INDEX

1 CSC AND VARIOUS SALES CHANNELS

1.1 LEARNING OBJECTIVES

At the end of this unit , you will be able to understand about :

- Operation And Maintenance Of BSNL CSCs
- CM Sales And Distribution Policy
- Rural Distributor Policy
- Role Of Sales Team Members
- Telecom Infrastructure Providers (TIPs)
- BSNL RED (Retired EMPLOYEE DISTRIBUTOR) POLICY

1.2 INTRODUCTION

BSNL is providing unique opportunity to Franchisees, System Integrators, DIDs, Franchisees of BSNL, any registered company or society, Local Cable TV Operators, Telecom Infrastructure Providers, BSNL Retailers, Direct Selling Agents Start-ups or local entrepreneurs for providing BSNL Telecom Services in the existing and upcoming residential/commercial complexes and all other parts of rural and urban areas on revenue sharing basis.

Where the Channel Partners Role involves building or extending and maintaining BSNL Network and its customers and to explore the possibility of expanding the BSNL Customer base through extension of last mile connectivity in provisioning of BSNL Services by the prospective partners and to expand the Telecom footprint for BSNL across India.

1.3 CSC CATEGORIES

CSC refers to BSNL Customer Service Centre. The CSCs of the SSA has been broadly classified into three categories, namely Category-I / Category-II / Category-III CSCs, depending upon the monthly volume of business conducted.

1.4 OPERATION AND MAINTENANCE OF BSNL CSC

a) Sale of new SIMs Normal and Bulk Booking/Vanity and fancy number Booking/Postpaid to pre-paid and vice versa conversions.

b) Plan change/ISD/International roaming.

c) VAS Services.

d) Replacement of SIMs

e) Sale of postpaid mobile connections

f) Sale of Top-ups/STVs/PVs.

g) Sales Complaint redressal

h) Processing of MNP requests

i) Bill collection of Landline/Broadband/FTTH/Postpaid Mobile.

j) New Phone booking and feasibility of land line / Broadband / FTTH / Wings / ASEEM, Vanity booking / ISDN / PRI / BRI

k) DND Activation/deactivation.

l) Handling of bill related queries and complaints.

m) Receiving and coordinating request for shift, name transfer, and closure of Connections.

n) All commercial and CSC Services which are presently being offered in CSCs (including services being provided free of charge) and all commercial and CSC services which may emerge in future.

1.5 TERMS AND CONDITIONS OF CSC:

a) The CSCs are to be manned minimum from 8.00AM to 8.00 PM for all Category-I and from 9.00 AM to 6.30 PM for all Category-II & III CSCs on all days except National holidays.

b) Proper training and dress code for staff manning the counters should be ensured.

c) Sale of products and services of BSNL should be restricted only within CSCs.

d) Non BSNL products will not be allowed to sale from the CSC,

e) The bidder will be paid for all sales as per franchise S&D Policy 2018 and related circulars on bill payments or as modified from time to time.

f) The bidder will get commission/facilitation charges as per franchisee policies of different products/services. All cash transactions in the CSC shall be done through the CBP/CTOPUP wallet and no cash transactions shall be done between BSNL and the bidder for collections done in CSC.

g) The bidder shall be paid Rs.2/- per transaction for items not defined in franchise S&D Policy 2018. There will be a capping of 150% for all non-commercial transactions e.g. issue of duplicate bills, DND activation / deactivation etc. based on average monthly volume of last six months, but it will be further restricted to ensure that it is not more than 10% of total charges/commission earned in a month.

h) For CM related sales no FOS will be paid on SIM sale or Recharge sale, which is otherwise paid as per franchisee S&D Policy 2018.

i) All changes in Franchisee S & D policy will be implemented with reference to commission structure as and when BSNL does so.

1.6 CM SALES AND DISTRIBUTION POLICY - 2018

Provisions of the franchisee S&D Policy -2012 have been amended and integrated “CM Sales and Distribution Policy -2018” is effective from **01.01.2018.**

This Policy is divided in four parts:

- **Franchisee Sales & Distribution Policy**

Franchisee will be responsible for selling of all BSNL to BSNL subscribers. Products, directly or through Rural Distributors (RDs) / retailers within a defined territory. To facilitate retailers, provision of three tier structure has been made by including Rural Distributor between franchisee and retailers only in rural territories to serve the area within the rural BTS.

- **e-Distributor Policy**

  e-Distributor will be responsible for selling of BSNL Products to customers through web-portal/ Kiosk/ ATMs/ POS (Retailers) and other electronic mode on Zonal/ PAN India basis.

- **DSA Policy**

  Direct Selling Agents ("DSAs") are individuals having direct agreement with BSNL. DSAs are responsible for selling of all BSNL Products, as assigned to them, to the customers at their door steps.

- **Rural Distributor Policy**

  Rural Distributors are individuals having agreement directly with BSNL or through franchisee. Rural Distributors will be responsible for selling of all BSNL Products in Rural BTS areas through retailers. Rural Distributor will be preferably served by concerned franchisee or by BSNL directly.

1.7 RESPONSIBILITIES OF FRANCHISEE

a) Selling of all BSNL Products purchased by Franchisee directly or through Rural Distributors (RDs) or retailers.

b) Two tier structure for urban and three tier structure for rural areas by incorporating intermediate channel of RDs.

c) Franchisee to make best efforts to actively market and promote the BSNL Products as permitted by BSNL.

d) Appointment of Retailers

e) Franchisee must appoint sufficient numbers of retailers in the territory such that:

   i. Each Urban BTS areas & Rural BTS areas should have at least 8 retailers and 4 Retailers respectively.

   ii. One retailer in urban commercial area at every 200 meter

   iii. One retailer in urban residential area at every 500 meter

   iv. At least one retailer in every Village

f) Retailers in the rural areas will be appointed and served by RDs.

g) Meeting all sales targets set by SSA/Circle for the franchisee territory. Franchisee is responsible for meeting these targets through all channel entities working under him.

h) CAF collection, documentation (physical documentation as well as electronic documentation) and timely submission of documents to BSNL as per regulatory guidelines and BSNL instructions. Once the CAF has

been deposited by the Franchisee under receipt to BSNL, the responsibility of documents submitted in support of customer identity & address will be on Franchisee for a period of 90 days from the date of deposit of CAF. BSNL official will check the documents within 90 days and if anything is found wrong with respect to DOT/TERM guidelines then the form should be rejected/corrected and a token penalty of Rs 200/- shall be imposed per wrong CAF on franchisee.

i) Verification of credentials of customers – Verification of POI/POA (photo, identity and address) of customer at the POS (Point of Sale) has to be done as per the various guidelines issued by DoT and BSNL from time to time. Franchisees will be responsible for the verifications done by all the channels i.e. Rural Distributors and retailers working within their network.

j) BSNL reserves the right for CAF entry/CAF collection/CAF submission through any third party on outsourced model. However verification of credentials as mentioned in para (h) above shall be the responsibility of franchisee.

k) Operation of IT tools and systems provided by BSNL as specified from time to time, including hiring data entry operator if required.

l) Appointing required number of FoS (Feet-on-Street) exclusively for BSNL Products to serve retailers as per guidelines in force.

m) Assist and cooperate and with the Franchisee Manager or any other BSNL employee appointed by BSNL in respect of sale of BSNL products, and provide him/her with the required details as specified by BSNL.

n) Providing List/Details of FOS and retailers to BSNL.

o) All details and information (including but not limited to FoS details, secondary sales, etc.) as specified by BSNL from time to time in BSNL specified system e.g. Sancharsoft.

p) After sales services to end-customers in its own capacity and at its own cost, which shall include receiving, attending & rectifying complaints.

q) All forms of complaint handling on phone and walk-in-complaints (hardware related, billing, service, performance related etc.) will be handled directly by Franchisee. Franchisee shall redress all possible complaints on the spot. If required, help from BSNL call centers may be taken. Remaining complaints can be forwarded to designated CSC/BSNL official for further disposal.

r) Serving retailers and Rural Distributors at their doorsteps. Franchisee must ensure that BSNL products are available with rural distributors as well as retail networks in sufficient quantity on demand. Franchisee must ensure that no black-marketing or mal-treatment to customer is done through its network.

s) The margin/ discount/ incentives / commissions extended by BSNL to franchisee and eligible retailers in their chain/ network, which shall be deemed to be extended to the franchisee, with whom BSNL has entered

into an agreement pursuant to this policy and statutory requirements shall be complied with, by the franchisee.

t) Receiving advertisement/ marketing material from BSNL, and displaying it at POS and distribution to Rural Distributors.

u) Promotion of BSNL Products at Franchisee's own cost.

v) Arranging special promotional events, as per BSNL requirements, at Franchisee's own cost, which shall include events and camps/canopy in unreached and potential areas.

w) Timely submission of bills and claims to the nodal officer

x) Storage of SIM's, data cards and other telecom products purchased by the Franchisee from BSNL in a proper manner.

y) Provide all necessary information to BSNL including but not limited to its books of accounts, or any other information for the purpose of submitting the same in any proceedings before any Government Authority or against any third parties.

z) Issue receipts: At the time of booking of any new connection, franchisee shall issue its formal receipt / invoice to the Rural Distributors (RDs) / retailers.

aa) Franchisee will be responsible for all the work done through its distribution network.

bb) The franchisees will be responsible for intimating their GSTN No. to BSNL for billing purposes

1.8 RESPONSIBILITIES OF BSNL

a. Appoint sufficient number of Retailer Managers, Retailer Manager Coordinator (RMC), and Franchisee Managers for providing time-to-time guidance, and addressing issues/ concerns raised by franchisees. BSNL shall also appoint other members of the Sales & Marketing team at Circle and SSA level.

b. BSNL shall communicate to the Franchisee the minimum sales required to be made by them on quarterly/ monthly basis, in order to remain eligible for the Franchiseeship Agreement. These quarterly/monthly sales target will be communicated by BSNL in last week of previous quarter/month or in the first week of the quarter/month. The target will be given on each parameter defined in "Performance Management System". Any exceptions to this have to be approved directly by GM (Consumer Mobility)/ designated GM by HOC. Failure to achieve the minimum sales requirement may lead to review / termination of the contract.

c. Resolution of issues (including supply of SIMs, payments, servicing of retailers, cross-selling, etc.) raised by franchisees, rural distributors, franchisee managers, RMC, retailer managers, retailers and any other member of the Sales & Marketing team. SSA Sales Head must maintain a log of all complaints received and provide regular update to SSA Head on action taken to resolve outstanding issues.

d. It will be the responsibility of the Account Officer to remit the collection from the franchisee to credit to Company's account on as and when purchases of BSNL Products (except post-paid products) are made by the Franchisee and ensure realization of the cheque.

e. The cheque deposited by the Franchisees should be deposited with bank for realization in a manner that it is realized latest by 3rd day (Date of purchase + 2 working days). The Account Officer shall be responsible for ensuring collection, deposit with the bank and realization of the cheque(s).The Account Officer shall maintain an account of inventory sold to the Franchisee and the defective goods received back from the Franchisee, and share the same periodically with BSNL's accounts wing along with payment balance statement.

f. Franchisee manager / SSA Sales Head (Mobility) to ensure that all sales made by BSNL to franchisee and is recorded in BSNL specified IT system. Further, the sales register/ books of accounts maintained by the Franchisee may be called for as and when required by BSNL, for examination and cross- verification of sales made by franchisees in respect of BSNL"s products.

g. The Sancharsoft & stock register giving details of material sold to the Franchisee should be properly maintained and monitored on regular basis by SSA Sales Head (Mobility).

h. Head of Circle / SSA will ensure that BSNL Product stocks are available in sufficient quantity with BSNL in required denominations well in advance. The SSA should maintain sufficient stock of inventory so that they can fulfil the demand for provisioning of the stock as required by the franchisees, Rural Distributors and other point of sales.

i. No refund requests of any defective or unused stock shall be entertained by BSNL. Defective stock (due to the default of BSNL) with the channel partners shall be replaced at the sole discretion of BSNL after due verification.

j. In order to manage returns of defective products, BSNL may, with prior approval of the Franchisee, inspect the stock at Franchisee's location to evaluate whether or not the products are maintained in proper condition.

k. MRP of the products should be displayed. The stocks and distribution of publicity materials like brochures etc., preferably in local languages also should be available in sufficient quantity.

l. In order to promptly receive CAFs, there should be at least one desk or counter, totally dedicated to accept CAFs from Franchisees/DSAs at a prominent location in every city and should be manned on all days, including holidays. Details of in-charge and location of such CAF Desk should be intimated to all Franchisees/ DSAs.

m. Ensure timely payments to all channel partners preferably online.

n. It will be mandatory on monthly basis to reconcile the account of prepaid product along with IN report.

o. The following items shall be given free of cost to franchisees for performing their responsibilities, including for demo purpose, and are not linked with the sales targets to be made by the franchisees:

i. One rent free landline connections with unlimited on net local calls (LL + Mobile) within circle.

ii. One rent free landline connection for incoming calls with Broadband plan – BBG Combo ULD 850 (350 monthly free call with unlimited download/Upload).

iii. One rent free VPN over Broadband (512 kbps VPNoBB plan)

iv. One rent free GSM post-paid Plan – 525, calls beyond freebies shall be payable.

v. Ensure alternate/standby media connectivity to Sanchar-Soft terminals working with franchisees.

Note: - Above facility shall be up-to the validity of agreement.

vi. Trade discounts:-

Attractive trade discounts / schemes shall be offered by BSNL to the franchisee time to time as per prevalent market dynamics.

1.9 E-DISTRIBUTOR

BSNL is serving customers through Franchisees/ Rural Distributors/ DSAs/ Retailers in the defined geographical area. To serve the customers through web portal/ Kiosk/ ATMs/POS (Retailers) and other electronic mode. There is a need to appoint Zonal level franchisees and will be known as e-Distributors.

To serve BSNL customers through web portal / Kiosk /ATMs /POS (Retailers) and other electronic mode, there is a need to appoint Zonal Level franchisees to be known as e-Distributors. There will be three types of e-Distributors:

1. Cat -1 : who is applying for single zone
2. Cat -2 : who is applying for two zones.
3. Cat-3 : who is applying for all four zones i.e. on PAN India basis

Following key features are there for e-Distributor Policy

- e-Distributors have to sell e-recharge/ top-up to prepaid connections and / or postpaid bill payment and / or other BSNL products purchased by them from BSNL, from time to time through web based platform / Kiosk /ATMs/ POS (Retailers) using Internet /API / mobile apps/ data access or other electronic modes.
- e-Distributor and BSNL shall act on a principal to principal basis and at no time, the distributor shall act in the capacity of an agent of BSNL.
- The e-Distributor shall be responsible for investment in setting up requisite infrastructure viz. Outlets, portals, servers, leased connectivity etc.
- e-Distributor shall integrate its system with BSNL's zonal C-top up systems and will ensure security of data link by way of Firewall/ IDS etc. C-top up vendor will share APIs for the integration purpose.

- The reports needed by BSNL for reconciliation and monitoring purpose will have to be developed by both parties and will be validated by BSNL team appointed by the GM (CMTS), Nodal Center before start of actual application.
- A secured password based account shall be created for BSNL to facilitate remote login to the server by designated BSNL staff. BSNL shall be permitted to view all reports and track sale and distribution to the EFTPOS terminals/NET/SMS.
- Messaging facility shall be provided between the central server and the EFTPOS terminals wherein BSNL shall be able to pass on marketing related information, special promotional schemes etc to the EFTPOS terminals.
- The e-Distributor shall store all records of sale at the Central server for a period of at least one year to enable tracking of Sale etc by Law enforcement agencies in India.
- BSNL may from time to time provide information, training and assistance relating to the services.
- BSNL may provide the marketing material to the e-Distributor.
- BSNL shall not be liable for any loss, pilferage or damage to the goods stored and sold at the premises and the merchandise shall be the entire responsibility of the e-Distributor.

1.10 DSA POLICY

I. Scope of the Work

The Direct Selling Agent shall market and sell all BSNL Products to customers at their door steps.

II. Selection of DSAs

1. Selection of DSAs will be done by SSA Head
2. The initial period of agreement shall be for 3 years.
3. Eligibility Criteria: Any person willing to serve customers/ prospects at their premises and fulfilling following criteria are eligible to apply.

A.	Turn over	:	No minimum turnover is required
B.	Age	:	18 Yrs
C.	Local Resident	:	Residing in Area for more than 1 year.

4. Valid PAN No.
5. Valid Goods and Services Tax (GST) registration Certificate No. for respective state (if applicable)
6. Self-declaration along with the evidence that the bidder is not black listed by the GST authorities
7. In case the DSA gets black-listed during the tenure of BSNL contract, then adequate indemnity clause should be inserted to ensure that no loss of credit is borne by BSNL due to a default of e-distributor

8. Security Deposit: Refundable Security Deposit of Rs.500/- (Rupees five Hundred only) (No security deposit from retired BSNL/DOT employee/ co- operative societies and spouse of BSNL/ DoT employee)
9. Area of Operation: within SSA.
10. DSAs will be given free C-TOPUP SIM with applicable concessional tariff and freebies.
11. Activation SIM: BSNL may give activation SIM to willing DSAs after taking additional security deposit of Rs.3000/- per SIM.
12. Verification of credentials of new customers.
    a. Verification of credentials of new customers – Verification of PIA (photo, identity and address) of new customer to be done as per the various guidelines issued by DoT and BSNL from time to time. DSA will be responsible for the verifications done by him.
    b. The DSA shall obtain from customers/subscribers such documents as prescribed from time to time by BSNL.
13. Discount: Franchisee discount / margin will be shared among DSAs
14. Minimum amount of sales to be made by DSAs shall be communicated by SSA on monthly basis.
15. Termination: If not found active for six consecutive months, the DSA may be terminated after issue notice and seeking explanation.
16. Extension/Migration: SSA Head may extend / migrate agreement on year-to- year basis for a period of two years with the DSA on mutually agreed terms for the active DSAs. The decision of BSNL shall be final in regard to the grant of extension.
17. BSNL and DSA shall observe the official procedure in connection with purchase and sale of BSNL Products.

1.11 RURAL DISTRIBUTOR POLICY

1.11.1 Policy Framework for Rural Distributors (RDs)

Rural distributors will cater to rural areas and engagement of these distributors will be through a committee constituted by the SSA head. The committee will recommend suitable persons/agency from amongst working FMCG distributors/retail shop or any other suitable person of the area. Based on recommendation of committee, RDs will be selected by the SSA head.

1.11.2 Concept of Rural Distributors:

- Rural distributors may work on non-exclusive basis i.e., they may also sell products of other operators.
- The territory of Rural Distributor should be designed in such a manner that maximum distance to be served by Rural Distributor is less than 15 km.
- Rural distributors must be residents of one of the villages of the area which they are serving so that they have good knowledge of local conditions and local market. They are able to push the product deep into the market due to

their personal relations with local people.

- Rural distributors directly serve the retailers and they do not have any employee(s). They will primarily be served by existing franchisee of that area. In case, the franchisee fails to serve, the RD will be served by BSNL directly.
- Retailer/POS in the area of RD will be managed by Rural Distributors and franchisee will have no direct role to play in that area.

1.11.3 Service to Rural Distributors (RDs)

- RDs will be served by the Territory Franchisee at his doorstep.
- If Territory Franchisee does not serve the RDs properly then RDs will be served by BSNL directly. SSA Head will make suitable arrangement for material delivery to RDs is such case at his doorstep.
- Territory Franchisee will collect all CAFs from RDs and will provide them SIM as well as Recharge Coupon/C-TOPUP.
- RDs will make payment at the time of delivery of stock. However, they should make the requisition to the territory franchisee in advance. Representative of Territory Franchisee will deliver the stock at their doorstep.
- Suitable unlimited Broadband plan will be given to willing RD free of cost.

Responsibilities of Rural distributor:

It is the responsibility of RDs to generate demand for providing services permitted by BSNL. Selling of all BSNL Products assigned to them, directly or through retailers. Not only the targets set are to be achieved but also efforts are to be made to surpass it.

- Timely submission of bills and claims to the nodal officer/ franchisee.
- MIS as per BSNL format to BSNL officials/ Franchisee as per frequency specified.
- Rural Distributor must ensure that BSNL products are available in retail networks in sufficient quantity on demand.
- Verification of credentials of customers .
- Rural distributors will be responsible for all the work done through retailers.
- Rural distributors are required to attend meetings in SSA/ Franchisee as and when needed. Rural Distributor must ensure availability of BSNL products.

1.11.4 Responsibilities of BSNL

- BSNL shall from time to time or in response to specific request by the Rural Distributor provide information, training and assistance relating to the services and arrange for qualified personnel / representatives of BSNL to render such training and assistance.
- BSNL may provide the marketing material to the Rural distributor.
- In order to manage returns of defective products, BSNL may, with prior approval of the Rural Distributor, inspect the stock at Rural Distributor's location to evaluate whether or not the products are maintained in proper condition.

- BSNL / its representative will ensure no black marketing happens & also have periodic inspection / surprise check to ensure all channels are working properly.
- The discounts offered by BSNL are subject to variation during the term of this Agreement at the sole discretion of BSNL.
- The Rural Distributor can supply the printed / display material etc. at his own cost without any liability on BSNL. He will keep BSNL indemnity from the content of the publicity/ display material so supplied.

1.12 ROLE OF SALES TEAM MEMBERS

Roles of different members of the mobility sales team are mentioned below:

1.12.1 Roles of Circle Sales Team

Circle sales team will consist of GM (Sales), DGM (Sales), AGMs (Sales), SDEs (Sales) and other supporting staff. Their roles and responsibilities will be as follows:-

- Monitoring of SSA / Franchisee wise sales and performance w.r.t. target.
- Appointment of franchisees.
- Ensuring the growth of sales channel network.
- Ensuring appointment of sales team in SSA.
- Monitoring the performance of FM/ RMC/ RM.
- Ensuring the action to be taken by the SSAs.
- Ensuring the smooth functioning of sales tools such as Sancharsoft, C-TOPUP, B&CCS terminals etc.
- Redressal of issues / queries reported by the SSAs/ Franchisees.
- Redressal of cross selling.
- Escalating the unresolved problems and suggestion to improve the sale to BSNL.

1.12.2 Roles of SSA Sales Team

SSA sales team will consist of DGM (Sales), DE (sales), SDE (Sales) and other supporting staff.

- Fixing of target for franchisees.
- Monitoring the sales and performance of sales partner w.r.t. the target on daily / weekly basis.
- Growth of sales channel network.
- Appointment of required sales team of FM/ RMC/ RM.
- Monitoring the performance and visit of FM/ RMC/ RM.
- Set-up and smooth functioning of sales tools such as Sancharsoft, C-TOPUP, B&CCS terminals etc.
- Area demarcation and allotment of retailers.

- Consolidation of priority list of retailers.
- Support in ordering and delivering of material to sales channel.
- Ensuring the availability of BSNL product, tariff details, advertising material to all POS.
- Redressal of cross selling.
- Payment of allowances / KPA.
- Redressal of issues / queries reported by Sales partner/ sales channel team.
- Escalating the unresolved issues and suggestions to improve the sale to Circle office.

1.12.3 Roles of SSA Franchisee Manager

- Communicating target before beginning of month i.e. by 25th of previous month.
- Support in ordering and delivery of material to Franchisee doorstep.
- Communication /action raised by the RMCs / RMs.
- Collection of data from franchisee.
- Review of franchisee data with SSA sales team.
- Supply of POS material to franchisee.
- Ensure proper uses of Sancharsoft and data entry by Franchisee.
- Redressal of issues / queries of Franchisee.

1.12.4 Roles of SSA Retail Manager Coordinator (RMC)

- Plan RM visit to existing retailers and to potential area for appointment of new retailer.
- Daily review of RM performance.
- Appointment of new retailers in potential area.
- Verification of cross selling cases.
- Compilation of daily report submitted by the RM.
- Submission of retailer wise data regarding material availability, issues etc to FM with a copy to SSA Sales Head for action.
- Providing the information regarding BSNL product / schemes / trade schemes/ VAS etc to retailer manager for further publicity.
- Conduct validation visits with RMs and FMs.
- Entry of new C-TOPUP retailer's information in Sancharsoft.
- Organization of joint visit of RM and FOS to some distressed retailers.

1.12.5 Roles of SSA Retail Manager (RM)

- Auditing the no. of visits by the FOS to retailers.
- Auditing the incentives paid to retailers by the Franchisee.

- Providing the information regarding BSNL product / schemes / trade schemes/ VAS etc to retailer for further publicity.
- Feedback about replacement of damaged material by the franchisee.
- Feedback on supply of POS material such as Glow sign board etc.
- Assessment of potential area for appointment of new retailers.
- Combined visit with FOS and on spot issuing of C-TOPUP.

1.13 TELECOM INFRASTRUCTURE PROVIDERS (TIPS)

1.13.1 Scope of TIPs

For providing FTTH, Broadband / voice services, Lease Circuits and value Added Services on Revenue Share Basis, BSNL has provided unique opportunity to Builders, Resident Welfare Associations (RWAs), Telecom Infrastructure Providers, Hotel Owners, Hospitals, Trust, Franchisees, System Integrators, DIDs, Franchisees of BSNL, any registered company or society, Local Cable TV Operators, Telecom Service Providers, Local Shop Owners, BSNL Retailers, Direct Selling Agents, Unemployed Graduates, Local Youth having matriculation/degree or ITI, Start-ups or local entrepreneurs, Spouses and Wards of BSNL/DOT employees or Retired BSNL/DOT employees etc. for registration as Telecom Infrastructure Providers BSNL (TIP) for providing BSNL Telecom Services in the existing and upcoming residential/commercial complexes and all other parts of rural and urban areas on revenue share basis.

1.13.2 Advantages For Customers Through TIP

For promotions of BSNL FTTH connections, BSNL has waived off the following charges for FTTH/BB Connections by TIPs

- Installation charges
- Security deposit for landline/ voice connections.
- ONT Rentals
- One month additional free service on payment of advance annual bill.

1.13.3 Additional Facilities Available to TIPs

- One rent-free VPNOBB connection may be provided to TIPs for monitoring purpose who is having minimum Five OLTs or having less than Five OLTEs but has provided hundred FTTH connections.
- One Free demo FTTH Connection in FTTH Plan of FMC Rs 675 may be provided for first month for demonstration in the targeted areas where new OLTs have been installed by TIPs which may be extended and same can be extended for one more month depending on expected demand that area.
- One Free Connection in FTTH Plan of FMC Rs 777 may be provided as an incentive to each TIP in his office who has provided 50 FTTH active connections.
- Dedicated Nodal officers at each SSA, level exclusively for coordination and support to TIP for FTTH related issues.

- Dedicated Nodal officers are also available at Circle Office Mumbai exclusively for TIP and FTTH related issues.
- Dedicated Nodal officers at Circle Office have been deputed exclusively for settlement of revenue share of TIPs.
- Total Technical guidance will be given by BSNL to TIPs through its highly experienced officers and staff.
- Access to Franchisee Management System (FMS) Portal shall be provided to TIPs. All required update information can be obtained by TIP through FMS Portal.
- Latest and updated information is also available on BSNL website

1.14 BSNL RED POLICY 2020

1.14.1 About BSNL RED Policy 2020

BSNL has recently launched VRS scheme 2019 for reducing aging employees, and approximately 75000 employees have opted for the scheme, and many of the VRS optees were working for Sales & Marketing units of the circles.

To address the shortage of direct selling agent / Sales persons and to make use of experienced BSNL VRS optees, BSNL introduced RED (RETIRED EMPLOYEE DISTRIBUTOR) Policy 2020 for utilization of best services of experienced people with attractive commission for each sale.

- BSNL Retailer CTOPUP Commission on Recharge, MNP, Bill Payment
- Know Your Nearest BSNL Retailer (KYR) Contact Details on SMS
- BSNL CTopUp Mobile Tariff with New Benefits for Retailer (POS)
- BSNL CTOPUP Registration for Retail Business (Prepaid/Postpaid)

In this new introduction, the RED (Retired Employee Distributor) shall market and sell the products like BSNL new prepaid SIM, CTop Up Recharge, Bill payment and other to customers at their door steps or through organizing Mela / Camp at various locations in the district or SSA / Business area, where the RED registered by earning huge commissions / discounts as defined subsequently under the BSNL RED policy.

1.14.2 BSNL RED Policy, Conditions & Requirements

- Refundable Security Deposit of Rs.500/- (Rupees five Hundred only) has to be paid in advance when allotted RED..
- The initial period of agreement shall be for 3 years and the selection of RED will be done by SSA Head
- Only retired employees of BSNL willing to serve customers/ prospects at their premises & through organizing Mela / Camp and shall be eligible to apply.
- Must have valid PAN Number
- Valid Goods and Services Tax (GST) registration Certificate Number for respective state (if applicable).
- If GST Certificates applicable, must submit along with application

- Self-declaration that the applicant is not black listed by the GST authorities.
- Self-declaration that the applicant is retired from BSNL.
- Security Deposit: Refundable Security Deposit of Rs.500/- (Rupees five Hundred only).
- Area of Operation: RED shall be allowed to operate within SSA where he/she is registered.
- BSNL RED will be given free C-TOPUP SIM with applicable concessional tariff and freebies.
- As per the BSNL Retired Employee Distributor Policy 2020, the RED can only do their sales within SSA where they can registered.
- RED can apply in any SSA, but can do business only within that registered SSA.

1.14.3 Targets for BSNL RED

- There shall be minimum monthly sales target of 50 no. SIM/FRC and C-top-up/recharge of Rs. 5000/- Sales targets assigned to RED shall be communicated by SSA on monthly basis. Targets will be reviewed every three months; if minimum monthly sales targets are not achieved by the RED then they would not be continued further.

1.14.4 Extension of RED Agreement

- SSA Head may extend / migrate agreement on year-to-year basis for a period of two years with RED on same terms for the active RED. Decision of BSNL shall be final and binding in this regard.

1.14.5 Termination for Inactive

- If not found active for six consecutive months, the RED may be terminated after issue of notice and seeking explanation. In case of any irregularity / violation of BSNL/ GoI rules, the RED registration may be terminated without any notice.
- In case the RED gets black-listed during the tenure of BSNL contract, then adequate indemnity clause should be inserted to ensure that no loss of credit is borne by BSNL due to a default of RED.

1.15 CONCLUSION

Initially BSNL was having one sales channel, that is Customer Care Center (CSC) through which BSNL was selling its product & services. Now as per the changing needs of the customer BSNL has opened up lots off sales Channel like Franchisee, e-Distributor, DSA, Rural Distributor etc. to better serve its customers.

Note: Pl check the latest circular of BSNL for any amendment /changes.

2 FTTH TECHNOLOGY & INTRODUCTION TO BHARATNET

2.1 LEARNING OBJECTIVES

- Concept of FTTH.
- Network Architecture of FTTH
- GPON and GEPON technology
- BharatNet

2.2 INTRODUCTION

Growing demand for high speed internet is the primary driver for the new access technologies which enable experiencing true broadband. Today's, there is an increasing demand for high bandwidth services in market around the world. However, traditional technologies, like Digital Subscriber Line (DSL) and cable modem technologies, commonly used for "broadband access," which have access speeds to the order of a megabit per second, with actual rates strongly dependent on distance from the exchange (central office) and quality of the copper infrastructure, can not fulfill today's customer demand for bandwidth hungry applications such as high-definition TV, high-speed Internet access, video on demand, IPTV, online gaming, distance learning etc. Amongst various technologies, the access methods based on the optical fiber has been given extra emphasis keeping into long term perspective of the country. It has many advantages over other competing access technologies of which 'Being Future Proof' and providing 'True Converged Network' for high quality multi-play are the salient ones. The stable and long term growth of Broadband is, therefore, going to be dependent on robust growth of fiber in the last mile.

However, for providing multi-play services (voice, video, data etc.) and other futuristic services fiber in the local loop is must. The subscriber market for multi-play is large and growing and includes both residences and businesses. Businesses need more bandwidth and many of the advanced services that only fiber can deliver. All view Multi- Play as a strong competitive service offering now and into the future and are looking at fiber as the way to deliver. Optical fiber cables have conventionally been used for long-distance communications. However, with the growing use of the Internet by businesses and general households in recent years, coupled with demands for increased capacity, the need for optical fiber cable for the last mile has increased. A primary consideration for providers is to decide whether to deploy an active (point-to-point) or passive (point-to-multipoint) fiber network. .

2.3 FIBER TO THE X (FTTX)

Today, fiber networks come in many varieties, depending on the termination point: building (FTTB), home (FTTH), curb (FTTC) etc. For simplicity, most people have begun to refer to the fiber network as **FTTx,** in which x stands for the termination point. As telecommunications providers consider the best method for delivering fiber to their subscribers, they have a

variety of FTTx architectures to consider. FTTH, FTTB, and FTTC each have different configurations and characteristics.

2.3.1 FTTH (Fiber To The Home):

FTTH is now a cost-effective alternative to the traditional copper loop. "Fiber to the Home" is defined as a telecommunications architecture in which a communications path is provided over optical fiber cables extending from an Optical Line Terminal (OLT) unit located in central office (CO) connects to an Optical Network Terminal (ONT) at each premise. Both OLTs and ONTs are active devices. This communications path is provided for the purpose of carrying telecommunications traffic to one or more subscribers and for one or more services (for example Internet Access, Telephony and/or Video-Television). FTTH consists of a single optical fiber cable from the base station to the home. The optical/electrical signals are converted and connection to the user's PC via an Ethernet card. FTTH is the final configuration of access networks using optical fiber cable.

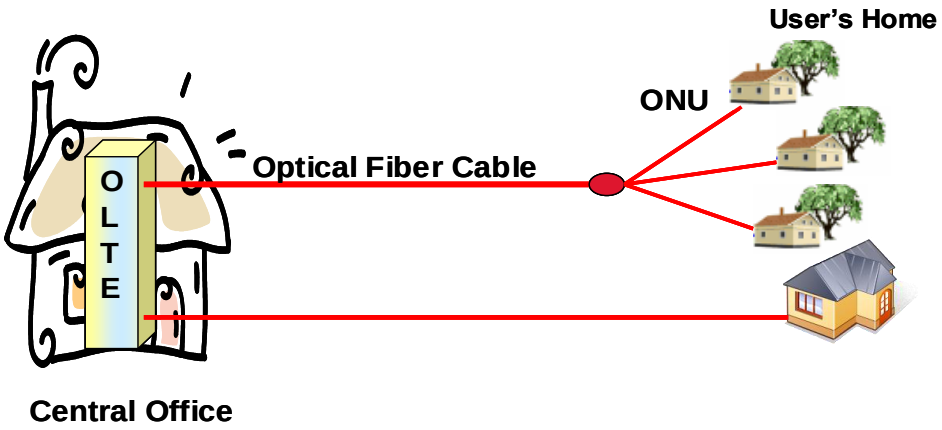

Figure: 1 FTTH Configuration

2.3.2 FTTB (Fiber To The Building):

"Fiber to the Building" is defined as a telecommunications architecture in which a communications path is provided over optical fiber cables extending from an Optical Line Terminal (OLT) unit located in central office (CO) connects to an Optical Network Unit (ONU at the boundary of the apartment or office or building enclosing the home or business of the subscriber or set of subscribers, but where the optical fiber terminates before reaching the home living space or business office space and where the access path continues to the subscriber over a physical medium other than optical fiber (for example copper loops).

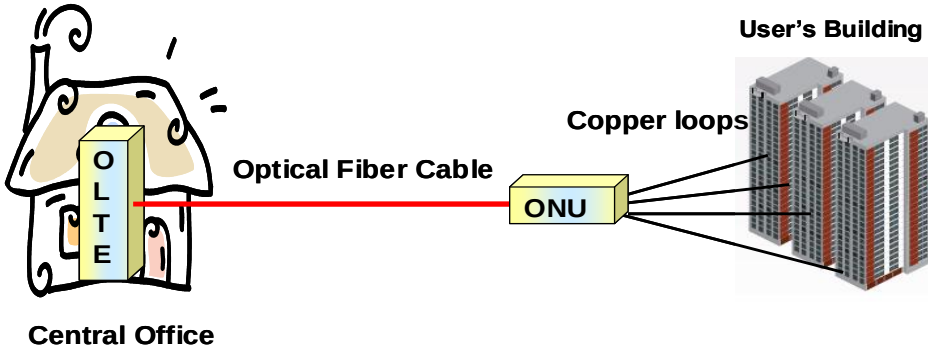

Figure: 2 FTTB Configuration

FTTB regarded as a transitional stage to FTTH. By introducing fiber cables from the fiber termination point to the home living space or business office space FTTB can be converted to full FTTH. Such a conversion is desirable as FTTH provides better capacity and longevity than FTTB. Optical fiber cable is installed up to the metallic cable installed within the building. A LAN or existing telephone metallic cable is then used to connect to the user.

2.3.3 FTTC (Fiber To The Curb):

A method of installing optical fiber cable by the curb near the user's home. An optical communications system is then used between the ONU installed outside (such as near the curb or on Street Cabinet) from the installation center. Finally, copper cable is used between the ONU and user.

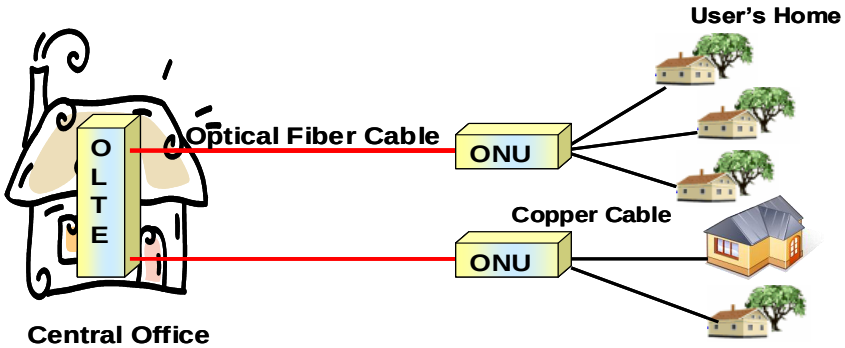

Figure: 3 FTTC Configuration

2.4 WHY FTTH?

FTTH is a true multi-service communications access which simultaneously handles several phone calls, TV/video streams, and Internet users in the home/office. There are several advantages of deploying FTTH over other traditional access technologies as given below:

- FTTH provides end-users with a broad range of communications and entertainment services, and faster activation of new services.
- Competition is beginning to offer a "multi-play" (i.e., voice, video, data etc) bundle.
- FTTH provides Service Provider's with the ability to provide "cutting edge" technology and "best-in-class" services.

