Practical Application of Common Channel Signaling

Chapter 4

4.1 Environment

Towards the end of the last millennium the digital switches with digital transmission were fully deployed in the telephone network. Also the computer networks interconnecting the world with the introduction of the World Wide Web found everywhere in the world. The signaling used in the data network like www has been very efficient and uses common channel signaling by way of packet data. In the telephone networks the transformation from the analog type of signaling toward the digital type of signaling was evolving. Under this scenario the conventional analog type of signaling has been adopted to suite for the common channel signaling.

The introduction of CCITT No. 7 common channel signaling with the telephone user part has been introduced as the linkage from analog type of signaling to the digital type of signaling, in the telephone networks. In this chapter detail analysis of CCITT No 7 telephone user part is discussed in order for the reader to understand the conceptual changes that has been deployed in transformation from analog type of signaling to digital type of signaling.

Today the telephone user part is obsolete and more general user part used is Integrated System User Part. Even ISUP is becoming obsolete with the evolution of digital switches to Near Generation Networks. Nevertheless study of the concepts of signaling will be useful for any reader to understand modern common channel signaling systems deployed in the telephone systems.

4.2 CCITT No 7 Signaling and message evolution

Message evolution applied to CCITT No. 7 can be summarized as follows

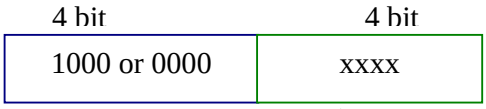
a. A basic message, say K is consist of two major parts, i.e. Instruction and Data, where instruction is fixed and the data subfield is variable. In CCITT No.7 the basic message is same where H_0 and H_1 form the basic instruction and for each instruction there is a defined corresponding data part. This is given in the annexure. This message K will differ from one user part to another user part.

b. This message K will evolve to K_1 to suite for non-homogeneous network. In CCITT No. 7 this will be implemented in the same way by introduction of 40 bit label which is having sub- labels as follows (there can be minor deviations for this and study is made only for the initial introduction)

   i. Circuit Identification Code – 12 bits
   ii. Originating Point Code – 14 bits
   iii. Destination Point Code – 14 bits

c. The homogeneous network message K_1 will evolve to suite for non-homogeneous message of K_2 with the introduction of Service Information Octet. In CCITT No. 7 this will be implemented in the same way by introduction of 8 bit SIO which is having sub-labels as follows

Service information Octet

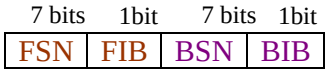


Whether the message is
From national (1000) or
International (0000).

which user part
xxxx
0000 – Signaling Network
0001 – Signaling Network Test
0011 - SCCP
0100 - TUP
0101 - ISUP

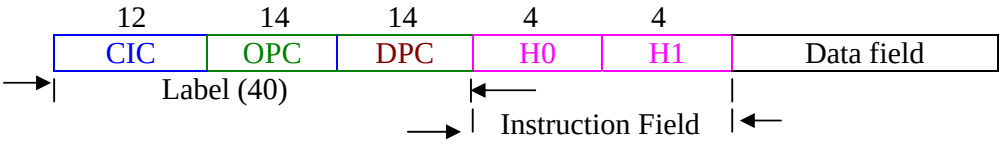
d. The non-homogeneous network of K2 will be evolved to suite for backward error correction. In CCITT No. 7 this will be implemented in the same way by introduction of 16 bit Cyclic Redundancy Code for error detection along with 16 bits of Sequence Control Field (for error correction) which is having sub-labels as follows

4.3 Structure of the sequence controlled field



Forward sequence number = FSN
Forward Indicator = FIB
Backward sequence number = BSN
Backward Indicator Bit = BIB

e. A non-homogeneous message which uses backward error correction is the total message that will be transmitted from one station to another station in CCITT No. 7 signaling. The example of such message is given below,



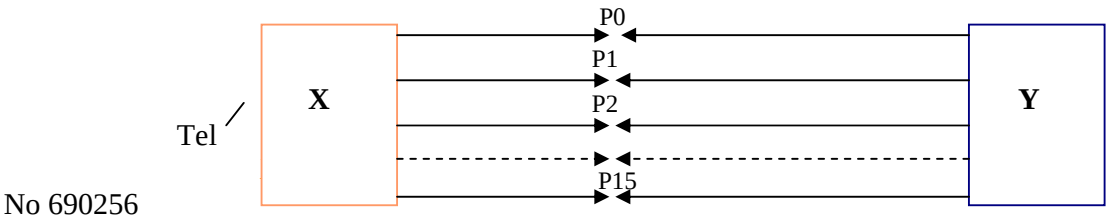
CIC - **Circuit Identification Code**
In general this gives the circuit number when voice paths are established.

