Major Physical Features of Common Channel Signaling

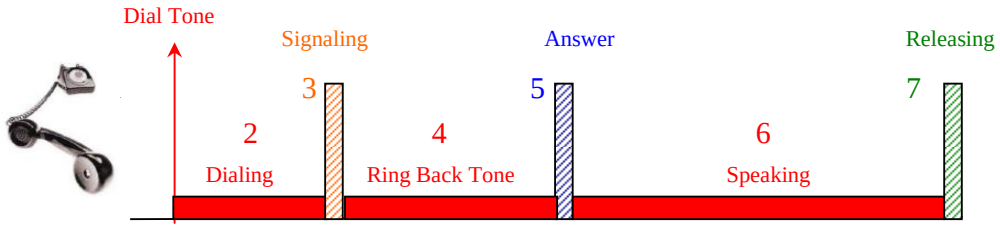
Chapter 3

Before Common Channel Signaling was introduced channel associated signaling was widely used. In Channel Associated signaling a family of PCM links connected from one node to another node can be easily visualized separately from one PCM link to another PCM link where each PCM link TS 16 carries the channel associated signal pertaining to the time slots in that PCM link. There is no co-relation what so ever from PCM link to another PCM link for signaling. This concept has been changed when moved to Common channel signaling. In order to understand the change a study will be made as to how to calculate the capability of a signaling time slot (signaling link) of a PCM link.

In a telephone conversation normally people will speak for 3 minutes. In order for the people to make this 3 minute call the telephone exchange has to send the information with regard to establishment of this call by way of signaling in a very short time (maybe a few seconds) from one exchange to another exchange. This can be understood by analyzing the phases of a call.

3.1 Basic Phases of a Call

The following diagram shows the transaction that will take place when a person trying to contact another person through the telephone network.



The details of the above 7 phases are analyzed below,

Phase 1- When a customer trying to make call he will lift the receiver. This intern will activate the telephone exchange and immediately dial tone will be fed from the exchange to indicate that exchange is waiting for the dialing digits.

Phase 2- Customer starts dialing. Normally this dialing period is variable and usually around 10 seconds.

Phase 3- When customer dials the complete B number (call number) the originating exchange will decide the route that has to be activated and send the B number details in an agreed protocol to the terminating exchange. The time taken for this phase too is variable but maybe limited to the maximum of one or two seconds.

Phase 4- When the terminating exchange finds the B customer is free it will send ringing current to the B customer and send Ring Back Tone to the A customer (A is the originating customer). This period is a variable and can go up even to two

minutes until the B customer answers. If B customer does not answer within two minutes (can be programmed) A customer will be disconnected.

Phase 5- When the B customer answers the terminating exchange will remove Ring Back Tone and ringing current and inform the answer condition to the originating exchange. Normally this will take around 100-200ms and generally is variable within millisecond periods.

Phase 6- A and B customers speaking. Without their knowledge they will follow the following phases

- Identify each other person to person and greeting
- Then Conversation
- During the conversation if there are any incomprehensible views that the other customer would request you to clarify.
- Concluding the conversation by end greeting and hang up the telephone.

Phase 7- Releasing. Through A and B humans have concluded the conversation the telephone exchanges A and B has to react depending upon whether A or B hang up the respective exchange will commence releasing the circuits which has been established for the conversation. Normally this time is around 100-200ms and similar to above phase 5.

The above will clearly explain that signaling takes a few milliseconds when compared to conversation (major aim), ringing and dialing and if the call is successful this few milliseconds has yielded for A and B to speak any length of time. The following explanation will extend this thinking in the common channel environment where instead of supervisory and register signals only message transmission is envisage.

3.2 Analysis of the Capability of Common Channel Signaling

Assume to establish (or management) a telephone call, the following data is used.

i. 5 messages (in one direction) to be sent to the other station (these messages can be the call number or its characteristics and the channel number to be used for voice) for a call,
ii. The maximum length of each message is of 128 bits.

(a) Hence in establishing a call 128*5 = 640 bits are needed.

(b) TS 16 of a PCM will transmit 64000 bits per second from one station to another station.

(c) Hence 100 calls can be connected per second, if a TS16 of a PCM is used. (Assuming 5 forward messages and 5 backward messages for a call)

(d) If two stations, station X and station Y are connected via PCM system, all 30 channels can be connected in around

300 ms. Hence after 300 ms, the signaling time slot will be idling until the conversations are over.

