Module 9

Digital Switching

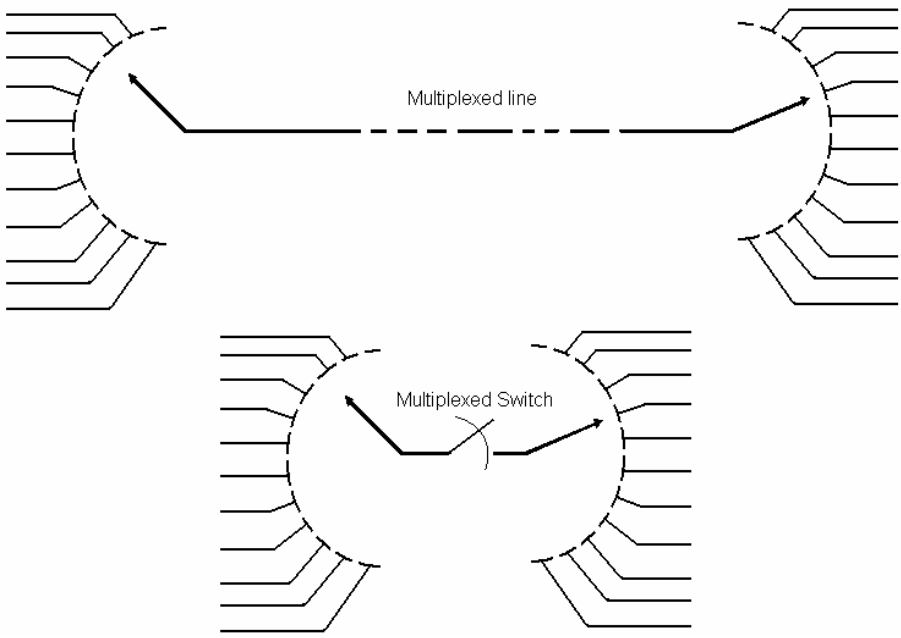
Lesson

31

Time Multiplexed Space Switching and Time Switching

9.3.1 TIME MULTIPLEXED SPACE SWITCHING

The switch that we have just studied is known as a Space Switch. This is a Time Multiplexed Space switch.



When electronic switch is used, it is called as Electronic Switching System ESS. It became popular when the switch is TMSS. It is not digital switching.

These switches are required in transit exchanges. Here, the inlets and the outlets are trunks which carry time division multiplexed data streams.

A time multiplexed space switch is shown in Fig. there are N incoming trunks and N outgoing traunks, each carrying a time division multiplexed stream of M samples per frame. For normal telephony, each frame is of 125 us. In one frame duration, a total of MN speech samples have to be switched. One sample duration, usually, 125/M us, is referred to as a time slot. In one time slot N samples are switched.

Time multiplexed switches do not provide full availability. Each incoming trunk carries multiplexed samples form M different voice sources and each stream on the outgoing trunk is demultiplexed to M different destinations. Sources, trunks, destinations have one-to-one time relationship as follows:

1. sources and incoming trunks time slots
2. outgoing trunk time slots and the destinations
3. time slots of incoming and outgoing trunks

The sample of the source *I* is always carried in time slot I of the inlet and time slot j of the outlet is always demultiplexed to destination j. the time slot k of any incoming trunk is transferred to time slot k on any outgoing trunk. As a result, a voice sample of slot I from any inlet cannot be transferred to slot k of any outlet (i!= k). a sample from input slot I can only be transferred to destination I of one or more outlets. In other words, interchange of samples among different time slots is not possible. Thus, the switch does not provide full availability.

In every time slot, up to N or M samples are switched simultaneously. The control store has N addresses corresponding to N vertical outputs with each address selecting one gate in each vertical output. The size of the control memory is N and its width (see page 206 viswanathan). Because of the parallel transfer of N or M data samples in each time slot, a large number of channels can be multiplexed per input line. The performance of this switch is similar to that of the time multiplexed space switch with N control memory modules.