OPC - **Origination Point Code**
Originating equipment number of originating signaling point number.

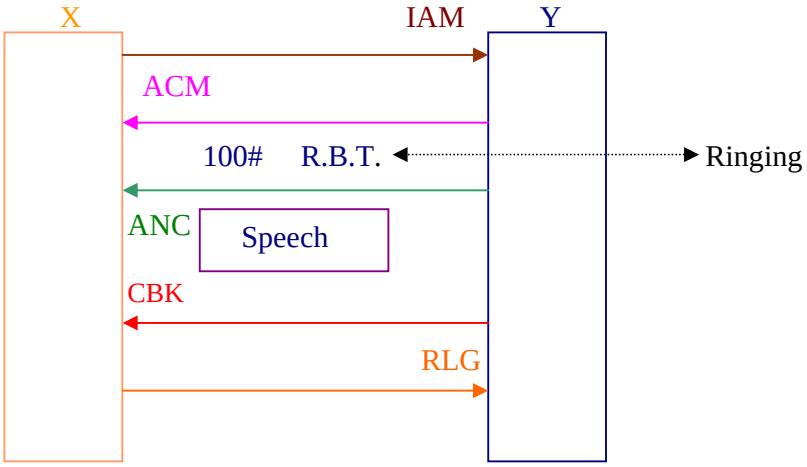
DPC - **Destination Point Code**
Terminating equipment number of termination signaling point number.

In general for processing of signaling each node in a given network is numbered. The numbering will be discussed in detail later.

4.4 Basic Messages utilized in establishing a call



Here you will see there are two exchanges X and **Y** (two switching nodes) connected with 16 PCM systems. PCM 0 and PCM 1 Time Slot 16 are used for CCITT No.7 signaling where as, all other time slots 16 of other PCM s used for voice unlike to channel associated signaling. The following shows basic messages exchanged between X and **Y** in establishing and releasing this call. A customer of exchange X, which we assume the telephone number as 690256 is dialing the B customer of exchange **Y** where between exchange X and **Y** the signaling is CCITT No.7.



Here it is assumed that channel number 100 is used for voice communication.

In this system there are 16 PCM s connected between exchange X and Y and for voice communication between X and Y there are 31*14 + 30*2 = 494 voice channels. If we number the voice channels from 0 to 493 for the above communication the time slot related to voice channel 100 is used.

Here you will see two messages are exchanged between X and Y prior to ringing and ring back tone (customer educating tones). The message ANC will result in disconnecting the customer educating tones and allowing both A and B customers to speak on the channel No. 100.

The message RLC and RLG allows both exchange X and Y to release the voice circuit 100 to be used for another conversation.

Let's analyze in detail the messages that have been exchanged, in the user part. This analysis will avoid the detail analysis of CRC, Sequence Control Field, service information octet and the Label in the message transfer part.

4.5 Basic Details of Messages

In order to analyze in detail the messages in the user part the following chart maybe used for a better understanding. In this chart the instruction field H_1 and H_o is selected in such a way that the reader can understand without any confusion before analyzing all the instructions given in the telephone user part. The overview of the following chart can be analyzed as follows

(i) There are 7 H_0 values with 12 H_1 values
(ii) Only 3 H_0 values will have 2 H_1 values each
(iii) There are 12 instructions. Out of this only 3 instructions will have data.

<table>
<tr><td colspan="8"></td><td>H_1</td><td>H_0</td></tr>
<tr><td colspan="8"></td><td></td><td>0000: spare for national use</td></tr>
<tr><td rowspan="2">Address signals n x 8 bits</td><td rowspan="2">Number of address signals 4 bits</td><td>L K J I H</td><td>G</td><td>F E</td><td>D C</td><td>B A</td><td></td><td>FEDCBA</td><td rowspan="2">0001: initial address message</td><td rowspan="4">0001: forward address message</td></tr>
<tr><td colspan="4">Indicators 12 bits</td><td>2 bits</td><td>Calling party's category 6 bits</td></tr>
<tr><td>Digit 0:0000 1:0001 : 9:1001 code 12:1100</td><td></td><td colspan="4">AB: address type
CD: circuit type
EF: continuity check
G: echo suppressor
H to L: spare</td><td></td><td>Example: 000 001 = French Speaking Operator</td></tr>
<tr><td colspan="5">Address signals
n x 8 bits</td><td>Number of address signals 4 bits</td><td>Fill in 4 bits 0000</td><td>0011: subsequent address message</td></tr>
<tr><td colspan="8"></td><td>0011: continuity signal</td><td rowspan="2">0010: forward set-up messages</td></tr>
<tr><td colspan="8"></td><td>0100: continuity failure signal</td></tr>
<tr><td colspan="8"></td><td>0001: calling line identity request message</td><td>0011: backward set-up request messages</td></tr>
<tr><td colspan="3"></td><td colspan="5">H G F E D C B A
Indicators 8 bits AB: type of signal (charge, no charge, etc)
C: subscriber free
D to H: spare</td><td>0001: address complete message</td><td>0100: backward successful set-up information message</td></tr>
<tr><td colspan="8"></td><td>0111: unallocated number</td><td>0101: backward unsuccessful set-up information message</td></tr>
<tr><td colspan="8"></td><td>001: answer, charge</td><td rowspan="2">0110: call supervision message</td></tr>
<tr><td colspan="8"></td><td>0011: clear back</td></tr>
<tr><td colspan="8"></td><td>0001: release guard</td><td>0111: circuit supervision message</td></tr>
</table>

