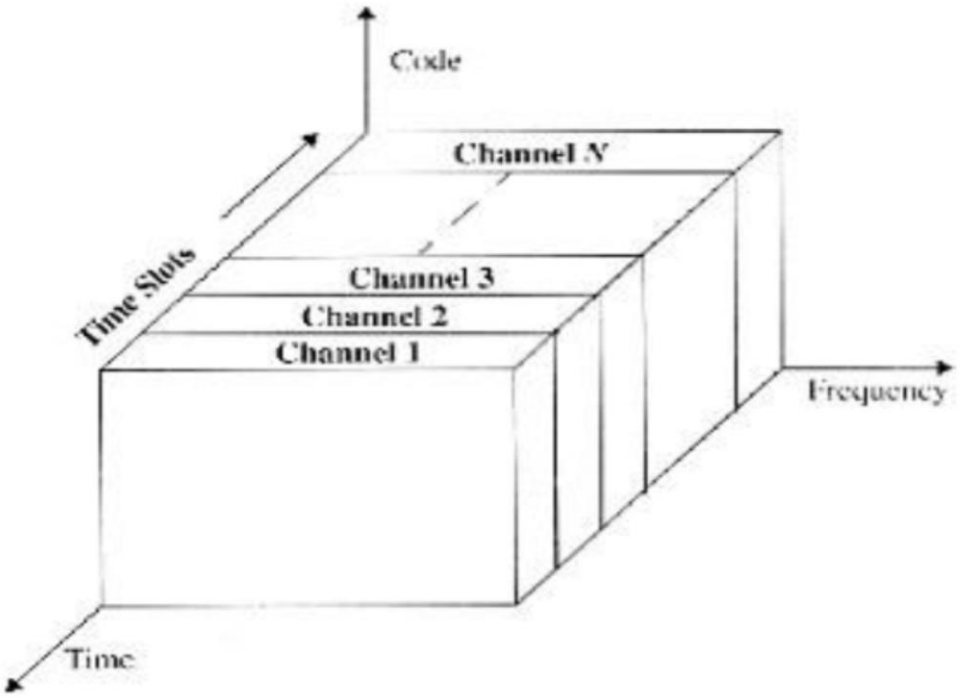

Fig 2.1.3: TDMA

[Source : "Wireless communications" by Theodore S. Rappaport,Page-401]

Features of TDMA:

TDMA shares a single carrier frequency with several users, where each user makes use of non overlapping time slots.

The number of time slots per frame depends on several factors, such as modulation technique, available bandwidth, etc.

Data transmission for users of a TDMA system is not continuous, but occurs in bursts. This results in low battery consumption, since the subscriber transmitter can be turned off when not in use (which is most of the time).

Because of discontinuous transmissions in TDMA, the handoff process is much simpler for a subscriber unit, since it is able to listen for other base stations during idle time slots.

An enhanced link control, such as that provided by mobile assisted handoff (MAHO) can be carried out by a subscriber by listening on an idle slot n the TDMA frame.

TDMA uses different time slots for transmission and reception, thus duplexers are not required.

Even if FDD is used, a switch rather than a duplexer inside the subscriber unit is all that is required to switch between transmitter and receiver using TDMA.

Adaptive equalization is usually necessary in TDMA systems, since the transmission rates are generally very high as compared to FDMA channels.

In TDMA, the guard time should be minimized. If the transmitted signal at the edges of a time slot are suppressed sharply in order to shorten the guard time, the transmitted spectrum will expand and cause interference to adjacent channels.

TDMA has an advantage in that it is possible to allocate different numbers of time slots per frame to different users.

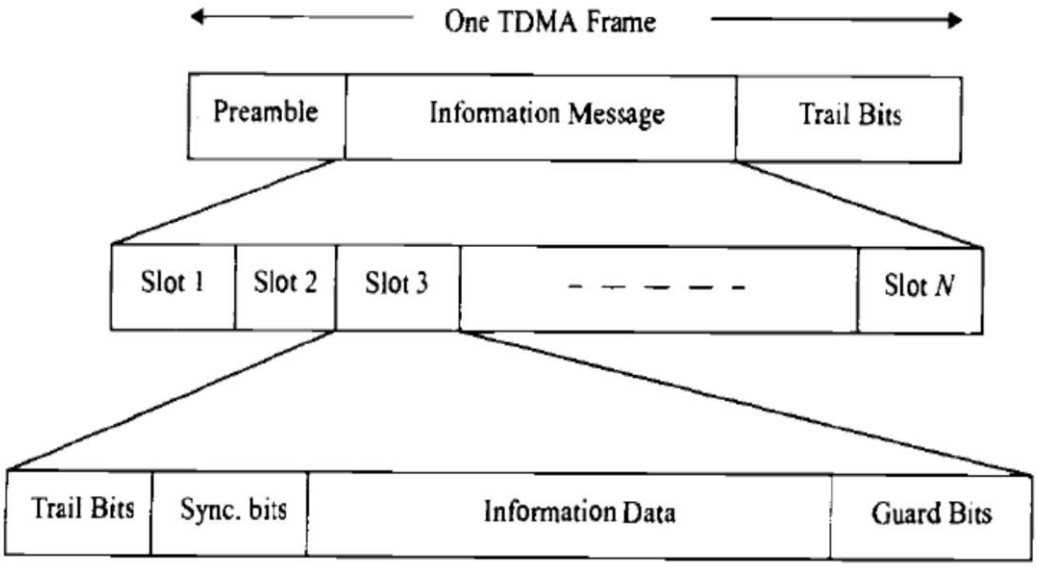

Fig 2.1.4: TDMA Frame structure

[Source : "Wireless communications" by Theodore S. Rappaport,Page-402]

Efficiency of TDMA:

The frame efficiency, is the percentage of bits per frame which contain transmitted data.

$$\eta_f = \left(1 - \frac{b_{OH}}{b_T}\right) \times 100\%$$

The number of overhead bits per frame is

$$b_{OH} = N_r b_r + N_t b_p + N_t b_g + N_r b_g$$

The total number of bits per frame, b_t, is $b_t = T_f R$

It is a measure of the percentage of transmitted data that contains information as opposed to providing overhead for the access scheme.

The transmitted data may include source and channel coding bits, so the raw end- user efficiency of a system is generally less than frame efficiency.

Number of channels in TDMA system:

Can be found by multiplying the number of TDMA slots per channel by the number of channels available. m is the maximum number of TDMA users supported on each radio channel.

$$N = \frac{m\,(B_{tot} - 2B_{guard})}{B_c}$$