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CHAPTER-9

SIGNALING IN TELECOM NETWORK AND SSTP

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Signaling In Telecom Network And SSTP

1 .0 Introduction

Communication networks generally connect two subscriber terminating equipment units together via several line sections and switches for exchange of user information (e.g. speech, data, text or images).

The term "signaling" consists of a word signal, which means "indication" about some information. The procedure for transfer of the signal between two nodes or points in telecom network is known as signaling. The signaling is used to transfer control information between the exchanges for call control and for the use of facilities.

There are three basic phases in a communication viz setup, conversation and release. Diagram shows a simple telecom network and indicates the component of network and type of signaling used therein.

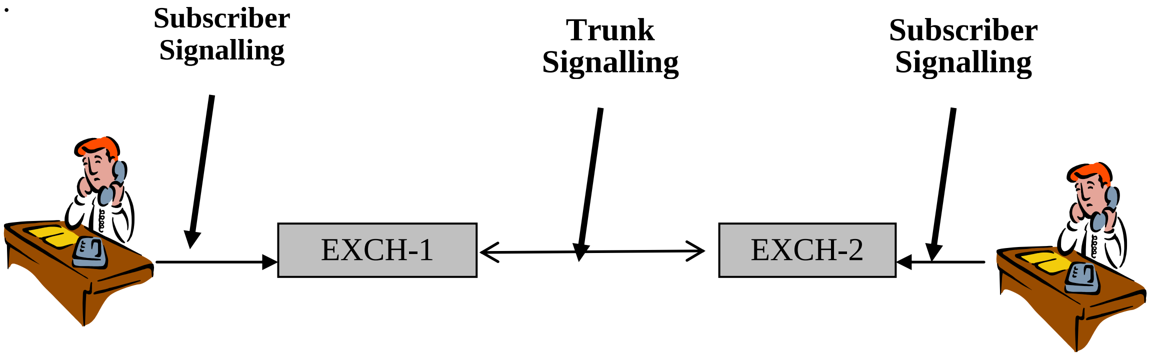


FIG.1.1

Subscriber Signaling Signaling systems used between the exchange and subscriber equipment, such as terminals and PBX (Private Branch exchanges), are called subscriber signaling systems. Subscriber signaling must not be confused with line signaling. Subscriber signaling can be transported over lines and subscriber trunks.

Trunk Signaling Trunk signaling are signals used between public exchanges. They are used to connect exchanges in order to build up a circuit. The signals can be divided in supervision and address signaling.

Supervision Signaling Supervision signaling (**also called line signaling**) is used to control and monitor the status of the transmission circuits. Examples of supervision signals are the seizure signal and idle state signal. Supervision signals do not contain any specific subscriber information such as the directory number.

Address Signaling Address signaling (also called build-up or **register signaling**) is a protocol, which is used to transfer the specific subscriber information necessary to connect the calling party to the called party. Address signaling is related to a certain call. Examples of address signaling information are the called party's directory number and the calling party's category.

1.2 Basic Class Of Signaling System.

(i) Multiple Frequency signaling

(ii) Digital signaling

1. Channel Associated signaling (CAS)
2. Common Channel Signaling (CCS)

Channel Associated Signaling

A signaling system is called a channel associated signaling system when the location of the signaling information is related directly to the user voice/data or . In the 30 channel PCM link (also called 2Mb link), a frame consists of 32 timeslots. Of the 32 timeslots, 30 channels are used to transport user voice/ data, one channel (timeslot 0) is used for timing, status and synchronization. One channel (timeslot 16) is used to carry signaling information related to the 30 voice data channels. Figure 2 shows the structure of a PCM link. Thus duration of a pulse frame is 125µs. Every timeslot consists of 8 bits. In timeslot 16, frame 1, signaling information related to the user voice/data in timeslots 1 and 17 is loaded. etc. Timeslot 1 to 15 and 17 to 31 are used for user voice/data (channels).

