Chapter 5

A message is evolving from homogeneous to non-homogeneous and a non-homogeneous message will further evolve to accommodate backward error correction. The previous chapters have explained how this evolution is realized. In this Chapter a study will be made to match CCITT No. 7 signaling with the concepts developed.

5.1 Concept of the basic message

Basic message in CCITT No. 7 is instruction and data. Instruction is given as a header while data is variable depending upon the header. This is normally called as the user part and constitutes the pure message that has to be transmitted from one place to another place.

Example of TUP simple message is as follows

Simple Message

4	4	8
H^0	H^1	Data
Instruction	Field	Data field

There are two headers in the instruction field. H^0 and H^1 each header has 4 bits. The length of data field varies according to H^0 and H^1 from 0 to about 60 octets.

5.2 Homogeneous Network Message

Simple message in one node has to be sent to another node of similar type. In this scenario when a message is to be received by a node, it is important to know which node this message has been sent and what path this message has taken to reach the terminating node. The simple message has to be evolved to accommodate the label. The following shows how this is being implemented in CCITT No. 7.

← label →					
CIC	OPC	DPC	H^0	H^1	Field
12	14	14	4	4	

CIC = Circuit Identification Code
OPC = Origination Pont Code
DPC = Destination Point Code

Signaling Point

Any switching node, which is capable of handling CCITT No.7 is named as a signaling point. This is defined with 14 bits which is indicated above OPC and DPC.

5.3 Routing of Common Channel Signaling

Common Channel Signaling will direct a call to be connected to the required destination and allow 2 parties to converse each other. Hence there are two basic paths need to be established between two signaling points for voice and data (signaling). In the case of analog type of signaling these two paths are always takes the same pipeline or same direction (i.e. if A is speaking with B via exchange C signaling and voice both will follow via exchange C). In the case of Common channeling signaling the distinct advantage over analog type of signaling is voice can be from A to B direct and the signaling can be A to B via C. Hence there can be three routing patterns that can be established in CCITT No. 7 signaling.

1. *Associated Mode*: Signaling takes the same path as voice.

2. *Non Associated* mode of signaling.

   The voice will be established from A to B and the signaling is always A via C to B (vice-versa). C can be a variable for establishing the voice path between A and B. Practically this type of situation seldomly exists. Always C will be defined to a few nodes such as C1, C2 C3 etc. leading non associated mode of signaling to become a quasi associated mode of signaling.

3. *Signaling Link*

   Signaling link is the data link used to transmit only signaling between 2 signaling points.

4. *Signaling Relation*
   Exists between two signaling points when it is possible for information to be exchanged between corresponding user parts at the two points.

5.4 Type of message

With common channel signaling all services will be integrated. So there will be various messages pertaining to telephony, Data, ISDN etc. Also these messages can be generated either locally or internationally, hence to find out the type of message 8 bits will be appended to the original message.

i.e.

5.4 a) Service information Octet

4 Bits	4 bits
Whether the message is From national (1000) or International (0000).	which user part Example: 0000 – Signaling Network 0001 – Signaling Network Test 0011 - SCCP 0100 - TUP 0101 - ISUP

5.4 b) Length Indicator

Basically a message comprises of label, Instruction field, data field and the type of the message.

Hence it is important to know the number of words in this message. This is given in LI-Length indicator in CCITT No.7.

6 bits
LI

So with SIO, the length of the message will be 2 to 63 octets. LI gives the number of octets (8 bits) in the message. i.e spare (2 bits) + SIO (8bits) + label (40 bits) + H_0 (4bits) + H_1 (4 bits) + data field (variable)

5.4 c) Error Correction

Backward error correction is used. Sequence control field of 16bits will be used for error correction in CCITT No. 7. The method employed is automatic repeat request ARQ.

