

# CHAPTER IX

## TELEPHONE EXCHANGE & TRUNK EXCHANGE

### 9.1 EXCHANGES :

9.1.1 All Telephone Exchanges shall be

- \* Automatic
- \* Electronic
- \* Digital
- \* Stored Programme Controlled (SPC)
- \* Pulse Code Modulation (PCM, Time Division Multiplexing (TDM) technology.

9.1.2 The exchanges shall be Transit cum Local Exchanges providing connectivity between :

- \* Subscriber to Subscriber
- \* Subscriber to trunk
- \* Trunk to Subscriber
- \* Trunk to trunk

9.1.3 Separate trunk Automatic Exchange shall be provided at Zonal Railway Headquarter for Indian Railways Network. The transit functions at other places shall be integrated in the Local-cum-Transit Exchange.

9.1.4 The manual trunk connections shall be provided through Operate consoles (Attendant Consoles). The Operator Console shall be an integral part of the Exchange. Separate manual trunk exchange are not required to be provided.

9.1.5 Attendant Consoles :

The attendant consoles which replaces the Trunk Boards shall be an integrated part of the exchange. This shall assist the trunk operator to provide Trunk connections. Facility shall exist to monitor the calls. Busy indication of the trunk shall be available. Head phones shall be provided with Attendant console.

#### 9.1.6 Subscriber Telephone Set :

All telephones shall be push button type. The signalling may be decadic or DTMF type. The telephones shall be of the following type :

- Ordinary
- Secretary and Executive type
- Digital
- Magneto
- 4 wire

#### 9.1.7 The IR (Indian Railway) exchange network is a hierarchical architecture with 3 levels.

Highest level - Zonal Head Quarters (ZHQ) and Railway Board (RB)

Medium level - Divisional HQ (DHQ)

Lowest level - Important activity centres

#### 9.1.8 The exchanges shall be interconnected using manual trunks through Trunk Operators or through Subscriber Trunk Dialing (STD) channels. Where digital transmission system is planned, the ZHQ to DHQ and DHQ to important location exchange shall be connected through high speed 2 MB/s (30 channel) trunk groups.

#### 9.1.9 All exchange shall be available on IR STD network subjected to availability of channels. Each exchange shall have a distinct STD code. Alternate routing shall be provided as far as possible.

#### 9.1.10 Wherever possible interconnection to DOT exchange shall be provided through Direct Inward Dialing (DID) and Direct Outward Dialing(DOD) facility. The traffic for such trunk lines shall be taken as 0.8 Erlang/Trunk line and calculation of trunk lines shall be done accordingly.

## 9.2 SPECIFICATION & PERFORMANCE PARAMETERS

#### 9.2.1 The digital exchanges shall be of the following basic capacity and shall be modularly expandable.

128 port

256 ports

512 ports

1024 ports

2048 ports

4096 ports

9.2.2 The exchange shall have ports to connect subscribers with

Decadic phones

DTMF phones

Digital phones

Hot line

Long distance

lead line through any media of communication

- Trunk through all media of communication  
(O/H, Cable, VHF, UHF, MW, OF)

- Attendant consoles

9.2.3 2 MB/s or higher speed trunk ports shall be planned in the exchange for high speed connectivity between exchanges.

9.2.4 The capacity of the exchange shall be defined with the following details :-

- Wire Capacity

- Equipped Capacity with

. No. of subscriber ports- decadic/DTMF and digital phones.

. No. of long distance subscriber, trunk ports with various type of signaling

. 2 MB or higher speed trunk port.

. Ports for attendant console

9.2.5 The Architecture of the Exchange shall be with the following protection arrangement.

a) Up to 128 ports

CPU and control cards -1 + 0 Configuration

Memory -1 + 0 Configurations

Power supply unit -1 + 1 hot Stand By (S/B)

b) Exchange with capacity higher than 128 ports

CPU and control card -1+1 hot Standby configuration & hot swappable

Memory -1+1 hot Standby configuration & hot swappable

Power supply card -1+1 hot Standby configuration & hot swappable

9.2.6 The exchange shall be fully non-blocking.

9.2.7 The minimum BHCA (Busy Hour Call Attempts) for exchange shall be as follows:-

Up to 128 port	=	20,000
Above 128 up to 256 port	=	50,000
Above 256 up to 512 port	=	1,00,000
Above 512 up to 1024 port	=	1,50,000

9.2.8 The exchange software shall be loaded on hard disc or flash RAM for operation as well as a back up copy must be available.