- Deploying a fiber optic cable to each premise will provide an extraordinary amount of bandwidth for future services.
- FTTH provides carriers with an opportunity to increase the average revenues per user (ARPU), to reduce the capital investment required to deliver multiple services, and to lower the costs of operating networks (fewer outdoor electronics, remote management, ..) will result in less operational expense.
- FTTH provides the community in which it's located with superior communications which enhance the efficiency of local business and thus deliver economic advantage for the community.
- Around the world FTTH is viewed as strategic national infrastructure similar to roads, railways, and telephone networks.

2.5 TECHNOLOGY OPTIONS FOR FTTH ARCHITECTURE:

When deciding which architecture to select a provider has many things to consider including the existing outside plant, network location, the cost of deploying the network, subscriber density and the return on investment (ROI). At present different technology options are available for FTTH architecture .The network can be installed as an **active optical network**, or **a passive optical network (PON)**.

2.5.1 Active Optical Network

The active optical network implementation is known as the "Active Node" and is simply described as a "point-to-point" solution. Subscribers are provided a dedicated optical cable and the distribution points are handled by active optical equipment. These active architectures have been setup as either "**Home Run Fiber**" or "**Active Star Ethernet**".

a) Home Run Fiber (Point-to-Point) Architecture

A Home Run Fiber architecture is one in which a dedicated fiber line is connected at the central office (CO) to a piece of equipment called an Optical Line Terminator (OLT). At the end user location, the other side of the dedicated fiber connects to an Optical Network Terminal (ONT). Both OLTs and ONTs are active, or powered, devices, and each is equipped with an optical laser The Home Run fiber solution offers the most bandwidth for an end user and, therefore, also offers the greatest potential for growth. Over the long term Home Run Fiber is the most flexible architecture; however, it may be less attractive when the physical layer costs are considered. Because a dedicated fiber is deployed to each premise, Home Run Fiber requires the installation of much more fiber than other options, with each fiber running the entire distance between the subscriber and the CO.

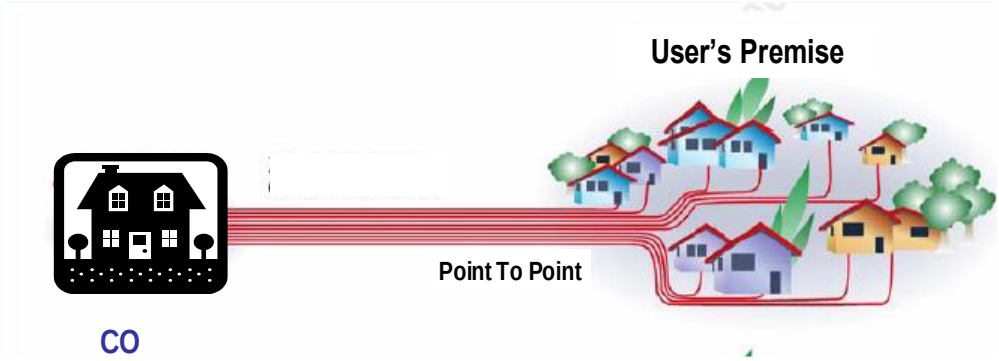

Figure: 4 Home Run Fiber (Point-to-Point) architecture

b) Active Star Ethernet (Point-to-Multi Point) Architecture

Active Star Ethernet (ASE) architecture is a point-to-Multi-point architecture in which multiple premises share one feeder fiber through a Ethernet switch located between the CO and the served premises.

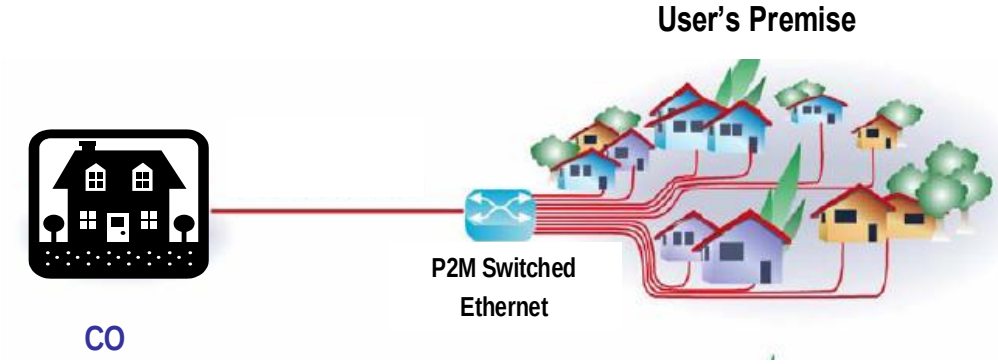

Figure: 5 Active Star Ethernet (ASE) architecture

With Active Star Ethernet (ASE) architecture, end users still get a dedicated fiber to their location; however, the fiber runs between their location and Ethernet switch. Like Home Run Fiber, subscribers can be located as far away from the Ethernet switch and each subscriber is provided a dedicated "pipe" that provides full bidirectional bandwidth. Active Star Ethernet reduces the amount of fiber deployed; lowering costs through the sharing of fiber.

2.6 PASSIVE OPTICAL NETWORK (POINT-TO-MULTIPOINT) ARCHITECTURE

The key interface points of PON are in the central office equipment, called the OLT for optical line terminal, and the CPE, called ONU for optical network unit (for EPON) and ONT for optical network terminal (for GPON). Regardless of nomenclature, the important difference between OLT and ONT devices is their purpose. OLT devices support management functions and manage maximum up to 128 downstream links. In practice, it is common for only 8 to 32 ports to be linked to a single OLT in the central office. On the other hand the ONT (or ONU) devices in the CPE support only their own link to the central office. Consequently, the ONT/ONU devices are much less expensive while the OLTs tend to be more capable and therefore more expensive.

2.6.1 OLT

The OLT resides in the Central Office (CO). The OLT system provides aggregation and switching functionality between the core network (various network interfaces) and PON interfaces. The network interface of the OLT is typically connected to the IP network and backbone of the network operator. Multiple services are provided to the access network through this interface,.

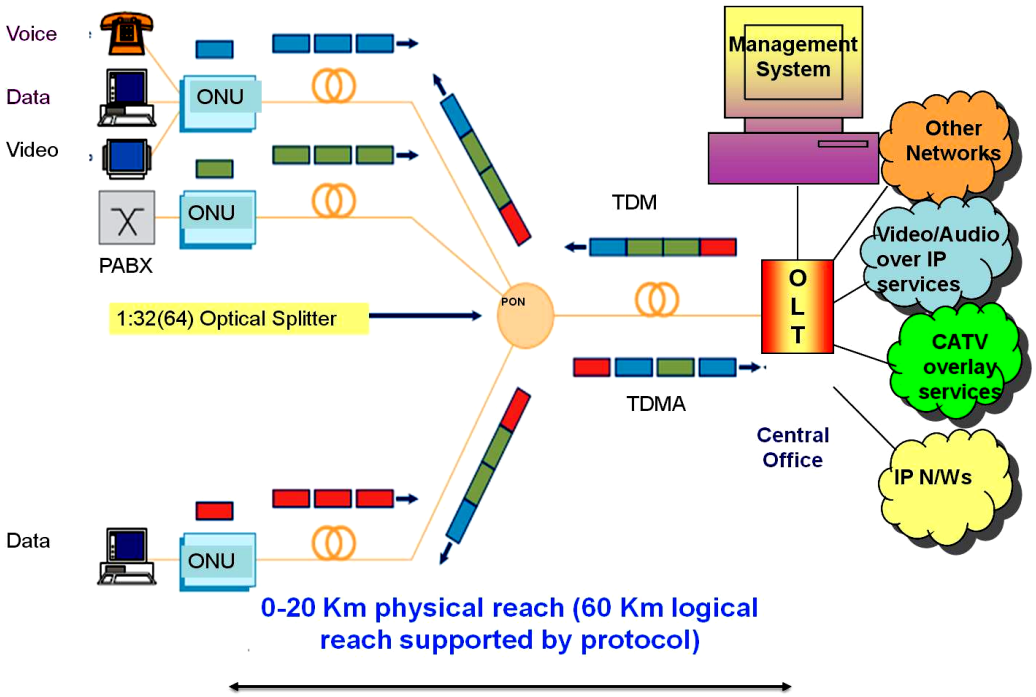

Figure: 6 PON Architecture

2.6.2 ONU/ONT:

This provides access to the users i.e. an External Plant / Customer Premises equipment providing user interface for many/single customer. The access node installed within user premises for network termination is termed as ONT. Whereas access node installed at other locations i.e. curb/cabinet/building, are known as ONU. The ONU/ONT provide, user interfaces (UNI) towards the customers and uplink interfaces to uplink local traffic towards OLT.

2.6.3 PON:

Distributed or single staged passive optical splitters/combiners provides connectivity between OLT & multiple ONU/ONTs through one or two optical fibers. Optical splitters are capable of providing up to 1:64 optical split, on end to end basis. These are available in various options like 1:4, 1:8, 1:16, 1:32 and 1:64.

2.6.4 NMS:

Management of the complete PON system from OLT.

- One OLT serves multiple ONU/ONTs through PON
- TDM/TDMA protocol between OLT & ONT

- Single Fiber/ Dual Fiber to be used for upstream & downstream
- Provision to support protection for taking care of fiber cuts, card failure etc.
- Maximum Split Ratio of 1:64
- Typical distance between OLT & ONT can be greater than 15Km (with unequal splitting - up-to 35Km)
- Downstream transmission I.e. from OLT to ONU/ONT is usually TDM
- Upstream traffic I.e. from ONU/ONT to OLT is usually TDMA
- PON system may be symmetrical or asymmetrical
- PON and fiber infrastructure can also be used for supporting any one way distributive services e.g. video at a different wavelength

PON is configured in full duplex mode in a single fiber point to multipoint (P2MP) topology. Subscribers see traffic only from the head end, and not from each other. The OLT (head end) allows only one subscriber at a time to transmit using the Time Division Multiplex Access (TDMA) protocol. PON systems use optical splitter architecture, multiplexing signals with different wavelengths for downstream and upstream.

2.7 SPLITTER CONFIGURATIONS

There are two common splitter configurations are being used for PON architecture i.e. **centralized and the cascaded** approaches.

2.7.1 Centralized Splitter Approach

In Centralized Splitter Approach typically uses a 1x32 splitter in an outside plant enclosure, such as a fiber distribution terminal. In the case of a 1x32 splitter, each device is connected to an OLT in the central office. In this approach, optical splitters are concentrated in a single location from which all customer's optical network terminals (ONTs) at 32 homes are connected as shown in fig. 7.

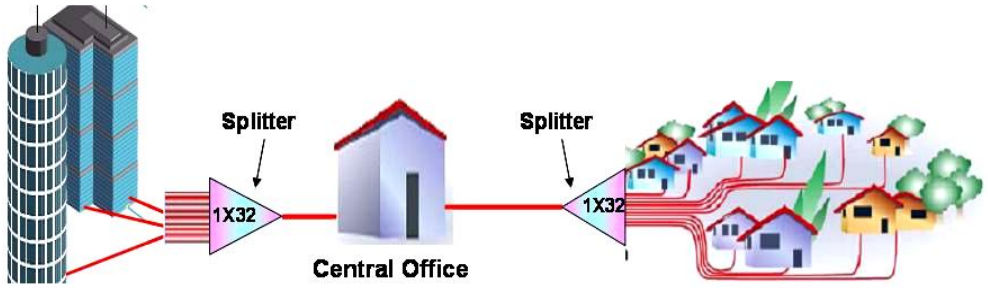

Figure: 7 Centralized Splitter Approach

2.7.2 Cascaded Splitter Approach

A cascaded split configuration results in pushing splitters deeper into the network as shown in fig.8. Passive Optical Networks (PONs) utilize splitter assemblies to increase the number of homes fed from a single fibre. In a Cascaded PON, there will be more than one splitter location in the pathway from central office to customer. Currently, standard splitter formats range from 1 x 2, 1 x 4, 1 x 8, 1 x 16 and 1 x 32 so a network might use a 1 x 4 splitter leading to a 1 x 8 splitter further downstream in four separate locations. Optimally, there would

eventually be 32 fibers reaching the ONTs of 32 homes.

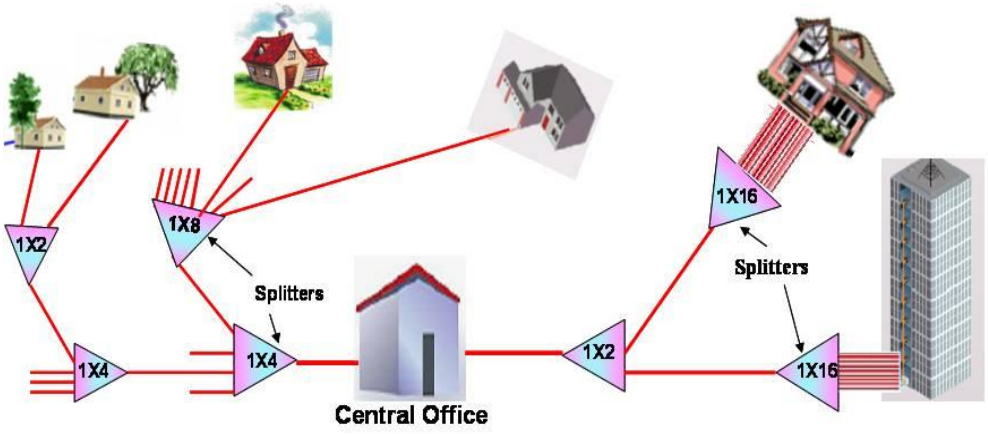

Figure: 8 Cascaded Splitter Approach

There are several "flavors" of PON technology, i.e. new access technology named **APON** (ATM Passive Optical Network), **BPON** (Broadband Passive Optical Networking), **EPON** (Ethernet Passive Optical Networking) and **GPON** (Gigabit Passive Optical Networking) which delivers gigabit-per-second bandwidths while offering the low cost and reliability.

2.7.3 APON

ATM PON (APON) was standardized by the ITU in 1998 and was the first PON standard developed. It uses ATM principles as the transport method and supports 622 Mbps downstream services and 155 Mbps upstream service shared between 32-64 splits over a maximum distance of 20 km.

2.7.4 BPON

Shortly after APON, Broadband PON (BPON) followed and is very similar to APON. BPON also uses ATM, but it also boasts superior features for enhanced broadband services like video. BPON has the higher performance numbers then APON pre-splitting maximum of 1.2 Gbps downstream and 622 Mbps upstream.

2.7.5 EPON

The IEEE standardized Ethernet PON (EPON) in the middle of 2004. It uses Ethernet encapsulation to transport data over the network. EPON operates at rates of 1.25Gbps both downstream and upstream (symmetrical), using 8B/10B encoding over a maximum reach of 20. EPON is also called now as Gigabit Ethernet PON (GE-PON). It is defined as a single fiber network using Wavelength Division Multiplexing (WDM) operating at a wavelength of 1490 nm downstream and 1310 nm upstream. This leaves the 1550 nm window open for other services, such as analog video or private WDM circuits.

2.8 GPON

Gigabit PON (GPON) is the next generation of PON's from the line of APON and BPON. The ITU has approved standard G.984x for it. GPON will support both ATM and Ethernet for Layer 2 data encapsulation so is clearly an attractive proposition. GPON supports two methods of encapsulation: the ATM

and GPON encapsulation method (GEM). GEM supports a native transport of voice, video, and data without an added ATM or IP encapsulation layer. GPONs support downstream rates as high as 2.5 Gbits/sec and an upstream rate from 155 Mbits/sec to 2.5 Gbits/sec. BSNL is procuring the GPON that will support downstream rate 2.5Gbps and upstream 1.25 Gbps.

2.9 THE FEATURES OF DIFFERENT PON STANDARD

Features	**BPON**	**GPON**	**EPON**
Responsible Standard body	FSAN & ITU-T SG15 (G-983 Series)	FSAN & ITU-T SG15 (G-984 Series)	IEEE 802.3ah
Bandwidth	Down Stream up to 622 Mbps Up Stream up to 155.52 Mbps	Down Stream up to 2.5 Gbps Up Stream up to 2.5 Gbps	Down Stream up to 1.25 Gbps Up Stream up to 1.25 Gbps
Downstream ג	1490 nm & 1550 nm	1490 nm & 1550 nm	1490 nm
Upstream ג	1310 nm	1310 nm	1310 nm
Layer-2 Protocols	ATM	ATM, Ethernet, TDM over GEM	Ethernet
Frame	ATM	GPON Encapsulation Method	Ethernet Frame
Max. Distance (OLT to ONU)	20 km	20 Km(supports logical reach up to 60 Km)	10 and 20 Km.
Split Ratio	1:16, 1:32 and 1:64	1:16, 1:32 and 1:64	1:16 and 1:32
Line Codes	NRZ (Scrambled)	NRZ (Scrambled)	8B/10B
Downstream Security	**AES:** Advanced Encryption Standard -128 bit key	**AES:** Advanced Encryption Standard (Counter mode)	Not Defined
FEC	None	Yes	Yes
No. of fibers	1 or 2	1 or 2	1
Protection Switching	Support multiple protection configuration	Support multiple protection configuration	None

Table: 1 Features of different PON standard

2.10 PROPOSED SERVICES ON FTTH NETWORK OF BSNL

The first and foremost service proposed in the deployment of these PON technologies is to roll out the **Next Generation Play Network (NGPN).** The

following services are proposed on the FTTH network:

- Basic internet Access Service controlled and uncontrolled from 256Kbps to 1000Mbps.
- TV over IP Service (MPEG2).
- Video on Demand (VoD)(MPEG4) play like VCR.
- Audio on Demand Service
- Bandwidth on Demand (User and or service configurable)
- Remote Education
- Point to Point and Point to Multi Point Video Conferencing, virtual classroom.
- Voice and Video Telephony over IP: Connection under control of centrally located soft switches.
- Interactive Gaming.
- Layer 3 VPN
- VPN on broadband
- Dial up VPN Service
- Virtual Private LAN Service (VPLS)

2.11 INTRODUCTION TO BHARATNET

BharatNet, also known as Bharat Broadband Network Limited, is a telecom infrastructure provider, set up by the Government of India under the Department of Telecommunications for the establishment, management, and operation of the National Optical Fibre Network to provide a minimum of 100 Mbit/s broadband connectivity to all 250,000 gram panchayats in the country, covering nearly 625,000 villages, to improve telecommunications in India and reach the campaign goal of Digital India. The last mile connectivity, with a total of 700,000 Wi-Fi hotspots to cover all 625,000 villages of India by adding 2 to 5 Wi-Fi hotspots per gram panchayat and a minimum of one Wi-Fi hotspot per village, have been created by connecting high-speed 4G base tower stations of commercial telecom operators to BharatNet, whereby commercially non-viable Wi-Fi hotspots will be subsidised by the union government grant to sustain the operation. The government has discounted the bulk BharatNet bandwidth rates to the commercial telecom operators by 76% to enable them to offer the highly discounted, affordable, competitive, and commercially viable BharatNet-enabled wireless cellular 4G broadband deals to the rural customers. The union government share of funding will come from the Universal Services Obligation Fund of the Department of Telecommunications. It will be rolled out with the additional funding by state governments to connect all gram panchayats in India. BharatNet is the world's largest rural broadband connectivity program. It is built under the Make in India initiative with no involvement of foreign companies.

BharatNet will provide more employment opportunities, improved service delivery (online e-gram panchayat services, e-governance, e-education, e-health, e-medicine, e-grievances, e-agriculture, e-citizen, etc.), and an impetus to the Make in India, Digital India and Startup India initiatives. According to Morgan

Stanley's research, of India's 33% internet penetration in November 2017 only 15% and 2% of total internet users use online shopping and retail shopping respectively, estimated to go up to 78% penetration, 62% online shoppers and 15% online retail shopper respectively by 2027. By the end of BharatNet Phase-II in March 2021, the total current fibre optical network will grow by 100% to 10 million kilometres. This 100% increment in the fibre optic network would result in several hundred percent increment in the internet usage when in addition to 625,000 villages (each with minimum 100 Mbit/s), 2,500,000 government institutions and 5,000,000 households will also be connected to the BharatNet broadband by 2020, by adding several hundred million more broadband users to the current figures of 276.5 million wireless and wireline broadband connections out of total of 422.2 million internet users on 31 March 2017.

BharatNet Phase-I, connecting 100,000 village councils covering 300,000 villages, was completed by December 2017. BharatNet Phase-II will be completed by 31 March 2021 to connect the remaining 150,000 village councils covering 325,000 villages. As of 31 December 2018, India had a population of 1.3 billion people, 1.23 billion Aadhaar digital biometric identities, 1.21 billion mobile phones, 446 million smartphones, 560 million internet users up from 481 million people (35% of the country's total population) in December 2017, and 51% growth in e-commerce.

It is both an enabler and a beneficiary of other key government schemes, such as Digital India, Make in India, the National e-Governance Plan, UMANG, Bharatmala, Sagarmala, the dedicated freight corridors, industrial corridors, and UDAN-RCS.

2.11.1 History

On 25 October 2011, the Government of India approved the National Optical Fibre Network (NOFN) initiative, later renamed as BharatNet, to connect all 250,000 gram panchayats in the country covering nearly 625,000 villages, by utilising the existing optical fibre network and extending it to the gram panchayats. To achieve this, Bharat Broadband Network was incorporated as a Special Purpose Vehicle(SPV) on 25 February 2012 under Companies Act of 1956. Between 2011 and 2014, project did not take off as planned, and only 350 km of optical fibre, out of 300,000 km optical fibre network needed for the Phase-I, was laid. Between 2014 and 2017, the original Phase-I target of laying 300,000 km of optical fibre was completed.

After renaming the project as the "BharatNet", several changes made to expedite the project, significantly enhanced the BharatNet funding to several billion dollars under the Digital India, set ambitious time-bound implementations deadlines, appointed government public sector units (BSNL, RailTel and PowerGrid Corp) for the swift implementation and monitoring, and to bypass the right of way issues for laying the optical fibre cable network the existing government-owned roads, rail lines and power lines were used. Bangalore based United Telecoms Limited won the bid, being almost 80% lower to the second lowest bidder ITI followed by Tejas, STL, etc. BharatNet collaborated with other government entities such as C-DOT, Telecommunications Consultants India Limited and National Informatics Centre for the design and rollout plan of BharatNet NOFN Project. BharatNet assigned the execution work of network roll

out to several other Government of India Public Sector Units, namely BSNL, RailTel and Power Grid Corporation of India. Project was rolled out as a collaboration between the Union Government (to provide broadband connectivity at sub-district Block-level), state governments (optical fibre to gram panchayat level) and private sector companies (Wi-Fi hotspots in each village and connections to the individual homes). Union government total share is ₹450 billion (equivalent to ₹510 billion, US$7.1 billion or €6.6 billion in 2019), the rest will be funded by the respective state governments.

Once all the gram panchayats have been connected by the dedicated fibre optical network, the last mile connectivity to all villages will be provided by the commercial telecom operators by expanding the current national network of 38,000 Wi-Fi hotspots to 700,000 Wi-Fi hotspots to cover all 625,000 villages in India. ₹36 billion (equivalent to ₹41 billion, US$570 million or €520 million in 2019), union government subsidy support will be given to the telecom service operators for rolling out Wi-Fi hotspots in commercially non-viable villages. BharatNet has offered the bulk broadband bandwidth at 75% discounted rates to the commercial telecom operators so that they can offer deeply discounted monetised competitive deals to the rural wireless broadband customers. Commercial operators Reliance Jio, Bharti Airtel, Idea Cellular and Vodafone have already connected their 4G-based-broadband base towers to BharatNet at various locations to provide the high speed last mile wireless broadband connectivity.

There are 36 states and union territories of India, likely to be included 28 states and 9 UTs. BSNL was awarded work for 18 of these, RailTel received work in 8 and Power Grid Corporation of India in 5. BSNL was awarded work for 18+ states and UTs, namely Andaman and Nicobar Islands, Assam, Bihar, Chandigarh, Chhattisgarh, Haryana, Jammu and Kashmir, Karnataka, Kerala, Lakshadweep, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Sikkim, Uttar Pradesh (divided into two projects, UP East and UP West), Uttarakhand and West Bengal. RailTel was awarded work for 8+ states and UTs, namely Arunachal Pradesh, Gujarat, Nagaland, Manipur, Mizoram, Meghalaya, Puducherry and Tripura.

Power Grid Corporation of India was awarded work for 5 states, namely Andhra Pradesh, Himachal Pradesh, Jharkhand, Odisha and Telangana. Delhi is included with Phase-I BSNL work for Haryana. Goa is also included with Phase-I BSNL work for Maharashtra. Dadra and Nagar Haveli and Daman and Diu are included with Phase-II work for RailTel. Tripura is likely included with Phase-II RailTel work for the Northeast India.

2.11.2 Technology

The components of the BharatNet architecture in the concept diagram are:

1. Gigabit passive optical network (GPON) technology at the national level.
2. Optical line terminal at subdistrict block level.
3. Optical fibre cable to each gram panchayat.
4. Beam splitters and combiners.
5. Optical network terminals at gram panchayat level.

6. Hotspot (Wi-Fi) at each village-level within the gram panchayat.
7. Connectivity to the individual homes.

2.11.3 Implementation

BharatNet Phase-I (Dec 2017):

BharatNet Phase-I, across 13 states and UTs was completed in December 2017 . It connected 100,000 gram panchayat, covering 300,000 villages by laying 300,000 km of optical fibre network. 13 states and UTs in this phase are: Andaman and Nicobar Islands, Chandigarh, Delhi, Goa, Haryana, Karnataka, Kerala, Lakshadweep, Manipur, Meghalaya, Puducherry, Sikkim and West Bengal.

BharatNet Phase-II (Dec 2018):

BharatNet Phase-II, to be completed by 31 March 2021, will connect the remaining nearly 145,000 gram panchayats covering 325,000 villages through additional 1 million km of optical fibre. Phase-II commenced , with the current 250 km per day pace of optical fibre network roll out which needs to be raised to 500 km per day to achieve the completion target of March 2019. Roll out will be expedited with November 2017 memorandum of understanding with seven more states, namely Andhra Pradesh, Chhattisgarh, Gujarat, Jharkhand, Tamil Nadu, Maharashtra and Telangana. Phase-II will double the total optical fibre network of the nation and will generate 100,000,000 mandays employment for the roll out.

DoT will invest on BharatNet in Northeast India, including erecting 6,673 towers to connect 8,621 villages and additional 4,240 gram panchayats by satellite broadband connectivity.

2.12 CONCLUSION

From the BSNL network point of view GPON, being the TDM based technology, shall integrate into the existing switching network. While the VOIP feature in the GE-PON provides easy migration path to the **Next Generation Network (NGN)** of the BSNL. Since TDM switches and the NGN are to coexist for up to 2015 as per the NGN vision plan both GPON and GE-PON are the most suitable PON technologies for BSNL.

3 RURAL BROADBAND AND MULTIPLAY

3.1 LEARNING OBJECTIVES

- Concepts of rural broad band, multiplay broad band
- VPN, SLA, value added services
- Messaging services, Internet data center services and other broad band services.

3.2 FEATURES OF NIB II NETWORK

It has the following features:

- It provides a diversified range of Internet access services including support for VPN (Layer-2, Layer-3 and Dialup and Broadband services)
- It also offers SLA Reports including security, QoS (quality of service) and any to any connectivity.
- It offers fully managed services to customers.
- It offers services like bandwidth on demand etc. over the same network.
- The network is capable of on-line measurement and monitoring of network parameters such as latency, packet loss, jitter and availability so as to support SLAs with customers
- The routers support value added services such as VPNs, Web and content hosting, Voice over IP, Multicast, Firewall Services, Network Address Translation (NAT) Service that will enable private users to access public networks etc.
- Internet Data Centre Services at Bangalore, Delhi (Noida) and Mumbai.
- Broad Band Services
    - Broadcast TV using IP Multicasting service
    - Multicast video streaming services
    - Interactive Distant learning using IP multicasting Services
    - Video on demand
    - Interactive gaming service

3.3 NIB-II PHASES OF IMPLEMENTATION

Name of project	Description
Project 1	MPLS based IP Infrastructure (The backbone consisting of Core & Edge Routers)
Project 2.1	Narrowband Access (Dialup Remote Access)
Project 2.2	Broadband Access (DSL Access)

Project 3	Messaging, Storage, Provisioning, Billing, Security, Order Management, Enterprise Management, AAA, Help Desk and Inventory Management.

Table: 2 NIB-II Phases of implementation

3.4 NIB-II PROJECT 2.2 NETWORK ARCHITECTURE

The cities in India have been classified in six types namely A1, A2, A3, A4, B1, B2. The network of NIB II consists of the following network elements:

- A1 Cities – 5 Core cities (Bangalore, Chennai, Mumbai, Delhi (Noida), Kolkatta)
- A2/A3 Cities – 9 next level core cities (Pune, Hyderabad, Ahmedabad, Ernakulam, Lucknow, Jaipur, Indore, Jullundur, Patna)
- A4 Cities – 10 Major cities
- B1, B2 Cities – 47 other cities

A1 city core routers are fully meshed between locations on STM-16. B1 and B2 cities have only EDGE routers. All Core locations also have edge routers. Primary Network Operating center is at Bangalore and Disaster Recovery is at Pune. The NIB II network has IGW (International Gateway Router) for Connectivity to Internet, IXP (Internet Exchange Point) through which ISP's connect each other and IDC (Internet Data Center) for connecting to BSNL Data Centers.

3.5 NIB2 EXPANSION AND YEAR 2 ORDER OVERVIEW

29 locations have been added for expansion of the network, which makes the total number of cities to 100. Core backbone is aligned to BSNL Transmission (DWDM) network. 24 City core network increased to 29 cities under this expansion work. In all these 29 cities, core network links are STM-16 (i.e. STM1 connectivity of A4 cities has been upgraded to STM16). New 5 Cities are Belgaum, Dehradun, Rajkot, Jodhpur, Jabalpur have been added.

3.6 COMPONENTS OF BROAD BAND ACCESS NETWORK

BBRAS: A Broadband Remote Access Server (BBRAS) routes traffic to and from the digital subscriber line access multiplexers (DSLAM) on an Internet service. In bigger cities like A1, A2, A3 and A4, one BBRAS per city has been deployed initially and the same is augmented as per the traffic in the city but there are no BBRAS at B1 and B2 cities and B cities are parented to the nearest A city. The BRAS terminates the PPP sessions initiated by the customer and extend the connection further to MPLS VPN/ Internet as desired by the customer.

- Gigabit and Fast Ethernet Aggregation Switches (LAN Switches) provide the aggregation of the network traffic.
- **Digital Subscriber Line Access Multiplexers (DSLAMs)** : It is a device that takes a number of ADSL subscriber line and concentrates these to a single Ethernet line. The DSLAMs are, in general, collocated with existing PSTN exchanges, which provide last mile access to customers over copper wire up to

average span lengths of 3 KMs. All DSLAMs have been aggregated through a FE/GE interface. The FX or GBIC module in DSLAM and LAN switch is capable of driving up to 10km on a single mode fiber. GBIC stands for Gigabit Interface Converter; a Fiber Channel optical or copper transceiver that is easily swapped to offer a flexible choice of copper or fiber optic media. The DSLAMs in B1, B2 and other lower hierarchical cities are aggregated through Layer 2 switches, and are connected to the nearest BBRAS of A cities on Ethernet over SDH.

- SSSS/SSSC (Subscriber Service Selection System/ Centre)
- Servers for AAA, LDAP at NOC.
- Provisioning and configuration management at NOC.
- DSL CPEs (ADSL MODEM) for customer to connect their devices and access internet.

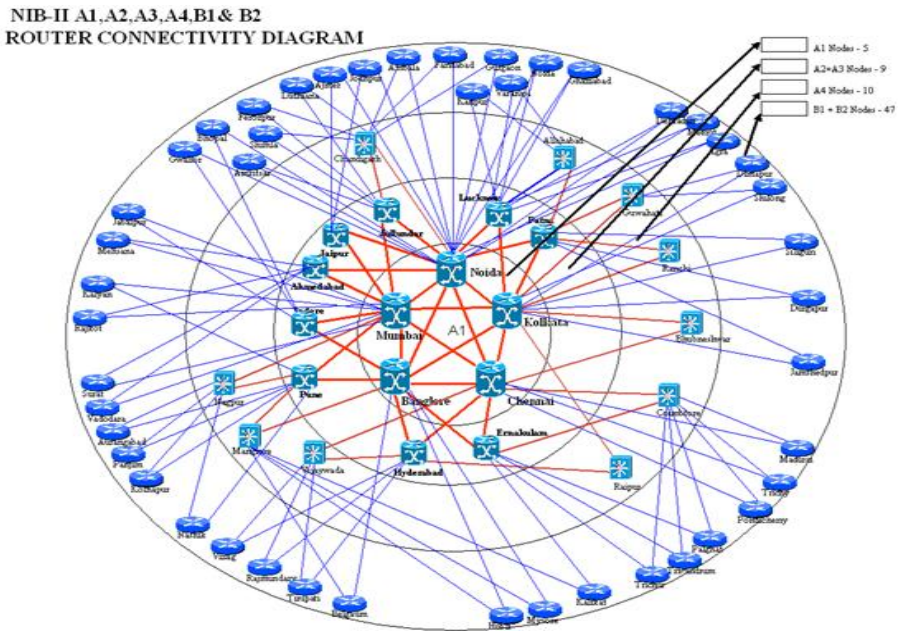

Figure: 9 NIB II Project 2.2 router connectivity diagram

3.7 COMPONENTS OF BSNL BROADBAND MULTIPLAY NETWORK

The BSNL's Broadband Multiplay network consists of the following components: -

a. L3PE (MCR / PE Router of NIB-2 Project 1)
b. BNG – Broadband Network Gateway – It connects Multiplay Network to NIB2 Backbone (Project 1) through L3PE
c. RPR Tier-1 Switch – It provides connectivity from BNG to Tier –2 network

d. RPR Tier-2 Switch
e. OC LAN Tier-2 Switch
f. DSLAM (64-ports DSLAM in case of Rural BB)
g. ADSL CPE
h. DSL Tester
i. Ethernet converter

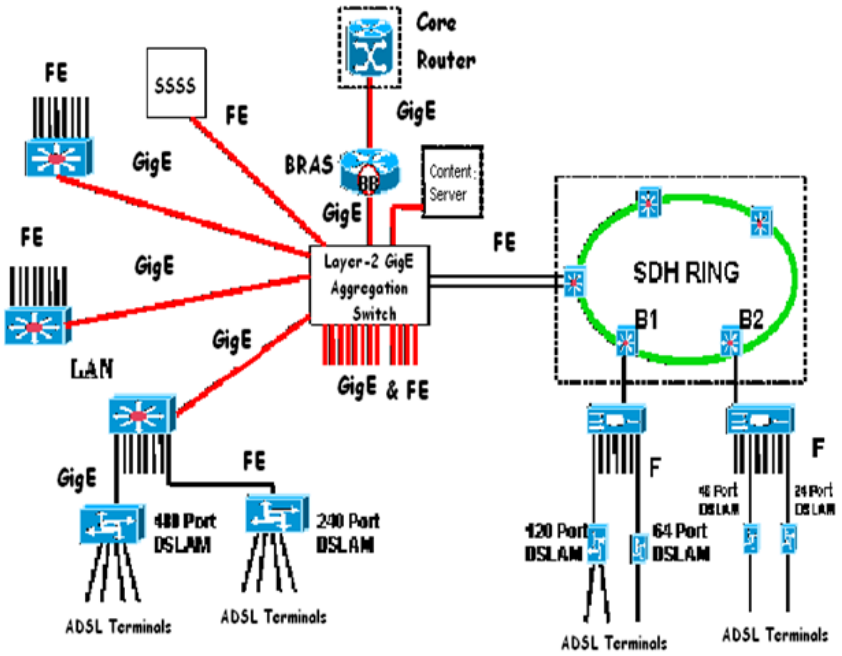

Figure: 10 Block Schematic of P2.2 Broadband Access Network

3.8 CHANGES IN BROADBAND MULTIPLAY VIS-A- VIS BROADBAND PROJECT

- T1 & T2 changed from star topology to RPR ring topology – High reliability
- IP-DSLAM connected on GE interface as compared to FE interface.
- BNG behaves as customer edge router whereas BRAS was a PE Router.
- BRAS were present at 23 "A" locations only whereas BNG is present up to "B" type cities.

3.9 ROLE OF OCLAN SWITCH

OCLAN Switches which becomes the Tier 2 component of the network resides in the Access layer. OCLAN switches aggregate the number of DSLAMs in every OC cities as required in the project.

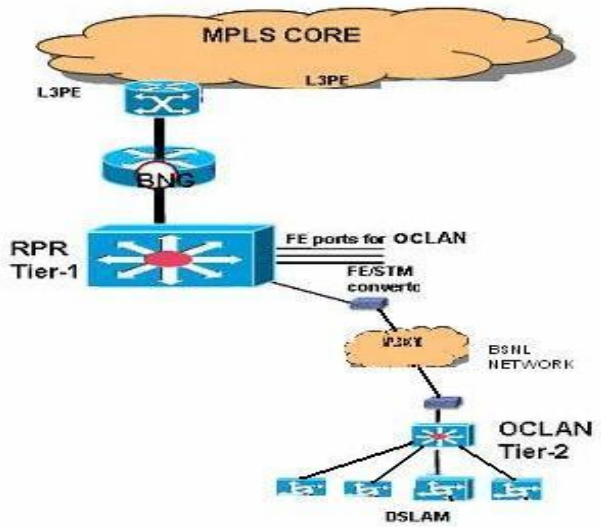

Figure: 11 Role of OCLAN Switch

3.10 NETWORK ARCHITECTURE OF BSNL MULTIPLAY AND RURAL BROADBAND

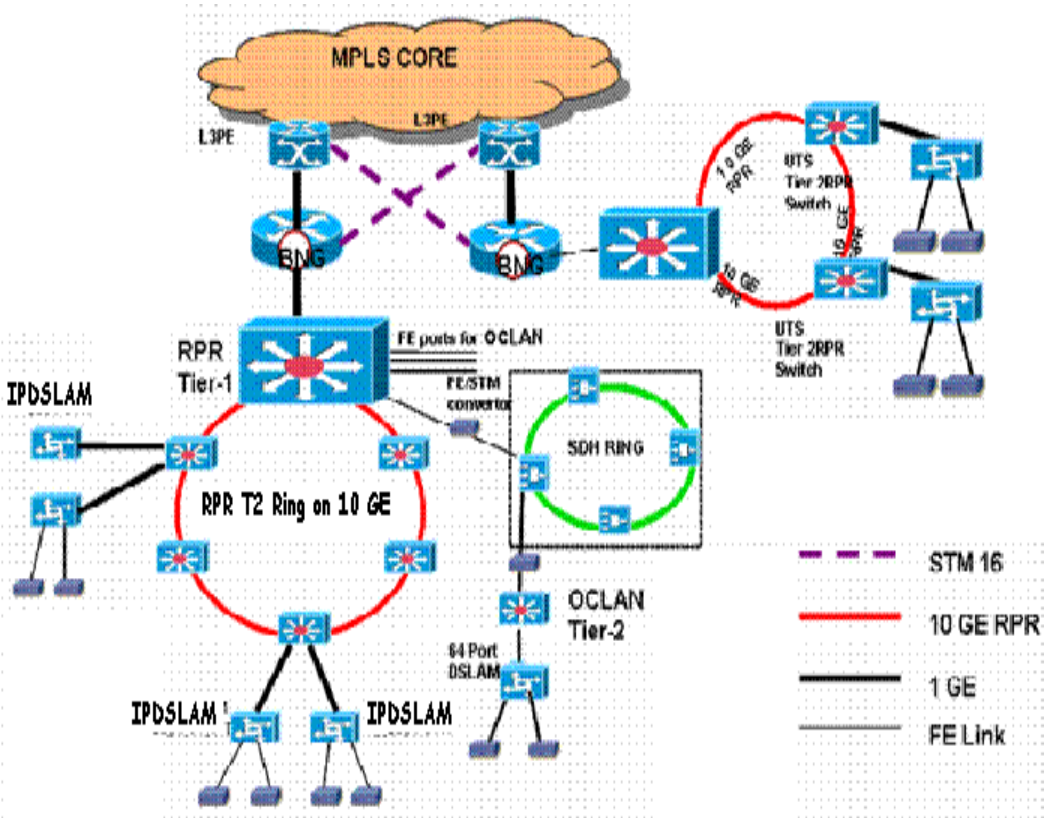

Figure: 12 Network Architecture of Multiplay & Rural Broadband

3.11 DETAILS OF OCLAN SWITCH ZXR10 TG64G BY ZTE

Figure: 13 OCLAN Switch ZXR10 TG64G by ZTE

3.11.1 Control Switching Board

The Control Switching Board (MCS) is the core of ZXR10 T64G, implementing the functions of control module and switching module. It performs the function of master/slave switchover.