(e) In general signaling information pertaining to 16 PCM systems can be connected through one TS 16 also for reliability, the same information will be duplicated in another TS 160

(f) Hence with a PCM TS 16, many PCMs signaling information can be sent. But other PCM (excepts P2 to P 15 PCMs) TS16s are not used to send messages but can be used to send voice.

3.3 Basic difference between Common Channel Signaling and Channel Associated Signaling

In Channel Associated Signaling for every 2ms (in a period of 125us) the status of one customer (A) will be informed to the other exchange. Similarly in the backward direction B customers status will be informed to the originating exchange. In this method the inforation transfer of the status of A and B is useless during the conversation period which is an appreciable time. But in Common Channel Signaling this monitoring of customers are completely eliminated making much efficient on the signaling. The elimination came from transferring the monitoring functions to the switching node and when one customer terminate the call the respective exchange will send a message to the other exchange that the customer has terminated.

In the above example assumption were made that 5 messages are needed to be transmitted in one direction to establish a call, and each message is of 128 bits in one direction.

To establish one call requires (one direction) =5x128 =640 bits. Hence time taken to connect 1 call is 10ms, since signaling TS is sending 64,000 bits per second to the other station. If we assume similar to channel associated signaling for one PCM system all signaling information carried only in that time slot 16 within 300ms all 30 channels signaling information has sent and for the rest of 3-5 mins (assuming average of 2 minutes and 3 minutes talk). Hence one PCM time slot 16 can be used to send the signaling information if many other PCMs going in the same direction. This is the basic difference between channel associated and common channel signaling. In channel associate signaling both voice and signaling follows the same pipeline of 1PCM, where in common channel signaling many PCM signaling information goes in only 1 or 2 PCM time slot 16. The capability of one signaling channel is analyzed below.

3.4 Traffic Calculation of one signaling Time Slot

In the a common channel signaling, the digital circuit of one TS 16 can handle signaling information of many calls. This signaling time slot does not transmit any signaling information, during the speech and it will be used to connect many other voice channels.

The occupancy of a circuit is measured in Erlang and is described in traffic engineering chapter.

Using the formula

Erlang = Average holding time x Busy Hour CA

With 5 messages in one direction, each message with 128 bits it was found that 100 calls per second can be connected.
If we assume Average holding of a circuit is 50 sec,

The traffic carried by the signaling channel = 50 x 100 = 5000 E

If assume 20% efficiency for the signaling channel = 1000 E

If one analog circuit can carry maximum of 0.7 Erlangs

$$\text{Equivalent no. of analog circuits} = \frac{1000}{0.7 \times 30} = 47 \text{ PCMS}$$

Normally average holding times are low in developing counties due to the repeated attempts. When the telephone penetration of a given country increases average holding time tends to be equal to the average conversation time.

Average holding time low means for the signaling channel is a high load and normally a loaded telephone network in the developing countries where the penetration is low this value can be expected. But in developed countries, whee the telephone penetrations is very high the average holding time is close to 3 minutes and the signaling channel will be slackly loaded. The following example gives such case.

If the average holding time is 3 minute, Traffic carried is

$$= 3 \times 60 \times 100 = 18000 \text{ E}$$

No of equivalent PCMS in a similar calculation = $18000/(0.7 \times 30) = 177$

3.5 The use of Time Slot 16 for Common Channel Signaling

Common channel signaling can be sent in any time slot except TS0. However conventional PCM systems used TS 16 to send channel associated signaling. In Common Channel Signaling too the same time slot 16 is used to send the signaling information. Here P0 TS16 information is duplicated for reliability purposes.

In the practical systems normally for 16 PCM s in one direction one time slot 16 more than sufficient to carry the signaling information of all these 16 PCM s voice channels. Under this scenario even a high traffic load such as 3 seconds average holding time can be handled in this signaling time slot. This is evident in the following calculation

If used for 16 PCM s, 1 signaling time slot, what is the average holding time expected?

Erlang = Average holding time x Busy Hour CA

16 x 30 x 0.7	=	AV hold time x 100
Av hold time	=	3.3 Seconds.
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Further you will notice an added advantage of using Common Channel Signaling i.e. P2 to P15 TS16 are used to transit voice information. In the normal channel associated environment using 16 PCM systems can carry 480 simultaneous calls. Where as in a similar environment of common channel signaling 494 simultaneous calls will be carried. This is illustrated in the following diagram