Structure of the sequence controlled field

BSN	BIB	FSN	FIB

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

Forward Indicator = FIB

5.5 Methods

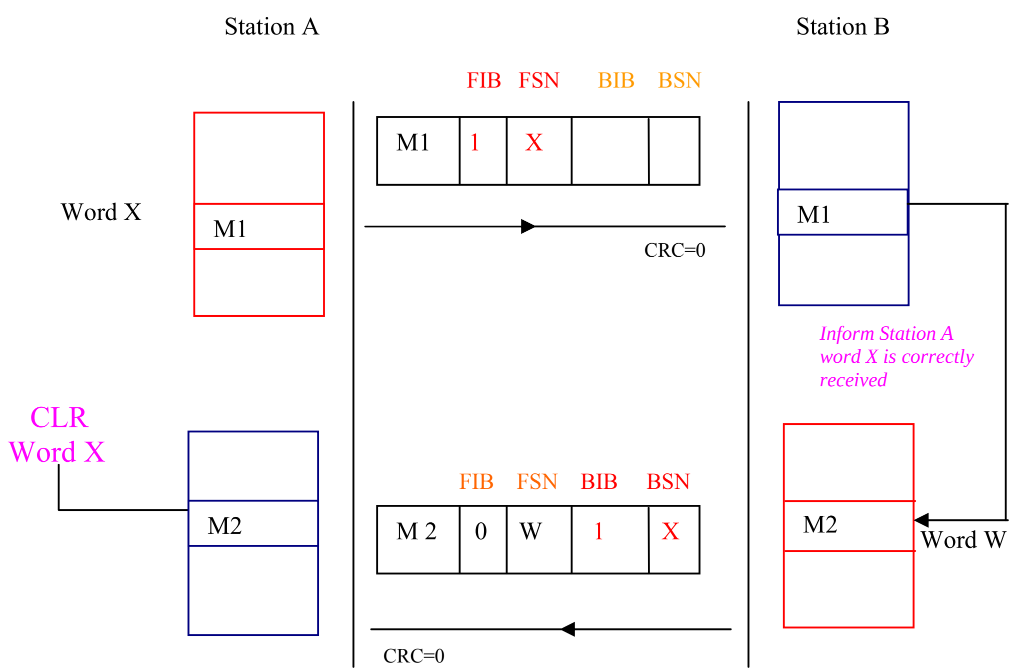
Two methods employed.

5.5 a) Basic Method

Here positive and negative acknowledgements are used for error correction and is used in domestic networks where the propagation delay is less than 30 msecs.

Hence uses the entire field given in the sequence control field. I.e. FSN, FIB, BSN, BIB.

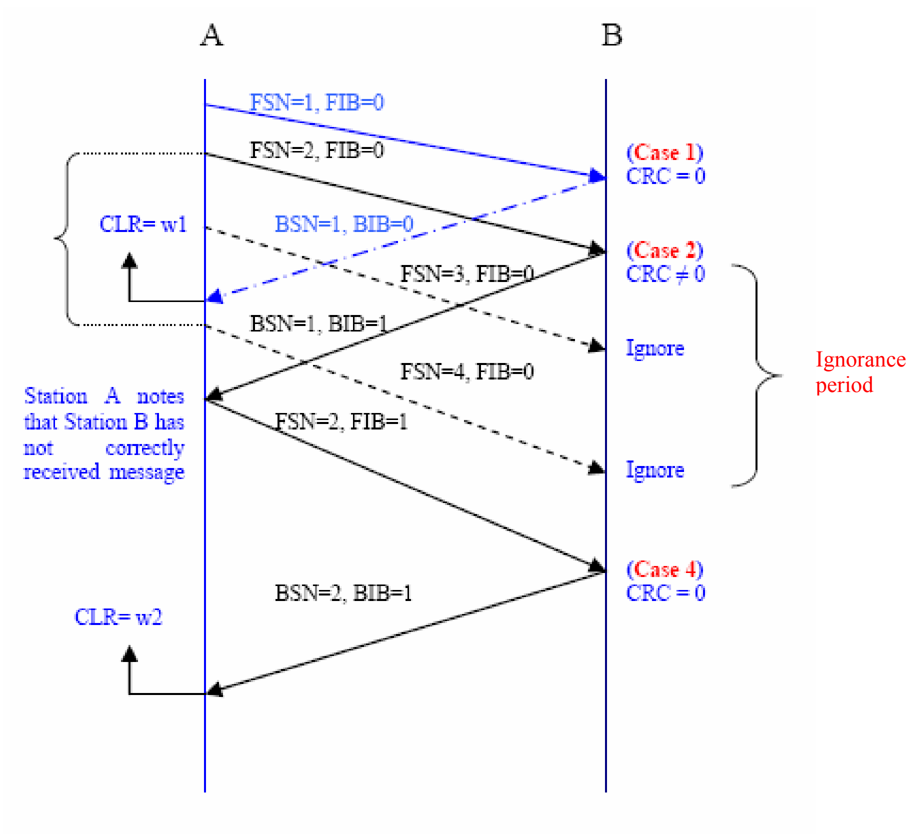
Example:



For a forward message any value of FIB can be given (0 or 1). If this message is correctly received the value of the BIB is to be same as FIB. For the above example FSN=X, FIB=1, If it is received correctly by B then it transmits BIB=1, BSN=X to station A.

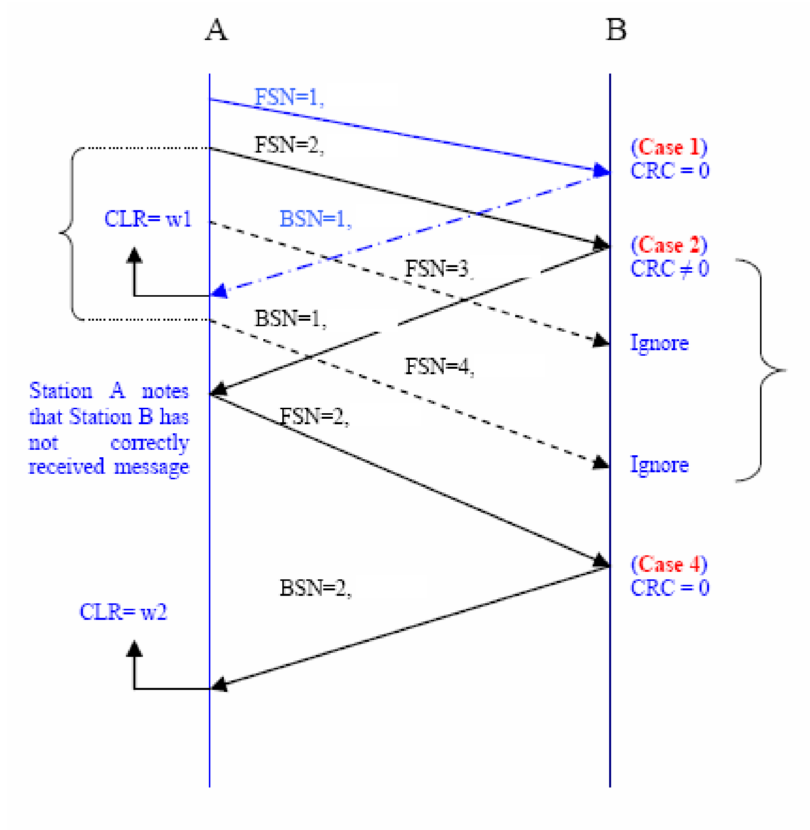
If an error occurred during transmission from A to B, B will identify this as an error with CRC≠ 0. The B will transmit at the immediate message from B to A, with BIB=0, BSN=(X-1) assuming (X-1) word has been correctly received. Hence the basic method of error control deploys positive and negative acknowledgements.

The following example will show how the messages are exchanged between two exchanges in a practical situation. Here message one has been correctly received. Message 2 has been sent twice as there was an error in the first time. During the ignorance period all the messages received from Station A to B with FIB=1 has been ignored by Station B. Station B will start to analyze if FIB=0. The word 2 to be cleared from the transmit buffer at Station A has taken higher time than word 1 to be cleared. In this method the clearing words in the transmit buffer is sequential.