3.11.2 Interfaces Available

Console Interface and 10/100 base TX Ethernet Interface.

3.11.3 Line Interface Cards:

The Line Interface cards include Fast Ethernet Interface board, Gigabit EthernetInterface board and 10giga bit Ethernet board.10 GB Ethernet is not being used in BSNL currently.

3.11.4 44 FE + 4 GE Interface Board

44FE + 4GE Interface card board provides 44 Fast Ethernet Optical Interfaces and 4 gigabit Ethernet electrical Interfaces.

3.11.5 24 port Gigabit Ethernet Interface Board

This provides 4 gigabit Ethernet Electrical Interfaces and 20 Ethernet Optical Interfaces.

3.11.6 Line Interface Cards Used

- 2 * 44FE + 4GE Interface card
- 1 * 24 GE Interface Card

3.11.7 Ports Used in BSNL currently

- GE Interfaces populated with SFPs : 17 nos
- FE Interfaces populated with SFPs : 16 nos

3.12 SERVICES ON BROADBAND MULTIPLAY AND RURAL BROADBAND

a. DATA SERVICE

High speed Internet Access: This is the always-on Internet access service with speed ranging from 512 kbps to 24 Mbps.

b. DIAL VPN SERVICE

This service allows remote users to access their private network securely over the NIB-II infrastructure

c. VIDEO SERVICE IPTV OR TVOIP

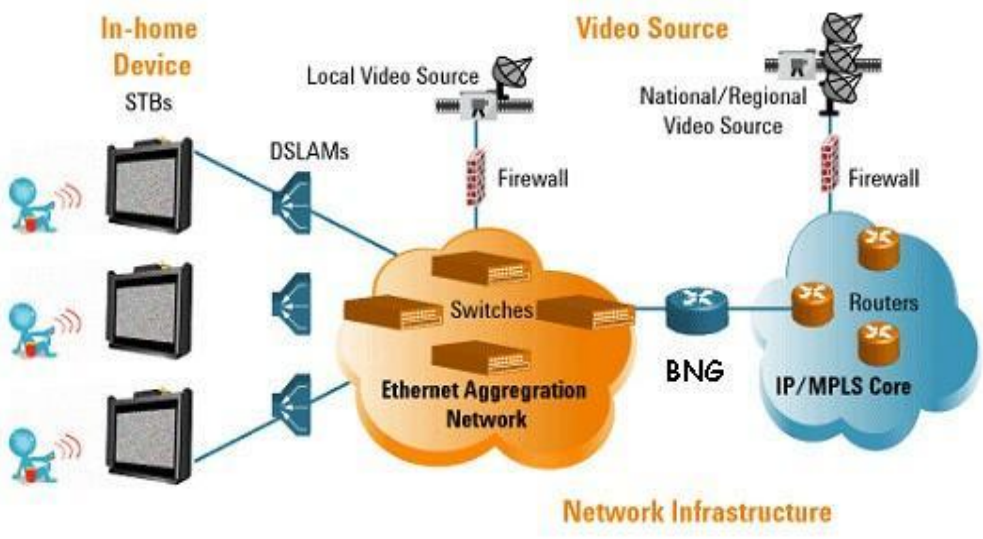

Figure: 14 IPTV Service

- **IPTV or TVoIP** delivers television programming to households via broadband connection using Internet protocols.
- It requires a subscription and IPTV set-top box **(STB)**, this box will connect to the home DSL line and is responsible for reassembling the packets into a video stream and then decoding the contents
- IPTV is typically bundled with other services like Video on Demand **(VOD)**, Voice Over IP **(VOIP)** or digital Phone, and Web access.
- IPTV viewers will have full control over functionality such as rewind, fast-forward, pause, and so on.
- If you've ever watched a video clip on your computer, you've used an IPTV system in its broadest sense.
- The video stream is broken up into IP packets and dumped into the core network, which is a massive IP network that handles all sorts of other traffic (data, voice, etc)

d. VOD (VIDEO ON DEMAND)

Video on Demand service allows the user the luxury of watching the movie of his / her choice at his / her convenience.

3.13 DIFFERENCE BETWEEN VOD ON BROADBAND AND DTH

In DTH, as it is broadcasting and not communication so the request for VOD has to be registered through some other mean than the Set top Box say can be through phone call, SMS or Internet and the same four to five movies are broadcasted and the viewers have to choose among them only and at predefined timings.

In true VOD, as offered by BSNL, the set-top box behaves just like a DVD player and viewer can select a movie from the boutique, view it at his / her desired time and day, pause it, rewind it, forward it or can have the exactly same experience has viewing from a personalized DVD player.

This is only possible because of the two-way communication between the set-top box and the server. In BSNL one has a choice of selecting from hundreds of movies while VOD offered by DTH providers may have only few movies to offer.

3.14 SET-TOP BOX

The set-top box is a smart solid-state device that acts as the gateway to a host of services offered on the BSNL Multiplay network. On one side the set-top box interfaces with the television using the 3-RCA or the S-Video ports, and on the other side it is connected to broadband ADSL modem via the Ethernet port.

BSNL franchisee in Pune has named the set-top box as WICE Box (**W**indow for **I**nformation, **C**ommunication and **E**ntertainment) and supports all sorts of inputs like audio, video, tablet data, text data, pointer devices etc. it has a USB port and a microphone and headphone jack in addition to essential ports. In future, it will be possible to connect keyboard, mouse, web cams, pen-drives and other such devices for various applications that will be provided on the box.

The WICE box is fully upgradeable through the network. This means, any new application launched will be directly uploaded into WICE box without getting the box to service center. All software upgrade will be handled this way.

3.15 VOIP (VOICE OVER IP) SERVICE

The technology used to transmit voice conversations over a data network using the Internet Protocol.A category of hardware and software that enables people to use the Internet as the transmission medium for telephone calls.VoIP works through sending voice information in digital form in packets,VoIP also is referred to as Internet telephony, IP telephony, or Voice over the Internet (VOI)

3.16 CONCLUSION

Multiplay and Rural Broadband network is a high capacity network capable of providing services that require high bandwidth as well services that have real-

time transport constraint. It can fulfill the stringent requirement in terms of Quality of Service imposed by various services, applications and customers.

4 CONVERGED PACKET BASED AGGREGATION NETWORK (CPAN)

4.1 LEARNING OBJECTIVES

- Limitation of circuit switched network signals.
- CPAN Technology.
- Network Architecture of CPAN.

4.2 INTRODUCTION

The purpose of a transport network is to provide a reliable aggregation and transport infrastructure for any client traffic type. With the growth of packet-based services, operators are transforming their network infrastructures while looking at reducing capital and operational expenditures. In this context, a new technology is emerging: a transport profile of Multi-Protocol Label Switching called MPLS-TP.

Transport network requirements of BSNL in the present scenario requires packet transportation, as all the new network elements are generating IP Traffic which is to be reliably transported. Based on this requirement, Packet Transport Network Planning guidelines have been prepared which outlines the basic concepts, technology & network architecture for the future transport network of BSNL. The network basically comprises of MPLS-TP based nodes.

- In BSNL transport network was designed and deployed to carry basically TDM traffic comprising of Els, STM-1s & STM-16s. The network elements such as Switches, BTSs, BSCs& MSCs etc utilized TDM interfaces for transportation of information from one place to the other as part of service delivery. With the introduction of Broadband for which large number of DSLAMs were installed for high speed Broadband delivery, transport of Ethernet traffic was also introduced in BSNL network, through RPR Switches deployed in metro districts.
- To carry TDM traffic efficiently & reliably SDH network comprising of STM-1 CPE, STM-1 ADM, STM-4, STM-16 ADM, STM-16 MADM and STM-64 has been extensively deployed which carried all type of TDM traffic. For long distance transport, linear DWDM systems (2.5G & 10G) were deployed which carried mostly SDH traffic through its lambdas (STM-1, STM-4, STM-16). During 2009 Digital Cross Connect (DXCs) were also introduced in BSNL network with granularity of STM-1 Cross Connect along with aggregation and ASON capability. Thus SDH, DXC and DWDM is presently the backbone of the transport network of BSNL.
- From 2006 onwards, with the advent of Ethernet over SDH (EoSDH) all SDH,DWDM & DXC Equipment procured by BSNL had the capability of transporting Ethernet traffic over SDH frame through Generic Framing Protocol (GFP) and Virtual Concatenation. This technology enabled BSNL to adapt to the transition phase in the technological development curve where the network elements were progressively switching towards Ethernet Interfaces (FE, GE) but continued to support TDM interfaces too. Further with deployment of large

numbers of RPR Switches and OCLAN Switches with Broadband network the requirement of Ethernet transport through traditional TDM transport backbone was minimal.Even the routers of MPLS network (P&PE) had substantial TDM interfaces to enable the transportation of traffic in secure reliable media, utilizing BSNL's traditional TDM transport backbone.

- But the situation depicted above is rapidly changing with 100% network elements being deployed by Mobile, Broadband and NGN for fixed access supporting only Ethernet interface for interconnection. Thus the volume of transport requirement for Ethernet Interfaces bas exponentially increased while requirement of TOM transport is rapidly vanishing. The network transportation requirement has clearly shifted from TOM with smaller portion of Packet to almost l00% Packet transport. As we move in the era of Packet transport, utilizing TDM network for the same becomes inefficient and costly. Moreover, the packet network gives support to different class of services, aggregation and dynamic statistical multiplexing etc. in transport layer for efficient delivery of services.

4.3 WHAT IS PACKET TRANSPORT NETWORK?

Attributes required for Ethernet transport.

Attributes	**Packet network**	**Transport network**	**Packet transport network**
Connection mode	Connectionless	Connection oriented	Connection oriented
OAM/Operation & maintenance	Out of band	In band	In band
Protection switching	Control plane depend	Data plane switching	Data plane switching
BW efficiency	Statistical multiplexing	Fixed bandwidth	Statistical multiplexing
Data rate granularity	Flexible	Rigid SDH hierarchy	Flexible
QoS	QoS differentiation	Single class	QoS differentiation

Table: 3 Packet Transport->Packet efficiency + Transport grade

4.4 MPLS-TP

The goal of MPLS-TP is to provide connection-oriented transport for packet and TDM services over optical networks leveraging the widely deployed MPLS technology. Key to this effort is the definition and implementation of OAM and resiliency features to ensure the capabilities needed for carrier-grade transport networks – scalable operations, high availability, performance monitoring and multi-domain support.

Objective of MPLS-TP is:

- To enable MPLS to be deployed in a transport network and operated in a similar manner to existing transport technologies (SDH/SONET/OTN)
- To enable MPLS to support packet transport services with a similar degree of predictability, reliability, and OAM to that found in existing transport networks

Current transport networks (e.g. SONET/SDH) are typically operated from a network operation center (NOC) using a centralized network management system (NMS) that communicates with the network elements (NEs) in the field via the telecommunications management network (TMN). The NMS provides well-known FCAPS management functions which are: fault, configuration, accounting, performance, and security management. Together with survivability functions such as protection and restoration, availability figures of >99,999% have been achieved thanks to the highly sophisticated OAM functions that are existing e.g. in SONET/SDH transport networks. This well proven network management paradigm has been taken as basis for the development of the new MPLS-TP packet transport network technology.

Moreover, MPLS-TP provides dynamic provisioning of MPLS-TP transport paths via a control plane. The control plane is mainly used to provide restoration functions for improved network survivability in the presence of failures and it facilitates end-to-end path provisioning across network or operator domains. The operator has the choice to enable the control plane or to operate the network in a traditional way without control plane by means of an NMS. It shall be noted that the control plane does not make the NMS obsolete – the NMS needs to configure the control plane and also needs to interact with the control plane for connection management purposes.

One of the major motivations for developing MPLS-TP was the need for the circuits in Packet Transport Networks. Traditionally packet transport switches each packet independently. However with connection oriented transport a 'connection' is first setup between the end points and then all the traffic for that connection follows only that path through the network. This makes the Packet Transport Network very similar to the TDM networks and simplifies management and migration of the transport network.

The concept of Label Switched Paths or LSPs from MPLS technology is already tried and tested and successful in the internetworking world. It made sense to adapt it for use in Packet Transport Networks. However there was a need to simplify the working of MPLS to make it more suitable for use in the Packet Transport World.

With this in mind, some features were removed from the traditional MPLS, since it was felt that these were not needed in Transport World and would simply the network. The features from MPLS that are not supported by MPLS-TP are:

a) MPLS Control Plane: MPLS-TP does not require LDP or any other control plane protocol to set up the circuits. Instead a user provisioned model is followed. The user can provision a circuit from a centralized Network Management System in a way similar to TDM networks.

b) Penultimate Hop Popping (PHP) : PHP is used by MPLS Edge Routers to reduce the load of two label lookups. However this causes problems with QoS and was disabled in MPLS-TP

c) LSP Merge: Merging two LSPs (going to the same destination) reduces the number of labels being used in the network. However it makes it impossible to

differentiate between traffic common from two different sources before the merging happened. To simplify things in transport networks, LSP merge was also disabled.

d) Equal Cost Multi Path: In traditional IP/MPLS networks different packets between a source-destination pair can take different paths. This is especially true when multiple equal cost paths exist. However this is in conflict with the concept of a circuit where all the traffic should follow the same path. Hence ECMP is disabled.

4.5 DIFFERENCES BETWEEN MPLS AND MPLS-TP

When it comes to the major differences between MPLS and MPLS-TP, here's what you need to know.

- **Bidirectional Label Switched Paths (LSPs).** MPLS is based on the traditional IP routing paradigm -- traffic from A to B can flow over different paths than traffic from B to A. But transport networks commonly use bidirectional circuits, and MPLS-TP also mandates the support of bidirectional LSPs (a path through an MPLS network). In addition, MPLS-TP must support point-to-multipoint paths.
- **Management plane LSP setup.** Paths across MPLS networks are set up with control-plane protocols (IP routing protocols or Resource Reservation Protocol (RSVP) for MPLS Traffic Engineering (MPLS-TE). MPLS-TP could use the same path setup mechanisms as MPLS (control plane-based LSP setup) or the traditional transport network approach where the paths are configured from the central network management system (management plane LSP setup).
- **Control plane is not mandatory.** Going a step farther, MPLS-TP nodes should be able to work with no control plane, with paths across the network computed solely by the network management system and downloaded into the network elements.
- **Out-of-band management.** MPLS nodes usually use in-band management or at least in-band exchange of control-plane messages. MPLS-TP network elements have to support out-of-band management over a dedicated management network (similar to the way some transport networks are managed today).
- **Total separation of management/control and data plane.** Data forwarding within an MPLS-TP network element must continue even if its management or control plane fails. High-end routers provide similar functionality with non-stop forwarding, but this kind of functionality was never mandatory in traditional MPLS.
- **No IP in the forwarding plane.** MPLS nodes usually run IP on all interfaces because they have to support the in-band exchange of control-plane messages. MPLS-TP network elements must be able to run without IP in the forwarding plane.
- **Explicit support of ring topologies.** Many transport networks use ring topologies to reduce complexity. MPLS-TP thus includes mandatory support for numerous ring-specific mechanisms.

4.6 MPLS AND MPLS-TP COMPONENTS

As mentioned previously, MPLS refers to a suite of protocols, and MPLS-TP refers to a set of compatible enhancements to the MPLS protocol suite. These protocols and new enhancements can be separated into the following categories:

- Network Architecture—Covers the definition of various functions and the interactions among them.
- Data Plane-Covers the protocols and mechanisms that are used to forward the data packets. This can further be divided into the following subcategories:
    - Framing, forwarding, encapsulation
    - OAM
    - Resiliency (protection and restoration)
- Control Plane—Covers the protocols and mechanisms used to set up the label-switched paths (LSPs) that are used to forward the data packets.
- Management Plane—Covers the protocols and mechanisms that are used to manage the network.

A list of protocols and mechanisms in each of these categories is provided in Figure below. The figure also highlights the set of enhancements that are being pursued by MPLS-TP. The protocol and mechanisms highlighted in blue are being added to the MPLS/GMPLS protocol suite as part of the MPLS-TP effort. In Figure below, the protocols and mechanisms highlighted in red might not be needed for the transport networks and are, therefore, being made optional. Note that these mechanisms will remain as part of the MPLS/GMPLS protocol suite. It is IETF's guidance to vendors that these mechanisms do not need to be supported on the platforms that are being targeted towards transport networks.

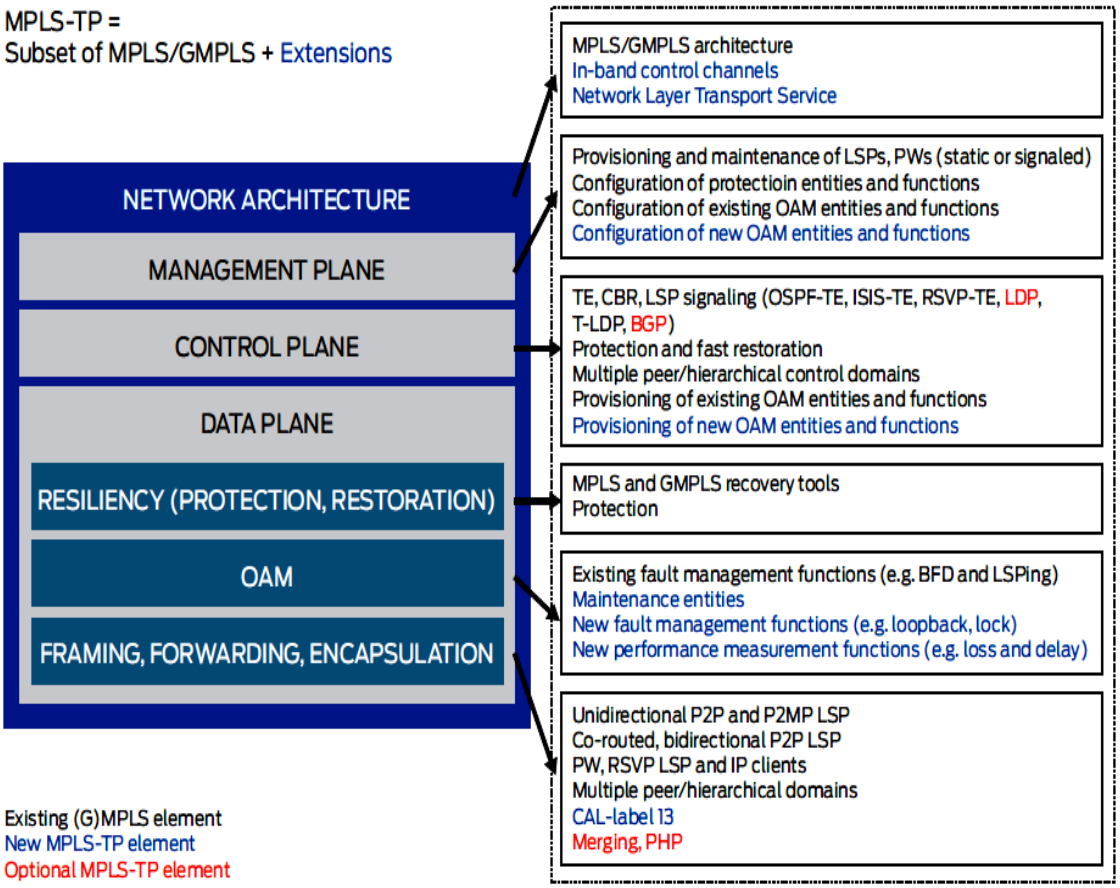

Figure: 15 Components of MPLS and MPLS-TP

4.7 APPLICABILITY AND DEPLOYMENT OPTIONS FOR CPAN

MPLS-TP enhancements are primarily applicable to the access and aggregation networks, where the majority of the migration from circuit-switched networks to packet-based networks is currently occurring, and where higher scale and lower cost is required. Juniper believes that the OAM enhancements to the MPLS protocol suite, however, will be extremely valuable to all MPLS networks, especially in the MPLS-based core networks. These OAM enhancements will allow service providers to have better visibility into their existing MPLS-based core networks, which will allow further optimization. The new OAM capabilities will also help the wholesale business by improving the tools required to measure and enforce strict SLAs. Juniper, therefore, is prioritizing the implementation of these OAM enhancements, such as the enhancements to BFD and LSP ping. Figure 16 illustrates how IP/MPLS and MPLS-TP can be deployed together and are very complementary in nature.

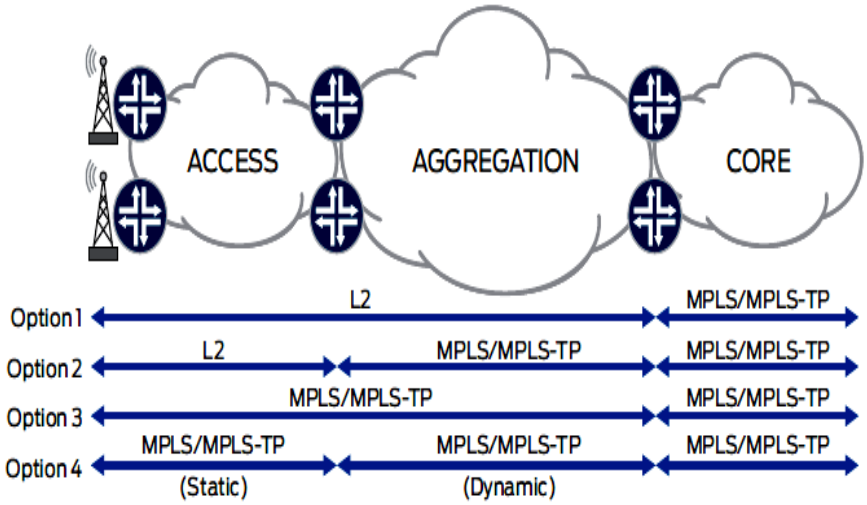

Figure: 16 MPLS and MPLS-TP Deployment Options

4.8 BSNL NETWORK EVOLUTION:

It is seen that BSNL requires immediate introduction of Packet Transport Network in order to provide reliable connectivity to the additional network elements and to meet the exponential growth in IP traffic. MPLS-TP enabled nodes with different configurations (as per the network requirement) maybe planned for transportation requirements in place of STM-1,16, 64 MADMs etc. where ever transport of packets is required. There is provision of carrying STM1 and E1 also in such devices.

4.8.1 Features:-

1. As these equipments are going to be used in place of SDH/TDM devices , which will be capable of servicing both TDM as well as packet (FE,GE etc.) clients, we need to have functionality similar to them and at the same time inefficiency of utilization of available bandwidth is to be minimized Hence for the user it should look like a SDH equipment. OAM (operation administration and maintenance) like SDH are available in these equipment. Some of them are:-
    - Point to point circuits can be provisioned.
    - The devices can be connected in ring /mesh.
    - End to end monitoring of each circuit is possible.
    - Protection 1 : 1(PW) or even 1 :n(LSP) can be provisioned.
    - Itcan transport synchronization information.
2. As switching in these devices are packet based ,it has features of packet based devices also. Some of these are:-
    - Point to multipoint or multipoint to multipoint circuits can be created.
    - Services can be provisioned at L1 or L2 layer.
    - QoS can be defined for individual customers.

4.8.2 Proposed configuration of nodes:-

Type-Al: (DC Powered Type)

Uplink	1GE (optical) - 2
Downlink	FE-4 FX-4 GE-2(Electrical) STM1-2 E1-8

Cross Connect Capacity - Minimum 5Gbps

Type-A2: (AC Powered Type)

Uplink	1GE (optical) - 2
Downlink	- FE-4 FX-4 GE-2(Electrical) STM1-2 E1-8

Cross Connect Capacity - Minimum 5Gbps

Type-B1:

Uplink	-	10 GE(optical)- 2
Downlink	-	1GE-16 (8Electrical+8 optical) FE-16 FX -16 STM1 -8 E1 -64

Cross Connect Capacity- 40 Gbps

Type-B2:

Uplink	10GE (optical) - 2
Downlink	10GE (optical) – 2 GE-32(16 Electrical + 16 Optical) FE-16 FX-16 STM1-8 E1-64

Cross connect capacity- 80 Gbps

Type C:

Uplink	40 GE(optical)-2
Downlink	10GE(optical)-12 FE/GE—64(32 optical + 32 electrical) (10/100/1000) STM 1-8 E1-64

Cross connect capacity— 240 Gbps

(Uplink- Line side,Downlink-Traffic side)

4.8.3 Distance between two nodes:-

Type Al/A2	-	30 Km.
Type Bl/B2	-	50 Km.
Type C	-	50 Km.

4.8.4 Power Supply:-

Type Al /A2- AC Type or DC Type.

Type Bl /B2- DC Type.

Type C- DC Type.

4.9 TYPICAL NETWORK TOPOLOGY FOR MPLS-TP NODES

- Co-located network elements connected directly while the traffic between non co-located ones is transported through packet transport network.
- Nodes to comply to the MPLS TP standards for OAM, Protection,Architecture, Synchronization etc.
- There will be minimum TDM interface and the existing infrastructure of SDH/DWDM will cater to the existing TDM traffic of BSNL where ever possible.
- Lower type nodes can be directly terminated on the interfaces of the higher level nodes i.e. I GE Uplink of Type-A node can be terminated on the I GE interface of Type-B nodes similarly 10GE Uplinks of Type-B node can be terminated on 10GE interface of Type-C nodes.
- Type-A, B & C shall have control card, switching fabric and power supply redundancy while Type-A will have only power supply redundancy.
- Exchange of traffic with MPLS will be through PE Routers on UNI interface at multiple points of connectivity.

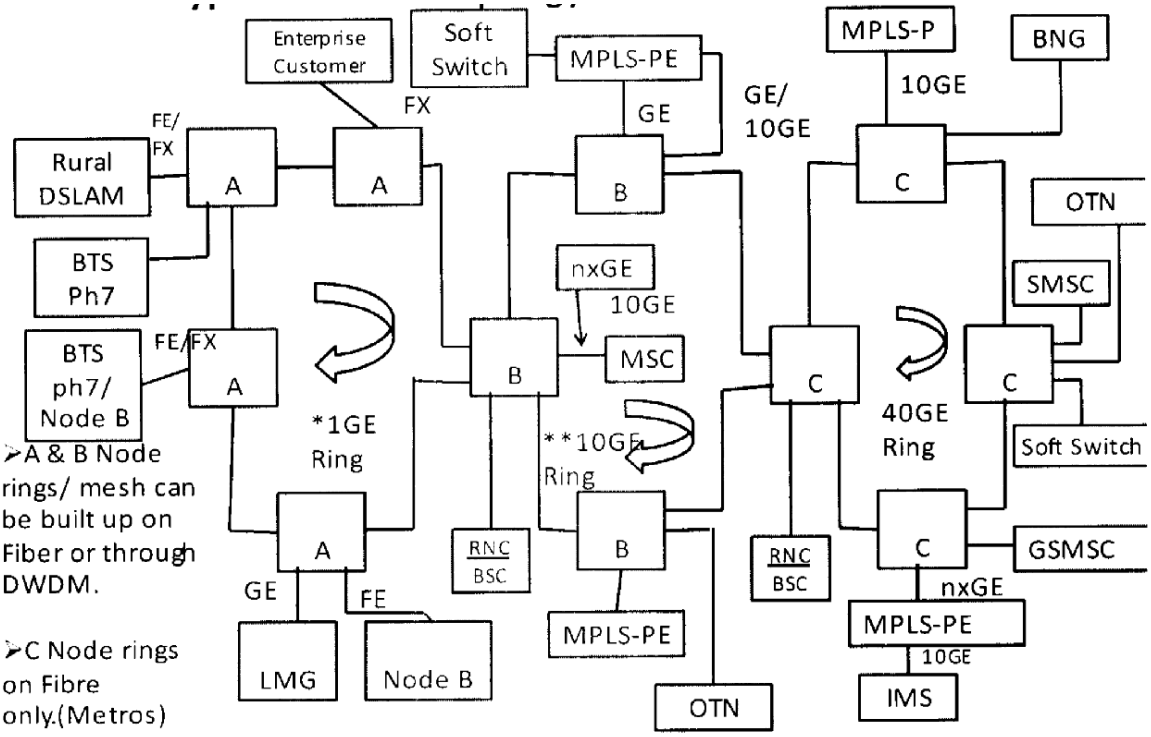

Figure: 17 Typical Network Topology for MPLS-TP Nodes

The planned A,B & C Nodes will perform the function of transport & aggregation of traffic from all access points such as HTS, Node Bs, RNCs, MSCs, MPLS-PE Routers, FTTH OLTs, DSLAMs etc. All the traffic aggregation in major cities with high traffic between POPS located within same city will be served by Type C nodes. Thus the functions presently being done by STM-I CPE, STM-1 ADM, STM-16 MADM and STM-64 will be done by MPLS-TP enabled packet transport nodes with configurations as shown above for all the future packet transport requirements. Number of nodes in a ring will depend on the amount of client traffic at each node.

Type A nodes can be very effectively used to replace present CPEs. Normally it will be used to give connectivity to standalone small capacity nodes like BTSs, consumers demanding higher BW, small capacity DSLAMs etc. In such cases they can be used in linear mode also.

Advantages of CPAN Technology:-

- Efficient bandwidth utilization,sharing bandwidth between services
- Includes the benefits of RPR.
- SDH packet switching based on statistical multiplexing.
- Path protection & recovery within 50 ms for any topology-Ring,Linear
- Support for TDM interfaces(E1,STM-1) & Multiservice traffic
- Both UNI & NNI interface upto max 100G capacity
- Access to last mile connectivity bandwidth upto 100G capacity.
- .bandwidth scalability -from 5G,40G to 100G

- OAM & Performance Monitoring-Proactive & Reactive
- Resiliency-1:1,1+1;Linear & Ring.
- GUI EMS provisioning.

4.10 CONCLUSION

MPLS-TP is a set of enhancements to the already rich MPLS protocol suite. The current MPLS suite has successfully served packet-based networks for more than a decade. The MPLS-TP enhancements will increase the scope of MPLS overall, allowing it to serve both the transport and the services networks.

The biggest and most important enhancements that are being developed under the MPLS-TP effort are OAM related (e.g., fault management and performance monitoring). These OAM enhancements will prove to be very valuable for the existing MPLS networks, as they will allow operators to improve the efficiency and effectiveness of their networks by enabling full end-to-end integration with the existing and the next-generation MPLSnetworks.

5 OPTICAL TRANSPORT NETWORK (OTN)

5.1 LEARNING OBJECTIVES

- OTN Hierarchy.
- Multiplexing Structure of OTN
- Advantages of OTN
- OTN Interfaces and layer architecture of OTN

5.2 INTRODUCTION

With the growing demand for services and bandwidth, now telecom operators are trying to converge their networks in order to reduce Operational Expenses (OPEX), and also to eliminate additional Capital Expenditures (CAPEX) on multiple parallel networks. The amount of data traffic relative to voice traffic on optical networks and the total traffic volume keeps increasing. These factors are the drivers behind emerging, flexible technologies to supplement the mature, voice optimized, SONET/SDH transport infrastructure and help manage network complexity. The aim of the optical transport network (OTN) is to combine the benefits of SONET/SDH technology with the bandwidth expandability of DWDM. OTN (Optical Transport Network) provides a vehicle to enable convergence, and for providing a common and SONET/SDH-like operational model for network operations, administration, maintenance and provisioning (OAM&P) functionality, without altering the individual services. This newly developed OTN is specified in ITU-T G.709 Network Node Interface for the Optical Transport Network (OTN).

Since the 1980s, SONET/SDH has supported a flexible and transparent mix of traffic protocols including IP, Fiber Channel, Ethernet and GFP by providing protection and performance monitoring. Whilst deployment of dense wavelength division multiplex (DWDM) networks during the following decade served to increase existing fiber bandwidth, it severely lacked the protection and management capabilities inherent in SONET/SDH technology.

The optical transport network (OTN) was created with the intention of combining the benefits of SONET/SDH technology with the bandwidth expansion capabilities offered by dense wavelength-division multiplexing (DWDM) technology.

5.3 WHAT IS OTN?

Networks employing OTN technology are designed and optimized to support current applications employing massive network capacity, and OTN is increasingly recognized as the transport standard of choice to meet the growing demand for network capacity. The ITU Telecommunication Standardization Sector (ITU-T) defines OTN in a set of standards, with the G.709 specification acting as the core technology definition. The ITU-T standards cover the encapsulation format, multiplexing, switching, management, supervision, and survivability of optical channels carrying client payloads. OTN also provides the ability to measure network performance across multiple service providers' domains and to provide seamless, end-to-end monitored services.

An Optical Transport Network (OTN) is composed of a set of Optical Network Elements connected by optical fiber links, able to provide functionality of transport, multiplexing, routing, management, supervision and survivability of optical channels carrying client signals. A distinguishing characteristic of the OTN is its provision of transport for any digital signal independent of client-specific aspects, i.e. client independence.

ITU Standard G.709 is commonly called Optical Transport Network (OTN)– sometimes referred to as **digital wrapper (DW),** allows network operators to converge networks through seamless transport of the various types of legacy protocols while providing the flexibility required to support future client protocols.

OTN provides transport for all digital payloads with superior performance and support for the next generation of dynamic services with operational efficiencies not expected from current optical wavelength division multiplexing (WDM) transport solutions and support for a wide range of narrowband and broadband services like

- SDH/SONET
- IP based services
- Ethernet services
- ATM services
- Frame Relay services
- Audio/Video services etc.

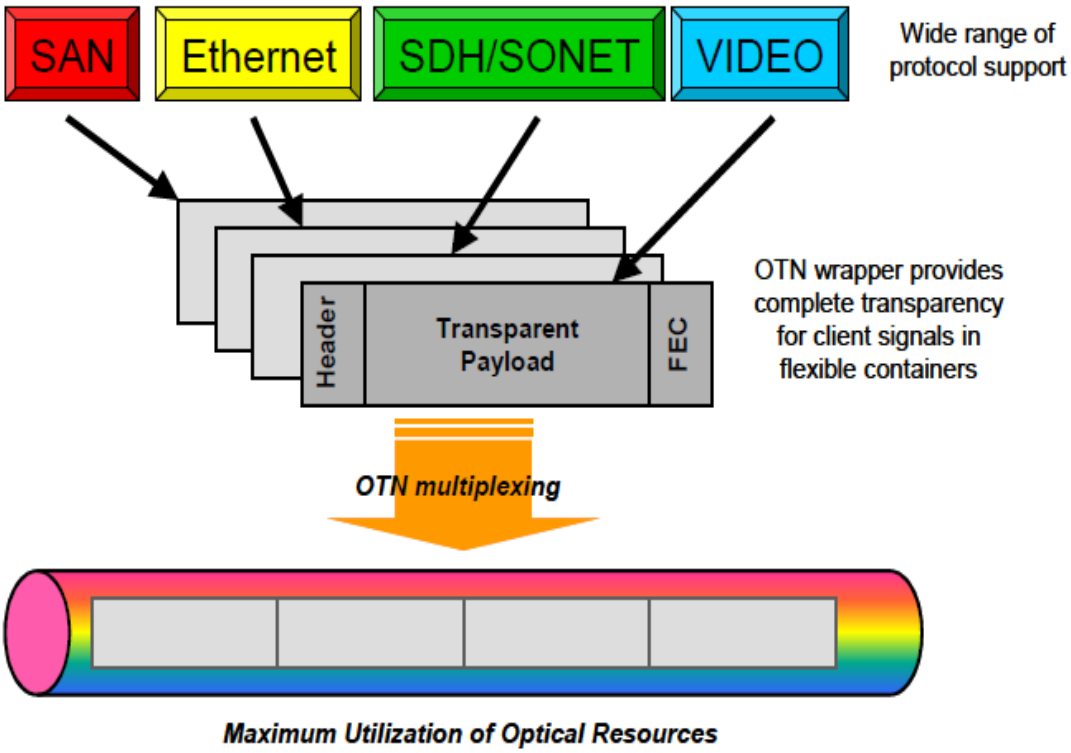

Figure: 18 Converged transport over OTN

5.4 KEY ADVANTAGES OF OTN

Unlike SONET/SDH, OTN was designed to be an efficient transport layer for packet services such as Ethernet. At the same time, OTN is able to support the multiplexing of

many different protocols including SONET/SDH, video, and storage protocols such as Fiber Channel.