Let's analyze how the user part is made in establishing a call from exchange X to exchange Y. Assume exchange X customer dials 690256 in the exchange Y. Exchange X has analyzed the dialed number and has to send the IAM (initial Address Message) to exchange Y.

The IAM is as follows

0001	0001	Calling party category	spare	Message indicators	Number of address signals	Address signals
4	4	6	2	12	4	n x 8

The IAM will have the instruction field of 8 bits out of 0001 0001 (normally this is divided into two sub fields). For IAM data field there are two parts, i.e. variable and fixed data field. The fixed data field consists of 24 bits and the length of the variable data field will depend upon the dialed number. The dialed number will be sent for each digit 4 bits in the address signal field. In the case of this example the address signal field will consist as follows

0110, 1001, 0000, 0010, 0101, 0110 (24 bits of converting 690256 digit by digit to binary)

When analyzing all the data fields only 2 important data fields has been considered as important to understand the concepts initially. These 2 data fields are

Number of address signals	Address signals
4	n x 8
0011	24 bits or 3 bytes

For the above example the IAM message is as follows. Only important parameters to understand the concept has been considered.

0001	0001	xxxxxx	xx	xxxxxxxxxxxx	0011	Address signals (Shown below)

Number of Address signals

0110	1001	0000	0010	0101	0110
6	9	0	2	5	6

x - For the time being not considered.

Let's analyze the address complete message

H G F E D C B A		
Indicators 8 bits AB: type of signal (charge, no charge, etc) C: subscriber free D to H: spare	0001: address complete message	0100: backward successful set-up information message

Assuming AB = 11 for charge and C = 1 for called customer free the message will be as follows

ACM - Address Complete Massage

H^0	H^1	HGFEDCBA
0100	0001	xxxxx111
4	4	8

ANC – Answer Signal Charge.

This message is as follows

H^0	H^1
0110	0001
4	4

RLG- Release Guard

0001: release guard	0111: circuit supervision message

Here assumption was made that the caller has on-hook (terminated the call) before the called customer.

Major Observations

With 5 messages (both way), the above call is established and released. When compared to analog type of signaling the following observations can be made.

(i) In analog type of signaling, dialing information will be sent digit by digit one after the other. Hence long time taken compared to common channel signaling.

(ii) During conversation supervisory signals exist; but in common channel signaling there is no supervisory signaling as such. Hence during the conversation there is no monitoring (signaling) in the transmission interfaces. resulting CCS, signaling to be more efficient than that of analog type of signaling

Standard user parts developed by CCITT

The above study reveals the workings of Common Channel Signaling with a more popular messages that will be used in normal calls. Many messages has to be defined to manage many types of calls under different scenarios. The following will show an example which has been used in early 1990s to define the telephone user part by CCITT. Through these messages are now becoming obsolete, a reader can obtain the conceptual understanding of signaling and can adopt the same principles even to the latest signaling that is deployed today.

H_0 / H_1	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000	← Spare reserved for national use →															
0001		IAM		SAM												
0010		GSM		COT	CCF											
0011		GRQ														
0100		ACM	CHG													
0101		SEC	CGC	NNC	ADI	CFL	SSB	UNN	LOS	SST	ACB	DPN	MPR			EUM
0110		ANC	ANN	CBK	CLF	RAN	FOT	CCL								EAM
0111		RLG	BLO	BLA	UBL	UBA	CCR	RSC								
1000		MGB	MBA	MGU	MUA	HGA	HBA	HGU	HUA	GRS	GRA	SGB	SBA	SGU	SUA	
1001		CFM	CPM	CPA	CSV	CVM	CHM	CLI								
1010					Spare reserved for international and basic national use											
1011																
1100																
1101				Spare reserved for national use												
1110																
1111																