9.2.9 The software must have self diagnostic feature and the failure must be available as print out.

9.2.10 The basic requirements of the protective device provided on MDF shall be as under :

- i) The device shall not operate on speech or signaling currents.
- ii) It shall not decrease the efficiency of speech or signaling circuit.
- iii) The device shall promptly operate in cases of the specified voltages or currents being reached.
- iv) The device shall promptly isolate the equipment and prevent further damage in cases of overload due to artificial or natural causes.
- v) The current rating of the device shall be such that they do not produce noticeable heat in the components of the main equipment.
- vi) The device shall prevent transient discharges which would normally injure the audio system of the listener.
- vii) The device shall be as far as possible self restoring type.
- viii) The prospective devices shall consist of fuse & lightning discharger. The fuse shall be connected in series with each external line.
- ix) The Integrated Protection Modules shall be provided in case of Krone type connectors.
- x) The rating of the fuse shall be as per the requirement of exchange equipment.
- xi) The Protection arrangement shall be installed on IDF or MDF.
- xii) The subscriber's protective device assembly shall consist of a single compact dust proof unit containing fuse and lightning arrester.

9.2.11 The Signalling used shall be :

- i) User line signalling \* Decadic dc loop/disconnect signalling
- \* DTMF signalling
- \* D-Channel protocol (ISDN)

ii)	Inter Exchange Signalling	*	4W E&M
		*	4W digital (64 kbs)
		*	DC - loop/disconnect signalling
		*	R2 MFC (Indian version)
		*	CCITT Signalling system No.7 (Common Channel Signalling)
		*	Q-Sig for feature transparency

### 9.3 SYSTEM REQUIREMENTS

9.3.1 The various components of the exchange system shall be

- a) Exchange hardware
- b) Exchange software
- c) Man Machine Interaction Terminal PC with Printer
- d) Test and measuring instruments
- e) Power supply Arrangement consisting of Batteries, Charger, Changeover panel and stand-by system.
- f) Intermediate Distribution Frame
- g) Main Distribution Frame
- h) Protection arrangement
- i) Attendant consoles
- j) Cable (underground and switch board)
- k) Subscriber telephone set
- l) Maintenance tools
- m) Documentation
- n) Lightning protection and Earthing arrangement

9.3.2 The man machine language must be in English and user friendly. A VDU, keyboard and a printer alongwith a PC must be available for interaction with the Exchange.

9.3.3 The exchange shall be worked with batteries on float. The capacity of the batteries shall be to provide minimum 8 hours back up. One set of battery, two chargers and a change over panel are to be provided for supplying power supply to exchange. The capacity of power supply arrangement shall be 30% higher than the exchange load. The charger shall be preferably SMPS (Switch Mode Power Supply) type.

9.3.4 The IDF (Intermediate Distribution Frame) shall have disconnecting type connectors with facility for isolating exchange indoor and outdoor side. The cable terminals shall be installed on a rack. Protection arrangement shall be available on IDF. All testing for line side shall be done from IDF. The IDF may be accommodated in exchange equipment room.

9.3.5 All outdoor cable shall be terminated on a rack forming the Main Distribution Frame (MDF). This shall provide connectivity between outdoor cable and indoor switch board cable. The Main Distribution Frame shall be installed in a separate room but not in the exchange room. An earth is connected across the frame for its entire length and preferably this shall be a copper strip clamped to the frame.

#### 9.3.6 Cables:

The outdoor cables shall be jelly filled underground type. The indoor cables shall be switch board cables. The outdoor cables shall be 20 pair, 50 pair and 100 pair capacity. The indoor cable shall be 5 pair, 10 pair, 20 pair and 50 pair.

The outdoor cable shall have outdoor Termination Box/Location Box with terminals for proper termination of the cable. The indoor cable shall be terminated on CT boxes of appropriate size. The cables, cable Terminals in CT Boxes shall be planned with 30% spare capacity. All outdoor cable sheath shall be earthed while entering the exchange at MDF.

#### 9.3.7 Lightning protection and Earthing arrangement

The earthing arrangement shall be consisting of

- Earth pits minimum four with Earth electrodes connected in a ring
- Two earth wires connecting Earth Electrodes to Earth Distribution Frame
- Earth wires from each equipment to Earth Distribution Frame (Exchange rack, IDF, MDF, Charger, Battery, Gen set, Power panel, Cables)

#### 9.3.8 Civil Infrastructure:

The exchange room shall be dustproof, with false ceiling, mosaic flooring, windows with double doors, underground duct or overhead trough for running of indoor cables. Separate Operator Console room, Power supply room, Battery room, DG set room and MDF room shall be provided. Floor should be strictly level and high enough to avoid flooding.

#### 9.3.9 Electrical Supply :

230 V AC single phase shall be available. With power lines suitable for taking the load, Alternate supply shall be provided either traction supply or DG set. The power supply shall enter the room through MCB and changeover switch with proper earthing arrangement.

9.3.10 The exchange equipment room shall be air conditioned. 22-25 degree C. shall be maintained inside the room. 50% standby air conditioners shall be provided. Lightning shall be adequate for maintenance.