OTN offers a number of advantages over legacy transport networks and the primary advantages of OTN include:

- **Reduction in transport costs:** By allowing multiple clients to be transported on a single wavelength, OTN provides an economical mechanism to fill optical network wavelengths.
- **Efficient use of optical spectrum:** OTN facilitates efficient use of DWDM capacity by ensuring fill rates are maintained across a network using OTN switches at fiber junctions.
- **Determinism:** OTN dedicates specific and configurable bandwidth to each service, group of services, or each network partition. This means that network capacity and managed performance (throughput, latency, jitter, and availability) are guaranteed for each client, and there is no contention between concurrent services or users.
- **Virtualize network operations:** The ability to partition an OTN-switched network into private network partitions, also referred to as Optical Virtual Private Networks (O-VPNs), provides a dedicated set of network resources to a client, independent of the rest of the network. Each network tenant sees only the resources associated with that tenant's private partition. Other resources associated with other tenants will not be visible. O-VPNs also ease network evolution because network upgrades can be tested or introduced in a protected network partition or 'sandbox,' without the risk of impacting day-to-day network operations in production partitions.
- **Flexibility:** OTN networks give operators the ability to employ the technologies needed now to support transport demands while enabling operators to adopt new technologies as business requirements dictate.
- **Secure by design:** OTN networks ensure a high level of privacy and security through hard partitioning of traffic onto dedicated circuits. This segregation of network traffic makes it difficult to intercept data transferred between nodes over OTN-channelized links. And because OTN-switched networks keep all applications and tenants separate, organizations can effectively stop hackers who access one part of the network from gaining access to other parts of the network.
- **Robust yet simple operations**: OTN network management data is carried on a separate channel completely isolated from user application data. This means OTN network settings are much more difficult to access and modify by gaining admittance through a client interface port.
- **Better Forward Error Correction**: OTN has increased the number of bytes reserved for Forward Error Correction (FEC), allowing a theoretical improvement of the Signal-to-Noise Ratio (SNR) by 6.2 dB. This improvement can be used to enhance the optical systems in the following areas:
    - Increase the reach of optical systems by increasing span length or increasing the number of spans.
    - Increase the number of channels in the optical systems, as the required power theoretical has been lowered 6.2 dB, thus also reducing the non-linear effects, which are dependent on the total power in the system.

- The increased power budget can ease the introduction of transparent optical network elements, which can't be introduced without a penalty. These elements include Optical Add-Drop Multiplexers (OADMs), Optical Cross Connects (OXCs), splitters, etc., which are fundamental for the evolution from point-to-point optical networks to meshed ones.

- **Tandem Connection Monitoring (TCM):** TCM enables the user and its signal carriers to monitor the quality of the traffic that is transported between segments or connections in the network.

5.5 OTN VS. SONET/SDH

Although OTN and SONET/SDH have similarities, there are also some significant design differences. Perhaps the biggest difference is that SONET/SDH was defined with fixed frame rates, while OTN was defined with fixed frame sizes.

Table: 4 Comparison of SDH/SONET and OTN

OTN	SONET/SDH
Asynchronous mapping of payloads	Synchronous mapping of payloads
Timing distribution not required	Requires tight timing distribution across networks
Designed to operate on multiple wavelengths (DWDM)	Designed to operate on multiple wavelengths
Scales to 100 Gb/s (and beyond)	Scales to a maximum of 40 Gb/s
Performs single-stage multiplexing	Performs multi-stage multiplexing
Uses a fixed frame size and increases frame rate to match the client rate.	Uses a fixed frame rate for a given line rate and increases frame size (or uses concatenation of multiple frames) as client size increases
FEC sized for error correction to correct 16 blocks per frame	Not applicable (no standardized FEC)

The G.709 standard defines client payload encapsulation, OAM overhead, FEC, and a multiplexing hierarchy. These functions deliver optical transport capabilities as robust and manageable as SONET/SDH, but with greater suitability for current traffic demands, and data center interconnection circuits in particular.

OTN is asynchronous and thus does not require the complex and costly timing distribution and verification of SONET/SDH. Instead, OTN includes per-service timing adjustments to carry both asynchronous (GbE, ESCON) and synchronous (OC-3/12/48, STM-1/4/16) services. OTN can additionally multiplex these services into a common wavelength.

Like SONET/SDH, OTN also offers comprehensive OAM, but with standardized FEC. OAM is used to efficiently manage network resources and services. FEC enables

service providers to extend the distance between optical repeaters, reducing expenses and simplifying network operations.

5.6 OPTICAL TRANSPORT NETWORK (OTN) LAYERS

The optical transport hierarchy (OTH) is a new transport technology for optical transport networks developed by the ITU. It is based on the network architecture defined in various recommendations (e.g., G.872 on architecture; G.709 on frames and formats; and G.798 on functions and processes). OTH combines electrical and optical multiplexing under a common framework. The electrical domain is structured in a hierarchical order just like SONET/SDH, and the optical domain is based on DWDM multiplexing technology but with standardized interfaces and methods to manage the network. ITU-T recommendation G.872, Architecture for the Optical Transport Network (OTN), defines two classes of OTN interfaces:

- **OTN inter-domain interface (IrDI)**: This interface connects the networks of two operators, or the subnetworks of one or multiple vendors in the same operator domain. The IrDI interface is defined with 3R (reshape, regenerate and retime) processing at each end. Since the IrDI is the interface for interworking, it was the focus of the initial standard development.
- **OTN intra-domain interface (IaDI):** This interface connects networks within one operator and vendor domain. Since the IaDI is typically between equipment of the same vendor, it can potentially have proprietary features added such as a more powerful FEC

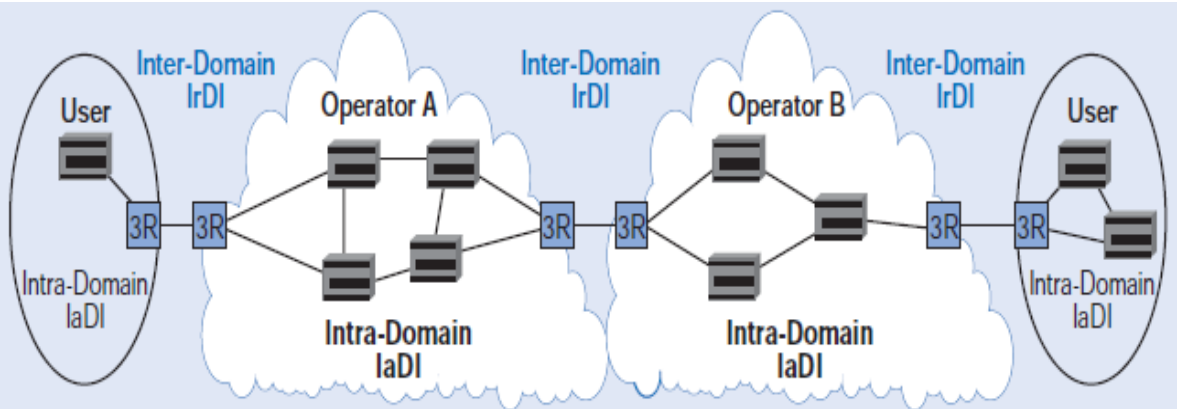

Figure: 19 IrDI Vs IaDI

The transport of a client signal in the OTN (shown in Figure i.e. Basic OTN Transport Structure) starts with the client signal (SONET/SDH, ATM, GFP, Ethernet etc.) being adapted at the optical channel payload unit (OPU) layer by adjusting the client signal rate to the OPU rate. The OPU overhead itself contains information to support the adaptation process of the client signal. Once adapted, the OPU is mapped into the optical channel data unit (ODU) with the necessary ODU overhead to ensure end-to-end supervision and tandem connection monitoring. Finally, the ODU is mapped into an OTU, which provides framing, as well as section monitoring and FEC.

Additional OH may be added to the OCh to enable the management of multiple colors in the OTN. The OMS and the OTS are then constructed. The result is an OCh comprising an OH section, a client signal, and a FEC segment.

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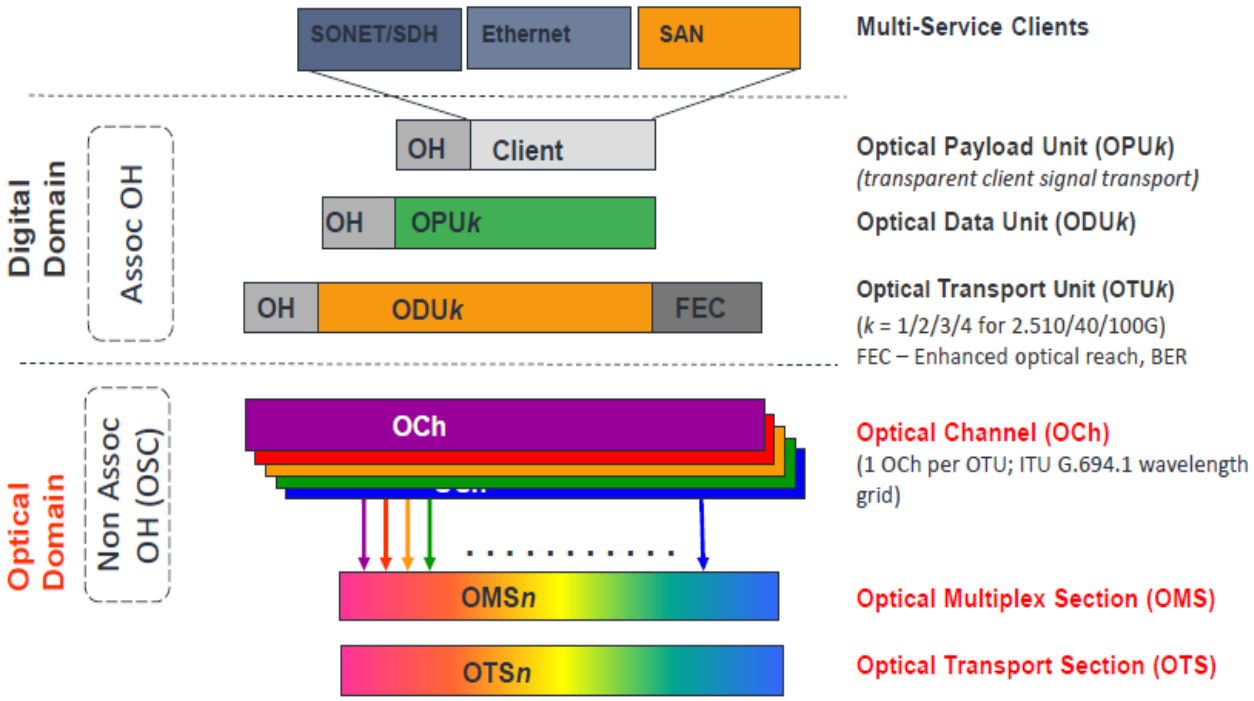


Figure: 20 Basic OTN Transport Structure

The OCh OH, which offers the OTN management functionality, contains four substructures: the OPU, ODU, OTU, and frame alignment signal (FAS).

Each OPUk (k=0,1,2,2e,3,4,flex) is transported using an optical channel (OCh) assigned to a specific wavelength of the ITU grid. Several channels can be mapped into the OMS layer and then transported via the OTS layer. The OCh, OMS and OTS layers each have their own overhead for management purposes at the optical level. The overhead of these optical layers is transported outside of the ITU grid in an out-of-band common optical supervisory channel (OSC). In addition, the OSC provides maintenance signals and management data at the different OTN layers

5.7 OTN LAYER TERMINATION POINTS

The ITU G.872 recommendation also defines the optical network architecture based on the optical channel (OCh) carried over a specific wavelength. Different from that of legacy DWDM systems, the structure of this signal is standardized. The OTN architecture is composed of three layers, shown in Figure - OTN Layer Termination Points, and constructed using the OCh with additional overheads.

- **Optical Channel (OCh)** – represents an end-to-end optical network connection with the encapsulated client signal in the G.709 frame structure.
- **Optical Multiplex Section (OMS)** – refers to sections between optical multiplexers and demultiplexers.
- **Optical Transmission Section (OTS)** – refers to sections between any network elements in the OTN, including amplifiers.

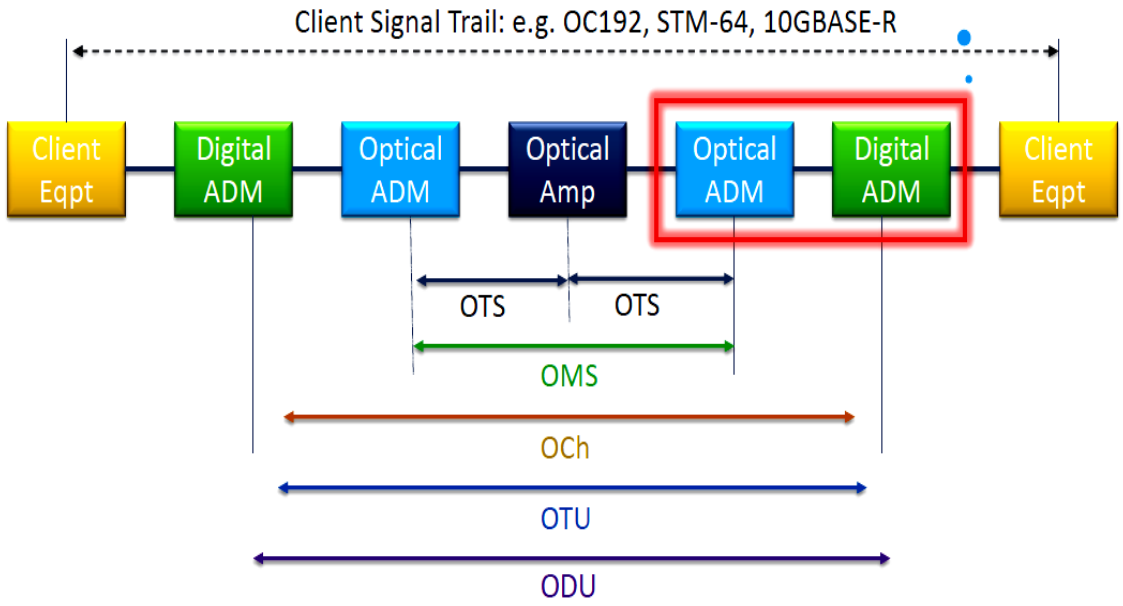


Figure: 21 OTN Layer Termination Points

The termination of the OTS, OMS and OCh layers is performed at the optical level of the OTN. The OCh payload consists of an electrical substructure, where the optical channel transport unit (OTU) is the highest multiplexing level. This layer is the digital layer — also known as the "digital wrapper" - which offers specific overhead to manage the OTN's digital functions. The OTU also introduces a new dimension to optical networking by adding forward error correction (FEC) to the network elements, allowing operators to limit the number of required regenerators used in the network and in turn reduce cost.

5.8 STANDARD OTN LINE RATES

G.709 defines standard interfaces and rates. OTN rates are equal to or higher than the bit rates of the client traffic. Typical client signals and corresponding to G.709 rates are listed in Table.

Client Signal Type	**Client Signal**	**OTN Line Signal (G.709)**	**OTUk Line Rate (kbit/s)**[	**OPUk Payload Rate (kbit/s)**	**OTUk frame period (µs)**	**OTUk frequency accuracy (ppm)**
SONET/ SDH	STS-48/STM-16	OTU1	2,666,057	2,488,320	48.971	± 20
SONET/ SDH	STS-192/STM-64	OTU2	10,709,225	10,037,629	12.191	± 20
Ethernet/ Fibre	10GBASE-R/10GFC	OTU2e	11,095,727	10,356,012	11.766	±100

Channel						
SONET/ SDH/Ethernet	STS-768/STM-256/ Transcoded 40GBASE-R	OTU3	43,018,413	40,150,519	3.034	±20
Ethernet	Up to 4 10GBASE-R	OTU3e2	44,583,355	41,611,131	2.928	±20
Ethernet	100GBASE-R	OTU4	111,809,973	100,376,298	1.167	±20
ODUflex signals are transported over ODU2, ODU3, ODU4						± 100

Table: 5 OTN Line Rates

Note: ODU0 signals are to be transported over ODU1, ODU2, ODU3, ODU4 or ODUCn signals, ODU2e signals are to be transported over ODU3, ODU4 and ODUCn signals and ODUflex signals are transported over ODU2, ODU3, ODU4 and ODUCn signals

Unlike SDH/SONET, the line rate is increased by maintaining the G.709 frame structure (4 rows x 4080 columns) and decreasing the frame period (in SDH/SONET the frame structure is increased and the frame period of 125 µs is maintained).

5.9 OTN FRAME STRUCTURE

There are three overhead areas in an OTN frame: the Optical Payload Unit (OPU) overhead, the Optical Data Unit (ODU) overhead, and the Optical Transport Unit (OTU) overhead. These overhead bytes provide path and section performance monitoring, alarm indication, communication, and protection switching capabilities. One additional feature is the inclusion of a Forward Error Correction (FEC) function for each frame. The FEC improves the Optical Signal-to-Noise Ratio (OSNR) by 4 to 6 dB, resulting in longer spans and fewer regeneration requirements.

Figure illustrates the three parts that constitute the G.709 OTN frame; **namely the overhead, the payload, and the FEC**.

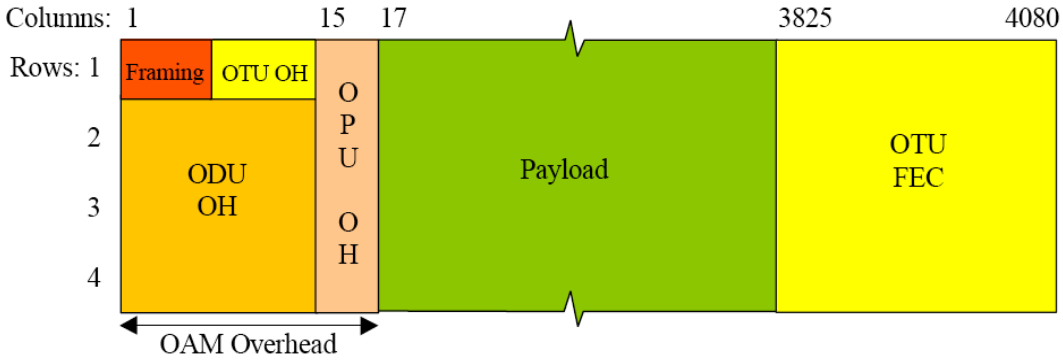


Figure: 22 OTN Frame

Although OTN and SONET/SDH have similarities but the biggest difference in respect of frame structure is that SONET/SDH was defined with fixed frame rates, while OTN was defined with fixed frame sizes.Perhaps the biggest difference is that SONET/SDH was defined with fixed frame rates, while OTN was defined with fixed frame sizes.

5.10 OPTICAL TRANSPORT NETWORK EQUIPMENT

There are several different types of optical transport network equipment being deployed based on the OTN standards. The most common types include:

- Regenerators,
- OTN terminal equipment
- Optical Add/Drop Multiplexer (OADMs),
- Optical cross connect (OXCs).

OTN terminal equipment is used for point-to-point connections through WDM networks, mapping the client signals into OPUs, sometimes multiplexing multiple signals in the electrical domain, and finally performing mapping/multiplexing in the optical domain. OADMs, OXCs, and some types of regenerators primarily process the OTN signals in optical domain.

5.11 CONCLUSION

OTN-based backbones and metro cores offer significant advantages over traditional WDM transponder-based networks, including increased efficiency, reliability, and wavelength–based private services. The IP-over-OTN infrastructure also offers better management and monitoring, reduced hops, increased protection of services, and reduced costs for equipment acquisition. In addition to scaling the network to 100G and beyond, OTN plays a key role in making the network an open and programmable platform, enabling transport to become as important as computing and storage in intelligent data centre-networking.

6 CFA PLANNING FOR DEVELOPING AREAS

6.1 LEARNING OBJECTIVES

- To know the customer requirements for Data service
- To know the basic Broadband service and its requirements
- To know and forecast the service requirements at new locations
- To plan out the feasibility at new locations and marketing.
- To know the different planning stages

6.2 INTRODUCTION

CFA (Consumer Fixed Access) mainly comprises of two things i.e. fixed line access and broadband. BSNL wants to check declining trend of landline users and meet the growing demand of broadband customers. The following applications are very much in use hence everyone wants broadband. We should not miss any opportunity to tap broadband customers. Our CFA planning mainly in developing areas should focus on these two points i.e. landline customers and broadband users.

6.3 REQUIREMENT OF THE CUSTOMER FOR DATA SERVICES

- Tele-medicine
- Tele-working
- Video conferencing
- Interconnection of LANs and WANs
- Video Distance Learning
- Internet connections with enhanced operations
- Travel Agency - booking online, etc.,
- Banking Industry for faster transactions
- Utility companies like Electricity Board, Gas co., etc.,

6.4 BASIC IDEA OF BROADBAND SERVICE

6.4.1 Old Definition of Broadband

As per TRAI Broadband is an "An always-on data connection that is able to support interactive services, and has the capability of minimum download speed of 256 kbps"

6.4.2 Modified Definition of Broadband

In November 2016 TRAI modified Broadband definition as "**An always-on data connection** that **is able to support interactive services, and has the capability of minimum download speed of 512 kbps"**

Note: This definition for throughput may undergo upward changes in the future.

As on Nov 2017, The Broadband India Forum (BIF), in a recent interaction with TRAI has suggested the apex telecom body to reconsider the broadband definition and the associated speeds in India. As per BIF, such a revision is long overdue and that the current 512 kbps of speed defining a broadband is dismally low.

In November 2020 ,The Broadband India Forum (BIF), further recommended that TRAI should provide additional guidelines for higher quality broadband services, as the industry body mooted minimum downlink and uplink speed of 15 Mbps to define 'fast broadband', and 30 Mbps for 'ultra-fast broadband'

6.5 BROADBAND REQUIREMENT AT CUSTOMER END

- BSNL's BFone
- Computer of minimum configuration, with 10/100 Mbps Ethernet Card
- DSL Modem + Splitter
- PPPoE software to be loaded in the Client
- Broadband Account (Username and Password)

6.6 BROADBAND CUSTOMER PREMISES INSTALLATION

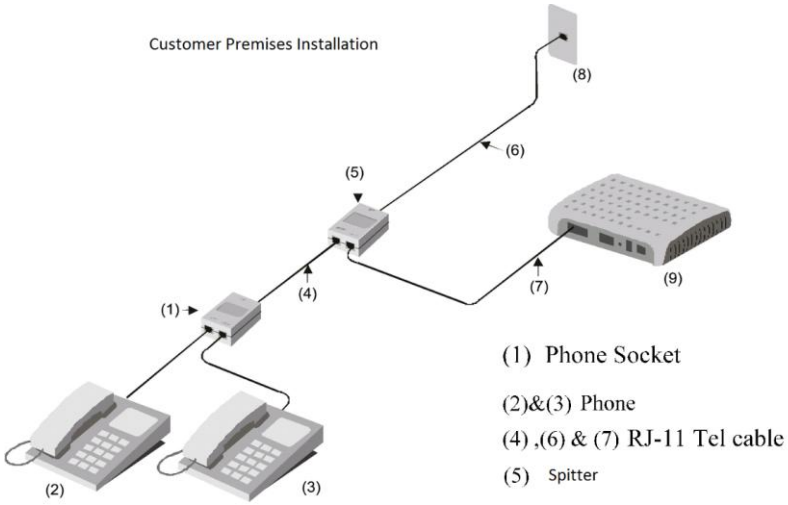


Figure: 23 Broadband Customer Premises Installation

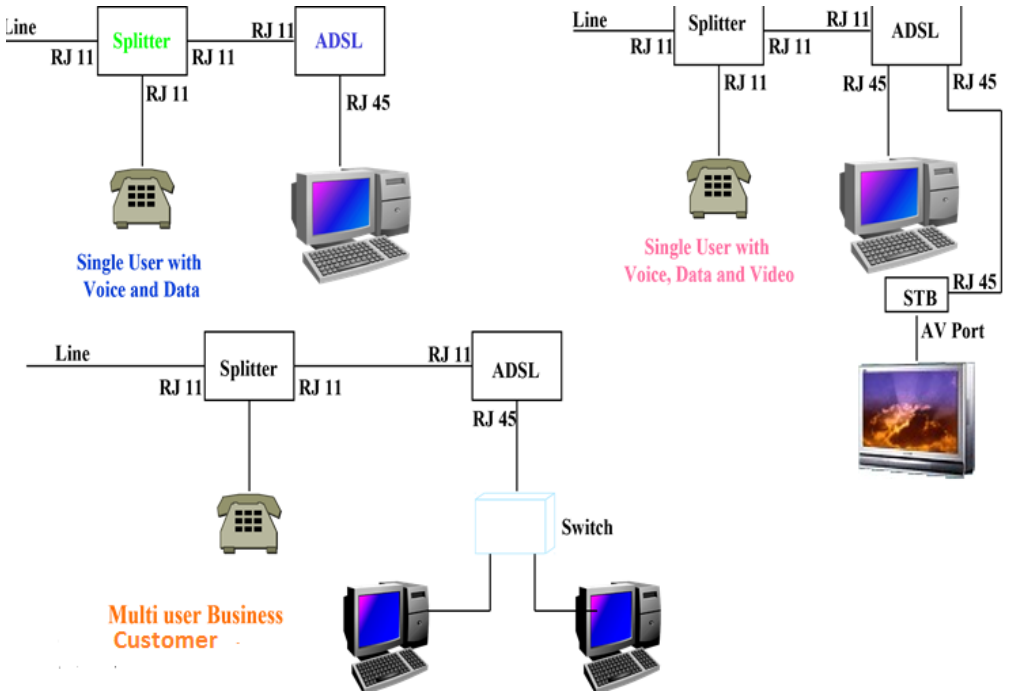


Figure: 24 Broadband Multiple User Installation

6.7 BACKGROUND ABOUT CFA PLANNING IN DEVELOPING AREAS

Vide D.O. No.617-6/2008-TPS(XT) dated 29-10-2008 the following measures were defined by CMD, BSNL for pushing up the growth of land line connections:-

In the light of the above initiatives taken by the circles , we can list the main points as under:

6.7.1 Identifying The Dwelling Units In The Area

Mostly the out skirts of the city are growing . In the major cities it may be multistory complexes and in the towns it is the growth of the new colonies. Our first job is to identify the upcoming dwelling units.

6.7.2 To Make these Area/Dwelling units feasible

On case to case basis e.g the multistory complexes can be connected through the DLC units, provisioning of the franchisee based voice and broadband solutions. This helps in provisioning of the telecom facilities in a faster way as most of the multi storey complexes goes for the internal wiring themselves. For the other areas either the cable is required to be laid or a new exchange is to be set up with broadband equipment.

6.7.3 To Get the Assured Business, MOU can be signed

At the starting stage of the unit with the builders or the societies for the provisioning of the telecom facilities. This will assure the availability of the space

and other infrastructure required for the provisioning of the services. The draft agreement has also been worked out by various circles and the corporate office that can be utilized or customized as per the specific requirement of the area or the city. The guidelines and the provisions as per the requirement of the local bodies can also be incorporated before the final stage.

6.7.4 Agreement with the Builders in early stages of the construction

In most of the cases it has been found that agreement with the builders and the resident societies shall be taken up at the early stage of the construction so as to have them a confidence level for provisioning and sharing of their infrastructure.

6.8 SERVICE PROVISIONING IN THE DWELLING UNITS

Various telecom services can be provided as per the requirement of the area and the residents. Some of them are listed as under:

1. Basic Voice communication: This can be provided through the installation of the voice network by installation of the RSU, DLC or the EPABX.

2. Laying of the U/G cable for the provisioning of the connections in the area. As indicated earlier in the multistory concept the connectivity is invariably provided by them.

3. For the connectivity of the main network the option of the laying of the Fibre link or the Microwave link can be planned as per the feasibility at the start of the roll out. The final solution for the connectivity is Fibre connectivity.

   At present the provisioning of the FTTx has been taken up, the same can also be explored as the first choice in the major city areas for the connectivity.
4. Some of the growth areas can be within the city limits areas and the requirement can be met in a faster way

5. For the provisioning of the data service the connectivity with a high bandwidth system i.e. fibre has become essential.

6. Once the fibre is got connected the provisioning of the broadband services and its value added services e.g. IPTV etc can be easily provided as the first initiative.

7. Based on the requirement e.g. if there is a group housing society requiring the internet connectivity at one point the same can be got provisioned either through copper pair, fibre or using the CDMA or 3G connectivity.

8. BSNL has also tied up with a number of system integrators and service franchisees for the roll out of the various value added services. The potential of these channel partners can also be explored for the provisioning of the services.

6.9 MARKETING OF THE SERVICES IN THE DWELLING AREAS

In order to have the feel of the telecom services and the competition available in the field of telecom BSNL has to take the lead for the marketing of the services in the new growing areas. It may be felt that the people are well aware of the telecom service but still it has been found and felt that when ever a person occupies the new area he/she shall be approached for the provisioning of the service even though the infrastructure for the provisioning of the services has been made available. Some of the activities that can be taken up are listed as

1. Voice/legacy service is now known to every one but the tariffs offer and the plans are to be appraised to the customers so as to give him the value for the money.

2. Demos of the various services such as broadband, Video Call etc is required to be arranged in order to generate the interest in these services.

3. Faster and "do it right- at the first time" shall be the key for the success in provisioning of these service in the new areas.

4. The above is required to be backed up by a good service complaint redressal system. If we once succeed then the service provisioning goes with the "word of mouth" and we will grow.

To monitor the work of such dwelling units the circles has adopted the monitoring mechanism. The sample Proforma is given as under for the SSA for persuasion of the activity.

S. No	Station	Name of Colony/ Building	Dwelling Unit planned	Dwelling Unit constructed/ completed as on ……..	Dwelling unit occupied as on …….	Cable pair laid/ available	Cable pair faulty	Cable pair planned	Status as on (last date of month)	Likely date of availability of cable pair to all D.Us.	NTC LL provided up to end of the month

Table: 6 Identification of Dwelling units/Colonies

All SSA heads were emphasized to submit the report in this format on monthly basis. The efforts have been made to make feasible by laying underground cable in new occupied dwelling units areas. So far the existing exchange equipment is being used to extend the telephone facility. The proposals for opening of new Remote Line Units have been received from few of the SSA. To generate the demand the personal visits and melas are organized by the officers.

6.10 STAGES OF CFA PLANNING IN DEVELOPING AREAS

1. Identification and MOU stage
2. Service provisioning
3. Service customization as per the need of the customer and area.
4. Marketing of the product in that areas
5. Service delivery and assurance

6.11 CONCLUSION

In the growing era of competition and for increasing the market share for broadband users it is necessary that we keep a watch on the developing areas and look for the opportunity to provide feasibility at these areas so as to convert the residents into subscribers. Planning is one of the most important aspects to achieve organizations goal. The stages of planning discussed in this chapter will give an edge over the competitors.

7 SSTP ARCHITECTURE AND NETWORK

7.1 LEARNING OBJECTIVES

- Different nodes in signaling networks
- Role of SSTP
- Functions of SSTP
- SSTP deployment in BSNL

7.2 INTRODUCTION

Signaling System No. 7 (SS7) is a signaling protocol that has become a worldwide standard for modern telecommunications networks. SS7 is a layered protocol following the OSI reference model . It enables network elements to share more than just basic call-control information through the many services provided by the SS7's Integrated Services Digital Network-User Part (ISUP), and the Transaction Capabilities Application Part (TCAP). The functions of the TCAP and ISUP layers correspond to the Application Layer of the OSI reference model, and allow for new services such as User-to-User signaling, Closed-User Group, Calling Line Identification, various options on Call Forwarding and the rendering of services based on a centralized database (e.g., 800 and 900 service). All of these services may be offered between any two network subscribers.

7.3 CCS NETWORK ARCHITECTURE

The CCS Network is comprised of Four Major Components:

- Service Switching Points [SSP]
- Signaling Transfer Points [STP]
- Service Control Points [SCP]
- Data Signaling Links (SLK)

An SS7 Network consists of a flat non-hierarchical configuration enabling peer-to-peer Communication. Figure below depicts SS7 Common Channel Signaling Networks depicts the makeup and connectivity of SS7 Common Channel Signaling networks.

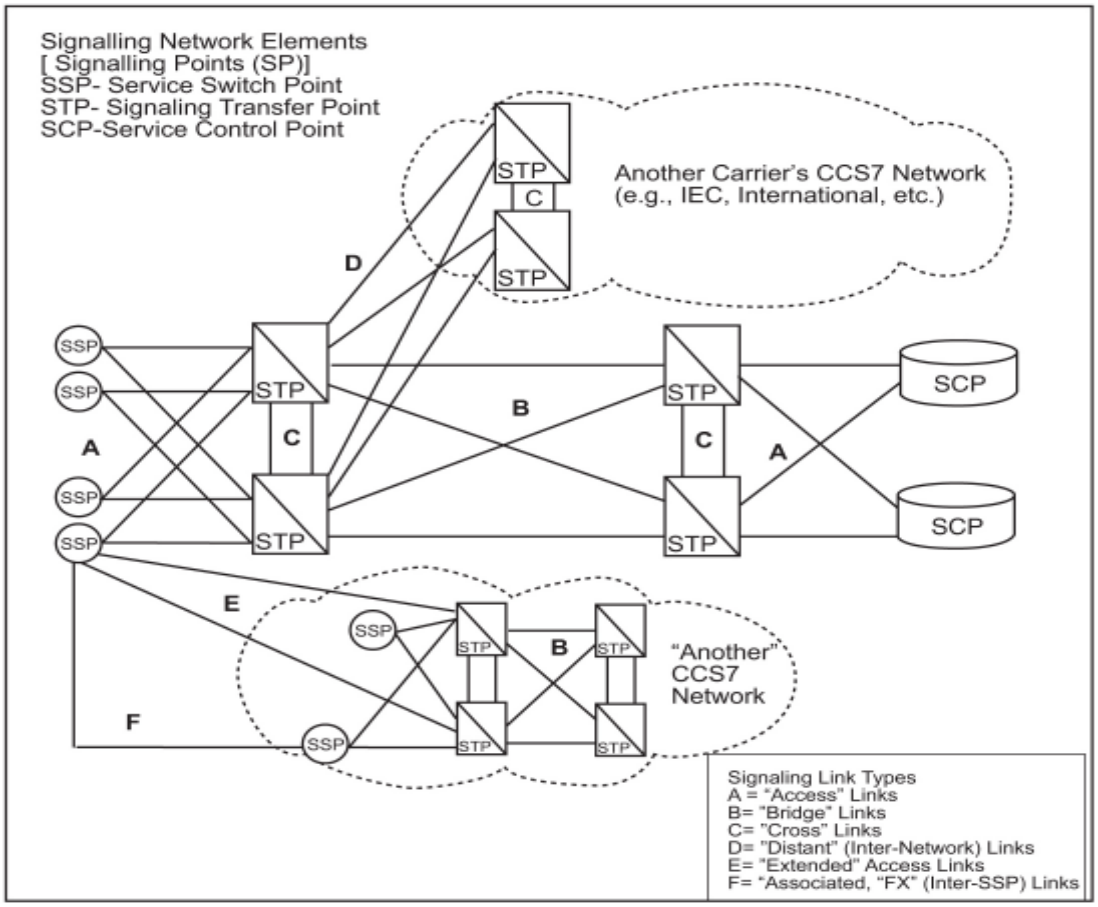


Figure: 25 Common channel signaling networks

SS7 Common Channel Signaling Networks shows the three principal network elements of SS7 Common Channel Signaling networks, interconnected by the six standard types of signaling links currently in use. Signaling links are data transmission links that ordinarily operate on digital carrier facilities at 64,000 bits per second in most regions of the world. High Speed Links (HSLs) at 2.048 Mbps are used.

Signaling links between any two signaling network elements are deployed in groups called "link sets," dimensioned to carry the estimated signaling traffic between two STPs. Because STPs are deployed in pairs, as shown in Figure, SS7 Common Channel Signaling Networks, an alternate route always exists between any two STPs. One combination of the link sets interconnecting an SSP or SCP with both members of the STP pair is called a "combined link set." The traffic carried between any two signaling network elements is load-shared across links in a link set, rotating through all links available according to the rules of the SS7 protocol.

Traffic destined for any network element through the STP pair is further load-shared over the combined link set, unless restricted by network management rules also established by the SS7 protocol.

7.3.1 Service Switching Point (SSP)

The SSPs are the legacy switches of the telecommunications network. SSPs are referred to as an "*End Office switch*", "*Central Office switch*", "Toll Tandem switch", etc. The central offices that house the SSP are identified by classes of ranging from a class 5-lowest, to a class 1 – highest office. The lowest class office in a network will be the one

providing dial tone to subscribers. SSP is typically found in tandem or Class 5 offices and is the interface to the networks outside of SS7.

A SSP can be any of the following:

- Customer switch
- End office
- Access tandem
- Tandem

Usually, a switch is used to interface to the customer premise, The CO switch then interfaces to the SS7 network via the SSP. The SSP is the interface between the subscriber and the telecom network, and provide the following functions:

Call Processing function

- Provides dial tone
- Routes calls between links and trunks
- Provides tones, and announcements
- Maintenance and revenue collection and generation

Query Processing

When necessary, it generates queries toward another signaling node or database to receive information necessary for certain calls.

SS7 Response Processing

Upon receiving queried information, carries out the connection function for proper handling of calls.

Resource Interface

For AIN services, establishes and maintains connections to Intelligent Peripherals (IPs)

7.3.2 Service Control Point (SCP)

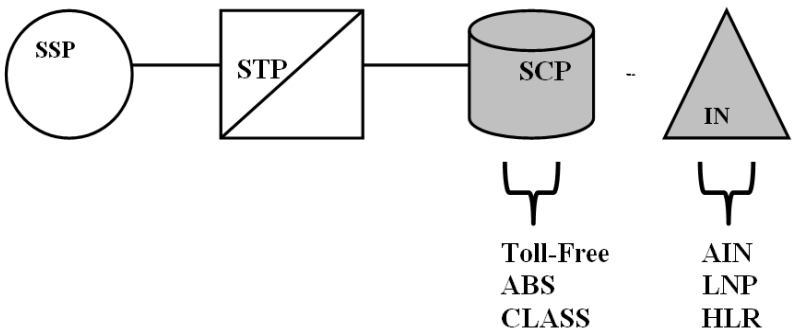


Figure: 26 SCP

SCP Connectivity

The SCPs and AIN SCPs are centralized database that provide real-time access to call completion and information services such as:

- Toll-Free Database Service
- Alternate Billing Service (ABS)
- Custom Local Area Signaling Services (CLASS)
- Advanced Intelligent Network Services (AIN)
- Local Number Portability (LNP)
- Home Location Register (HLR)
- Visitor Location Register (VLR)

7.3.3 Signaling Transfer Point (STP)

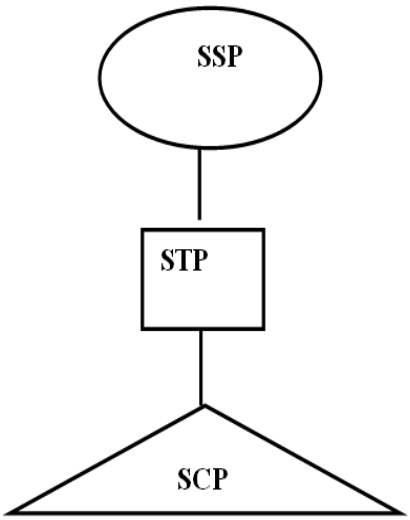


Figure: 27 STP

STPs are routers that are placed within the heart of the CCS Networks. STPs are packet switches that provide common channel message routing and transport. STPs are stored programmed control switches that use information contained in messages in conjunction with information stored in memory to route message to the appropriate destination signaling point.

