Time Division Multiplexing (TDM)

Chapter 6

The calculated sampling time period for telephone signals is 125µs. This means that Robot 1 sleeps for 125µs before the next sample and in that time it samples only a signal of a single telephone.

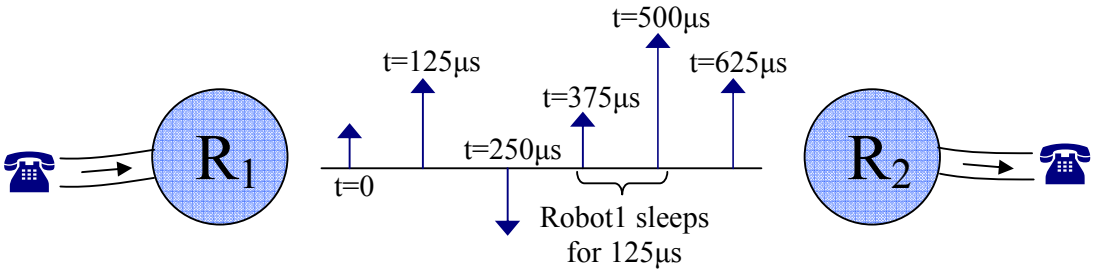

Figure 6.1

Considering modern technology 125µs is too much of a sleeping time. Therefore instead of letting it sample only one telephone, it was decided that signals of many channels should be sampled during that time. This is called Time Division Multiplexing.

There are two systems as at present for TDM.

I. European (CEPT) system
II. American system

In European system 32 channels are used while 24 channels are used for the American system.

Most of the countries use the CEPT 32 channel system. This means in 125µs, Robot1 samples signals of 32 telephones. This is called a FRAME.

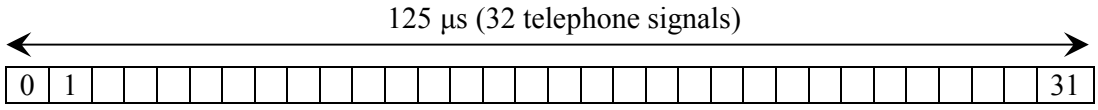

Figure 6.2

The above diagram is a frame consisting 32 telephone signals numbering from 0 – 31. They are referred as TIME SLOTS. Each time slot takes (125 / 32 =)3.9µs of the whole time of its frame. And each time slot contains 8 bits of information. See figure 6.3.