30 Chl PCM system (2 mbps Stream)

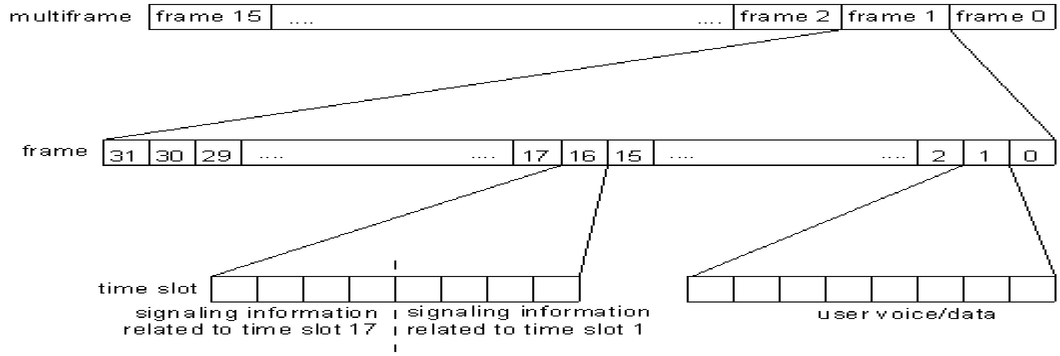


FIG.1.2

Common Channel Signaling (CCS)

A signaling system is called a Common channel signaling system when a channel is common for sending all the signaling information of a nos. of users on sharing basis. In this case also TS16 is normally used as common channel i.e. signaling link. All the 8 bits of time slot 16 are used for signaling / control information.

The CCITT has therefore specified the common channel signaling system no.7. CCS-7 is optimized for application in digital networks with the following main features:

- internationally standardized (national variations possible)
- suitable for the national and international intercontinental network level
- suitable for various communication services such as telephony, text , data services
- high performance and high reliability for message transfer
- signaling links always available, even during existing calls
- used on various transmission media
- use of the transfer rate of 64 kbit/s typical in digital networks
- automatic supervision and control of the signaling network.

- **Signalling Network**

In CCS7 the signaling and call control messages are sent separately via separate signaling links (see Fig. 2.1). One signaling link can convey the signaling messages for many user circuits.

The CCS7 signaling links connect signaling points (SPs) in a communication network. The signaling points and the signaling links form an independent signaling network, which is overlaid over the circuit network.

- **Signaling Points (SP)**

Various terminologies used in this concepts are **Signaling points (SP), Signaling End Point (SEP), Signaling transfer points (STP**) and. **Signaling transfer End point (STEP**).

The SP / SEP is the source (originating point) and the sink (destination point) of signaling traffic. In a communication network these are collocated with the exchanges.

The STPs / STEPs switch signaling messages received to another STP or to a SP on the basis of the destination address. No call processing of the signaling messages occurs in a STP/STEP. A STP can be integrated in a SP (i.e. STEP) or can form a node of its own in the signaling network. One or more levels of STPs are possible in a signaling network, according to the size of the network.

All SPs in the signaling network are identified by means of a code (SPC) and theoretically there can 16384 codes within a network.