STPs are generally deployed in pairs with mirrored databases. If one of the STPs are removed from service or signaling links fail, the mate can process all of the traffic that is typically shared by the mated pair. STP mated pairs are geographically separated , This helps ensure protection for message routing they perform if a natural disaster occur, etc.

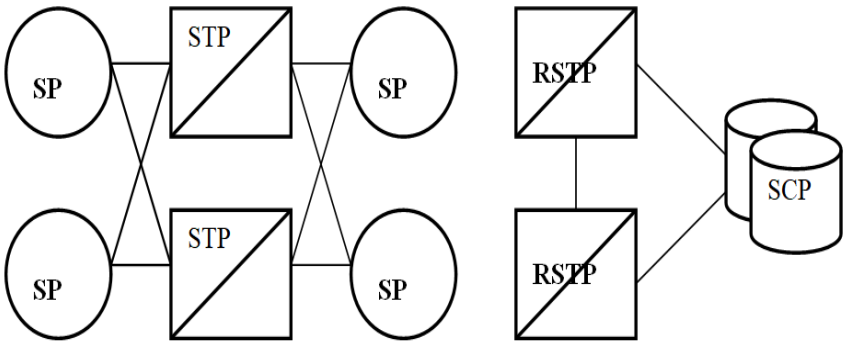


Figure: 28 STP two-level Architecture in CCS Network

In large CCS networks, STPs are deployed in a hierarchical arrangement, and typically identified as Regional STPs, and Local STPs.

- There are no functional differences in the two STPs.
- The LSTP handles call set-up and network management traffic within the network.
- The RSTP only handles query traffic within the network requiring access to SCP databases.

STPs are mainly of two types:

1. **Integrated STP**
   When STP functionality is incorporated along with 'Service Switching Point' in the 'Service Switching Node', it is known as Integrated Signalling Transfer Point. It performs call switching functions as well as Signalling transfer functions
2. **Standalone STP**
   Standalone STP performs only the core function of SS7 signalling transfer, It enables the operator to manage the network resources in more effective way and to host more applications.

7.4 SSTP FUNCTIONS

- SS7 Message routing
- Global Title Translation
- SS7 Network Management
- Network Interconnection
- Gateway Screening

7.4.1 SSTP Function – Message Routing

Message Routing: By using outgoing DPC contained in MTP's routing

label in a datagram environment (where a separate route may be chosen for each message packet) Routing tables which are prepared to allow message transport between any given pair of SSTPs are stored and maintained within SSTPs. The SSTP's SNM (signaling network management) functions control message routing during periods of link congestion or failure.

- Routing is performed using Destination Point Codes (DPCs) similar to street address for the Postal Service. STPs have the ability to route messages to all types of signaling points.
- All nodes in the network are identified by a unique point code. This point code is used by CCSS #7 as the Origination Point Code (OPC) and the Destination Point Code (DPC) in the routing label of all Message Signaling Units (MSUs).

7.4.2 SSTP Function – Global Title Translation

Global Title translation : By using SCCP to translate addresses (Global titles) from signaling messages that do not contain explicit information allowing the MTP to route the message. For (e.g. SSTP translates dialed 1+ 800 number into an SCP's DPC for MTP routing and gives sub system number SSN for delivery of the good data base application at the SCP. When more information is needed to process a call, such as an 800 number, queries are processed for SSPs. STPs contain a GTT table with routing information for the type of query and address of SCP.

7.4.3 SSTP Function – Network Management

- Acts as traffic cop to route traffic around failures in a network, and to control link congestion.
- **TFP** Transfer Prohibited tells the connecting nodes not to send anything that is destined for the affected node.
- **TFR** Transfer Restricted tells the connecting nodes – if all possible, not to send anything that is destined for the affected node.

7.4.4 SSTP Function – Gateway Screening

Screening is the capability to examine Incoming and Outgoing packets and allow those which are authorized. This is done by going through a series of Gateway screening tables that must be configured by the service provider. For example out of the messages which are coming via a link set only ISUP messages can be allowed whereas on another link only SCCP messages can be allowed by utilizing two basic function allow and block..

Software in SSTPs with inter-network connection is used to control who has access into a Telco's network.

7.5 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 Signaling Services to other Wire line & Wireless Network Operators.

7.6 STAND-ALONE STP NETWORK IN BSNL

7.6.1 Advantages:

- Dedicated signaling processors, resources
- Upgrade path divorced from MSC / SSP functions, growth
- Most effective method to manage network level resources, features
- Frees up processing capacity from the switches
- Can host most of the applications, centrally
- Full mated pair redundancy

7.6.2 Disadvantages:

- Requires additional investment (However compensated by freeing up extra resources of the switches)
    - Requires traffic study, SS7 management

The PO no. P.O.No. SE/PO/005/2016-17/SSTP/New/UTStarcom dtd.01.03.2017 was issued by BSNLCO, for Supply, Installation, Commissioning and Migration to replace the existing SSTP network of M/s.Tekelec (now M/s. Oracle), with a new SSTP network to M/s.UTStarcom India Telecom Private Ltd., Gurgaon. As per the tender and PO, there are total 18 SSTP nodes (with EMS NOC at Bangalore & DR EMS NOC at Mumbai. M/s UTStarcom has supplied all equipments, installed and ATed at all nodes.

7.7 ISG6400

The new UTSTARCOM SSTP iSG6400 primarily implements translation, adaptation and distribution functionality for SIGTRAN and SS7 signaling messages on the bottom layer, and the translation, adaptation and distribution functionality for M3UA-based SIGTRAN signaling、M2UA-based SIGTRAN signaling , SIP and Diameter signaling. The iSG6400 has the following features:

- Flexible Hardware and Software Platforms
- Carrier-Class High Availability
- Powerful System Functions
- MTP Message Screening
- Number Portability
- Diameter Signaling Controller
- Graphical and Convenient Network Management.

BSNL existing SSTP network comprising of 16 SSTP nodes installed in mated

pair configuration. The SSTPs at Delhi, Chennai, Pune, & Ernakulum shall be with International Signaling Gateway functionality

Each of the TAXs/IP TAXs & MSCs in BSNL Network shall be connected to at least two SSTPs through IP and/or E1 link per SSTP on load balancing and failover manner

The MSCs in the Indian Telecom Network connected to TAXs/IP TAXs of BSNL Network shall be routed through one of the sixteen SSTPs installed as part of this tender .

SSTPs shall be connected with the BSNL's IP MPLS network through two L3 LAN switch with minimum two GE interfaces The Layer-3 switches shall be deployed in high availability mode (Active-Active) across different arms of each site.

SSTPs shall be interconnected with mated SSTP node with FE links /HSL links through the SDH network of BSNL for redundancy purposes in addition to interconnecting the SSTPs amongst themselves and to the EMS locations on the IP MPLS networks. Some network elements are also connected with HSL/FE links. NOC/ DR NOC at Bangalore and Mumbai.

The chassis accommodate the same types of function boards that fall into the following six categories:

MPU Card (MPU1A):

- This is the system main control board. It manages all hardware resources; provides a common, manageable and HA platform for the system. The MPU board in the chassis functions as a communication agent for the SNMS.

Line Card (PEM-S8):

- It supports TDM-based MTP2 protocol and IP-based M2PA protocol; and implements reliable signaling link transmission between iSG6400 and SS7 devices. It also provides translation between SS7 common channel signaling and MTP3 messages.

CLOCK I/O board (PCU1A):

- This provides the synchronization clock signal for E1/T1 trunks.

SPU (Signaling Processing Unit):

- This is the signal processing equipment that provides SIGTRAN and SS7 signaling messages translation and distribution functionality. It supports MTP3, SCCP, and M3UA protocols.
- Hardware Platform : X86 based Server
- Both ISG6400 Chassis are active and active load sharing mode . Failure of any hardware module in one chassis does not impact any services. The LSL and HSL links from SSP are duplicated and to be connected to E1 ports on both chassis. LAN SW Pair works in Active –Active mode.
- This software application runs are based on IBM severs . This is the signal processing equipment that provides SIGTRAN and SS7 signaling messages translation and distribution functionality. It supports MTP3, SCCP, and

M3UA protocols.

Two SPUs run on active – Active load sharing mode

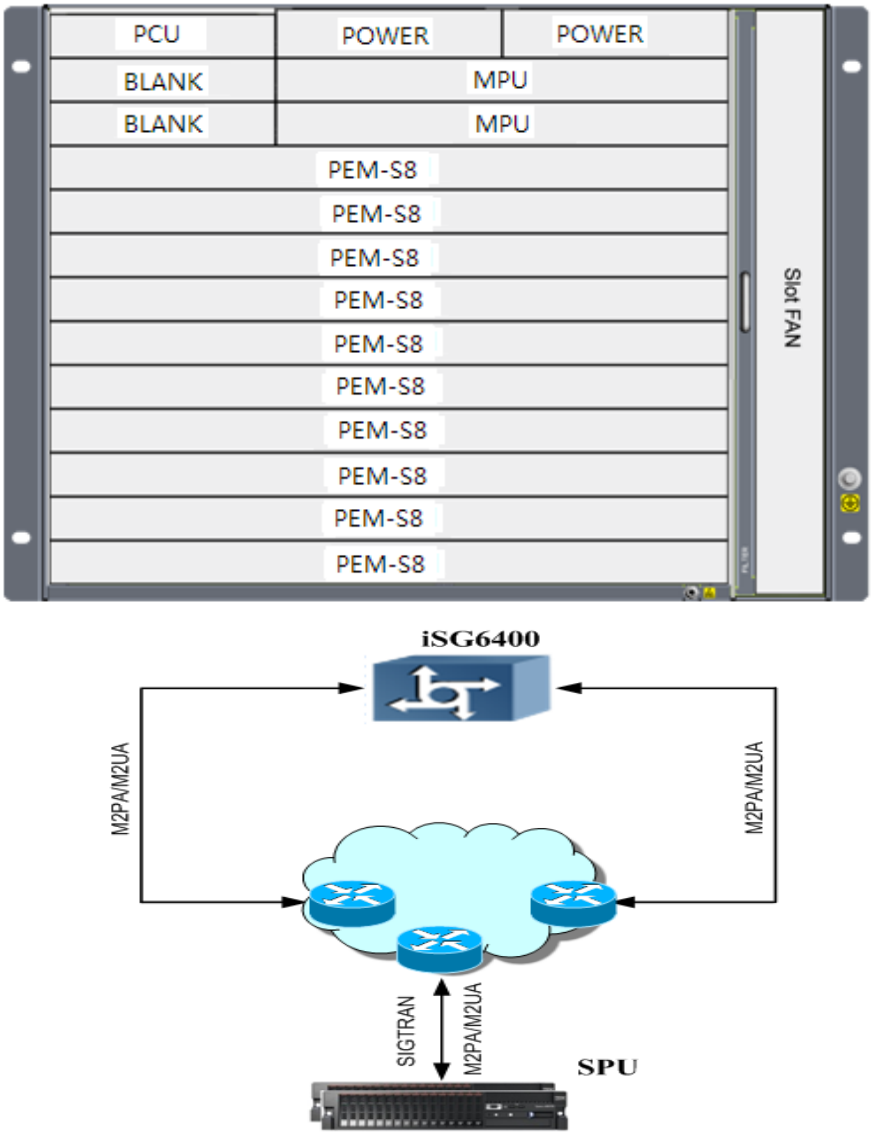


Figure: 29 SSTP hardware

Unique features of UTSTARCOM SSTP :

1. MNP capacity is 250M NP entries and can be further expanded
2. UT SSTP use Oracle DB for eMS and NP DB. Oracle database is a truly carrier-class DB, with high reliability, centralized data management
3. UT SSTP network is composed by distributed SSTP nodes and Centralized eMS/NP SRV /DB SRV, it is more flexible and a better cost structure. All SSTP node share the centralized DB/eMS/NP SRV
4. Centralized DB means low CAPEX and OPEX
5. Veritas used to synchronize the Oracle DB between different NOC/DR-NOC to implement DB Geographic Redundancy. Veritas is most reliable tools to do this

6. Centralized eMS manage all the SSTP node which is deployed around PAN India.
7. eMS is GUI based, easy to operate and use, and more friendly
8. Support SS7 and SIGTRAN
9. Support the emerging DIAMETER AND SIP protocol.

7.8 CONCLUSION

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. 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. SSTP also handle the non call related messages efficiently. The new SSTPs will be capable of supporting new signaling technologies like SIP and diameter, in addition to existing SS7/SIGTRAN and planned to cater to the signaling needs of BSNL network for future.

8 INTERCONNECTIVITY ISSUES

8.1 LEARNING OBJECTIVES

- The chapter aims to describe what is and how interconnection is done.
- Regulatory, characteristics and technical aspects of interconnection
- Provisioning and augmentation of POI's
- A/T of POI's

8.2 WHAT IS INTERCONNECTION?

Interconnection means the commercial and technical arrangements under which service providers connect their equipment, networks and services to enable their customers to have access to their customers, services and networks of their service providers.

8.3 HOW IS INTERCONNECTION DETERMINED?

- Regulatory Authority of a given country may adopt one or a mixture of the following approaches to different interconnection issues.
- Commercial negotiation between parties. If parties fail to agree, they may appeal to general competition and anti trust law.
- Commercial negotiation subject to regulatory intervention if the parties fail to agree.
- Commercial negotiation with the help of established framework for negotiation by the Regulatory Authority and it has to prove the agreement or intervened if the parties fail to agree.
- The Regulatory Authority prescribes specific issues from the outset, and parties negotiate over the remaining issues.

8.4 REGULATORY PRINCIPLES FOR INTERCONNECTION

The regulatory principles for interconnection are:

- Transparency
- Non-discrimination
- Cost based tariff
- Without regulatory intervention and direction, interconnection negotiations do not usually proceed successfully
- Delays and failures during negotiations
- The regulators can intervene by applying benchmarks or best practices from other countries.

8.5 TECHNICAL ASPECTS OF INTERCONNECTION

Some of the technical and operational aspects of interconnection are:

- The number and the location of points of interconnection
- Network management across points of interconnection
- Equal technical access
- Co-location and sharing of infrastructure
- Quality of Service
- Interconnect Services

8.6 CHARACTERISTICS OF INTERCONNECTION

- Interconnection is mandatory;
- It should be nondiscriminatory;
- It should be made available in a timely manner;
- Interconnection charges shall be cost based, unless as may be specified otherwise

8.7 INTERCONNECT AGREEMENT

As per interconnect agreement, the demand note for technically feasible number of E1s should be issued to the interconnection seeker within 30 days.The POI should be commissioned with live traffic within 3 months' time from the date the payment has been made by the interconnection seeker.If it is not feasible to provide any ports immediately, the interconnection seeker should be informed of the same in writing along with expected time frame of feasibility. If the other party agrees, demand note should be issued accordingly.

8.8 POINT OF INTERCONNECTION (POI)

It is a point at which the GMSC of fully mobile network of UASL/ CMSP and gateway switch of BSNL or local / tandem / TAX exchange of the basic service network of UASL/ BSO/ NLDO/ ILDO and local / Tandem / TAX of BSNL are interconnected by the facility of interconnection seeker and where the specified network-network interface standards are applicable.

8.9 POINT OF PRESENCE (POP)

It means setting up of switching centre and transmission centre of appropriate capacity for basic telephone service by UASL/ BSO/ NLDO at the SDCA level to provide, on demand, service of prescribed quality and grade of service in a non- discriminatory manner.

8.10 PROVISIONING OF POI

- The Circle office as a nodal point should handle the applications submitted by various operators for POI and issue of demand note/ advice note.
- The SSA Heads may be advised to speed up the process of feasibility report. This can be done if there is proper coordination between Circle office and SSA.

- The nodal officer for POI should review the pending feasibility reports from SSAs regularly to ensure that response to the interconnection seeker in the form of demand note for full or part of the requirement as per feasibility report is issued in timely manner.
- Once the interconnection seeker has made the payment as per the demand note for E1s and space/ power (Infrastructure) requirements, the advice note should be issued immediately.
- In order to avoid the delay in commissioning of POI, the infrastructure and necessary power requirements should be made available to interconnection seeker promptly once the advice note has been issued.
- Efforts should be made to observe a time limit of 3-5 days for completing both the above works unless some additional works are to be carried out.
- Circle office should also maintain database of spare capacity of E1 ports capacity available in the switches designated for POI. This will help in sanctioning POIs without asking for feasibility out of the spare E1 capacity earmarked, if any, for interconnection purposes after taking case of expected requirement for expansion/ augmentation of BSNL own services.
- Designate tandem exchange in each SDCC well in advance for providing connectivity to NLDOs/ BSOs. This will not only reduce the time taken in issuing demand note for interconnection to BSOs/ NLDOs, but also help the BSO/NLDO to plan and ensure that their transmission link is available near the SDCC tandem exchange timely.
- The testing team for each SSA consisting of representative from SSA and Inspection(T&D) Circle, should be nominated well in advance so that some time saving is achieved.
- CGM Inspection(T&D) Circle, may work out necessary arrangements in this regard. Wherever required, separate representatives for transmission A/T and switching A/T should be nominated.
- The SSA representative should be well conversant with the framework of the interconnect agreement specially relating to the traffic routing and charging at the POI for each type of service.
- Inspection & QA (T&D) Circle may make their representative available as per schedule. Efforts should be made to complete both, transmission and switching A/T within 7 days from the date of start of testing.
- In order to save time and effectively utilize the technical manpower, POI configuration by the SSA may be carried out just before start of switching A/T so that same person may become part of the switching A/T team.
- Acceptance testing time schedules should be prepared in advance for transmission as well as switching on Quarterly basis taking into account the POIs likely to come up for acceptance testing in near future.
- If there are no pending points in A/T report, prompt clearance for commercial traffic may be given by Circle Office to the concerned SSA Head along with POI clearance certificate.
- In case of any pending points, the same should be communicated to the

interconnection seeker without delay.

- Minor pending points not affecting the quality of service, measurements and integrity of the network, should not delay the flow of commercial traffic subject to the undertaking from the seeker that the pending points will be cleared within 15 days time failing which BSNL will have right to discontinue the service.
- All efforts should be made to commission the POI within 30 days from the date when the interconnection seeker submits the application, excluding the time taken by the interconnection seeker for completing the concerned activities marked in the line diagram.
- The periods mentioned in the interconnection agreement are upper limit. However, efforts should be made to reduce the time taken for commissioning of POI.

8.11 AUGMENTATION OF POI

- For augmentation of junctions at POI, traffic measurements shall be taken by BSNL and private operator during agreed route busy hour for seven days on quarterly basis.
- Based on the route busy hour traffic printouts, the number of junctions may be calculated as per Erlang Table for the Grade of Service (0.005) as per interconnection agreement including 25% additional junctions for future traffic requirements.
- However, the provision of E1s shall be subject to the terms and provisions of interconnection agreement and guidelines given above.
- The POI capacity on the basis of traffic should be reviewed regularly and the number of E1s may be reduced if not justified as per traffic requirement, as per the provisions of interconnection agreement if BSNL/ other operator requirements are pending.
- TRAI (Telecom Regulatory Authority of India) vide its notification number 409-5/2003-FN dated 29.10.2003 had issued Regulation, which has been, implemented w.e.f. 01.02.2004.
- Due to non-availability of CDR based billing platform, IUC applicable for the calls handed-over to BSNL at the PoI (Point of Interconnect) have been converted into different pulse rates as per Appendix B. The pulse rates have been calculated at a per MCU (Metered Call Unit) rate of Rs
- 0.10 for all calls except outgoing ISD calls which shall be measured at a rate of Rs 1.20 per MCU.
- Cellular Mobile Service Provider (CMSP) – POI at Level-II/ Level-I TAXs (In case of Metro Cities, POI at SDCC Tandem also)
- National Long Distance Operator (NLDOs) – SDCC Tandem
- International Long Distance Operator (ILDOs) – Level-I TAXs
- Universal Access Service Provider (UASP) – Mix of CMSP and BSO
- Basic Service Operators (BSOs) – POI at SDCC Tandem/ Level-II TAX

- Firming up of demand/ forecast by the interconnection seeker at least 12 months before the date on which the required connectivity is required in a prescribed format.
- Provisioning of transmission links at permitted interface points is the responsibility of the interconnection seeker.
- Provisioning of transmission links by BSNL against payment of prescribed charges subject to technical feasibility, if requested by Interconnection seeker.
- About 55000 E1s are working as POI with various private operators.
- At about 1700 places POI exists in BSNL network either at SDCC or LDCC level.
- Approx. Rs. 2978 Crores revenue from POI business (p.e. Mar.2010)
- BSNL on receiving the interconnect capacity shall intimate, within a period of 15 days from the date of receipt of appropriate demand, either the acceptance or otherwise an alternative proposal for meeting the demand.
- In case, an alternate proposal is not made within such 15 days, the interconnect policy demand shall be deemed to have been accepted.
- In case an alternative proposal is made, both parties will meet to firm up the mutual agreed proposal within next 15 days.
- After the acceptance of interconnect capacity demand, BSNL will issue a demand note on the interconnect capacity demand within 15 days to the interconnection seeker, who will pay such demand note within 15 days of its issue date.
- Interconnect capacity demand will be treated as firm demand from the date of receipt of payment of demand note.
- The time scale for the provision of capacity shall be 12 months from the date of the receipt of firm demand.
- After placement of the firm demand to provide the interconnect capacity, if BSNL fails to provide the connectivity within 12 months from the date of payment of demand note, BSNL has to pay, on demand, to interconnection seeker, liquidated damages as prescribed in the interconnection agreement and vice versa.
- To summarise, demand note for technically feasible no. of E1s should be issued to interconnection seeker within 30 days.
- POI should be commissioned with live traffic within 12 months time from the date payment has been made by interconnection seeker.If it is not feasible to provide ports immediately, interconnection seeker shall be informed of the same in writing along with expected time frame of feasibility. If other party agrees, demand note should be issued accordingly.

8.12 MAIN REASONS FOR DELAY IN POI PROVISIONING

BSOs, NLDOs and ILDOs normally complain about general delay in commissioning of POIs. Main reasons for delay intimated by them are as follows:

- Delay in issue of demand note due to non-receipt of feasibility report from SSAs.
- Delay in nomination/ declaration of a local exchange (in case of non-availability of separate SDCC tandem) as SDCC tandem for providing connectivity to NLDOs/ BSOs
- Delay in provision of infrastructure and power after payment of demand note.
- Delay in constitution of testing team or nomination of representative on behalf of BSNL for acceptance testing.
- Non-availability of interconnection agreements and test schedules in concerned SSAs.
- Non-availability of A/T wing representative in time due to pre-occupation in other acceptance testing works.

8.13 APPROVAL OF A/T REPORT BY CIRCLE OFFICE.

- The circle office as a nodal point should handle the applications submitted by various operators for POI and issue of demand note/ advice note.
- The SSA Heads may be advised to speed up the process of feasibility report. This can be done if there is proper coordination between circle office and SSA.
- The nodal officer for POI should review the pending feasibility reports from SSAs regularly to ensure that response to the interconnection seeker in the form of demand note for full or part of the requirement as per feasibility report is issued in timely manner.
- Once the interconnection seeker has made the payment as per the demand note for E1s and space/ power (Infrastructure) requirements, the advice note should be issued without delay.
- In order to avoid the delay in commissioning of POI, the infrastructure and necessary power requirements should be made available to Interconnection seeker promptly once the advice note has been issued.
- Efforts should be made to observe a time limit of 3-5 days for completing both the above works unless some additional works are to be carried out.
- Circle office should also maintain database of spare capacity of E1 ports capacity available in the switches designated for POI.
- This will help in sanctioning POIs without asking for feasibility out of the spare E1 capacity earmarked, if any, for interconnection purposes after taking case of expected requirement for expansion/ augmentation of BSNL own services.
- Designate tandem exchange in each SDCC well in advance for providing connectivity to NLDOs/ BSOs. This will not only reduce the time taken in issuing demand note for interconnection to BSOs/ NLDOs, but also help the BSO/NLDO to plan and ensure that their transmission link is available near the SDCC tandem exchange timely.

- The testing team for each SSA consisting of representative from SSA and Inspection & QA (T&D) Circle, should be nominated well in advance so that some time saving is achieved.
- CGM Inspection & QA (T&D) Circle may work out necessary arrangements in this regard. Wherever required, separate representatives for transmission A/T and switching A/T should be nominated.
- The SSA representative should be well conversant with the framework of the interconnect agreement specially relating to the traffic routing and charging at the POI for each type of service.
- Inspection & QA (T&D) Circle may make their representative available as per schedule. Efforts should be made to complete both, transmission and switching A/T within 15-20 days from the date of start of testing.
- In order to save time and effectively utilize the technical manpower, POI configuration by the SSA may be carried out just before start of switching A/T so that same person may become part of the switching A/T team.
- Acceptance testing time schedules should be prepared in advance for transmission as well as switching on quarterly basis taking into account the POIs likely to come up for acceptance testing in near future.
- In case of any pending points, same should be communicated to the interconnection seeker without delay.
- Minor pending points not affecting the quality of service, measurements and integrity of the network, should not delay the flow of commercial traffic subject to the undertaking from the seeker that the pending points will be cleared within 15 days time failing which BSNL will have right to discontinue the service.
- If there are no pending points in A/T report, prompt clearance of commercial traffic by Circle Office to concerned SSA Head along with POI clearance certificate.
- All efforts should be made to commission the POI within 30 days from the date when the interconnection seeker submits the application, excluding the time taken by the interconnection seeker for completing the concerned activities marked in the line diagram.
- The periods mentioned in the Interconnection Agreement are upper limit. However, efforts should be made to reduce the time taken for commissioning of POI.

8.14 ACTIVITIES FOR POI

(i) Activity 1-Submission of Application by Private Operator to CGM Office.

(ii) Activity 2 (15-20 Days)-Feasibility Report Submission by Field Units to CGM Office.

(iii) Activity 3 (5-7 Days)-Issue of demand Note for Port Charges/ Space/ Power/ Infrastructure.

(iv) Activity 4-Payment of Demand Note by Private Operator.

(v) (Activity 5) (3-5 Days)-Issue of advice Note & Availability of Infrastructure.

(vi) (Activity 6)-Extension of Tx Link to BSNL premises/ Testing Document Submission

(vii) (Activity 7) (5-7 Days)-Transmission A/T as per Interconnection Agreement

(viii) (Activity 8) (2 Days)-Signing, Forwarding & Approval of Tx A/T Report

(ix) (Activity 9) (3 Days)-Wiring up to Switches & Switch Configuration in BSNL

(x) (Activity 10) (7-10 Days)-Switching A/T as per Interconnection Agreement

(xi) (Activity 11) (3 Days)-Signing & Forwarding of Switching A/T Report Interconnection Agreement

(xii) (Activity 12) (3 Days)-Approval of A/T Report by CGM Office

(xiii) (Activity 13) (2 Days)-Start of Live Traffic on POI

8.15 SUMMARY OF TRAI REGULATIONS W.E.F. 1ST APRIL 2009

(i) Termination charge for all types of domestic calls has been reduced to 20 paise per minute from 30 paise per minute.

(ii) Termination charge for incoming international calls would be 40 paise per minute against the existing charge of 30 paise per minute.

(iii) Ceiling on carriage of domestic long distance calls retained at 65 paise per minute. Reporting requirements have been prescribed.

(iv) No origination charge has been specified. The origination service provider shall retain origination charges from the residual after payment of other IUC.

(v) Transit/Carriage charge from Level-II Trunk Automatic Exchange to Short Distance Charging Area(SDCA) would be 15 paise per minute.

(vi) Intra SDCA and TAX transit charges to be lower than 15 paise per minute.

(vii) IUC for SMS shall continue to be under forbearance. However, these charges should be transparent, reciprocal and non-discriminatory. Reporting requirements have been prescribed.

(viii) Termination charge for 3G voice calls shall be same as 2G voice calls.

8.16 CONCLUSION

In any telecom network interconnection of different network nodes is one of the major and important activities. It is the interconnections that make routing of calls between different nodes possible. The stability of interconnections reflects from the KPI reports of the exchange. Also traffic on POI's between different operators are used for charging purpose. Therefore upmost importance may be given and proper monitoring of POI's is a must for any telecom operator.

9 IMS BASED SERVICES

9.1 LEARNING OBJECTIVES

- Architectural concepts of IMS
- Overview of IMS architecture

9.2 INTRODUCTION

Operators are looking for quick and flexible ways to respond to new business opportunities. As users expand their voice telephony behaviour into more data-oriented and multimedia services, operators want to deliver a seamless and consistent user experience wherever and however the services are accessed. Also, operators need to be able to charge on the basis of value, and not just time or volume. This means it has to be easy for operators to create, implement and charge for service bundles that attract repeated use over an extended period. It must be possible to deliver these services at a cost that the user is willing to accept – and charge on the basis of value rather than time. Naturally, the services must meet user needs for ease-of-use, manageability and seamless access – there must be no barriers to accessing the desired content and services.

At the same time, operators do not want service creation and provisioning costs to spiral out of control as the service mix expands.

Both fixed and mobile operators face problem of subscriber churn, and the issue is getting worse as new service providers offers cheap, or free, calls over the Internet continue to arrive on the scene and gain market share.

- One key way to attract and retain subscribers is to offer differentiation in areas like personalization, service bundling, co-branding, business-to-business relations, tariffs, single sign-on and quality of service.
- Another key way to retain subscribers is to build on and strengthen the customer relationship so that subscribers are far more reluctant to switch suppliers, even if switching means lower call charges in the short term.

9.3 WHAT IS IMS

IMS offers standardized service enablers and network interfaces that will make interoperability of new MM services easier to achieve

IMS is a tool for operators to that enable the creation and delivery of PS based person-to-person MM services in a way that protects the operator business model and generates new revenue. Service scalability is solved by the IMS architecture. It offers support to compose services and expand existing services.

The core of IMS is combining the best of two worlds datacom industry & telecom industry. IMS is developed with a core offering for both wireless and wireline operators and is a cornerstone for providing converged multimedia services across multiple accesses

IMS consists of a common core, enablers, support systems and interworking functions enabling operators and service providers to leverage on

installed legacy networks, thus reducing cost, while providing key end-user benefits like reliability and security

IMS is based on the layered architecture, which separates functionality into three layers - an application layer, a control layer and a connectivity layer

The layered architecture allows each layer to evolve independently as market and technology demands change. For example, it supports the migration to new transmission technologies by making the upper layers independent of the transmission technology in the connectivity layer.

IMS is an architectural framework for delivering IP multimedia to mobile users. It was originally designed by the wireless standards body 3rd Generation Partnership Project (3GPP), and is part of the vision for evolving mobile networks beyond GSM. Its original formulation represented an approach to delivering Internet services over GPRS. This vision was later updated by 3GPP, 3GPP2 and TISPAN by requiring support of networks other than GPRS, such as Wireless LAN, CDMA2000 and fixed line making IMS access independent.

To ease the integration with the Internet, IMS as far as possible uses IETF (i.e. Internet) protocols such as Session Initiation Protocol (SIP). According to the 3GPP, IMS is not intended to standardize applications itself but to aid the access of multimedia and voice applications across wireless and wireline terminals. This is done by having a horizontal control layer that isolates the access network from the service layer. Services need not have their own control functions, as the control layer is a common horizontal layer

9.4 WHY IMS

The reason Why IMS can be understood from following Table.

Table: 7 Why IMS

Operator perspective	**End-user perspective**	**General**
Quality Of Service	New, exciting services and enhancements of existing services	Faster time to market with new services
Service Integration	Same services available regardless of terminal and access type	Grow and protect subscriber base, increase ARPU
Keeps charging relation with user	Ease of use & Security	Controlling CAPEX and OPEX

9.5 IMS STANDARDIZATION

The IMS was initially standardized by the 3rd Generation Partnership

Projects (3GPP) as part of its Release 5 specifications & is practically speaking targeted at supporting non – real time services .The second release is 3GPP Release 6 & is targeted at supporting real time services .3GPP release added inter-working with WLAN.

With the increasing penetration of Wireless Local Area Networks (WLANs) and emerging Wireless Metropolitan Area Networks (WiMax) as access network technologies, the IMS scope is now extended within the ongoing Release 7 standardization for any IP access network, including fixed access networks, i.e. DSL.

9.6 IMS ARCHITECTURE

IMS is an architecture designed to support the Control Layer for packet based services, which uses the bearer services of the Access Network to support the media associated with the service. IMS is access agnostic and as such is independent of the access technology used. In a multi-access environment it ensures service availability to all Access Networks (subject to the limitations of the Access Networks, of course).

The IMS provides all the network entities and procedures to support real-time voice and multimedia IP applications. It uses SIP to support signaling and session control for real-time services.

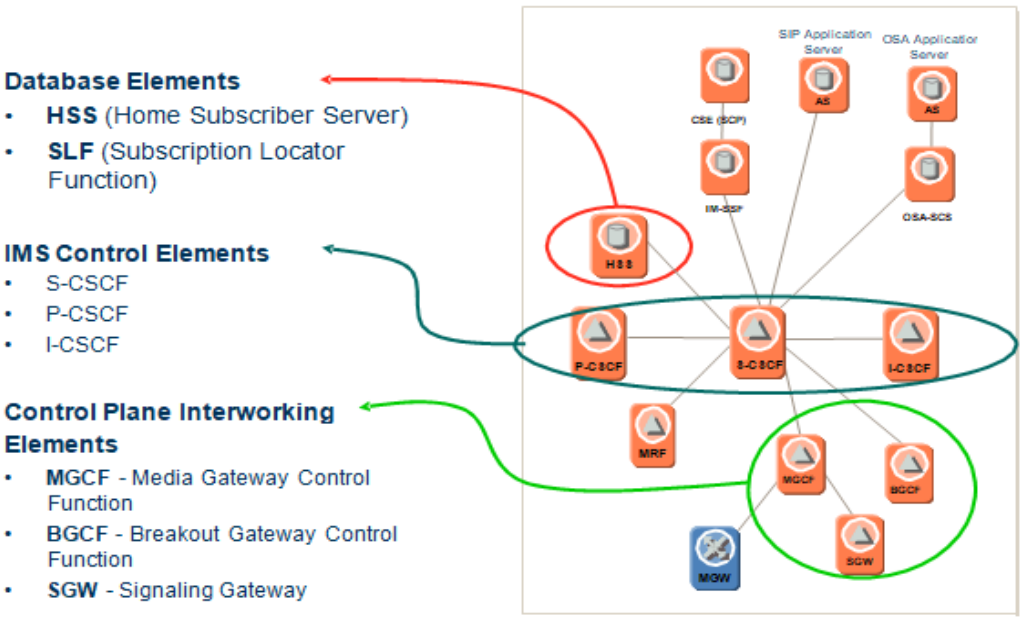


Figure: 30 IMS Architecture

The IMS nodes can be split into 3 groups of elements:

- Database Elements (HSS, SLF)
- IMS Control Elements (P-CSCF, I-CSCF and S-CSCF)
- Control Plane Interworking Elements (MGCF, BGCF and SGW)

9.6.1 Database Elements

HSS (Home Subscriber Server)

- The main database element is the HSS (Home Subscriber Server).
- This element is an evolution of the HLR element. The HSS contains the features of the HLR (subscriber data and authentication data) and other functions such as Location Register, IMS Service Profile Processing and IMS Subscription and Authentication Data.
- The HSS will be accessed by the I-CSCF, the S-CSCF and external platforms. The HSS uses the Diameter protocol with the Diameter Multimedia Application.

SLF (Subscription Locator Function)

- This database is accessed by the I-CSCF and the S-CSCF in order to obtain which HSS stores the user data when more than one HSS is present in the network. The query will contain the identification of the user and the response will contain the HSS that stores the data for the specific user.

9.6.2 IMS Control Elements

- The main functional entity in an IMS is the Call State Control Function (CSCF). A CSCF is a SIP server.
- Depending on the specific tasks performed by a CSCF, CSCFs can be divided into three different types.
    - Serving CSCF (S-CSCF).
    - Proxy CSCF (P-CSCF).
    - Interrogating CSCF (I-CSCF).
- The three IMS Control Elements are nodes that act on the control (SIP) signalling flows. These nodes provide Call Session Control Functions (CSCF)s and each separate node (Serving, Proxy and Interrogating) has a different role and function.

9.6.3 S-CSCF (Serving Call Session Control Function)

- The Serving-CSCF is the node that performs the session management within the IMS network for the UE. The S-CSCF operates in a stateful manner. The S-CSCF also ensures end-to-end reachability for users and services by interacting with other SCSCFs, SIP servers and application servers. The S-CSCF also authenticates the user.
- The S-CSCF is the main control point for services. The S-CSCF enforces the rule set for services based on the general policy of the operator and the users subscription parameters. The S-CSCF may reject a service request according to these factors.
- The S-CSCF decides on the handling of service requests from the user based on the user's profile (provided by the HSS during registration). Where the services of an Application Server are required to complete the requested service, the S-CSCF will forward the request to the appropriate Application

Server either based on the user's profile or based on the operator's local policy.

- The S-CSCF is always located in the home network. There can be several S-CSCFs in the network. They can be added as required based on the capabilities of the nodes or the capacity requirements of the network and if required can be assigned dedicated functions.
- The management of S-CSCFs in the IMS network is dynamic and the I-CSCF can allocate the S-CSCF for a user at registration time.
- The S-CSCF may be chosen based on the services requested or the capabilities of the mobile. One key advantage of this architecture is that the home network provides the services and service features.
- This means that the user's configurations are always the same and are always provided by the home network operator. The user is not restricted to the capabilities of the visited IMS network as is seen in the current wireless network (i.e. if an MSC does not support a feature that you have subscribed to, you will not be able to use that feature).
- However the user is still limited by the visited access network capabilities.

- An S-CSCF provides session control services for a user. It maintains session states for a registered user's on-going sessions and performs the following main tasks.

i. **Registration**: An S-CSCF can act as a SIP Registrar to accept users' SIP registration requests and make users' registration and location information available to location servers such as the HSS (Home Subscriber Server).
ii. **Session Control**: An S-CSCF can perform SIP session control functions for a registered user. Relay SIP requests and responses between calling and called parties.
iii. **Proxy Server**: An S-CSCF may act as a SIP Proxy Server that relays SIP messages between users and other CSCFs or SIP servers.
iv. **Interactions with Application Servers**: An S-CSCF acts as the interface to application servers and other IP or legacy service platforms.
v. **Other functions**: An S-CSCF performs a range of other functions not mentioned above. For example, it provides service-related event notifications to users and generates Call Detail Records (CDRs) needed for accounting and billing.