5.4. b) Preventive Cycle Retransmission

Here only positive acknowledgement is used for error correction. This method is used in international networks where the propagation delay is more than 30 msec. Here the sequence control field does not use FIB & BIB and hence those bits will be spare.



5.6 <u>Error Detection</u>

The CRC will be used as the error detection method in CCITT No.7 signaling. It will be formed just before transmitting a message with all the fields mentioned except flags.

5.7 <u>Summary of Error Detection & Correction</u>

<u>Basic Method</u>

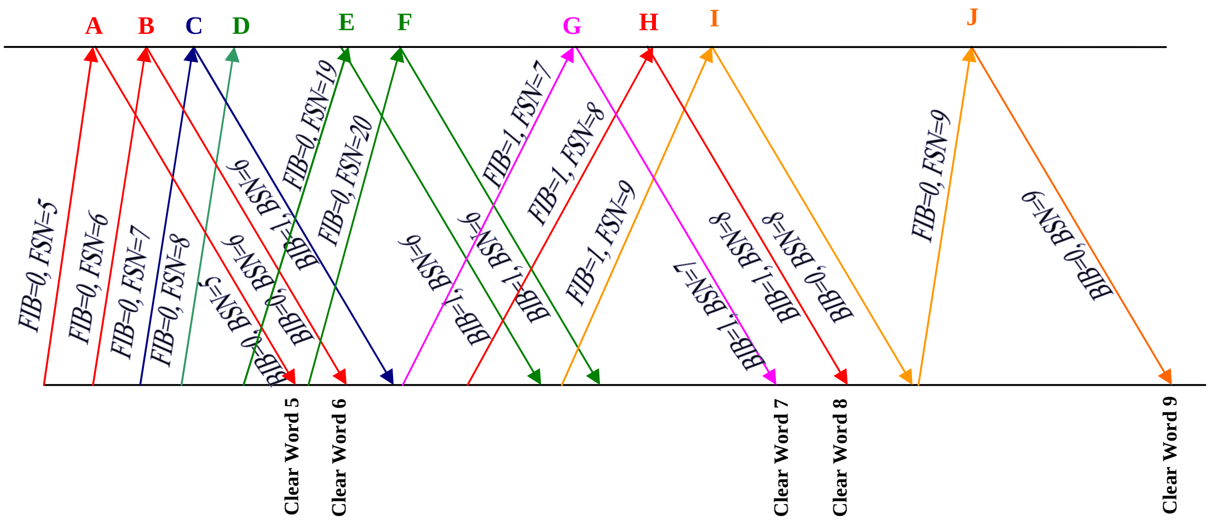
<u>Principle</u>

Basic method → non compelled positive /negative acknowledgement retransmission –uses "GQ back – N" technique of retransmission used in many other protocols if a negative acknowledgement is received, the transmitting terminal stop sending new MSU's and roll back to the MSU received in Error, and it retransmit everything from that point before resuming retransmission of a new MSU's Positive acknowledgements are used to indicate correct reception of MSU's and as an indication that the acknowledgement buffered MSU's can be discarded (or cleared) at the transmitting end.

Implementation
For sequence control, each signal unit is assigned forward and backward sequence number and forward and backward indicator bits. Seven bits are allocated to the sequence number which means maximum of 127 messages can be transmitted without receiving acknowledgement.

Example of Basic Method

The following shows a timing chart of signals exchanged in two signaling nodes. Only the sequence control field pertaining to transmitting station and the respective sequence control field responding from the other node is shown below. The basic method of error correction is being used.



The above timing chart shows how messages are exchanged between two stations. A to J are highlighted incidents in this message transactions. The following are observed.

A: Word number 5 (MSU) in a buffer memory is transmitted to the other station, and it has been received without any error (Positive acknowledgement where FIB=BIB=0). When the transmitter received BSN=5 it will clear word No.5 from the transmitting buffer.