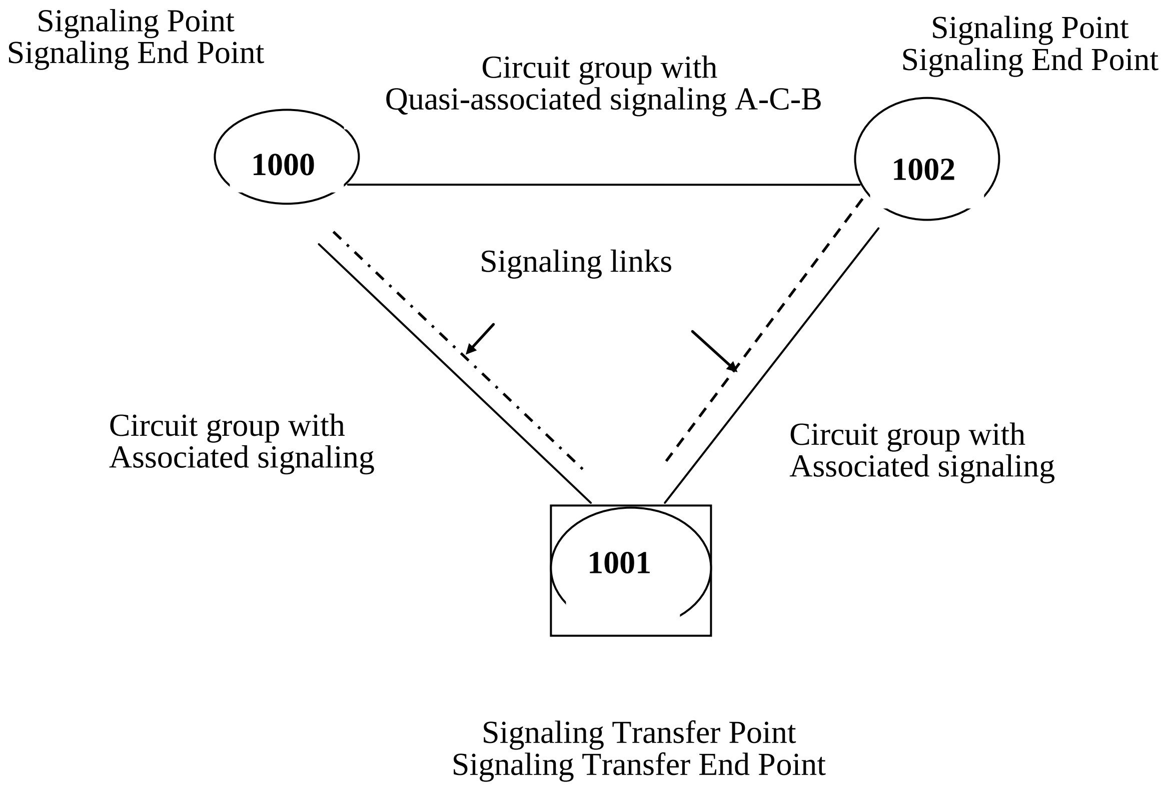


Fig. 2.2

- **Signaling links**

A channel of an existing transmission link (e.g. a PCM30 link) is used as the signaling data link. Generally, more than one signaling link exists between two SPs in order to provide redundancy. In the case of failure of a signaling link, functions of the CCS7 ensure that the signaling traffic is rerouted to fault-free alternative routes.

- **Signaling modes**

Two signaling **modes** can be used in the signaling networks for CCS7.
In the **associated mode** of signaling, the signaling link is routed together with the circuit group belonging to the link. In other words, the signaling link is directly connected to SPs which are also the terminal points of the circuit group.. This mode of signaling is recommended when the capacity of the traffic relation between the SPs A and B is heavily utilized.

In the **quasi-associated mode** of signaling, the signaling link and the circuit group run along different routes, the circuit group connecting the SP A directly with the SP B. This signaling mode is favorable for traffic relations with low capacity utilization, as the same signaling link can be used for several destinations.

- **Signaling routes**

The route defined for the signaling between an originating point and a destination point is called the signaling route. The signaling traffic between two SPs can be distributed over several different signaling routes.

- **Structure of CCS7**

The signaling functions in CCS7 are distributed among the two parts:

- Message Transfer part (MTP)
- User Parts (UP).

The functions of the MTP and the UP of CCS7 are divided into 4 levels. Levels 1 to 3 are allotted to the MTP while the UPs form level 4 (see Figure 3.1).

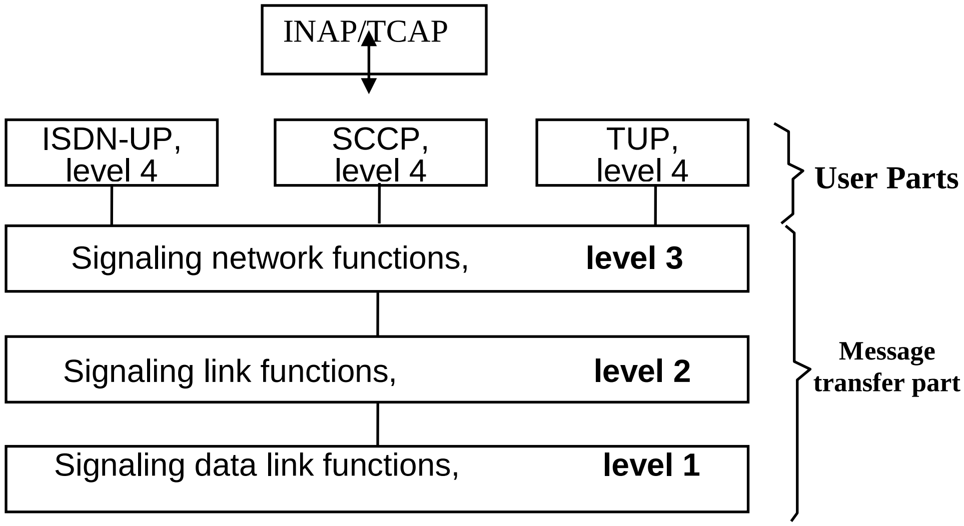


Fig. 3.1: Functional Levels of CCS7

- **Level-4 (User Parts)**

Level 4 functions include formatting of messages based on the applications, are allotted to UPs. Each UP provides the functions for using the MTP for a particular user type. The following UPs are specified by the CCITT;