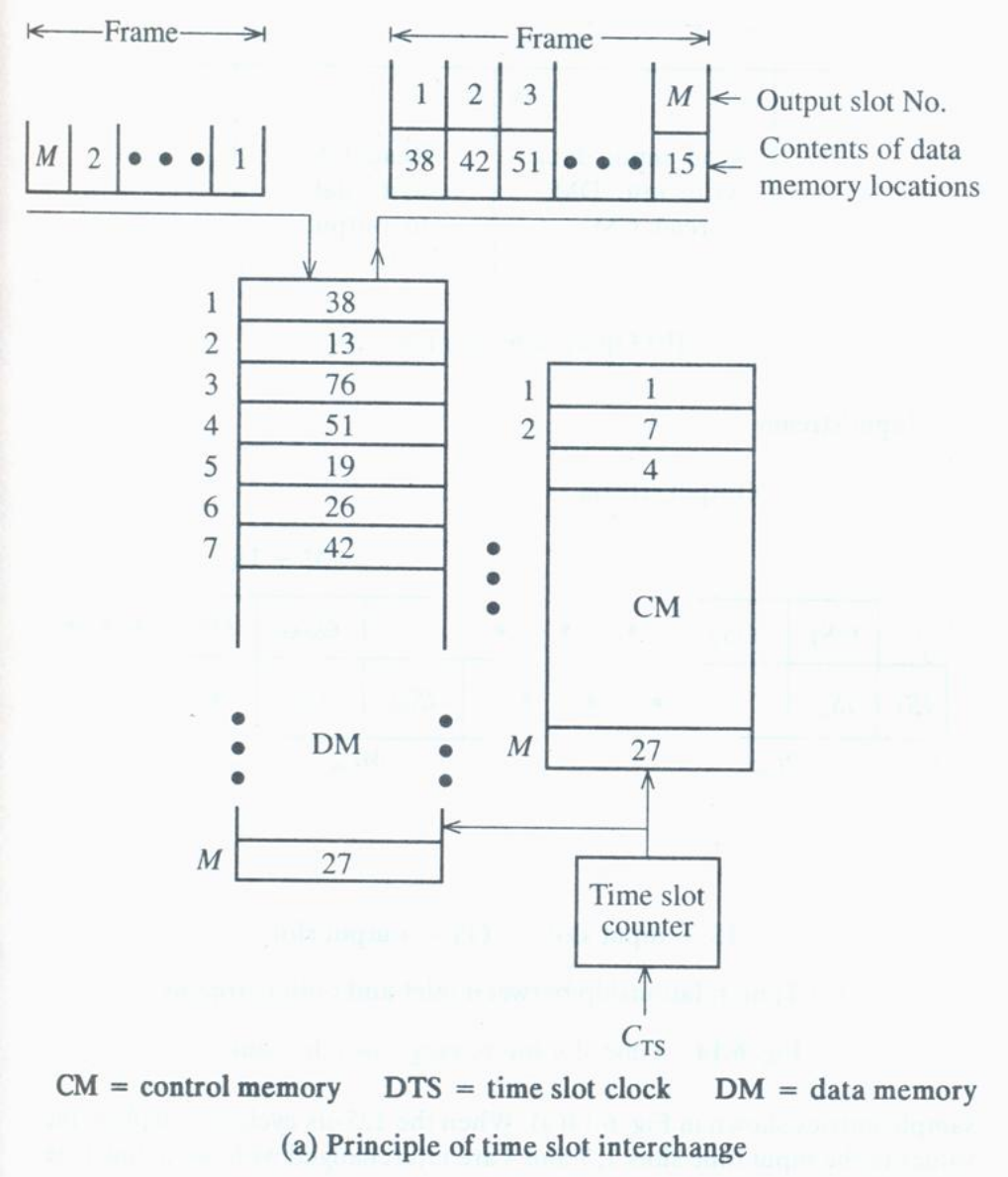
☞*THE PBXS USED PAM SWITCHES AS A SINGLE SWITCH COULD SERVE 30 USERS. SO THE SIZE OF THE PBX IS REDUCED.*

9.3.2 CONCEPTS OF TIME SWITCHING

In the 1960s Bell Labs introduced the Time switch or Digital switch. This switch is nothing but a delay device. So a memory can be used as a switch.