9.3.11 All equipment shall be provided on racks. Mounting on the walls shall be avoided. The equipment rack shall be minimum 1 meter away from the wall. The racks shall be fixed on the floor with proper arrangement. Underground ducts shall be provided for entry of UG cables. Duct/overhead troughs shall be provided to run the indoor cables. In case of UG cable entry the duct shall be filled with sand and plastered on the top.

## 9.4 MAINTENANCE

### 9.4.1 PREVENTIVE MAINTENANCE

- A) Daily
  - i) Batteries voltage and charger output voltage.
  - ii) AC supply voltage and charger output voltage.
  - iii) Cleaning of equipment rooms with vacuum cleaner and wiping of the floor for all rooms.
  - iv) Failure list of the subscribers.
  - v) Testing of all the trunks (STD,OTD and other) circuits.
  - vi) Working of Lights, Air conditioners.
  - vii) System status listing
  - viii) Failure history list
  - ix) Alarm checking
  - x) Room temperature recording
  
- B) Weekly
  - i) Specific gravity, voltage and load test of the batteries, sulphation of terminals.
  
- C) Monthly :
  - i) Wiring and connecting terminals of power supply arrangement.
  - ii) The different modes of operation of FCBC, the internal checking and cleaning of FCBC.
  - iii) Earthing connections of all equipment and earth electrodes.
  - iv) All cabinets of equipment, Man machine interaction, terminal printer, attendant consoles to be cleaned.
  - v) Cable termination MDF and IDF to be cleaned and checked.
  - vi) Cable runs-inter rack, rack to IDF, MDF and Attendant consoles to be checked.
  - vii) Transmission loss test of all trunk circuits
  - viii) Office Data Back up to be updated.
  - ix) Checking of GD tubes
  - x) Functional Testing of Attendant console
  - xi) Tone testing of MW circuits & realignments
  - xii) Traffic data listing & analysis

- D) Quarterly :
- β i) Contact points of Attendant console to be cleaned with contact cleaner.
  - ii) Testing of All Service features from the Test Telephones.
  - iii) Cleaning of terminations in CT boxes, Location boxes.
  - iv) Adjustment of SMPS modules

- E) Yearly :

- i) Earth resistance value measurement
- ii) Line loop resistance and insulation testing
- iii) Checking of wiring of subscribers premises, CT boxes and location boxes.
- iv) Testing of spare cards
- v) Analysis of load distribution among operators console
- vi) System programme backup

#### **9.4.2 Inspection :**

The following are the details to be checked during routine Inspection.

- a) Subscriber's office
  - i) CT boxes
  - ii) Wiring
  - iii) Lightning arrester
  - iv) Batteries/power supply arrangement
- b) Cables/overhead alignment
  - i) Type of cable and length
  - ii) Cable route conditions with special attention at culverts, bridges, road crossings, track crossing, building entry points.
  - iii) All registers pertaining to cable laying, testing
- c) Exchange
  - i) MDF/IDF wiring, connectors, terminals, fuses, GD tubes.
  - ii) Earth connections, Earth readings.
  - ii) Power supply arrangement, battery registers, battery terminals, wiring, charger and power panel.
  - iv) Internal cabling, cabinets, visual inspection of wiring.
  - v) Fault register
- d) Periodical Inspection



- i) All exchanges and other telephones installations shall be inspected and tested, where necessary, by ASTE/DSTE/Sr.DSTE at least once a year. Maintenance records and faults registers shall be checked for their proper upkeep.
- ii) Sr. Section Engineer Telecom should carry out detailed and effective inspection and testing once in a quarter year and Junior Engineer(Tele) once in a month.

#### 9.4.3 Testing and Commissioning :

- i) Cable/overhead line testing shall be conducted for each subscriber. Insulation, loop resistance for cable/OH line is to be tested and recorded.
- ii) Provision of fuses, GD tubes are to be checked for all lines.
- iii) The earth resistance for each earth electrode is to be measured. The connectivity of earth wires to each equipment is to be checked.
- iv) Hardware testing shall be conducted as per instructions of manufacturer.
- v) Software testing shall be done as per guidelines given by supplier.

#### 9.4.4 Documentation :

The exchange shall have the following documentation :

- a) Indoor Equipment
  - Exchange layout plan
  - Rack layout plan for each rack with connection details
  - MDF and IDF termination plan
  - Installation manual for equipment
  - Software documentation
  - Operation and maintenance manual
  - Wiring diagram for power panel
  - Manual for chargers
- b) Outdoor Equipment :
  - Telephone No. wise subscriber's details
  - Subscriber wise Telephone Directory
  - Cable/Overhead layout plan

- Subscriber premises wiring plan typical.

9.4.5 The tools available in exchange shall consist of

- Screw drivers assorted
- Nose Plier
- Crimping tool
- Krone Extractor
- Cutter
- Soldering kit

9.4.6 The following test and measuring instruments shall be available in exchange for testing and maintenance

- \* Line tester to test line conditions
- \* Megger for testing of insulation of line.
- \* Digital multimeter

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