- telephone user part (TUP)
- integrated services digital network user part (ISUP)
- the signaling connection control part (SCCP)
- the transaction capabilities application part (TCAP)
- the mobile application part (MAP)

For Intelligent Network (IN) application, Intelligent Application Part (INAP) and TCAP are used. SCCP forms the interface between these UP and MTP.

- **Message Transfer Part**

The message transfer part (MTP) is used in CCS7 by all user parts (UPs) as a transport system for message exchange. Messages to be transferred from one UP to another are given to the MTP. The MTP ensures that the messages reach the addressed UP in the correct order without information loss, duplication or sequence alteration and without any bit errors.

- **Functional levels**

Level 1 (signaling data link) defines the physical, electrical and functional characteristics of a signaling data link and the access units. Level 1 represents the bearer for a signaling link. In a digital network, 64-kbit/s channels are generally used as signal-ing data links.

Level 2 (signaling link) defines the functions and procedures for a correct exchange of user messages via a signaling link. The following functions must be carried out level 2:

- error detection using check bits
- error correction by re-transmitting signal units
- error rate monitoring on the signaling data link
- restoration of fault-free operation,

Level 3 (signaling network) defines the inter-working of the individual signaling Links. Following functions are performed.

- message handling, i.e. directing the messages to the desired signaling line, or to the correct UP
- signaling network management, i.e. control of the message traffic, message route and message link by means of changeover of signaling links if a fault is detected and change back to normal operation after the fault is corrected.

- **Signal Units (SU)**

The MTP transports messages in the form of SUs of varying length. A SU is formed by the functions of level 2. In addition to the message it also contains control information for the message exchange. There are three different types of SUs:

- Message Signal Units (MSU)
- Link Status Signal Units (LSSU)

- Fill-In Signal Units (FISU).

The MTP transfers user messages by using MSUs between the UPs, for call control and messages from the signaling network management (level 3). The LSSUs contain information for the operation of the signaling link (e.g. link status and alignment).

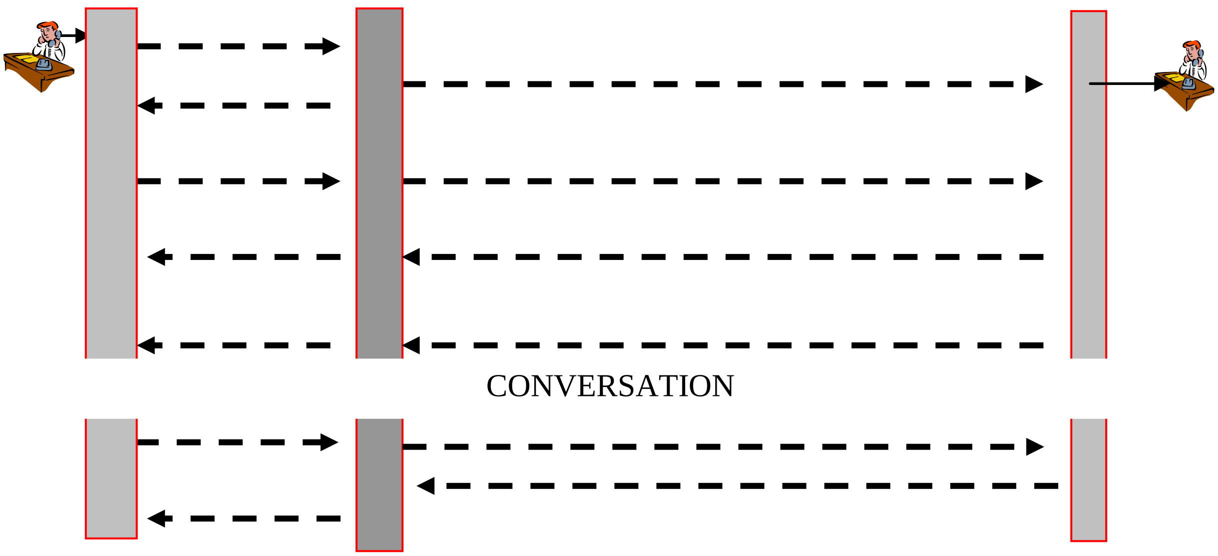
The FISUs are used to maintain the acknowledgment cycle (sync) when no user messages are to be sent in one of the two directions of the signaling link.

