Chapter 2

2.1 Influence of CCITT

CCITT has decided for the multiplexing of four 2.048 Mbps (Primary PCM) into higher order PCM, the higher order bit speed to be 8.448 Mbps and it has further decided to allocate 2bits per PCM stream (tributary) for synchronization and maintenance.

Without synchronization and maintenance multiplexing of four 2.048 Mbps will result in 8.112 Mbps in the higher order PCM. In order to accommodate 8.448 Mbps in the higher order PCM the bit period pertaining to Primary PCM has to be further shrunk from 122μs to 117μs. This will result in sending 336 kbps (8.448Mbps - 8.112 Mbps) for synchronization and maintenance of the 8 Mbits MUX and DEMUX equipment.

How many bits that has to be received at the MUX from Primary tributary so that n bits are received, in the higher order PCM n+2 bits to be sent?
Assume four 2 M bit Primary PCMs are multiplexed into 8 Mbit one higher order PCM. Four bits are named as P_0, P_1, P_2 and P_3. These four bits in the higher order PCM will carry in one time slot.

P_0	P_1	P_2	P_3

(117*4)ns

When n bits come from Primary PCM it will take a time of $n/(2.048*10^6)$ seconds. Similarly during this time the higher order PCM of 8.448 Mbps has to send these n bits and in addition two bits. The time taken in the higher order PCM to send n+2 equivalent bits of a particular primary PCM = $4* (n+2)/ 8.448*10^6$ (if you see the above diagram it is clear to send n bits of primary PCM in the secondary PCM it will jump 4 bit by 4 bit since other three PCMs same bit has to be multiplexed).
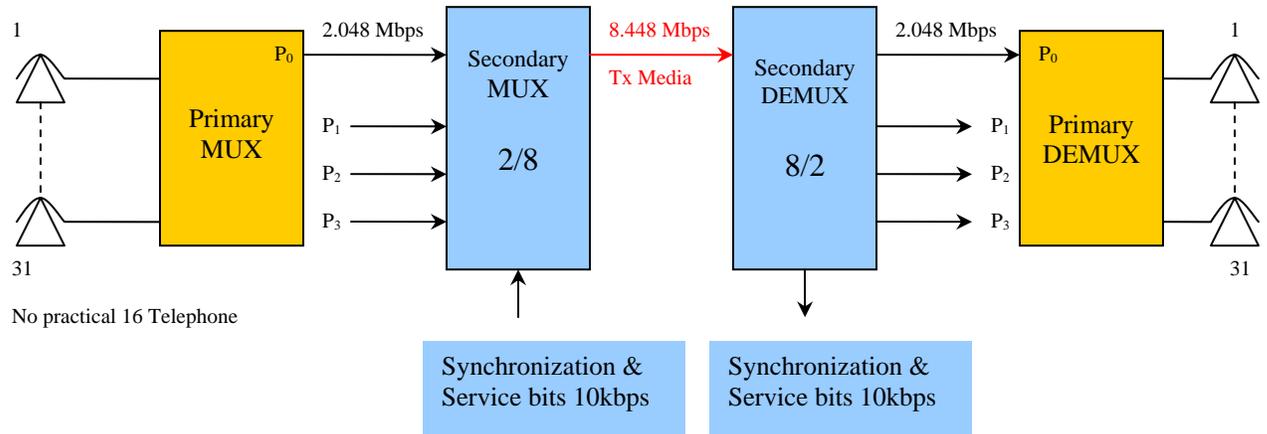
$$\frac{4*(n+2)}{8.448*10^6} = \frac{n}{2.048*10^6}$$

$$\frac{n+2}{n} = \frac{2.112}{2.048}$$

$$n = 64$$

Hence 64 bits are scanned in the primary tributary will result in 66 bits in the secondary tributary or higher order PCM. Where the additional 2 bits are used to send synchronization and maintenance information of the multiplexer to the de-multiplexer.

2.2 Summary of 8 Megabits Multiplexing/De-multiplexing Structure

| 1 | | 2.048 Mbps | | 8.448 Mbps | | 2.048 Mbps | | 1 |

Primary MUX — P_0, P_1, P_2, P_3 — Secondary MUX 2/8 — 8.448 Mbps Tx Media — Secondary DEMUX 8/2 — P_0, P_1, P_2, P_3 — Primary DEMUX

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Synchronization & Service bits 10kbps   Synchronization & Service bits 10kbps

Only the forward pathway is shown. Similar concept exists for the reverse path.

Figure: 2.1

The following points are summarized for converting four 2.048 Mbits Primary tributaries into a Higher Order tributary of 8.448 Mbps.

1. The Primary tributary of 2.048 Mbits will be received equal in time and shape at the receiver after undergoing transformation to 8.448 Mbps. Hence one forward path multiplexing and de-multiplexing will be carried out.

2. At the 2/8 multiplexing point additional bits of 336 kbps introduced and these bits will be extracted back at the de-multiplexing point. These bits will be used to synchronize the higher order multiplexer with the higher order de-multiplexer and it is further used to carry order wire information for maintenance.

3. The micro information of the primary tributary is a bit and will have a cycle time of 488ns. The same information will be transported in the secondary tributary in 117ns. Hence multiplexing means the time taken for a primary information to be shrunk from 488ns to 117ns. At the de-multiplexing point a bit information received in 117ns will be expanded back to 488ns to be carried out as a primary information in the primary tributary.