P-CSCF (Proxy Call Session Control Function)

- The Proxy-CSCF is the entry point towards the IMS network from any access network. The assignment of a P-CSCF to a user is determined by the access network configuration. In the case of UMTS/GPRS the allocation takes place at PDP context activation, where the UE may use a DHCP query to obtain the list of P-CSCFs or the UE is provided the IP address of the P-CSCF by the GGSN in the PDP activation message. The P-CSCF is located in the same PLMN as the GGSN.
- The P-CSCF is a stateful SIP proxy and all signalling flows between the user and the IMS system will be routed through the PCSCF. The P-CSCF will also enforce the routing of signaling messages through the user's home network.

The P-CSCF is responsible for sending the first SIP message (SIP registration query) towards the corresponding I-CSCF, based on the domain name in the registration request. After successful completion of the registration procedure, the P-CSCF maintains the knowledge of the 'SIP Server' (the serving S-CSCF, located in the home network) associated to the user, and will forward all requests from the user toward it.

- The P-CSCF is responsible for establishing a security association with the user, which it maintains for the lifetime of the 'connection'. Once the security association is established, it is responsible for receiving and validating all session requests.
- The P-CSCF also includes the Policy Decision Function (PDF) which authorises the use of bearer and QoS resources within the access network for IMS services.
- The P-CSCF is always located in the same network as the GGSN is located. Therefore, both the GGSN and the P-CSCF are located either in the visited PLMN or the home PLMN. Note that in roaming scenarios the SGSN is always located in the visited PLMN.
- A P-CSCF is a mobile's first contact point inside a local (or visited) IMS. It acts as a SIP Proxy Server. In other words, the P-CSCF accepts SIP requests from the mobiles and then either serves these requests internally or forwards them to other servers. The P-CSCF includes a Policy Control Function (PCF) that controls the policy regarding how bearers in the packet-switched network should be used. The P-CSCF performs the following specific functions:
  i. Forward SIP REGISTER request from a mobile to the mobile's home network. If an I-CSCF is used in the mobile's home network, the P-CSCF will forward the SIP REGISTER request to the I-CSCF. Otherwise, the P-CSCF will forward the SIP REGISTER request to an S-CSCF in the mobile's home network. The P-CSCF determines where a SIP REGISTER request should be forwarded based on the home domain name in the SIP REGISTER Request received from the mobile.
  ii. Forward other SIP messages from a mobile to a SIP server (e.g. the mobile's S-CSCF in the mobile's home network). The P-CSCF determines to which SIP server the messages should be forwarded based on the result of the SIP registration process.
  iii. Forward SIP messages from the network to a mobile.
  iv. Compression and decompression of SIP messages. Compression is required to minimize the air-interface time.
  v. Perform necessary modifications to the SIP requests before forwarding them to other network entities.
  vi. Maintain a security association with the mobile.
  vii. Detect emergency session.
  viii. Create CDRs.

I-CSCF (Interrogating Call Session Control Function)

- The Interrogating-CSCF is the first point of contact within the home network from a visited network or external network. It's main job is to query the HSS and find the location of the S-CSCF.

- The functionality is similar to that of a Gateway MSC.

- The I-CSCF may act as a hiding entity into a home network's IM subsystem, in order to mask the internal configuration of the home network's environment from external interrogating devices – which hides such things as the configuration, capacity and topology of the network to prevent roaming partners from discovering each other's network configuration. However the use of this function alters the behavior of signaling messages in a manner not compliant to the use in the Internet world. This discussion is on-going in the standards organizations at the time of writing.

- An I-CSCF is an optional function that can be used to hide an operator networks internal structure from an external network when an I-CSCF is used. It serves as a central contact point within an operator's network for all sessions destined to a subscriber of that network or a roaming user currently visiting that network. Its main function is to select an S-CSCF for a user's session, route SIP requests to the selected S-CSCF. The I-CSCF selects an S-CSCF based primarily on the following information:

  i. Capabilities required by the user.
  ii. Capabilities and availability of the S-CSCF and
  iii. Topological information, such as the location of an S-CSCF and the location of the users P-CSCFs if they are in the same operators network as the S-CSCF.

9.7 CONTROL PLANE INTERWORKING ELEMENTS (MGCF, BGCF AND SGW)

- The Media Gateway Control Function (MGCF) and the IM Media Gateway (IM-MGW) are responsible for signaling and media inter-working, respectively, between the PS domain and circuit-switched networks (e.g. PSTN).
- The Breakout Gateway Control Function (BGCF) selects to which PSTN network a session should be forwarded. IT will then be responsible for forwarding the session signaling to the appropriate MGCF and BGCF in the destination PSTN network.

9.8 IMS SERVICES IN BSNL

The two main services deployed in BSNL over IMS platform are:

1. Convergent Conference Solution:

   It supports Video conference, Instant messaging, Application share, Electronic Whiteboard, Automated dial out conference. Any combination of POTS, SIP phones, PC soft clients can be used for conference.

2. Convergent Centrex Solution:
Dedicated AS is required for convergent centrex solution. SLF comes into picture for querying HSS about the subscriber profile. It supports wide variety of terminals and access modes. It facilitate Fixed to mobile convergence.It also support multiple PBX modes.

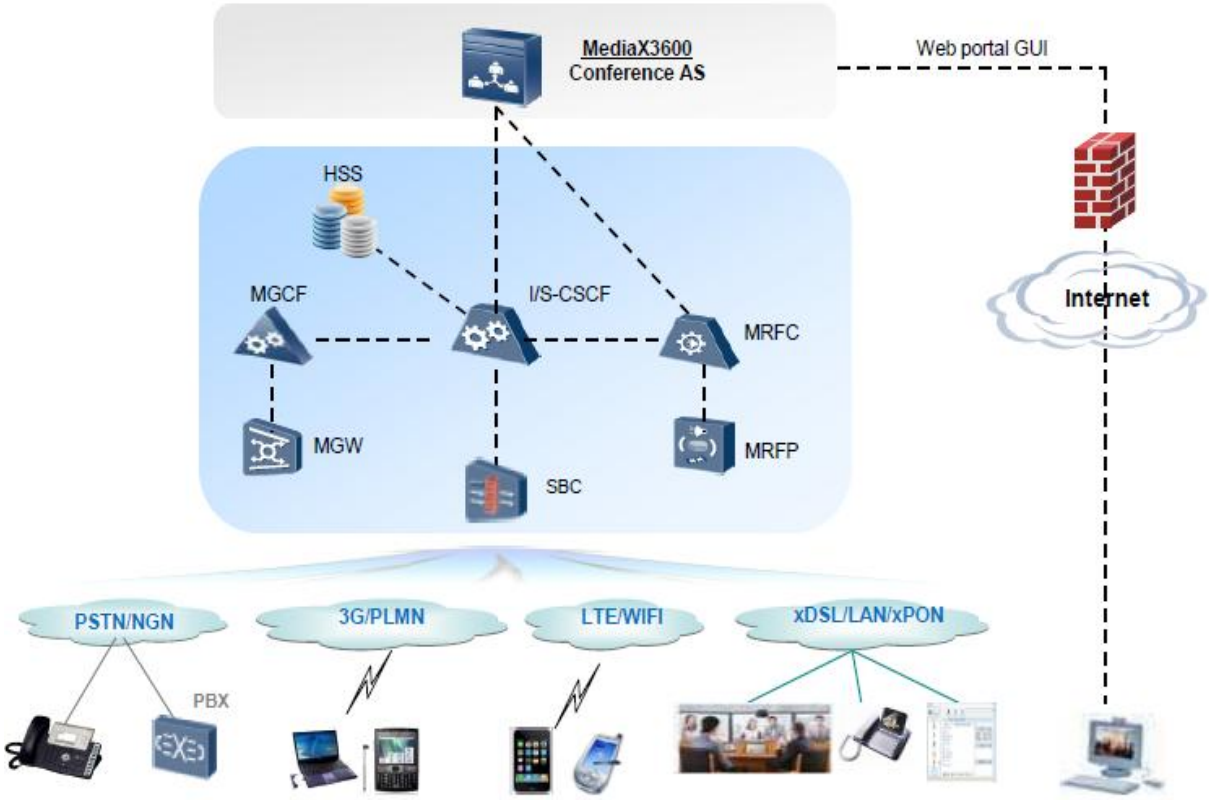


Figure: 31 Convergent Conf Solution Huawei

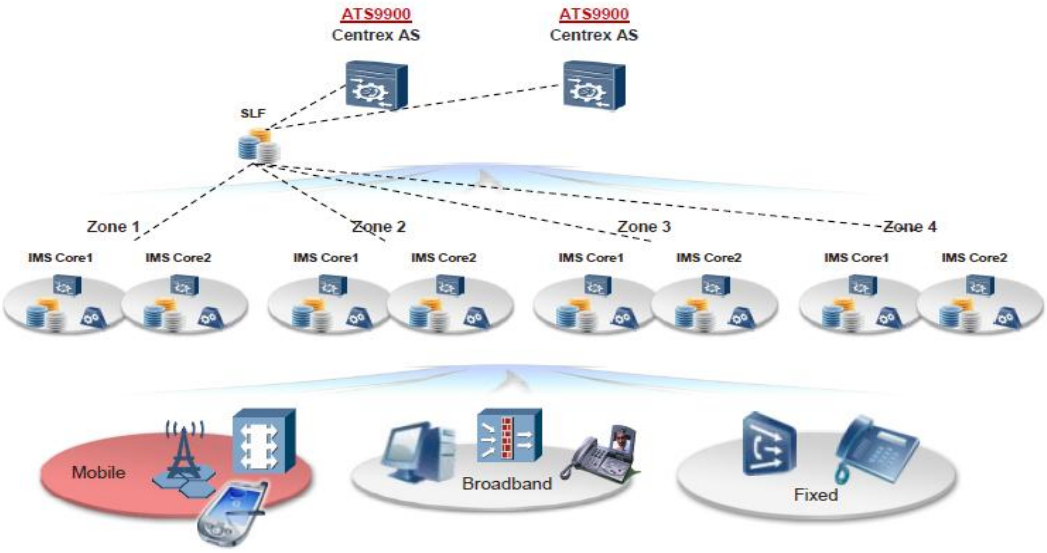


Figure: 32 Convergent Centrex Solution Huawei

9.9 CONCLUSION

The new communication paradigm is about networking Internet Protocol (IP)-based mobile devices. These terminals have large, high-precision displays, they have builtin cameras and a lot of resources for applications. They are always-on-always connected application devices. This redefines applications. Applications are no longer isolated entities exchanging information only with the user interface. The next generation of more exciting applications are peer-to-peer entities, which facilitate sharing: shared browsing, shared whiteboard, shared game experience, shared two-way radio session (i.e., push to talk). The concept of being connected will be redefined. Dialing a number and talking will soon be seen as a narrow subset of networking. The ability to establish a peer-to-peer connection between the new IPenabled mobile devices is the key ingredient required.

In order to communicate, the IP-based applications must have a mechanism to reach the correspondent. The telephone network currently provides this critical task of establishing a connection. By dialing the B number, the network can establish an ad hoc connection between any two terminals. This critical IP connectivity capability is offered only in isolated and single-service provider environments in the Internet. We need a global system—the IMS. It enables applications in mobile devices to establish peer-to-peer connections.

10 CONCEPT OF ONE NETWORK(CENTRALIZED NOC FOR CFA)

10.1 LEARNING OBJECTIVES

- Concept and requirement of One Network
- Activities involved in one network concept
- Implementation of one network program
- Network and partner team management

10.2 INTRODUCTION TO ONE NETWORK

- The activities related to network management and customer management are being done currently at the exchange / equipment location level. Customer
- service management is generally done through indoor staff stationed at main exchange locations and outdoor takes care of last mile activities. The commercial activities related to partner (cluster, FTTH) management are being done in decentralized manner.
- With the change in technology and management methodologies, it is very much desired that 24/7 network management is done through a centralized location for first level monitoring and corrective action required for the operational excellence. Wherever physical presence of staff is required for change of network card etc., there should be common staff at site to manage technical equipment, power plan, electrical infrastructure, etc.
- One network program was started by BSNL on 16-12-2020
- One network is Centralized NOC (Network operations center) for CFA (Consumer Fixed Assets)

Figure: 33 Services covered under One Network

10.3 ACTIVITIES IN ONE NETWORK

Following Activities are proposed for centralized network/customer/partner management.

10.3.1 Network Management

- FTTH /OLT Management.
- OMCR- BTS Monitoring
- OF Route Patroller Monitoring
- NIB Network Elements Management (BNG/RPR/OCLAN/MNGPAN /Facebook Cache Server/Google Cache Server)
- Monitoring and Management, Escalation of faults to maintenance in-charge
- Monitoring of Leased circuits (MLLN & Non-MLLN both), Monitoring ofWi-Fi Hotspots, intimation regarding faulty nodes to field maintenance teams
- Monitoring of BBNL OLTs
- Testing of OLTs of TIPs from BNG
- PING Test, Profile check, handling customer speed issues
- ILL testing of MPLS customers, CRC error testing
- Coordination with Transmission teams for fault and speed related issues
- BTS nodes (2G/3G/4G) - Periodic reporting of faulty BTS nodes to BTS maintenance teams
- TRE Combiner reset, partial fault reset of 2G/3G/4G BTS nodes
- Alarm Extension of unmanned BTS sites
- Clearance of all types of network faults and clearance of faults even in odd hours, thus facilitating network availability to the customer very high

10.3.2 Partner Management

A Centralized Group for Partner Support (CGPS) shall operate performing the following separate activities for the cluster / FTTH partners.

- Partner on boarding including all paper work for signing, creation of user id/login to various IT systems like FMS, DKYC, CDR systems, E-pay system, Wallet, etc.
- Monthly settlement of revenue share through ERP and Wallet.
- Exchange of all information related to sales and market activities.
- Common toll free number opened by ITPC is 18005991001 (created by Bangalore Telecom District for partner management activities) shall be mapped with the telephone number at respective BA level CGPS.

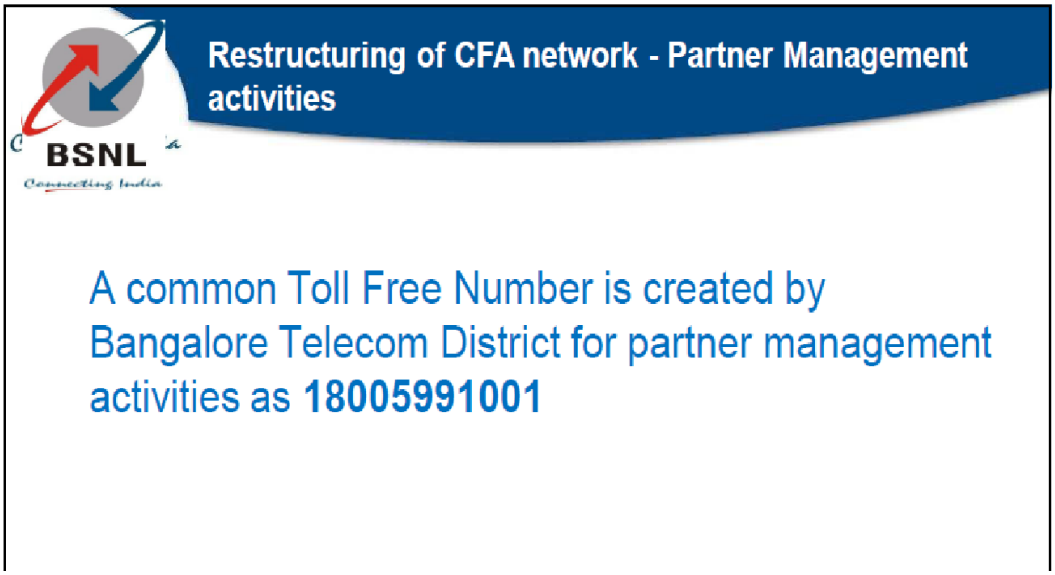


Figure: 34 Common Toll Free Number for partner management

- A telephonic PIN (T-Pin) shall be issued to all partners so that call from the partners can be routed to the respective BA P-CSG.
- For this every BA will have its own 3-digit PIN and its corresponding destination number/ line hunting group.

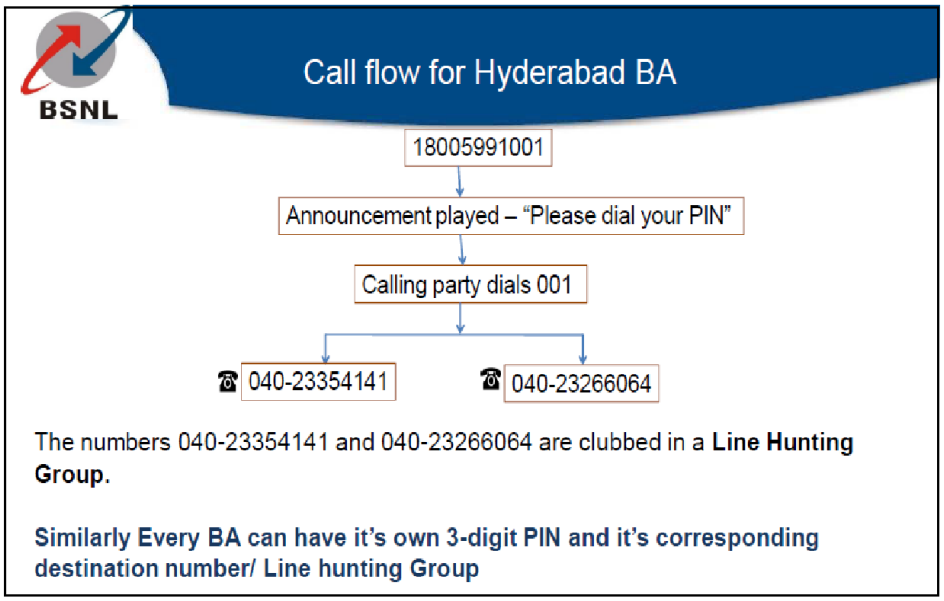


Figure: 35 Call flow for BA

10.3.3 FTTH Management (BSNL OLT/TIP OLT/BBNL OLT)

- FTTH OLT Management (EMS)
- FTTH Soft Switch Management (Voice Creation)
- FTTH Lead Management.
- FTTH Fault Management.
- FTTH CAF Approval.

- CDR activities with respect to FTTH.
- FTTH TIP support.

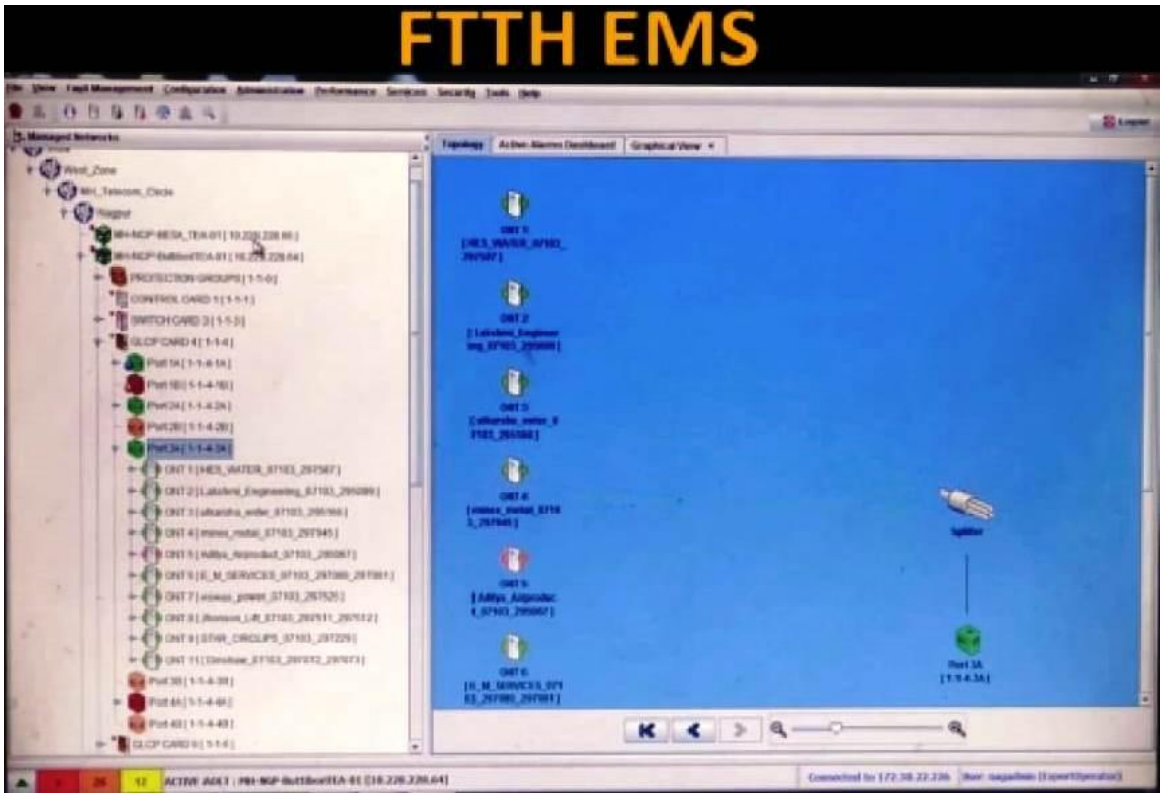


Figure: 36 FTTH EMS

10.3.4 OMCR Activities

- BTS Monitoring (2G/3G/4G) and Reporting
- TRE/Combiner HW Reset
- Partial Fault Monitoring
- Attending calls from field persons
- BTS External Alarm Monitoring

10.3.5 OFC Route Patroller Monitoring

- Patroller Monitoring and Reports.
- Updation of data for Patrollers and New OF route in Patroller Monitoring System.

10.4 MORE ACTIVITIES PROPOSED IN ONE NETWORK

- Transmission system monitoring and management
- NGN-LMGs/DSLAMs/OLTs/Exchange Monitoring and management
- NOFN – OLT/ONT monitoring and management
- PRI & SIP Monitoring and Management

- LEASED CIRCUIT & MLLN Monitoring and Management (DXC/V-MUX/Circuits)
- CDR/FMS SYSTEM management (Central Router/Exchange Router/MLLN Circuits)
- Wi-Fi Hotspots- monitoring & Management
- High Bandwidth Circuit Monitoring & management
- MPLS Monitoring (Edge Router/Core Router/Super Core Router/Circuits)

- **NOC FOR ONE NETWORK**

NOC of ONE Network has terminals of OMCRs, FTTH, NIB, eMS, Softswitch, ROT, CPAN, CDR, ERP extended for operations, monitoring and control. It is equipped with large LED screens for display of status and health of the network.

10.5 NETWORK MANAGEMENT BA TEAM

BA Team wise size required for centralized NOC activities and partner support group is to be prepared in following format

10.5.1 Network Management Team Details

Name	Designation	Monitoring on network elements (FTTH/OLT/BNG etc.)	Mobile No.	E-mail ID

Table: 8 Network Management Team Details

10.5.2 Partner Management Team Details

Name	Designation	CLUSTER FTTH	Mobile No.	E-mail ID

Table: 9 Partner Management Team Details

10.6 ONE NETWORK BA TEAM CASE STUDY OF MAHARASHTRA CIRCLE

Sl.	Name of	Name of BA	BA Type	Members in the lized NOC team network ement	Members in the for the /FTTH partner
1	MH	Ahmednagar	Category-B	12	6
2	MH	Amaravati	Category-C	8	4
3	MH	Aurangabad	Category-C	8	4
4	MH	Chandrapur	Category-C	8	4
5	MH	Goa	Category-C	8	4
6	MH	Jalgaon	Category-C	8	4
7	MH	Kalyan	Category-B	12	6
8	MH	Kolhapur	Category-B	12	6
9	MH	Nagpur	Category-C	8	4
10	MH	Nanded	Category-C	8	4
11	MH	Nashik	Category-C	8	4
12	MH	Pune	Category-A	16	8
13	MH	Satara	Category-C	8	4
14	MH	Solapur	Category-C	8	4

Table: 10 Case Study of Maharashtra Circle

10.7 CONCLUSION

As the name suggests, one network program is a drive to monitor all the network components at a centralize location with 24x7 watch on the entire level and provide first level of escalation. With the growing number of subscribers and network elements to cater to such huge subscriber base, it is necessary to monitor the entire network for seamless services round the clock. One Network program is an initiative towards the NOC based approach.

11 ENERGY CONSERVATION & FIRE SAFETY

11.1 LEARNING OBJECTIVES

- Energy management and its objectives
- Energy management
- Energy conservation
- Significance of energy efficiency
- Fire Safety

11.2 INTRODUCTION

The ever-increasing cost of energy (i.e. Electrical power & diesel) has contributed immensely to the operating expenses of BSNL. The solution for controlling this operating expense lies in conserving energy by effective Energy Management. This chapter deals with Energy management objectives, system, benefits of energy conservation and duties and responsibilities of Energy Manager.

11.3 ENERGY MANAGEMENT & ITS OBJECTIVES

"Energy Management is the judicious and effective use of energy to maximize profits (minimizing costs) and enhance competitive positions**".** The objective of energy management is to achieve and maintain optimum energy procurement and utilization throughout the organization and

- To minimize energy cost/waste without affecting production and quality.
- To minimize environmental effect.

Energy management can be incorporated in to safety, quality (ISO 9000) or environmental management system. (ISO 14001)

There are four vital requirements for a successful energy management. Any successful energy management programme within an organization needs the total support of top management. Hence, top management support is the key requirement for success. Top management should give energy efficiency equal importance in their corporate objectives as manpower, raw materials, production and sales. The other important requirements are a well charted strategy plan, an effective monitoring system and adequate technical ability for analyzing and implementing energy saving options.

11.4 ENERGY MANAGEMENT SYSTEM

Organizations seeking financial returns from superior energy management continuously strive to improve their energy performance. Their success is based on regularly assessing energy performance, planning and implementing action plans to improve energy efficiency. Hence a sound energy management system is a prerequisite for identifying and implementing energy conservation measures,

sustaining the momentum and for effecting improvements on a continuous basis. The various steps for energy action planning are shown in the figure.

Figure: 37 Steps in Energy Action Planning

11.5 ENERGY CONSERVATION AND ITS IMPORTANCE

Coal and other fossil fuels, which have taken three million years to form, are likely to deplete soon. In the last two hundred years, we have consumed 60% of all resources. For sustainable development, we need to adopt energy efficiency measures. Today, 85% of primary energy comes from non-renewable, and fossil sources (coal, oil, etc.). These reserves are continually diminishing with increasing consumption and will not exist for future generations

11.6 WHAT IS ENERGY CONSERVATION?

Energy Conservation and Energy Efficiency are separate, but related concepts. Energy conservation is achieved when growth of energy consumption is reduced, measured in physical terms. Energy Conservation can, therefore, be the result of several processes or developments, such as productivity increase or technological progress. On the other hand Energy efficiency is achieved when energy intensity in a specific product, process or area of production or consumption is reduced without affecting output, consumption or comfort levels. Promotion of energy efficiency will contribute to energy conservation and is therefore an integral part of energy conservation promotional policies.

Energy efficiency is often viewed as a resource option like coal, oil or natural gas. It provides additional economic value by preserving the resource base and reducing pollution. For example, replacing traditional light bulbs with Compact Fluorescent Lamps (CFLs) means you will use only 1/4th of the energy to light a room. Pollution levels also reduce by the same amount (refer Figure below).

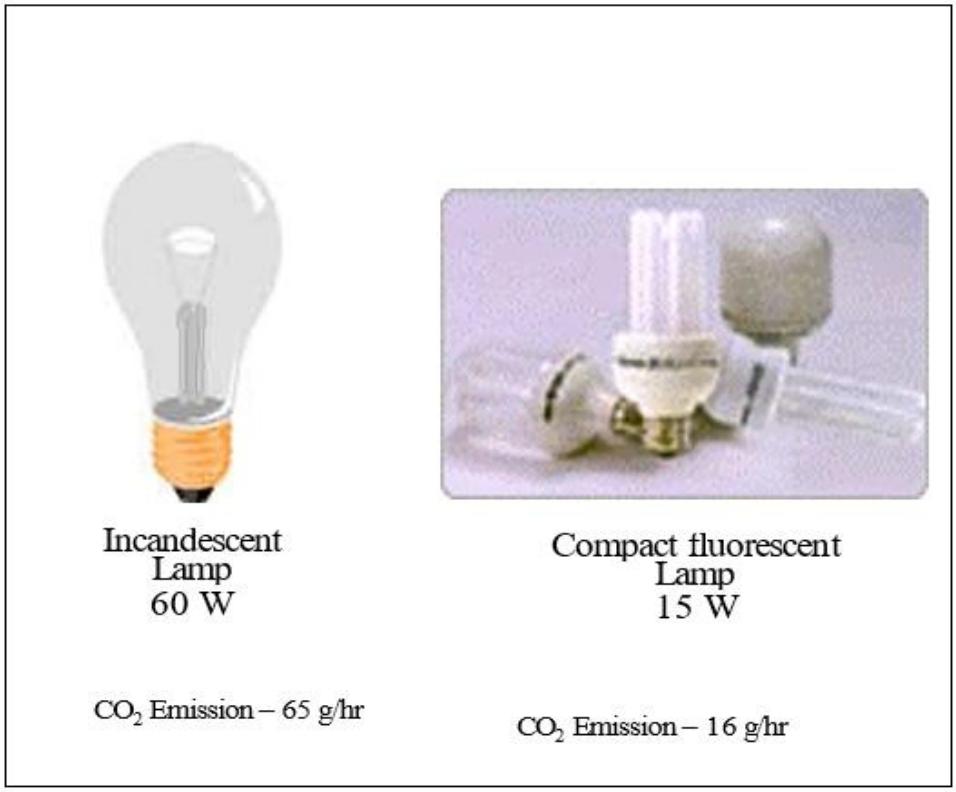


Figure: 38 Energy Efficient Equipment uses less energy for same output and reduces CO_2 emissions

Nature sets some basic limits on how efficiently energy can be used, but in most cases our products and manufacturing processes are still a long way from operating at this theoretical limit. Very simply, energy efficiency means using less energy to perform the same function.

Although, energy efficiency has been in practice ever since the first oil crisis in 1973, it has today assumed even more importance because of being the most cost-effective and reliable means of mitigating the global climatic change. Recognition of that potential has led to high expectations for the control of future CO2 emissions through even more energy efficiency improvements than have occurred in the past. The industrial sector accounts for some 41 per cent of global primary energy demand and approximately the same share of CO2 emissions.

11.7 BENEFITS OF ENERGY EFFICIENCY

Being energy efficient means using less energy to achieve the same outcomes. Energy productivity (doing more using the same or less energy) includes energy efficiency, along with other ways to reduce energy costs. These can include changing energy purchasing contracts, switching fuels and using renewable energy and battery storage.

Being energy efficient and improving energy productivity in our products, homes and commercial buildings can help to:

- reduce consumer energy bills
- protect the environment
- enhance industry energy productivity
- contribute to a competitive energy market
- better manage energy demand.

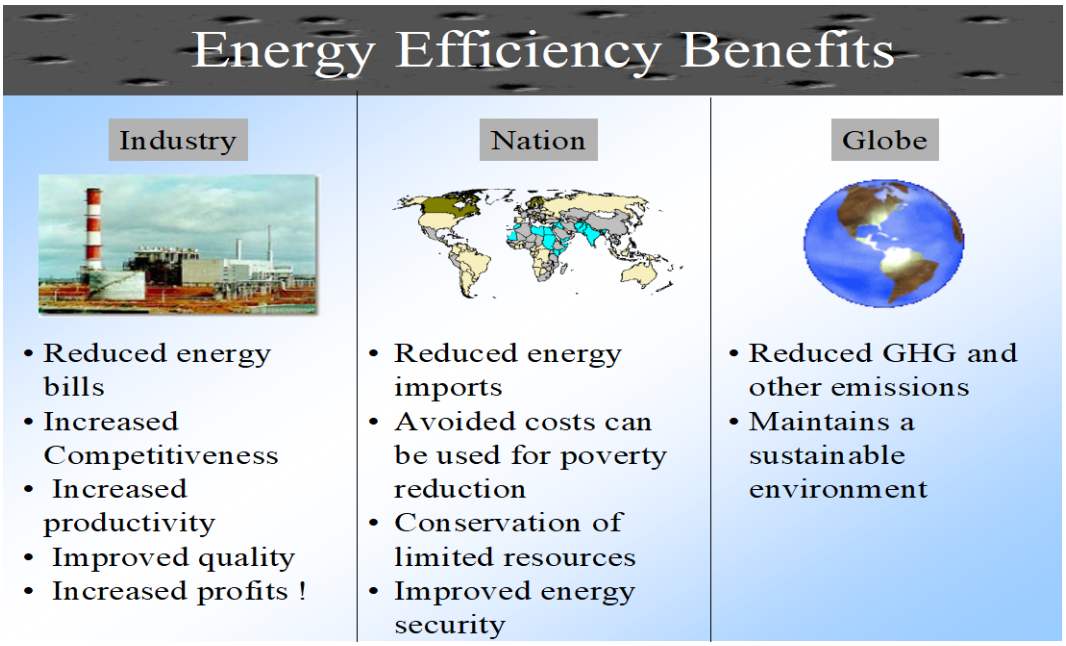


Figure: 39 Energy efficiency benefits

The many benefits of energy efficiency include:

- **Environmental**: Increased efficiency can lower greenhouse gas (GHG) emissions and other pollutants, as well as decrease water use.
- **Economic:** Improving energy efficiency can lower individual utility bills, create jobs, and help stabilize electricity prices and volatility.
- **Utility System Benefits**: Energy efficiency can provide long-term benefits by lowering overall electricity demand, thus reducing the need to invest in new electricity generation and transmission infrastructure.

- **Risk Management**: Energy efficiency also helps diversify utility resource portfolios and can be a hedge against uncertainty associated with fluctuating fuel prices.

- **Productivity**: Energy efficiency increases productivity.

The energy management can be effectively used by BSNL to reduce its operating expense and increasing profitability. Energy conservation is not only useful for the organization, but also for the protection of the global environment.

11.8 MANAGERIAL BARRIERS

- Energy management is side-lined as a technical speciality.
- Line management is inadequate .
- There is insufficient interest and driving force from above.
- There is little incentive for departmental managers and general staff to save energy.
- Lack of senior management commitment.
- Senior management unaware of potential savings.
- Higher priority given to “more important” issues.
- It is seen as an overhead cost.
- Energy is consumed by a large number of users.
- Users are unaware of energy use and costs.

Technical

- Getting accurate data on time is a key problem.
- Monitoring and targeting is not integrated with financial accounting.
- Output is not reported to either users or senior managers in a form they can readily understand and use.
- Users have no information on how to make savings.

11.9 TOP MANAGEMENT SUPPORT

The decision of company management to control energy costs is a vital first step. This must be clearly stated and understood by all within the company.

Senior management should participate in energy committee meetings or in other energy related activities.

One of the roles of the top management is to publish a formal statement of its energy policy, which can be used to define company activities in energy matters for its employees. It can also serve to inform the general public about the company commitment to energy efficiency.

Finally, an important part of top management commitment is to empower those given responsibility for implementing the energy management programme. The evidence of top management commitment will be seen in the level of support given to the Energy manager, especially such resources as manpower, budget etc.

11.9.1 Planning

Planning of an energy management strategy needs to be carried out at various levels within an organization.

At the corporate level, a favourable climate should be created which will facilitate planning at other levels in the organisation. At this level, planning will provide overall direction in setting targets.

These targets should be specific, verifiable and attainable. These objectives should be communicated clearly throughout the whole organisation.

11.9.2 Accountability

Periodical reporting to the Management is needed for controlling all energy management activities, budget etc. Clear delegation of responsibilities, reporting procedures and accountability should be assigned for all stakeholders likes energy users, energy committee, energy managers, energy coordinators and top management.

One of the key factors, which often work against energy efficiency, is poor management of the structure of the system within which the costs of energy are incurred. If the people who control the ability to change energy use are not responsible for the energy budget, then the costs of energy efficiency will always be viewed as a distraction from core business. However, if we allocate a single budget to cover energy purchase, energy management activities and energy efficiency investment, the controllers and operators of this budget have a strong motivation to work to reduce energy expenditure. Furthermore, this approach allows innovative management of the budget, by allowing savings to be re-invested into further energy efficiency measures.

Thus, it is strongly recommended that an integrated energy purchase and energy management budget be developed as part of the energy management action plan.

11.9.3 Motivation Of Employees

One of the most successful means of motivating employees is through “awareness”. Employees can be stimulated to support an energy management program if they are informed of

(1) the amount of energy they are using

(2) the costs involved

(3) the critical part that energy plays in the continued viability of their job

(4) the many ways they can save energy in their operation

(5) the relationship between production rate and energy consumption and

(6) the seriousness of the energy problem and its potential effects upon the nation economy in the future.

Another effective way to motivate employees is through recognition. Employees should be involved personally in setting realistic but challenging energy conservation goals through involvement cum commitment.
Fostering reasonable competition between departments is another healthy practice. It motivates individuals to set their sights higher and to work harder to achieve their goals.
Potential areas for motivating employees to generate ideas in saving energy are rewards, especially as financial rewards, job security, job enrichment, public recognition and greater authority etc.

11.9.4 Marketing And Communicating

Although, the main function of energy management is to control energy consumption and provide information to support decision making, there is also a need to promote energy management and marketing of various activities. Promoting energy management involves the following key objectives:

- Raising awareness of the importance of energy efficiency to cost control and environmental conservation
- Promoting energy efficiency measures
- Publishing your achievements in energy management inside and outside the organization

Many companies want to capitalize on any corporate activity that improves their image in their marketplace. Implementation of energy conservation and environmental protection measures –indicative of a good corporate citizen - should be made known to customers and community.
Through effective communication, Energy Manager needs to engage the attention of various groups and motivate them to follow his advice and adapt better practice. In particular, energy manager has to promote respect for energy management and increase its take-off.

11.9.5 Training

Training that pertains to energy management takes many form, depending on who are the target audience. Training may include the complex technical issues that relate to energy efficient technologies as well as general programs that increase awareness among general staff such as:

- Awareness of energy efficiency as a corporate priority
- Understanding of issues
- Commitment to achievement of goals
- Understanding of personal impact on energy consumption

There are many ways to approach training at this level. The important principle is that the development of a staff training program requires some considerable thought about the present needs, knowledge and attitudes of staff. Performing a training needs assessment would be of immense help in providing the required inputs.
Energy forums, training days, seminars and talks all offer opportunities to create energy awareness and to build commitment. Energy managers can make presentations to all kinds of gatherings, for example: board meetings, management team meetings, and seminars for budget holders and middle managers.