B: Similar to above A for the word No. 6

C: The transmission of word No.7 is received in error. (Negative acknowledgement where FIB≠BIB, and the BSN=6 to inform the transmitting station the last correctively received forward message)

D: Still the transmitter doesn't know that the message No.7 is in error. So he keeps on transmitting the word N0.8 with FIB=0 where the receiver ignore this message since FIB=0

E & F: Similar situation like D (In between D and E about 13 message have been transmitted but no response)

G: At this point that the transmitter has got to know his message number 7 is in error. Hence he re transmit the message No.7 by changing the FIB from 0 to 1. This message has been correctly received by the receiver and BIB=1 with BSN=7 has been sent from receiver to transmitter. Assuming that transmitter has received this message correctly allow the transmitter to clear the word No.7 from the transmitting buffer.

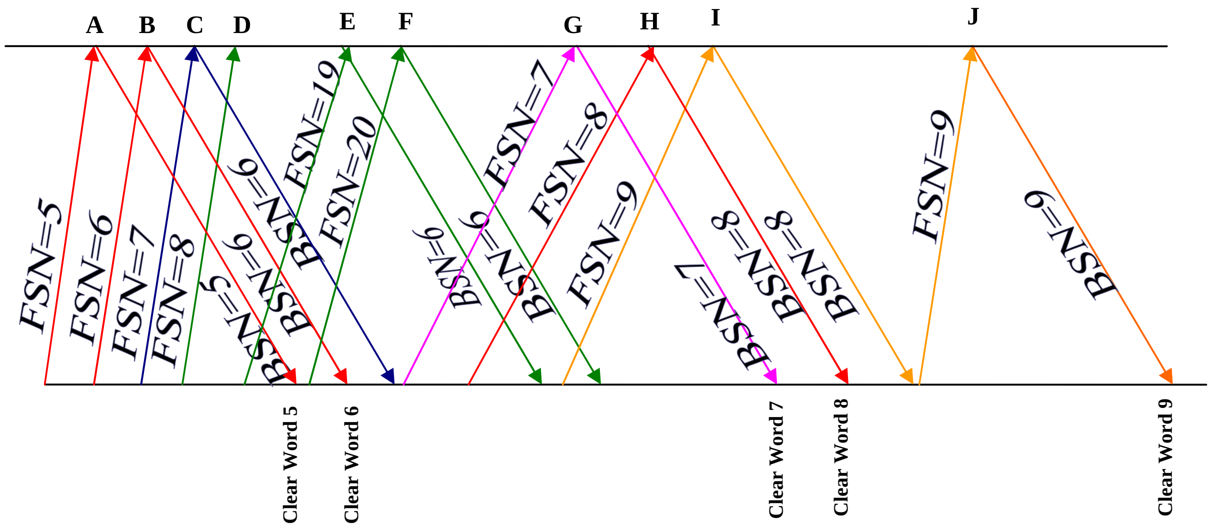
H: Transmitter is starting to retransmit from word number 8, assuming it is correctly received transmitter will receive BSN=8 and BIB=1.

I: The word No.9 is in error. Hence the transmitter received BSN=8 with BIB=0.

From I to J there ca be many messages transmitted from word N0.9. But all these messages will be responded back to the transmitter with BSN=8 and BIB=0 and ignored by the receiver.

J: The retransmitted word No.9 is correctly received and the transmitter is informed with FIB=BIB=0 and FSN=9 so that word No.9 in the transmitter buffer will be cleared.

The above exercise can be illustrated for the preventive cycle retransmission where only the positive acknowledgements are used. Hence FIB and BIB is not used. This can be illustrated as follows.



The above timing chart for both basic method and Preventive Cycle Retransmission, shows how five words in the transmit buffer memory is being transmitted to the other station and how the buffer memory clears. It should be noted the circumstances shown here is purely a imagination to explain the concept of the operation of the sequence control field.