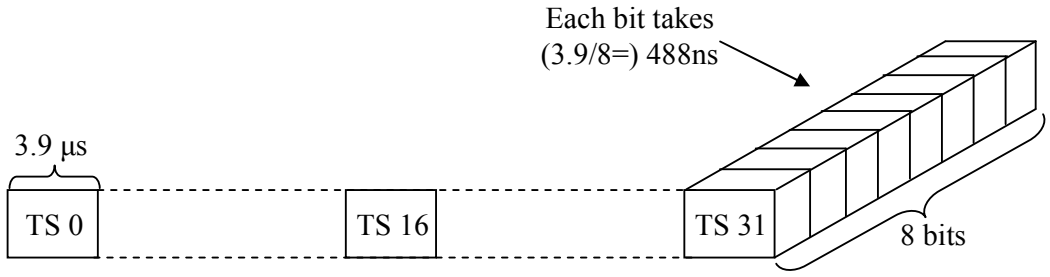

Figure 6.3

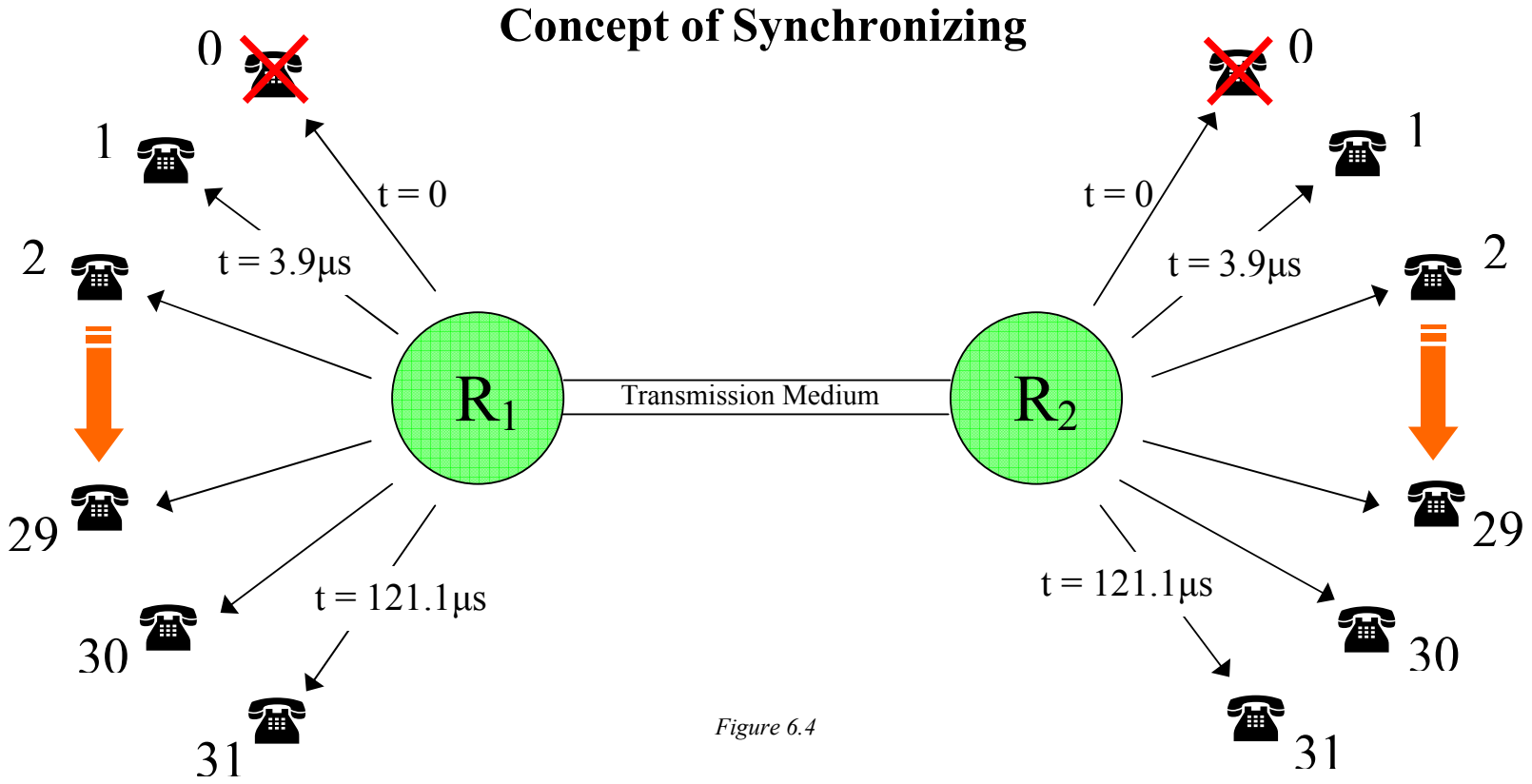

Figure 6.4

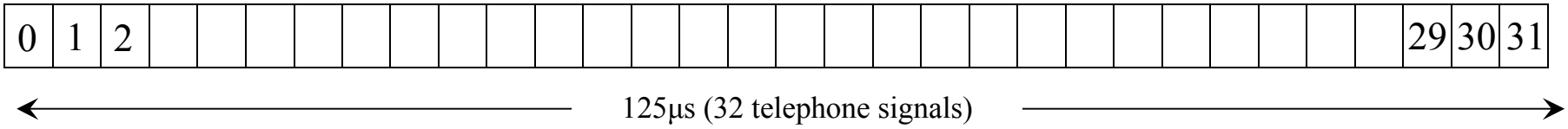

Figure 6.5

At t=0 both robots conduct TS0 which is the synchronising bit. Then after 3.9µs R_1 passes a sample value of subscriber 1. Then again after another 3.9µs R_1 goes to subscriber 2. Likewise it goes on and comes to the last subscriber of the frame which is the 32^{ndth} sub at t=121.1µs. Upon finishing it, R_1 goes back into frame synchronizing bit of the next frame after 125µs. This is the procedure of Time Division Multiplexing.

In the transmission media all these frames are sent one after the other. In another word a whole series of '1's and '0's are received at the receiving exchange. What if one bit gets misplaced? It definitely would make a mess of every bit after that. The receiving information will be wrong.

In order to avoid such confusion and to obtain the correct sample value, a frame synchronizing bit is introduced. The time slot 0 of every frame is taken as the synchronizing bit. That is why the 0 numbered telephones are crossed out in the previous diagram.

Hence at the beginning of every frame the receiving exchange synchronizes itself with the oncoming signal.

There are 32 channels in a frame. The speed of a frame can be calculated as follows.

Time taken for the whole frame = 125μs

Number of bits in a frame = 32 x 8
= 256 bits

Hence the speed of the frame = 256 bits / 125μs

$$= \frac{256 \text{ bits}}{(125 \times 10^{-6}) \text{ s}}$$

= 2.048 Mb/s

Therefore the speed of one link from one exchange to another is 2.048 Mb/s. Practically these are referred to as "2M's".

The speed of one telephone channel can be calculated in the same way. One telephone means one time slot.

Time allocated for the whole frame = 125μs

As one telephone channel occurs only once during this whole time, 125μs is equal to the time taken for one channel.

Number of bits in a single time slot = 8 bits

Hence the speed of one telephone channel $= \frac{8 \text{ bits}}{3.9\mu s}$

$$= \frac{8 \text{ bits}}{(125 \times 10^{-6}) \text{ s}}$$

= 64 kb/s

Therefore the speed of any telephone channels is 64 kb/s.