11.10 INTRODUCTION TO FIRE SAFETY

A telecom installation with high concentrations of cables and electronics switching equipment within relatively small areas constitutes a HIGH RISK installation. We have to prevent fire before everything is afire. This section deals with Fire Safety measures in telecom installations. After undergoing this topic, the participants will be able to:

- Understand Active & Passive approach of Fire Protection
- Understand types of Fire & suitable fire extinguishers for quenching it.

11.10.1 Fire Protection Measures

Fire protection measures in telecom building can be classified in two parts

Passive Fire Protection Measures

Passive fire protection measures are those which are adopted at the planning stage of the building or facility such as:

- Provision of adequate fire resistance of the structure.
- Provision of proper FAR, open spaces.
- Provision of adequate access to sufficient and readily available water supply etc. for fire brigade.
- Telephone exchange buildings have been classified as E4 business buildings in the “National Building-Code of India”. As such building Material(s) of suitable fire retardant ability as mentioned therein shall only be provided.

Active Fire Protection Measures

Active fire protection measures are those which operate (manual/Automatic) in the event of outbreak of fire such as:

- Provision of suitable and adequate Fire detection system with audio visual alarm.
- Wet riser & fire Extinguishers.

11.10.2 Fire Detection And Alarm

If outbreak of fire is detected promptly in its incipient stage and simultaneously, a correct fire fighting media is applied, losses from fire can be minimized. Thus philosophy of fire detection and alarm system is to provide an audio visual signal for alerting the building occupants.

Manual Fire Alarm

All buildings excepting manual local exchange and MAX III, shall have a manual fire alarm system. In multistoried buildings, each floor shall constitute one or more zone depending on the area of floor. Fire alarm switches shall be mounted at conventional locations in the zones. The call boxes shall be accessible to all occupants without having to travel more than 22.5 meter and shall be mounted at a height of 1.2 meter from floor level. It shall be colored red.

Automatic Fire Detection System

All buildings above 15 meter height and all Digital Electronic exchanges and all the exchanges of 1K or above shall be provided with an automatic fire detection system, in addition to manual fire alarm system. In case of any other NT exchanges, false floor plenum and false ceiling shall constitute separate zones.

The detectors shall be of rate of rise of temperature type and smoke type. Wherever smoke detectors are provided, a mixture of photoelectric and ionization type will be used.

A control indication panel to which detection circuits in all the zones are connected, shall be installed in the fire control room or in the main entrance lobby on the ground floor of the building. Light indications on the panels shall unable the fire to identify the fire site. The alarm system shall provide both alert system and evacuation alarm with different distinctive tones.The alarm system shall have a battery backup so that in case of mains failure, the backup batteries take over and feed the power to the system.

A direct fire emergency telephone shall be provided in the equipment room to all Telecom buildings for direct communication with the fire brigade.

One of the extensions of the non exchanges line shall also be available at the ground floor in the sentry cabin or at the reception. The fire telephone shall be tested daily.

11.10.3 Fire Fighting Appliances

- Sufficient number of fire Extinguishers (portable type) shall be brought or kept in shelves or mounted on wheels at conspicuous places (but not too close to the equipment). The operating instructions shall be clearly printed

on the body of extinguishers.

- Sufficient quality of refills for the extinguishers shall be stored.
- For buildings above 15 Meter in height one wet riser for every 1000 Sq. Meter or part therefore of floor area shall be provided. The hydrant shall be so located that it is not father than 30 Meter from any point in the area covered.
- In data centers, automatic flooding system is provided keeping in view the importance and fire risk involved.
- Two water buckets and two sand buckets shall be provided at each floor.
- All fire fighting appliances shall be maintained in working condition.
- For more details the latest "Fire protection manual" of the department can be referred.

11.11 CLASSES OF FIRE AND FIRE EXTINGUISHERS

The Nation Fire Protection Association (NFPA) extinguisher standard classifies fire into four types.

Table: 11 Class of Fire and suitable Fire Extinguisher

Class of Fire	**Fire in Type of Material**	**Suitable Fire Extinguisher**
Class A	Fire in ordinary combustible materials (like wood, cloth, paper, rubber, etc.)	Water, Foam
Class B	Fire inflammable liquids, gasses etc	Foam, CO2, Dry Powder
Class C	Fire in live electrical equipment.	CO2, Halon
Class D	Fire in reactive metals (Like Mg, Ti, Na, K, etc.).	Special Dry Chemical Powder

11.12 CONCLUSION

Business can benefit significantly by moving towards energy management practices. Effective energy management can drive whole business to improved performance through its effect on production. Energy management can be incorporated in to existing business system to provide an integrated approach to business sustainability.

Fire safety measures are very much required in telecom buildings as damage caused by fire not only affects the person and property but it is felt throughout the population due to the effects of service breakdown.

12 REPORTS IN CDR SYSTEM

12.1 LEARNING OBJECTIVES

- Concept of CDR used in BSNL.
- Implementation of CDR based convergent billing and customer care system.

12.2 INTRODUCTION OF CDR PROJECT

BSNL has implemented a CDR (call detail record) based convergent billing and customer care system. This project has replaced all the traditional systems of Commercial, TRA (Telecom Revenue Accounting), FRS (Fault Repair Service) and DQ (Directory Enquiry).

The project also covers customer care and billing for the Landline, Broadband and Leased Line Services.

The project is not simply a replacement of the traditional systems, but it is much more than that. For the first time in the history of BSNL, we are having State- of-the-Art Customer Relationship Management (CRM) software. This software will take care of all types of requests from the customers and integrate with other systems such as Order Management and Billing systems. This software also provides a Web Self Care (WSC) module which enables customers to access the system through Internet for placing any request, for making payments, or for general enquiry.

In this project, provisioning and mediation systems is interfaced with around 3000 PSTN switches. The subscriber management is done through the Provisioning system. The CDRs generated for all the calls are pulled by the Mediation system.

The combination of CRM and the billing system enables BSNL to introduce flexible user-friendly tariff Plans. It also enable us to introduce schemes which we were not able to do with traditional billing systems. This also provides facility of Convergent Billing through e-stapling facility.

The project also involves implementation of Payment Management system. It is specially designed and developed by TCS for BSNL. This system is common for all the Circles in BSNL.

It allows acceptance of payments from all types of channels i.e. online terminals, Post Offices, Banks, Internet payments, etc. The Payment Management system and the Billing system are integrated with an Accounting system which performs the accounting functionality and generation of sub-ledgers.

12.3 CDR IMPLEMENTATION

The entire project is implemented with four Data Centres at Hyderabad, Pune, Chandigarh and Kolkata. These four Data Centres takes care of all the activities of the Circles in the respective Zones. The South and East Zones are considered as one project and the North and West Zones are considered as the second project.

The Billing system for South and East zone is from M/s.Comverse with whom BSNL has a 10-year contract. So the same billing system as is being used in the GSM and Broadband is used in this project for the South and East Zone as well. In the North and West zone, the system for billing is from M/s.Converges.

12.4 BEFORE AND AFTER CDR PROJECT

The introduction of this new project eliminates the need of individual SSAs maintaining and operating IT systems for all the four functionalities, i.e. Commercial, TRA, FRS and DQ. The SSAs are the end-users of the systems and have better tools and software at their disposal to provide better customer services, leaving the database related jobs to the IT team at the Data Centres. Because of the introduction of new systems and to take advantage of the features of the system, certain business processes within BSNL are changed. Few of them are:

12.4.1 Revenue Accounting:

In the CDR system Balance brought forward accounting method is used instead of invoice based accounting. For example, a June Bill issued to a customer if not paid, is added to the July Bill and the July Bill is issued for an amount which is equal to both the June and July amounts. Every customer is identified by an Account Number which is unique throughout the country. Revenue booking is based on the Account even though the services under the account are scattered across the various SSAs. The customers now pay any amount at any time and it is credited to the account and adjusted against the outstanding.

12.4.2 Surcharge/Late Fee

Surcharge is treated as late fee, which is a percentage of the outstanding instead of at the slab rate as is being done traditionally. The late fee concept was introduced in the GSM billing system and the same is followed here.

12.4.3 PCO Billing

For PCO billing, the commission payable and the minimum guarantee is as per the billing cycle instead of on a monthly basis. PCO operators are now eligible for discounts instead of commission. These changes were already done in the traditional systems and shall be continued in the CDR system.

12.4.4 Deposits

Deposits are already made uniform i.e. Rs.500/- for Local, Rs.1000/- for STD and Rs.2000/- for ISD. This is common for all the Plans. Therefore, we are not offering any OYT or TATKAL deposits/schemes. The existing OYT subscribers is continued to be billed till the completion of 20 years. However, no new OYT connection is to be provided.

12.4.5 Billing Cycles

The number of billing cycles in an SSA are increased. The CDR system is having a centralized billing process common for all the SSAs in a zone. Therefore, the customers in the entire zone are divided into different billing cycles to evenly distribute the process load on the servers. The number of billing cycles have gone up to 15 since the project is rolled out in all the SSAs.

12.4.6 CDR based billing

The traditional tariff which was based on MCUs and number of calls is migrated to MOU (Minutes of Usage) based system. The discounts are given not in terms of Free Calls, but in terms of Free Talk Time (given as Minutes per month or Rupees per month).

12.5 ACCESSING CDR REPORTING SYSTEM

The reporting system of CDR is very powerful tool. This enables decision maker to take better decisions as better facts and figures are available at their disposal. The reports in CDR system are accessible through Enterprise reporting module (SAP – BI). An SAP Business Intelligence (BI) tool is used to design the report layout for the data stored in the warehouse and generate reports on the web. These reports can be viewed with the help of web browser.

For accessing the reports, individual are provided user account with specific privilege. Various reports using the SAP BI too have been developed by taking into consideration of BSNL needs and requirements. These reports are fully flexible and can be extracted as per the need of user.

In order to access the CDR reports, the system should be connected to the CDR network. The CDR network administrator of your area can convey the URL for accessing the CDR reports. When system is connected on CDR network and correct URL is typed, following screen will be visible.

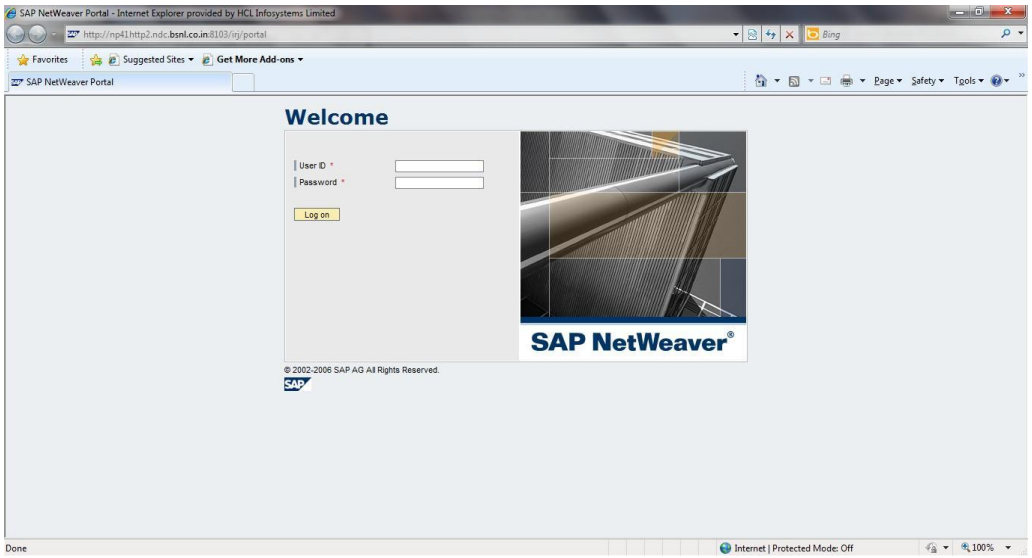


Figure: 40 Login Screen

On successful login, following screen will be visible:

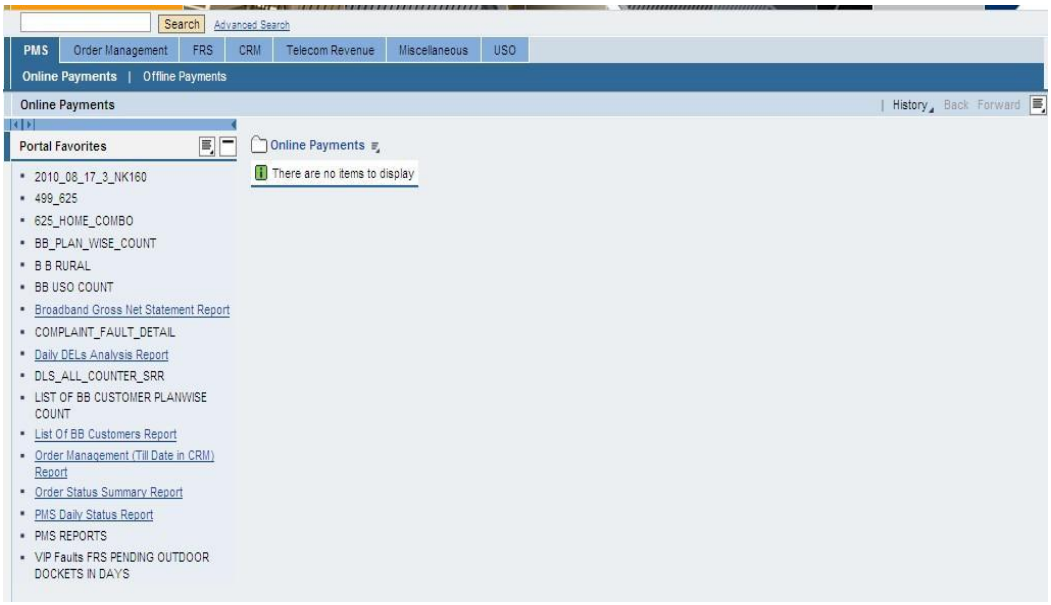


Figure: 41 Home Screen

12.6 VARIOUS REPORTS IN CDR SYSTEM

As seen from the above, reports are in CDR system are categorized into seven categories, namely:

- PMS – Payment management System
- Order Management
- FRS – Faulty Reporting System
- CRM – Customer Relationship Management
- Telecom Revenue
- Miscellaneous
- USO

12.6.1 Payment Management System Reports in CDR

Through PMS payments are received and accounted. Under PMS, reports are categorized into:

- Online Payments
- Offline Payment

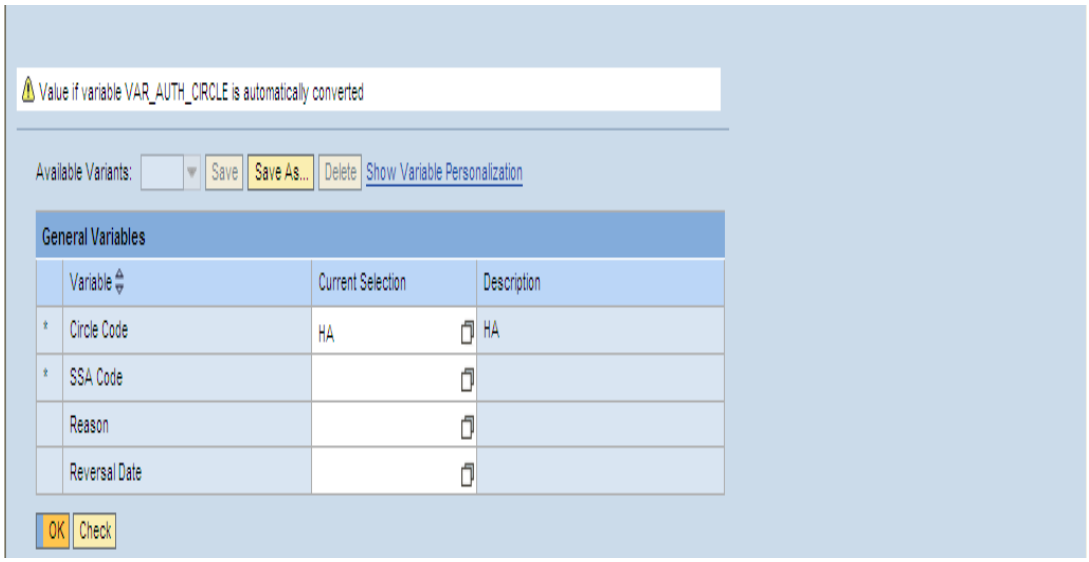
Under offline Payment, following reports are available as:

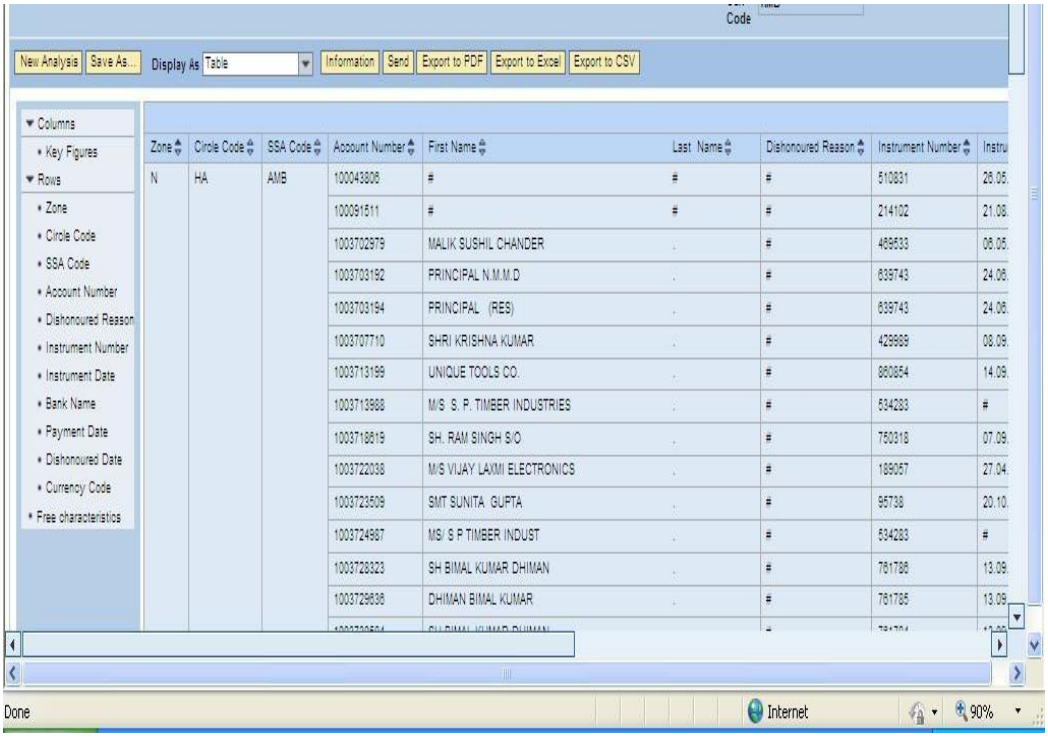
- NRPMS01 – Cheque Dishonored Report
- NRPMS02 - Daily List Summary for All Counters Report
- NRPMS03 - AIP Payment Details Report

Figure: 42 Payment Management System Interface

In order to take report of, say, Cheque Dishonored Report, user needs to click the hyperlink, which will open following window:

Then user needs to select requisite parameters like Circle, SSA, reason, and reversal date. Out of these, field marked with asterisk (*) are mandatory like, Circle and SSA. Once these parameters are selected and OK is pressed, a report similar to below will be visible on the screen:





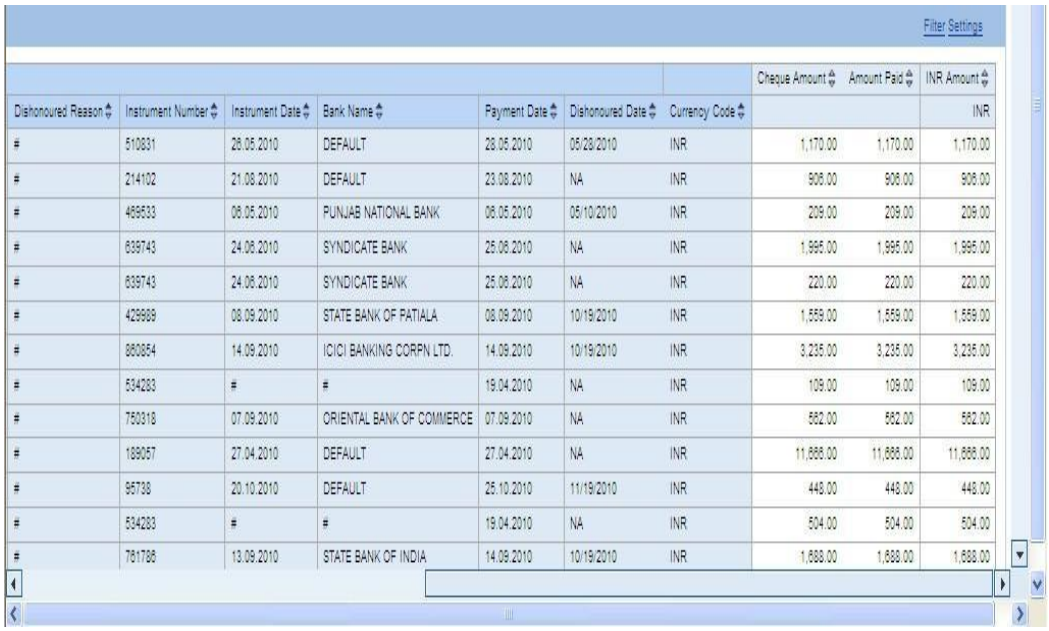


Figure: 43 Various Fields in reports

As seen from above, various fields like Zone, Circle Code, SSA, Account Number, Instrument Number, Name, Amount, etc. are visible. The report format is flexible and fields can also be dropped if these are not significant. Also, these reports can be exported as PDF or excel format for further actions. Similarly, other reports can be generated.

12.6.2 Order Management Reports in CDR

Order management is further categorized into:

- OM
- INVENTORY

Under Order Management, 26 reports are available.

- NROM01 - Advice Note Register Report
- NROM02 - Broadband Gross Net Statement Report
- NROM03 - Centrex Connection Report in a group id
- NROM04 - CUG Connection in a group id
- NROM05 - Daily DELs Analysis Report
- NROM06 - Daywise Analysis of Orders Report
- NROM07 - DNP History Report
- NROM08 - Enquiry of a Connection on Demand Notes Report
- NROM09 - List of PT in an Exchange Report
- NROM10 - List of Working Casual Connection in an Exchange Report
- NROM11 - List of Working Connections in an Exchange Report
- NROM12 - Monthly Analysis of Orders Report
- NROM13 - Monthly DELs Analysis Report
- NROM14 - Order Management (Till Date in CRM) Report
- NROM15 - Order Pending Order Type Wise
- NROM16 - Order Status Summary Report
- NROM17- Pending And Cancelled Orders Report
- NROM18 - Pending NPC Work Orders Report
- NROM19 - Pending Outdoor Orders in Days
- NROM20 - Permanent Closure Cases Report
- NROM21 - Planwise NPC Booking Report
- NROM22 - Shift Work Orders Report
- NROM23 - Surrender Analysis of Landline Connection Report
- NROM24 -Taskwise Status for Disconnection of Permanent Cases Report
- NROM25 - Temporary Disconnections Report
- NROM26 - User Activity Analysis Report

Under Inventory, following 7 reports are available:

- NRIV01 - Connectable Capacity Report
- NRIV02 - DP Card Report
- NRIV03 - Exchangewise Missing Pillar Data Summary Report
- NRIV04 - List of Vacant Telephone Numbers Report

- NRIV05 - Modems Issued Report
- NRIV06 - Pillar Card Report
- NRIV07 - Vertical Card Report

12.7 FRS REPORTS IN CDR

FRS is categorized into:

- Faults
- Complaints

These reports are great significance, which can give real picture of the area.

Under Faults, different 36 types of reports are available.

- NRF01 - Cleared Instrument Faults Report
- NRF02 - Cleared NFF Report
- NRF03 - Cleared SWRM Faults Report
- NRF04 - Complaints & Faults Details Report
- NRF05 - Daily Fault Booking/Clearance for Last 30 days Report
- NRF06 - Daily Fault Consolidation Report
- NRF07 - Dockets pending at Task Report
- NRF08 - Dockets Pending at Task Summary Report
- NRF09 - Fault Rate Analysis Report
- NRF10 - FRS Details Report DP No wise
- NRF11 - FRS Details Report equipment wise
- NRF12 - FRS Details Report Phone-no wise
- NRF13 - FRS Details Report Pillar-out wise
- NRF14 - FRS Details Report Pillar-wise
- NRF15 - FRS Details Report Vertical No wise
- NRF16 - JTO Wise Cleared Faults with Duration Report
- NRF17 - Lineman Cleared Faults Report
- NRF18 - Monthly Cleared Fault Analysis Durationwise Report
- NRF19 - Monthly Fault Category Report
- NRF20 - Outdoor Faults Ordered To Lineman Report
- NRF21 - PCO Monthly Fault Analysis Report
- NRF22 - Pending Accessory Fault Report
- NRF23 - Pending Cable Faults Report
- NRF24 - Pending Faults MDF Report
- NRF25 - Pending Faults- Supervisory Verification Report

- NRF26 - Pending Faults SWRM Report
- NRF27 - Pending Instrument Faults Report
- NRF28 - Pending NIB Faults Report
- NRF29 - Pending Outdoor Faults Report
- NRF30 - Pending Outdoor Faults Summary Report
- NRF31 - Pending Outdoor Faults Summary Rolewise
- NRF32 - Repeat Faults Details Report for last 30 Days
- NRF33 - Repeat Faults Summary for last 30 Days Report
- NRF34 - Weekly Fault Category Report
- NRF35 - Subscriber Fault Card Report
- NRF36 - Lineman Docket Report

Under Complaints, following 5 reports are available**:**

- NRC01 - Cleared ROT Complaints Report
- NRC02 - Pending Complaints Initial Testing Report
- NRC03 - Pending Complaints Under Verification Report
- NRC04 - Repeat Complaints Details report for last 30 days
- NRC05 - Repeat Complaints Summary for last 30 days Report

12.7.1 CRM Reports in CDR

CRM Reports under CRM is categorized into:

- Advice Notes
- Waitlist
- Customer Accounts
- Franchisee Reports

At present no items are available under this.

12.7.2 Telecom Revenue Reports in CDR

Under Telecom revenue, following sub categories have been created:

- Billing
- Accounting

Under Billing, 16 reports are available:

- NRBILL01 - Accounts Refunded Report
- NRBILL02 - Adjustment Summary Report
- NRBILL03 - Annual Plans Report
- NRBILL04 - Bill Register Report
- NRBILL05 - Bill Register Summary Report

- NRBILL06 - Broadband Usage Customer wise Report
- NRBILL07 - Credit Broadsheet Report
- NRBILL08 - Outstanding Detailed List Report
- NRBILL09 - Payment Receipt Summary of Permanently Closed Accounts Report
- NRBILL10 - Per Line Revenue Report
- NRBILL11 - Receipt Classification Report
- NRBILL12 - Subledger Report
- NRBILL13 - Write Off Month Wise Report
- NRBILL14 - Project Kuber Report (Bucket 1)
- NRBILL15 - Project Kuber Report (Bucket 2)
- NRBILL16 - Project Kuber Report (Bucket 3)

Accounting: Under accounting, no report is available:

12.7.3 Miscellaneous Reports in CDR

Under Miscellaneous, master category has been created.

- Masters

Under this category, 9 reports are available pertaining to daily status

- NRMISC01 - Clarity Order Status Summary (OM) Report
- NRMISC02 - Clarity Pending(In Progress) - Breakup Report
- NRMISC03 - Daily Status of Faults Report
- NRMISC04 - Lineman Performance Report
- NRMISC05 - List of BB Customers Report
- NRMISC06 - Pending Indoor Tasks for Dunning Report
- NRMISC07 - Plan Change Details Report
- NRMISC08 - PMS Daily Status Report
- NRMISC09 - Tasks in error state Report

12.7.4 USO Reports in CDR

- VPT
- RH BB
- RH DELs

Under VPT (Village Public Telephone) category, 8 different reports are available.

- NRVPT01 - Details of VPT Added during the Month Report
- NRVPT02 - VPT Billed Usage Details Report
- NRVPT03 - VPT Billing Details (Billed Amount) Report

- NRVPT04 - VPT Billing Details (Outstanding Amount) Report
- NRVPT05 - VPT Fault Report
- NRVPT06 - VPT Permanent Disconnections Report
- NRVPT07 - VPT Usage Details Report
- NRVPT08 - VPT Suspend and Restore Orders Details

Under RH BB (Rural Household Broadband) report category 5 different reports are available

- NRHHBB01 - BB New Connection Rural Report
- NRHHBB02 - BB New Connection With Billing Details Report
- NRHHBB03 - Broadband Closures Report
- NRHHBB04 - Rural BB Fault Report
- NRHHBB05 - Suspend and Restore Rural BB Orders Details

RH DELs - Rural Household Broadband report: Under this, 5 different reports are available

- NRHHDEL01 - First Bill Details of RHDELS Installed in a month Report
- NRHHDEL02 - RHDELS Billing Details
- NRHHDEL03 - RHDELs Fault Report
- NRHHDEL04 - Rural Dels Permanent Disconnection Report
- NRHHDEL05 - Suspend and Restore RHDELs Orders Details

As seen, under CDR system around 120 different reports are available. These reports are fully customizable and can be exported to excel for further analysis. Therefore, we should take advantage of information available to server our customers better.

12.8 CONCLUSION

CDR project has set up an entirely up-to-date convergent billing system in place for Landline and Broadband services. It has facilitated the customers and BSNL staff with all the latest features and functions to fully fetch and utilize the services. It has opened new channels of revenue collection and handling the customer with the knowledge of their complete profile.

13 INSPECTION OF CFA NETWORK

13.1 LEARNING OBJECTIVES

- Explain the activities regarding Inspection of Exchanges.
- Explain the activities regarding Inspection of Broadband Services.

13.2 INSPECTION OF EXCHANGES

Inspection of every Telephone Exchange/ telecom equipments of BSNL is to be done once a year by Inspection Circle, erstwhile T&D Circle. If due to any reason it could not be completed in the current year next year inspection of that exchange is done on priority basis.

The following proforma is used for covering all the points of inspection.

INSPECTION PROFORMA FOR EXCHANGE			
NAME OF CIRCLE		Name of SSA	
LOCATION			
NAME OF THE EXCHANGE		DATE:	
TYPE & MAKE OF EXCHANGE			
A. INFRASTRUCTURE			
	Details Of Check List	Observation	Remark
1	Check the Measured Earth value and date of measurement		
2	Check the availability of earth distribution diagram and physical check of connectivity		
3	Check the working of E/A sets Main & S/B and switchover of load		
4	Check for diesel availability	Yes/No	
5	Check the working of fire alarm system	Yes/No	
6	Check the availability of fire extinguishers/ sand bucket	Yes/No	
7	No of A/C installed/Working & Room Temp		
8	Check Maintenance schedule of A/C units		
9	Capacity of power plant in (Amp) & working load		
10	No. of power plant modules in working conditions (out of total no…..)		
11	Check of log book being maintained for battery health		
12	Check for battery test discharge conducted		

12.1	No. of Hrs battery sets is able to take load? (both set combined if available)		
12.2	No. of faulty cells (both sets combines)		
13	Availability of spare fuses		
14	DC emergency light in case of power failure		
15	General cleanliness of the battery room		
B. MDF			
16	Earthing of MDF		
17	Protective devices in the line/exchange side		
18	Maintenance of records in MDF		
19	Neatness in the MDF jumpering		
20	Line testing arrangement		
C. SWITCH ROOM			
21	Total capacity of the exchange		
22	% of loading		
23	Log book and other records		
24	Availability of tools and testers (e.g. multi- meter)		
25	Availability of spare cards		
26	Sample check of announcements		
27	Sample check of emergency services like fire etc.		
28	Check of faulty PCBs & turn around time		
29	Check for critical pending alarms in the exchange		
30	Generation & availability of traffic reports		
31	Type and capacity of transmission media		
32	Checking of synchronization of transmission		
	node like DXC,MADM and switching nodes		
33	Checking of logic switchover from main to standby in alternate time gap		
34	Check of redundancy of transmission media		
35	Any other comments		
Signature of Inspecting Officer			
Name			
Designation			
Date			

13.3 INSPECTION OF BROAD BAND SERVICE

Inspection of every Broad Band service is to be done once a year by Inspection Circle, erstwhile T&D Circle. If due to any reason it could not be completed in the current year next year inspection of that exchange is done on priority basis.

The following proforma is used for covering all the points of Broad Band service inspection.

Technical inspection of Broad Band Service		
I.	**GENERAL INFORMATION**	
NODE DETAILS		
1.	Name of SSA/Circle:	
2.	Name of City / Exchange	
3.	Type of City/ Exchange	
4.	Type of Equipment (BNG/T-I/T-II/ OCLAN/ DSLAM with Capacity and make)	
5.	Whether A/T certificate issued or not	

II.	**GENERAL TECHNICAL INSPECTION**		
Sl No	DETAILS OF CHECK LIST	OBSERVATION	REMARK
1.	Whether a network diagram indicating the connectivity of the node to other nodes as well as internal connectivity of the equipment i.e. how the various routers, servers are connected and the IP addresses of various interfaces is prominently displayed?	Yes / No	
2.	Whether a board is displayed indicating the number of Broad Band customers?	Yes / No	
3.	Whether the equipment room is clean and the equipment dust free? (Check for dust prevention measures that can cause damage to the modules. Modules can be jacked out and observe for any dust accumulation on the components / terminations of the modules.)	Yes / No	

4.	Whether the environment variables like temperature, dust, humidity are being maintained as per maintenance guidelines?	Yes / No	
5.	Whether the date of commissioning of the node is displayed?	Yes / No	
6.	Whether battery, power plant and inverter are in good working condition?	Yes / No	
7	Check for battery test discharge conducted		
7.1	No. of hrs battery sets is able to take load? (both set combined if available)		
7.2	No. of Faculty Cells (both sets combines)		
8	Whether the fire extinguishers are available?	Yes / No	
9	Whether the fire alarms are in working condition?	Yes / No	
10	Whether the equipment is properly labeled so that the equipment name is properly identified?	Yes / No	
11	Whether the wiring is properly laced?	Yes / No	
12	Whether the proper method for reporting the link faults is being followed?	Yes / No	
13	Whether log book is available in the equipment room containing details like the downtime of the equipment/node, cause of downtime, downtime links, downtime of customers etc?	Yes / No	
14	Whether a log book is available in the equipment room containing details of routine testing of different ports?	Yes / No	
15	Type and capacity of transmission media		
16	Check of redundancy of transmission media		
A. BRAS / BNG			
Name of BRAS/BNG			
Sl No	DETAILS OF CHECK LIST	OBSERVATION	REMARK
1.	Total downtime of BRAS/BNG during last one month		

2.	Check for alarms, whether alarms are actually raised on a fault / check for fake alarms		
3.	Check whether eMS is being utilized by the in-charges.	Yes/No	
B. RPR T-I/T-II/ OCLAN and Tier-1/ Tier-2			
Name of Tier-1/Tier-2/ OCLAN			
Sl. No	DETAILS OF CHECK LIST	OBSERVATION	REMARK
1.	Note down the environment variables, temperature, humidity.		
2.	Total downtime during last one month		
3.	Check for alarms, whether alarms are actually raised on a fault / check for fake alarms		
4.	Check whether eMS is being utilized by the in-charge.	Yes/No	
C. DSLAM			
Name of DSLAM			
Sl No	DETAILS OF CHECK LIST	OBSERVATION	REMARK
1.	Note down the environment variables, temperature, humidity.		
2.	Status of ADSL ports,total ports, total working ports, total faulty ports	Total port :	
3.	Total downtime during last one month		
4.	Check for alarms, whether alarms are actually raised on a fault / check for fake alarms		
5	Check whether eMS is being utilized by the in-charge.	Yes/No	
Observation/ Suggestion/ Remarks of Inspection officer			

		Signature of Inspecting Officer	
		Name	
		Designation	
		Date	

13.4 CONCLUSION

Inspection of telecom equipment on regular basis plays a key role in proper upkeep and health of telecom equipments.

14 QOS OF CFA NETWORK

14.1 LEARNING OBJECTIVES

At the end of this session, participants will be able to:

- List various sectors of nation's economy
- Define difference between a Product and service
- Explain service systems
- Describe Service Quality and its key contributors
- Explain Service Operations
- Business process reengineering of service operations
- Explain Service Quality and Service Operations for Telecom sector

14.2 INTRODUCTION

A nation's economy can be divided into various sectors to define the proportion of the population engaged in the activity sector. In the last few decades contribution of services sector to National GDP is increasing. Telecom services play a very significant role in strengthening National economy. The quality of service and its operations is not only important to the customers but also desirable by the operators for their survival as well as growth. This unit deliberates on various aspects of service quality and services operations.

14.3 VARIOUS SECTORS OF ECONOMY

14.3.1 Primary Sector

The primary sector of the economy extracts or harvests products from the earth. The primary sector includes the production of raw material and basic foods. Activities associated with the primary sector include agriculture (both subsistence and commercial), mining, forestry, farming, grazing, hunting and gathering, fishing, and quarrying. The packaging and processing of the raw material associated with this sector is also considered to be part of this sector.

14.3.2 Secondary Sector

The secondary sector of the economy manufactures finished goods. All of manufacturing, processing, and construction lies within the secondary sector. Activities associated with the secondary sector include metal working and smelting, automobile production, textile production, chemical and engineering industries, aerospace manufacturing, energy utilities, engineering, breweries and bottlers, construction, and shipbuilding.

14.3.3 Tertiary Sector

The tertiary sector of the economy is the service industry. This sector provides services to the general population and to businesses. Activities associated with this sector include retail and wholesale sales, transportation and distribution, entertainment (movies, television, radio, music, theatre, etc.), restaurants, clerical services, media, tourism, insurance, banking, healthcare, and

law. In most developed and developing countries, a growing proportion of workers are devoted to the tertiary sector. In the U.S., more than 80% of the labor force is tertiary workers.

14.3.4 Quaternary Sector

The quaternary sector of the economy consists of intellectual activities. Activities associated with this sector include government, culture, libraries, scientific research, education, and information technology.

14.3.5 Quinary Sector

Some consider there to be a branch of the quaternary sector called the quinary sector, which includes the highest levels of decision making in a society or economy. This sector would include the top executives or officials in such fields as government, science, universities, non profit, healthcare, culture, and the media.

14.4 PRODUCT VERSUS SERVICE

Since a product differs from service, marketer has to understand these differences so as to apply proper tools & techniques to be successful.