- **Advantages of CCS7**

- Signaling Channel is allotted only for the duration of the signaling (optimum utilization & space saving)
- Faster call setup
- Introduction of new services is possible
- More call completion
- Security of calls ensured
- Efficient NMS
- Easy & Efficient traffic engineering

- **Some Messages for an ISUP / TUP call**

In this example, we can see how C#7 signaling is used for call setup and call release in case of ordinary or ISDN subscriber. C7 is a message based signaling and messages are being sent in message signaling unit. These signaling units are routed through signaling network in a particular signaling link.



- **SSTP (STANDALONE SIGNAL TRANSFER POINT)**

- **Need of SSTPs**

The efficiency of SS7 had made a numbers of applications possible with e.g. fast connection setup in PSTN, "short message service" and "location update" messages in GSM world. As the size of the network grew, it became more and more difficult to manage the direct SS7 links between the switches and from switches to other network elements like HLR, SMSC, SCPs etc. The introduction of Standalone Signal Transfer Point (SSTP) was a historic step from that perspective. It immediately solved issues related to the complexity by converting the mesh networks into the star networks. It is now able to handle the signaling very efficiently. This capability also offloaded some of the processing power required in the L-1 TAX and all switches could breathe easier.

SSTP also handle the non call related messages efficiently. These messages exist in all the technology and may not be needed to be hand by a switch. Many times these will actually involve multiple technologies and in absence of the uniform signalling layer, the complexity increase many fold. For example a simple service like SMS, a CDMA subscriber may send the message to a GSM subscriber that could go through the long distance network. This involves three different networks and three technologies. However one thing is common, which is signalling as the transport to carry this.

The SSTP suddenly became the vantage point in the network because of the simple reason that the signalling protocol was common i.e. SS7, independent of the technology and the access. Be it GSM or CDMA, the connectivity was based on SS7 with different application parts (MAP, INAP etc.). Thus the SSTPs are actually a centralized routing database and not a transmission system for SS7 packet.

As the subscribers are growing, the number of nodes involved in the routing is also increasing exponentially. If the management of the routing is to be done on these individual nodes, the complexity increases accordingly, which also mean the increased chances of error and hence loosing the revenue. The SSTP, enabling the uniform signalling in SS7 domain, provided a single routing database, which is managed centrally. This routing database is able to make the routing decision based on the destination point codes (DPC), global title translation (GTT), routing keys etc.

When any mobile subscriber of a private operator roams into service area of other operator (say BSNL), the signaling traffic or SMS are being handled by signaling channel of BSNL taken by private operator against the POI. BSNL was not able to measure the traffic and it was also not known about the type of signaling traffic. To measure and know type of signaling traffic, SSTP was planned and installed so that billing to private operators can be done accordingly.

Due to reasons explained above, BSNL decided to have a separate signalling network by installing a number of SSTPs at various locations.

- **Objectives of SSTP's**

Following were the main objectives:-

- Regulate, measure, and account for inter-network traffic including SMS messages from mobile networks including GSM and CDMA
- Achieve a flexibility and transparency in management of signalling for BSNL's wired and wireless networks.
- Optimal expansion of GSM & CDMA network of BSNL
- Introduction of new services.
- Offer CCS7 & IP Signalling Services to other Wire line & Wireless Network Operators.

With the above objectives in mind, BSNL awarded a contract to Ms. ITI for the supply and installation of 10 SSTP nodes in September, 2005. Later on, the scope of the project was further expanded to provide 24 nodes in total covering all the major location including all the level-1 TAX locations. This was a significant step in the direction of the giving the decades old BSNL network an uplift.