Time multiplexed time switches permit time slot interchange (TSI) of sample values. In TSI, a speech sample input during one time slot maybe sent to the output during a different time slot. Such an operation necessarily implies a delay between the reception and the transmission of a sample. The switch is organised in the sequential write/random read fashion. The time slot duration t_{TS} is given by

$t_{TS} = 125/M$



(a) Principle of time slot interchange

The time slot clock runs at the time slot rate, i.e. at the rate of one pulse every *125/M* microseconds. The time slot counter is incremented by one at the end of each time slot. The contents of the counter provides location addresses for the data memory and the control memory; Data memory and control memory accesses take place simultaneously in the beginning of the time slot. Thereafter, the contents of the control memory are used as the address of the data memory and the data read out to the output trunk. The input sample is available for reading in at the beginning of the time slot and the sample is ready to be clocked in on the output stream at the end of the time slot. Even if there is no time slot interchange, a sample is delayed by a minimum of one time slot in passing from, the input stream to the output

stream because of the storage action. In other words, a time-slot switch may be considered to have an inherent time delay of one time slot. In effect, the output stream is delayed by t_{TS} microseconds when compared to the incoming data stream. Depending on the output time slot to which an input slot contents are switched, the sample experiences a delay in the range of t_{TS} to $M\ t_{TS}$ microseconds.

Since there are no switching elements in this configuration, the cost is equal to the number of memory locations. There are *M* locations each in the control and in the data memory. Therefore, the cost is given by
$C = 2M$ units

A TSI switch may be designed to be expanding or concentrating. In such switches, the number of time slots (samples) per frame in the input stream and in the output stream are different. If we represent these numbers as *M1* and *M2* respectively, the switch is expanding when *M2 > M,*vice-versa. The bit rates of the input and output streams are also different. For an expanding switch, the output bit rate is higher and for a concentrating switch, the input bit rate is higher.

In practical configurations of time multiplexed time switches, there are *N* time multiplexed input streams each multiplexing *M* subscribers, and there are *N* time multiplexed output streams each carrying *M* subscribers. The problem is to handle *NM* subscribers in the time duration of 125 microsecond. This can be done in four different ways:

1. Serial-in/serial-out
2. Parallel-in/serial-out
3. Serial-in/parallel-out
4. Parallel-in/parallel-out.

☞*DIGITAL OR TIME SWITCH IS LIKE A DIARY WHERE WE WRITE SOMETHING TODAY AND READ IT AGAIN ON A LATER TIME.*

The working of this switch can be explained with the diagram below. The incoming line carries multiplexed data which is written into the memory at different locations according to the settings of the control memory. Say the Incoming line 3 is to be switched to Outgoing line 5 then the contents

from slot 3 in the multiplexed stream are stored at memory location 5 and then read out.

☞*IN A SINGLE INCOMING LINE, SINGLE STAGE SWITCH, THE MAXIMUM DELAY IS EQUAL TO THE MULTIPLEXED FRAME PERIOD.*

For voice communication the delay between writing and reading should be as low as possible. If the delay for voice is les than 300 ms then the system works perfectly as a switch and is known as Time Switch. Switching is done in time domain, but no sampling/ mixing is performed. It is also known as digital switching because the memory is digital computer memory.

Thus digital switching is basically Time slot Interchanging (TSI). Computer here is used as switch and not only as control.

☞*THE PAM SWITCH WAS MUCH CHEAPER THAN THE TSI SWITCH.*

Objective Questions

31.01

Subjective Questions

31.11

Level 2 Questions

31.21

Source:http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Communication%20network/pdf/9.3%20Lesson%2031.pdf