SSTP's at BSNL Network

- 21 TAX Locations with an STP at each location.
- Pair of STPs are designated as mated pair with identical routing data and complete failover capability.
- **Phase 1 -** 10 Locations
- **Phase 2** - 11 additional locations: This was later changed to 24 locations to take care of the connectivity issues.
- 4 Additional locations are Jammu, Shimla, Dimapur, Shillong and droping Raipur
- Phase 3 Expansion of all 24 nodes to about capacity of 1800 LSL per node

- 6 STPs are designated as ANSI-ITU MTP gateway (ILD Gateways).
- Connect multiple SS7 nodes (MSC, L1 TAX, L2 TAX, Local Exchanges, SMSC, HLR, SCP) to a mated pair uUsing SS7 E1 links.
- SSTPs interconnected using BSNL's IP/MPLS network on M2PA
- Later on M3UA functionality is also included to connect the access nodes e.g. Soft switch, GMSC, IN, HLR etc.
- Centralized Network Management with an Active and DR Standby site
- Central Billing Server for billing inter-carrier SS7 usage

Planned Applications on SSTP Network

- Lawful Intercept of SMS
- Mobile Number Portability

Plan: Phase-1 & Phase-2:

Name of SSTP Location	**Plan in phase-1 (no. of links)**	**Plan in phase-2 (no. of links)**	**Total**
AHMEDABAD	300	900	1200
BANGLORE	300	900	1200
BHOPAL	300	900	1200
CHENNAI	300	900	1200
HYDERABAD	300	900	1200
JALANDHAR	300	600	900
KOLKATA	300	900	1200
LUCKNOW	300	900	1200
MUMBAI	300	900	1200
New Delhi	300	600	900
Total	3000	8400	11400

New Nodes in Phase -2

Name of SSTP Location	Links Capacity
Agra	900
Ambala	600
Coimbatore	1200
Cuttak	600
Ernakulam	1200
Guwhati	1200
Jaipur	900
Nagpur	900
Patna	900
Rajkot	600
Shimla*	600
Jammu*	600
Shilong*	300
Dimapur*	300

SSTP Phase-3

SSTPs in phase-3 were planned to handle NGN IP TAX network Signaling load.

Sl. No.	**Name of station**	**LSL**	**Total ph.(1+2+3)**	**SIGTRAN**	**HSL**
1	Agra	950	1850	8	8
2	Ahmedabad	650	1850	20	20
3	Amabala	1250	1850	8	8
4	Bangalore	650	1850	20	20
5	Bhopal	650	1850	12	12
6	Chennai	650	1850	20	20
7	Coimbatore	650	1850	12	12
8	Cuttack	1000	1600	8	8
9	Ernakulam	650	1850	12	12
10	Guwahati	650	1850	12	12
11	Hyderabad	650	1850	20	20
12	Jaipur	950	1850	8	8
13	Jallandhar	950	1850	20	20
14	Shimla	1000	1600	8	8
15	Jammu	1000	1600	8	8
16	Kolkatta	650	1850	20	20
17	Lucknow	650	1850	20	20
18	Mumbai	650	1850	20	20
19	Nagpur	950	1850	8	8
20	New DelhI	950	1850	8	8
21	Patna	950	1850	8	8
22	Rajkot	1000	1600	8	8
23	Shillong (NE-1)	550	850	6	6
24	Dimapur (NE-2)	550	850	6	6
	TOTAL	**19200**	**41400**	**300**	***300***

Chapter 9. Signalling in Telecom Network and SSTP

Sample Self study Objective type questions &Answers

1. CCS 7 stands for :-
   a) Common Channel System,
   b) Common Communication System
   c) Common Channel Signalling System
   d) All of the above

2. What are the two types of digital signaling ?
   a) CAS
   b) CCS
   c)both a and b
   d) none

3. Which of the levels of CCS7 is called Signalling data link ?
   a) level 1
   b) level 2
   c) level 3
   d) level4

4. Transfer of messages reliably on an individual signaling link is the job of :-
   a) level 1
   b)level 2
   c)level 3
   d) level4

5. Network Management and message handling is done by :-
   a) level 1
   b) level 2
   c)level 3
   d) level 4

6. Which level of CCS7 is responsible for grouping of various user parts ?
   a) level 1
   b) level 2
   c)level 3
   d) level 4

7. The two modes of digital signaling are :-
   a) Associated
   b) Quasi-associated
   c) both 1 and 2
   d) none

8. What is true about SSTP?
   a)It handles only signaling traffic and not voice traffic.
   b) It is deployed in mated pairs.
   c) It is required for MNP and lawful message interception

9. SSTP stands for :-
   a) Super Signaling traffic point
   b). Standing signaling transfer point
   c) standalone signaling transfer Point