14.4.1 Products Physical Distinctions

- **Form:** size, shape, physical structure; for example, aspirin coating and dosage
- **Features:** such as a word processing software's new text-editing tool
- **Performance quality:** the level at which the product's primary characteristics function
- **Conformance quality:** the degree to which all the units of the product perform equally
- **Durability:** the product's expected operating life under natural or stressful conditions
- **Reliability:** the probability that the product won't malfunction or fail
- **Reparability:** the ease with which the product can be fixed if it malfunctions
- **Style:** the product's look and feel
- **Design:** the way all the above qualities work together (it's easy to use, looks nice, and lasts a long time)

14.4.2 Products Service Distinctions

- Ordering ease: how easy it is for customers to buy the product
- Delivery: how quickly and accurately the product is delivered
- Installation: how well the work is done to make the product useable in its intended location
- Customer training: whether your company offers to train customers in using

the product

- Customer consulting: whether your company offers advising or research services to buyers of the product
- Maintenance and repair: how well your company helps customers keep the product in good working order

14.4.3 Services Distinctions

- Intangible: Customers can't see, touch, smell, or handle services before deciding whether to buy.
- Inseparable: Services are usually delivered and consumed simultaneously, so both the provider and the buyer influence the outcome of the service delivery.
- Variable: Services vary depending on who provides them and when and where they're provided; thus, controlling their quality is difficult.
- Perishable: Services are used up upon delivery, not stored for future sale.

All these characteristics can make it difficult for customers to judge the quality of a service they've purchased.

14.5 A SERVICE SYSTEM

A **service system** (or **customer service system, CSS**) is a configuration of technology and organizational networks designed to deliver services that satisfy the needs, wants, or aspirations of customers. Service system is a value coproduction configuration of people, technology, internal and external service systems connected via value propositions, and shared information (language, laws, measures, etc.).

A system is an organized set of objects which process inputs into outputs that achieve an organizational purpose and meet the need of customers through the use of human, physical, and informatics enablers in a sociological and physical environment. It is architectured as a set of nine interlinked classes of objects: A service system is nevertheless distinguished from other types of systems by the fact that the customer may be actively involved in all nine classes:

1 **Customer** - as initiator and receiver of the service (e.g., the customer is characterized as looking for novelty, reliability - or both);
2 **Goals** - as setting the primary objectives for the design and operation of the service (e.g., the service should an Internet shopper to configure the product variant he wishes to purchase);
3 **Input** - as a client upon whom the service is to be performed (e.g., a patient coming for treatment);
4 **Output** - as a client upon whom a service has been performed (e.g., the patient after treatment);
5 **Process** - as a participant in the process (e.g., an Internet sales transaction incorporates a dialogue facility between a customer and a sales agent);
6 **Human enabler** - as a resource in the process (e.g., an Internet sales transaction involves the customer as an independent agent);
7 **physical enabler** - as providing a resource to the process (e.g., an Internet

shopper uses his own computer to access the vendor site);

8 **Informatics enabler** - as applying his own knowledge to the process (e.g., an Internet shopper uses his own know-how regarding the product to configure the model he wishes to buy); and

9 **Environment** - as setting constraints or standards for acceptable service levels (e.g., an Internet shopper demands 24-hour availability of a dialogue facility).

14.6 TYPES OF SERVICE SYSTEMS

Service systems range from an individual person equipped with tools of the trade (e.g., architect, entrepreneur) to a portion of a government agency or business (e.g., branch office of a post office or bank) to complete multinational corporations and their information systems (e.g., Domino's Pizza, Federal Express). Hospitals, universities, cities, and national governments are designed service systems.

The language, norms, attitudes, and beliefs of the people that make up a service system may evolve over time, as people adjust to new circumstances. In this sense, service systems are a type of complex system that is partially designed and partially evolving. Service systems are designed to deliver or provision services, but they often consume services as well.

Every service system is both a service provider and a customer of multiple types of services. Because service systems are designed both in how they provision and consume services, services systems are often linked into a complex service value chain or value network where each link is a value proposition. Service systems may be nested inside of service systems (e.g., staff and operating room unit inside a hospital that is part of a nationwide healthcare provider network).

Service system designers or architects often seek to exploit an economic complementarities or network effect to rapidly grow and scale up the service. For example, credit cards usage is part of a service system in which the more people and businesses that use and accept the credit cards, the more value the credit cards have to the provider and all stakeholders in the service system. Service system innovation often requires integrating technology innovation, business model (or value proposition) innovation, social-organizational innovation, and demand (new customer wants, needs, aspirations) innovation.

14.7 KEY STRATEGIES FOR MANAGING SERVICE QUALITY

- Demand management
- Pre processing
- Standardization
- Managing expectations
- Capacity planning
- People management
- Differentiation

- Quality management

14.8 VALUE OF GOOD SERVICE

- Service commands price premium
- Average happy customer tells 5 others
- Of the unhappy ones, 95% are happy if the problem is resolved quickly
- Costs 5 times as much to obtain a new customer as keep an existing one
- Service can help offset product quality

14.9 COST OF POOR SERVICE

- Customers are 5 times as likely to stop doing business because of poor service than quality or cost
- 96% never complain
- 90% stop being a customer
- Average unhappy customer tells 9 others
- Cost of losing a customer is 5 times his account

14.10 DIMENSIONS OF SERVICE QUALITY

- **Tangibles**:Appearance of physical facilities,equipment, personnel & communication materials
- **Reliability** : Ability to perform the promised service dependably & accurately
- **Responsiveness**: Willingness to help customers & provide prompt service
- **Assurance**: Knowledge and courtesy of employees and their ability to convey trust and confidence
- **Empathy**: Caring, individualized attention
- **Competence**
- **Courtesy**
- **Credibility**
- **Security**
- **Access**
- **Communication**
- **Understanding the User**

14.11 SERVICES QUALITY: GAP ANALYSIS MODEL

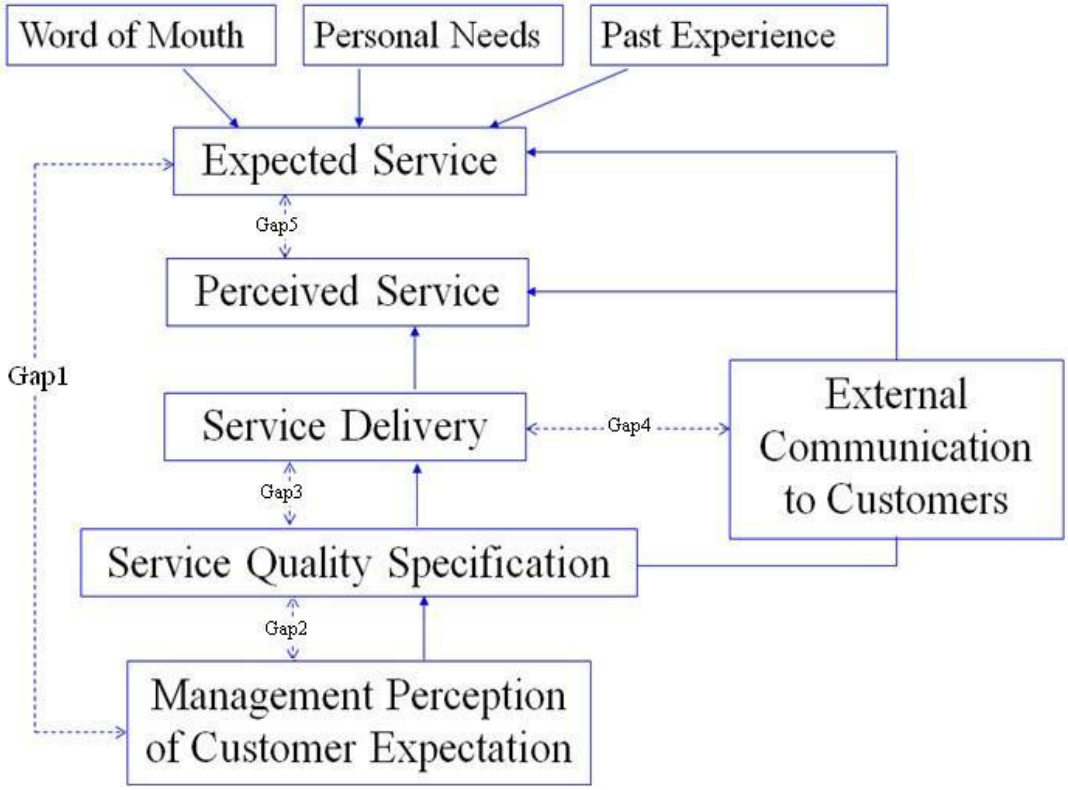


Figure: 44 Service Quality GAP Analysis Model

14.12 SERVICES OPERATIONS

- Production & Consumption occur simultaneously

  So - Management of service production & service consumption processes
- Customer is a participant in the process So - Sensitive
- Time perishable capacity

  So - Problem of peak demand: Customer wait
  - Problem of low demand: Low utilization
  - Can demand be smoothed?
- Waiting lines are caused by variability in either rate of arrivals or rate of service or both.
- Over the long run, a service system will have both idle capacity and waiting lines. Hence, an important decision in designing a service system is how much excess capacity should be provided, to be traded off with service levels.
- Waiting times should be made proportional to service times by proper segmentation. (A move towards shortest processing time rule).
- The monotony of waiting times must be reduced. Many clever means are available.
- Any attempt at reducing variability of service times would be a good strategy in

reducing waiting times. Standardization of service is possible approach.

14.13 BUSINESS PROCESS RE-ENGINEERING

It is a technique to improve services operations

- Several jobs are combined into one
- Workers make decisions
- The steps in the process are performed in a natural order
- Processes have multiple versions
- Work is performed where it makes the most sense
- Checks and controls are reduced
- Reconciliation is minimized
- A case manager provides a single point of contract
- Hybrid centralized/decentralized operations are prevalent
- Restructuring
- Customer involvement
- Use of IT
- Minimize no. of steps
- Centralized information
- Decentralized decision making
- Service quality in telecom sector

Cut throat competition and capital intensive nature of Telecom Projects provoke the service providers to think over service quality in a different perspective. In the process of faster roll out of networks to meet the demand, quality is the first probable item to be dropped from investments. In India, TRAI was established in 1997 to protect the interests of telecom customers. Now two factors force the operators to improve the quality of service, one is the competition and the other is regulator. Every quarter, TRAI conducts a Quality of telecom Services survey and publishes its results in public domain. The SQ benchmarks for important services are given in the annexure at the end of chapter. Many operators including BSNL are also adopting ISO 9001 certification to strengthen its system for consistent delivery of service quality.

14.14 SERVICES OPERATIONS IN TELECOM SECTOR

Most of the Telecom Operators have automated the operations part by deploying Telephone order Management Systems, mediation devices, Element Management Systems by networking their exchanges with customer interface terminals. Call centers are computerized. All above is implemented through ERP system. In BSNL, a massive exercise is going on for putting in place CDR based, convergent billing system which has centralized CRM for all telecom services provided by BSNL. ERP deployment is also underway where BPR is being done to improve the efficiency of various processes.

14.15 TRAI BENCHMARKS FOR QUALITY OF SERVICE (QOS)

TRAI has laid down the Quality of Service Standards for Basic Telephone Service (Wire line) and Cellular Mobile Telephone Service through the Standards of Quality of Service of Basic Telephone Service (Wire line) and Cellular Mobile Telephone Service Regulations.

TRAI has been monitoring compliance to these regulations through monthly / quarterly performance reports submitted by service providers. Wherever non-compliance with the benchmark is observed the service provider is given an opportunity to explain the matter and after considering the reply submitted by the service provider, financial disincentives are imposed on the defaulting service providers. TRAI has analyzed the compliance reports of cellular mobile telephone service providers for past several weeks and it is observed that in many cases, the present amount of financial disincentives has not acted as a sufficient deterrent against non-compliance as there have been repeated cases of non-compliance with the benchmarks, though the % of noncompliance has decreased. This indicates lack of commitment or initiative on the part of cellular mobile telephone service providers to improve the quality of service

TRAI Benchmark are as below.

14.15.1 Basic Telephony

1. Provision of telephone within 7 days for exchange areas declared "On Demand".
2. Fault incidences per month per 100 telephones (should be less than 5 Faults per 100 phones per month)
3. Percentage of faults repaired by next working day (should be >90%)
4. Mean Time to repair (MTTR) (should be <8hrs.)
5. Grade of Service for junction between local exchanges (should be < 0.002)
6. Call Completion Rate in local network (should be >65%)
7. Metering and Billing credibility (Not more than 0.1% of bills should be disputed over a billing cycle
8. Operator assisted Trunk Calls (Urgent calls should be answered within 1 hr and Ordinary calls within 2 Hrs.)
9. Customer Care: Promptness in attending 95% of customers requests (Benchmarks for Shifts, Closures and providing additional facilities are <3 days, <24 hours and <24hours respectively)
10. Percentage of repeat faults (should be <1%)

14.15.2 Cellular Mobile Service

1. No. of faults (per 100 subscribers per) <1
2. Faults cleared within 24 hrs 100.00%
3. Accumulated down time of community isolation <24 hrs
4. Call Success Rate (within licensee's own network) >99%
5. Service Access Delay Between 9 to 20
6. Call Drop Rate <3.0%
7. % of connection with good voice quality >95%
8. Complaints per 100 bills issued <0.1%
9. % of complaints resolved with 4 weeks 100.00%

10. Period of all refunds/payment due to customers from the date of resolution of complaints as in (9) above <4 weeks

14.15.3 Internet

1. Service Activation Time: 6 hrs
2. Time to Access: 30 sec
3. Probability of Accessing the ISP Node: 80% for the first attempt, 90% for the second attempt and 99% for the third attempt.
4. ISP Node unavailability: < 30 minutes/month
5. Grade of Service: 1 in 100.
6. Mean Time to Restore (MTTR): 90% within 24 hours and 99% within three days.

14.15.4 Broadband

1. Service Provisioning/Activation Time : <= 15days, Rs 10/day credit for delay up to maximum installation charge or equivalent usage
2. **Fault Repair / Restoration Time:**

   90% next day,

   99% 3 days,

   rebate slabs

   3 to 7 day-7day rental,

   7 to 15 day-15day rental,

   15-30 days-month rent

3. Billing performance

   <2% per month,

   complaint 100% within 4 week,

   refund 100% within 60days

4. Telephonic Response : 60sec >60%, 90sec >80%
5. Bandwidth utilization: <80% in peak, download->80%
6. Service availability:>90% up to june 07, beyond >98%
7. Packet loss <2%
8. Latency: wired <120msec, terrestrial<350msec, satellite<800msec

14.16 CONCLUSION

Quality of service consists of a set of parameters related to the performance of traffic on telecommunication network.A network with better QoS is more likely to retain the existing customers and may increase again from the rival operator customer churn.

15 AMC ISSUES OF CFA NETWORK

15.1 LEARNING OBJECTIVES

- AMC Issues of CFA Networks
- Preventive maintenance checks by the Vendor
- Penalties that can be imposed

15.2 INTRODUCTION

BSNL's business is directly related with revenue against supplied services. Uninterrupted or trouble free services are required by esteemed customers of any company. So to provide such a high standard and quality service, the concerned equipments should always be in healthy and proper working condition. For doing so, every telecom personnel of BSNL should be aware about the Annual Maintenance Contract (AMC) issues of CFA network. These issues are very important and required for keeping the system in healthy condition without any delay and confusion/ excuse. An agreement is made between two parties to follow the AMC issue in true spirit.

AMC is an agreement made between CONTRACTOR / PURCHASER under Companies Act, 1956 M/S VENDOR (herein after referred as **contractor** which expression shall include its successors and permitted assigned) on the one part and **Bharat Sanchar Nigam Limited** (herein after referred as **BSNL/Purchaser/SSA Head / DE in-charge of a Division and permitted assign**) represented by SSA Head / Divisional Engineer in-charge of division.

15.3 MAIN AMC ISSUES OF CFA NETWORKS

1. General issues
2. Technical assistance
3. Preventive maintenance visit
4. Performance bank guarantee
5. AMC charges and payment
6. Termination of contract
7. Force Majeure
8. Penalties

15.3.1 AMC General Issues

These **issues** are used to know each other and their requirement for better understanding in future. These issues are used to remove any type of confusion between two parties e.g.

- This agreement shall come into effect from the…….
- The vendor shall be responsible for provisioning of on-going support - services through a single point of contact to resolve emergency, non critical day to day assistance, repair of cards, updation / upgradation and subsequent implementation in all the exchanges under the contract. The VENDOR

shall:

- Diagnose the hardware & software faults
- Rectify the hardware / software fault detected
- Carry out the periodic preventive maintenance
- Repair/replacement of faulty cards
- Upkeep the software periodically
- Up-grade the software to latest version
- Provide assistance for making changes / modifications in exchange database
- Induction/invoking of new features/services
- Issue of Guidelines / application note /procedure

- The contract shall be for the exchanges/switches, whose warranty period has elapsed.
- The contract work shall be awarded by respective Head of the Circle as per the requirements of each SSA, at the rates and terms & conditions finalized.
- The circles/SSAs shall enter into the agreement with successful vendors within three months of finalization of tender.
- The rates and terms & conditions of the agreement shall be applicable for three years.
- It will be mandatory on part of L-1 bidder to accept the work order for any or all circles. The bid security shall be released only thereafter. It is implied that the agreement shall be effective from the date of signing.
- At the time of entering into AMC contract, the rates for the equipped capacity slab, in which the MSU along with associated RSUs is falling, shall be considered. Review of capacity shall be done only at the time of renewal of AMC after every one-year, depending upon the addition/deletion of the equipped capacity.
- The system has to be maintained during the entire period of contract in working condition with preventive maintenance, checking with software test programs and removal of faults on calls, including removal of any functional disorder of the systems.
- The faults shall be rectified and system shall be restored to normalcy in minimum time frame depending up on the seriousness of the problem.
- BSNL shall be responsible for providing the necessary symptoms related to the diagnosis of faults.
- Normally, the vendor shall not visit the site for Hardware/ software up-gradations. However, the vendor shall ensure all necessary support for carrying out such activities at site, if field units are not able to carry out the work successfully by remote support.
- The vendor shall be responsible for induction/invoking of all the features/

services as per supply tender compliance / TEC GRs. The supply tender refers to the latest tender under which the switches are under procurement/ expansion in the network. In such a situation BSNL will procure hardware upgrade, if any, at latest supply tender rate.

- The vendor during the course of attending the fault or during the course of Preventive maintenance, noticing requirement of any spare parts shall replace such parts and clear the fault at the site of equipment. Replacement of parts shall be done with the approval of BSNL personnel and a record is to be maintained with the exchange in-charge.
- The faults booked or the faulty cards handed over for repair during the currency of AMC shall be resolved as per the AMC terms and conditions, even after the completion of AMC period.

15.4 TECHNICAL ASSISTANCE

Issues related to technical assistance are decided according to requirement of infrastructure specific new technology switching exchange in the field e.g.

1. The vendor shall have its own technical assistance and repair centers in India. Vendor shall have sufficient expertise/ resources available and shall produce a proof of infrastructure and expertise/ resources availability. BSNL shall physically verify the same, if required. The vendor shall provide the details of technical assistance and repair center's location along with its complete address– phone numbers / FAX numbers / Email etc of the contact persons in advance, in writing to the exchange in-charge.
2. There shall be at least two telephone lines, one mobile number, one email address and one FAX line available with the vendor for registering the faults etc..
3. Assistance over designated phone/Fax /e-mail/help-desk shall be made available round the clock by the vendor for trouble and fault reports, service request, routine O & M queries etc.
4. All the routine, day-to-day activities pertaining to the first level maintenance of exchange shall be carried out by exchange personnel.
5. The scope of the activities to be performed under first level maintenance are as per existing operation & maintenance procedures/ manuals supplied by the vendor.
6. The vendor shall provide detailed instructions/procedures specifically listing all the actions to be taken in each case.
7. Minimum necessary changes in the exchange database may be done by the vendor through remote login after due permission from exchange incharge.
8. The log/ details of all such activities carried out remotely shall be provided to BSNL.
9. On receipt of information from the exchange-I/C, the vendor shall assess the emergency situation and shall provide the technical assistance immediately.
10. On site assistance shall be provided for emergency situation, where problem

can not be solved remotely.

11. Round the clock assistance shall be provided in case of emergencies.
12. The vendor shall ensure proper and timely communication on all support and maintenance related issues.
13. The vendor shall provide detailed procedure to the exchange –I/C for any action that will help in maintaining the exchange effectively and shall educate the exchange personnel about the system's existing and new features.
14. The vendor shall not delay or refuse the attending /rectification of the fault on account of change of technology, hardware expansion/up-gradation, software up-dation / up-gradation, non availability of support from the principals etc.
15. The vendor shall prepare a summary of monthly status for all the exchanges under AMC, and submit the same to BSNL.
16. Replacement of any part shall be done with the approval of exchange I/C and a record is to be maintained.
17. Response time for attending an emergency condition shall be recorded by the exchange – I/C and shall be communicated to the vendor.
18. The vendor shall have an adequate capacity of spare stocks as well as adequate tools and test equipment, etc to ensure smooth support and for ensuring the time limits for clearing the critical/major faults
19. Spares, if available in that exchange shall also be made available to the vendors for rectification of faults, if and when required.
20. The vendor is required to keep sufficient number of spares, taking into account the obsolescence of components, so as to run the exchange for its expected life time.
21. In case the obsolete hardware is required to be replaced by an equivalent hardware, the vendor shall replace the same, at no additional cost to BSNL.

15.5 PREVENTIVE MAINTENANCE VISIT

These issues are required for advanced action to avoid any unexpected failure of the switching system in future e.g.

1. The vendor shall visit the system site once in a year/ once in six months for preventive maintenance, for analysis of major problems based on trouble reports, for technical audit or for other maintenance related purposes.
2. The vendor shall prepare the schedule of preventive maintenance, ensuring that all exchanges in a particular region are scheduled in a cyclic manner. The schedule shall be submitted to BSNL in advance and shall be mutually agreeable.
3. On no account, equipment or its accessories shall be allowed to be taken out of its normal installed location. Only replacement of sub assemblies of the whole unit on a like-by-like or later version basis will be permissible and the replacement of such assemblies should be done with the written approval of exchange I/C.
4. The vendor shall submit a service slip to exchange I/C after each replacement

of parts showing the parts removed and parts installed with full details of the part name, type, model No, Sl. No.etc.

5. The vendor shall ensure that normal service of the exchanges is not effected during preventive maintenance.
6. The report of preventive maintenance shall be jointly signed by the exchange in- charge and the site engineer of the vendor.

15.6 PERFORMANCE BANK GUARANTEE

1. The vendor shall furnish Performance Bank Guarantee to the purchaser for an amount equal to 25% of the AMC value for a year within 21 days, after receipt of advance purchase order in the standard format ofBSNL.
2. The Performance Bank Guarantee shall be valid for 18 months and shall be extendable on yearly basis at the time of renewal of the contract.
3. The PBG shall be submitted on circlebasis.
4. The proceeds of performance security shall be payable to BSNL as compensation for any loss resulting from the contractor's failure to complete its obligation under the contract/Agreement.

15.7 AMC CHARGES AND PAYMENT

1. BSNL shall not pay any charges in advance. Bills for AMC shall be paid by Heads of SSAs concerned at the end of each quarter, in arrears, after successful execution of the works under this Agreement on production of certificate from concerned Divisional Engineer in this regard.
2. Divisional Engineer of the designated exchange shall issue the necessary certification for satisfactory performance within 10 days from the date of receipt of invoices and the payments shall be made within 21 days after issuance of such certifications.
3. All payments shall be made, after deducting penalties, if any.
4. BSNL reserves the right to adjust any over-payment of AMC charges in any quarter, any time during the period of AMC.
5. No charges other than the AMC charges shall be payable. Vendor shall not claim separate charges for the visits for attending to faults/ repairs/ supply of spare parts or any other pretext.

15.8 TERMINATION OF CONTRACT

In case the services provided under this contract are not satisfactory in opinion of BSNL, the contract can be terminated by BSNL after giving a notice of 3 months to the vendor. However, the vendor shall continue to provide the services during the intervening period.

15.9 FORCE MAJURE

Neither BSNL nor the VENDOR shall be liable to the other for any delay in or failure of performance of their respective obligation under the agreement caused by occurrences beyond the control of BSNL or the VENDOR including but not limited to fire (including failure or reductions), acts of God, acts to the

public enemy, war, insurrections, riots, strikes, lockouts, sabotage, any law, status or ordinance, thereof of any other local authority, or any compliance therewith or any other causes ,contingencies of circumstances similar to the above. Either party shall promptly but not later than twenty days thereafter notify the other of the commencement, and cessation of such contingencies, and if such contingencies continue beyond three months. Both parties agree upon the equitable solution for termination of this agreement or otherwise decide the course of action to be adopted.

15.10 PENALTIES

15.10.1 Penalty for Technical Assistance

The penalty charges applicable will be as per the conditions of contract.

1. **Critical Faults**: For a delay of more than 6 hrs for rectification (or providing a workable solution), penalty will be imposed by BSNL and shall be applicable after the elapse of six hours from the time of reporting to the vendor.
2. **Major Faults**: For a delay of more than 24 Hrs. for rectification (or providing workable solution) penalty will be imposed by BSNL and shall be applicable after elapse of 24 hours from the time of reporting to the vendor.
3. **Minor Faults**: If the vendor fails to provide required support within 2 days, penalty will be imposed by BSNL and shall be applicable after elapse of 48 hours from the time of reporting to the vendor.

15.10.2 Penalty for Repair of Cards

As per the terms and conditions of AMC, penalties are imposed if the faulty cards are not repaired in time.

15.10.3 Penalty for Preventive Maintenance Visit

If the vendor fails to perform yearly preventive maintenance visit, penalty charges **of** 20 % of yearly AMC cost of that MSU shall be levied.The maximum penalty **is** restricted to 25% of the contract value.

15.11 ACTIVITIES TO BE CARRIED OUT DURING PREVENTIVE MAINTENANCE

- Software conformity test
- Complete system / exchange status checkup as per maintenance manual.
- Alarm status checkup & removal of alarm.
- Check up of the correctness of the backup by taking backup of any or some of the exchange units and by regenerating the unit with the backup tape.
- If vendor observes any anomaly regarding maintenance of exchange, the same should be conveyed to exchange in-charge and should be resolved.
- Guidelines / briefing to the exchange in-charge about the new software/ hardware inducted in the system during currency of AMC or any other specific query of exchange in-charge.

- During preventive maintenance visit, the vendor shall check the alarm status for major faults and long pending minor faults, which exchange staff is not able to clear. Necessary assistance shall be provided to clear such faults/ alarms.

15.12 CONCLUSION

Annual Maintenance Contract plays an important role when it comes to repair and maintenance of the telecom equipments, reducing the downtime and lowering overall costs. One needs to ensure that all the terms and conditions of the AMC of are being followed to avoid any losses due to any lapse by the vendor.

16 NOFN

16.1 LEARNING OBJECTIVES

- About NOFN Project Of India.
- NOFN Applications For Government.
- NOFN ROADMAP
- NOFN Features.

16.2 INTRODUCTION

a. **NOFN** is a Countrywide National Fibre Optical Network project
b. **Objective:** Extend existing Optical Fiber Network to Panchayats by utilizing Universal Service Obligation Funds (USOF) and creating an institutional mechanism for management and operation of NOFN.
c. **Institutional Mechanism:** Bharat Broadband Network Limited (BBNL), a PSU has been registered under The Companies Act 1956 on Feb 25, 2012 for management and operation of NOFN
d. **Government Initiative**: - Government of India has approved on 25-10-2011 for the setting up of National Optical Fiber Network (NOFN) to provide connectivity to 2.5 lakh Gram Panchayats (Village Govt Office) of the country using optical fiber, which would ensure broadband connectivity with adequate bandwidth. This is to be achieved utilizing the existing optical fiber and extending it to the Gram Panchayats (Village Govt Office) i.e. by bridging the gap in the Aggregation Layer.
e. **Asset** :- NOFN is a National Asset
f. **Now NOFN will be called as BharatNET**
g. **BBNL** (Bharat Broadband Network Limited), is a Special Purpose Vehicle (SPV), set up by Govt of India incorporated as a Public Sector to implement and operate the NOFN project.
h. NOFN will provide Non-discriminatory access to all the Service Providers .This Telecom infrastructure which will bridge the gap (digital divide) in rural access. NOFN is being funded by the Universal Service Obligation Fund (USOF). Department of Telecom, Ministry of Communications & IT, Govt. of India provide secretariat service to project.
i. "The establishment of NOFN will open up new avenues for access service providers like mobile operators, cable TV operators etc. to launch next generation services and spur creation of local employment opportunities encompassing e-commerce and IT outsourcing, as well as e-banking, e-health and e-education".The project is being implemented by three central PSUs (CPSUs) namely BSNL, PGCIL and Railtel in the phase first.
j. The Government of India entity, Bharat Broad Band Nigam Limited (BBNL), will centrally manage the project through a high capacity Network Management System being developed by C-DOT. A key feature of the project is that the GPON equipment used in the project has been indigenously designed and developed by C-DOT and manufactured domestically.
k. The monitoring of the progress of the project will be done through Primavera Software(Oracle's Primavera Professional Project Management Software).In

the first phase NOFN shall be extended to cover 50,000 GPs, with the balance 2,00,000 GPs expected to be covered in a phased manner .

l. NOFN is part of the Digital India initiative of the Government of India. Digital India is an initiative of the Government of India to integrate the government departments and the people of India to ensure effective governance. It also aims at ensuring that the government services are made available to citizens electronically by reducing paperwork. The initiative also includes a plan to connect rural areas under high-speed internet networks.

The programme also aims at providing digital infrastructure as a utility to every citizen as well as high-speed internet as a core utility in all Gram Panchayats (Village Govt Office) through NOFN. On its completion, NOFN is expected to facilitate broadband connectivity to over 600 million rural citizens of the country.

16.3 WHY NOFN?

16.3.1 Bandwidth Requirement of Applications used in Indian scenario

Table below summaries various applications in Indian scenario and bandwidth required to support such applications. From this, It is observed that tentative bandwidth requirements to run various applications ranges from 64 Kbps to 8 Mbps.

Bandwidth for applications

Application	Minimum bandwidth Required
1.Internet Surfing	1.Upto 256Kbps
2.E-Mail	2.64 Kbps
3.Voice Chatting	3.64 Kbps
4.Voice & Video Chatting	4.256-512 Kbps
5.Video Clips	5.256-512 Kbps
6.Tele-education	6.256-512 Kbps
7.Tele-Medicine	7.256 Kbps
8.Video Streaming	8.2 Mbps
9.Video Gaming	9.256-512-2Mbps
10. High Definition Videos	10. 4-8 Mbps

a) 256 Kbps - This speed is appropriate for viewing most websites, taking about 3 secs for the website to load.
b) 512 Kbps - This is the most common speed used in homes and small businesses. It takes 1.6 secs for a website to load and about 1.5 mins to download a 5min music file at maximum speed. Suitable for video and music streaming.
c) 1Mbps - This speed is also commonly used amongst homes and small businesses. It is appropriate for website viewing, streaming and online gaming. It takes 0.8 secs to load a web page and about 40 secs to download a 5 min music file at maximum speed.
d) 2 Mbps - This and faster speeds are more suitable for people who play a lot of demanding online games. It is also suitable for people who share one Internet connection between many PC-s. It takes 0.4 seconds to load a website and about 20 seconds to download a 5 minute music file at maximum speed.

e) 24 Mbps - Ultra fast broadband offered these high speed services are particularly good for watching real-time DVD quality film.

16.3.2 Bandwidth Available in Various Technologies

Table: 12 Bandwidth available via different technologies

Connection Type	Megabytes per second	Connection Type	Megabytes per second
14.4 modem	0.014	ISDN	0.125
28.8 modem	0.028	Wireless local area network	0.127
V.92 Modem	0.055	Satellite	0.391
100 kbps	0.098	Broadband over power	0.488
Wireless Cellular	0.098	ADSL	0.625

16.4 THE SOLUTION – TECHNOLOGY USED - GPON

a) The GPON (Gigabit Passive Optical Network) standard differs from other PON standards in that it achieves higher bandwidth and higher efficiency using larger, variable-length packets.

b) A Passive Optical Network (PON) is a network architecture that brings fiber cabling and signals to the home using a point-to-multipoint scheme that enables a single optical fiber to serve multiple premises.

c) GPON (Gigabit Passive Optical Network) will be used for NOFN Project. GPON is an open standard technology. C-DOT has developed this technology and the approval has been obtained for the same from TEC.(Telecommunication Engineering Center India)

d) Encryption maintains data security in this shared environment. The architecture uses passive (unpowered) optical splitters, reducing the cost of equipment compared to point-to-point architectures.

e) C-DOT has done the Transfer of Technology for GPON to manufacturers which includes both CPSUs and private, to meet NOFN timely supply of equipments.

Need a countrywide National Fibre Optic Network to use GPON Technology

16.4.1 NOFN -Applications for Government

- e-Monitoring and empowering of Various Govt Schemes like

NREGS (National Rural Employment Guarantee Scheme), IAY (Indira Awas Yojna), NFSM (National Food Security Mission), RKVY (Rashtriya Krishi Vikas Yojna), BRGF (Backward Regions Grant Fund), RGGVY (Rajiv Gandhi Grameen Vidyutikaran Yojna), NRHM (National Rural Health Mission), SSA (Sarva Shiksha Abhiyan), MDM (Mid Day Meal), IWMP (Integrated Watershed Management Plan), PMGSY (Pradhan Mantri Gram Sadak Yojna), ICDS (Integrated Child Development Scheme), SGSY (Swaranjayanti Grameen Swarojgar Yojna) Scheme for Universal Access and Quality at Secondary Stage, NHM (National Horticulture Mission), Macro Management of Agriculture Scheme Central Rural Sanitation Program, NLRMP (National Land Records Management Program), TSC (Total Sanitation Campaign), APDRP (Accelerated Power Development and Reform Program), RMSA (Rashtriya Madhyamik

Shiksha Abhiyan), ARWSP (Accelerated Rural Water Supply Program)

- To meet Policy Aspiration for Broad Band

a) Teledensity of the country is 73%, while broadband density is only 1.4%.
b) Vision: BB on demand
c) Increase rural teledensity from 35 to 60 by 2017 and 100 by 2020.
d) Affordable and reliable broadband on demand by 2015.
e) Achieve 175 Million Connection by 2017, and 600 Million Connection by 2020 at minimum 2 mbps speed and higher speed upto 100 mbps on demand.
f) Recognize Telecom and BB connectivity as a basic necessity like education and health and work towards, " Right to Broadband"
g) Many Information and communication (ICT) application such as e-commerce, e-banking, e-governance, e- education and tele-medicine require high speed internet connectivity.

16.4.2 NOFN Applications in Panchayats

i **Panchayat Management:-**
- Gram sabha meetings, village records,
- Updating of citizen databases,
- Effective performance monitoring of Panchayats.

ii **Community Participation :-**
- Intra-village, Intra-district sharing of practices and resources ,
- Communication with Block, and District

iii **Knowledge Dissemination :-**
- Sharing of Agricultural practices, productivity techniques ,
- Small enterprises, Vocational learning

iv Delivery of Citizen Services:-
- Delivery of services including Health, Education and Finance, etc ,
- Single point of Government to citizen interaction for Centrally sponsored/Central sector/ State sponsored schemes ,Grievance redressal**.**

v Developmental planning :-
- Road, transportation and power connectivity ,
- Knowledge connectivity in the form of good educational & training institutions ,
- Provision of drinking water and up-gradation of existing health facilities ,

- Market connectivity to enable farmers to get the best prices for their produce.

16.4.3 NOFN Statistics

- About 850 million population resides in 600,000 villages/ 250,000 Village Panchayats.
- Village Panchayat is the lowest level of governance in rural India Average population of 500 to 5,000.
- Panchayat are administered by 6,600 Blocks and 651 Districts.
- OFC POP reaches all Districts, Blocks and some major Panchayts of about 60,000.
- Government is implementing to connect 250,000 Village Panchayats on OFC within two years by laying 500,000 Route Km OFC over existing 1000,000

Km .

16.4.4 NOFN Roadmap

- Bridge the gap in Aggregation Layer by extending the existing networks
- 2.5 lakh Gram Panchayats (Village Govt Office) to be connected on Optical Fiber
- Approx 100 MB bandwidth at each Gram Panchayat
- Non discriminatory Access to all SPs
- Access Layer OFC to be provided through market dynamics
- CUG connectivity to be provided at Gram Panchayats (Village Govt Office) for G2C services
- Approx 5 lakh km new incremental OFC required
- Approx 4 to 5 lakh km of dark fiber from existing OFCs of BSNL/Railtel/Powergrid required on long term lease basis
- A High Level Committee (HLC) formed on 25-April-11 to guide the project

16.5 ROLE OF BBNL (BHARAT BROADBAND NETWORK LIMITED)

- BBNL is a The Special Purpose Vehicle (SPV) to implement and operate the project
- BBNL is a PSU set up under companies act by Govt of India under Rule 1956 has been registered on Feb 25, 2012 for management and Operation of NOFN.
- Constitution of BBNL Director Planning ,Director Operation , Director Finance working under CMD BBNL
- Vision of BBNL is **"To become the leading Telecom company to provide secure, reliable, affordable and high quality connectivity across India."**
- NOFN Phase I -Government of India has approved on 25-10-2011 for the setting up of National Optical Fiber Network (NOFN) to provide connectivity to 2.5 lakh Gram Panchayats (Village Govt Office) of the country using optical fiber, which would ensure broadband connectivity with adequate bandwidth. This is to be achieved utilizing the existing optical fiber and extending it to the Gram Panchayats (Village Govt Office) .
- NOFN Phase II - Bharat Broadband Network Ltd (BBNL) is in the process of building the National Optical Fiber Network (NOFN) that aims at providing broadband connectivity up to all 2,50,000 Gram Panchayats (Village Govt Office) across India.
- As part of this initiative, BBNL outsources the work of laying fiber itially connecting approximately 50,000 Gram Panchayats (Village Govt Office), that in turn laying an estimated 120,000 kilometres of optical fiber cable and connecting it to pre-determined end points. Survey has been completed for more than ninety percent of the Gram Panchayats (Village Govt Office). MoU for Right of Way has

also been signed with most of the states and union territories

16.5.1 Other Institutes and Agencies Involved for NOFN Project

- DOT (Department of Telecommunications Govt of India) :- Secretariat service to the Project
- USOF: The Funding Agency via Ministry of Finance under Planned schemes.
- HLC: High Level Committee under the Chairman of Sh. Sam Pitroda, Advisor to Prime Minister on PIII, Co-Chairman Sh Nandan Nilekani, Chairman UIDAI (Unique Identification Authority of India) , Secretaries- DoT, DIT (Department of Information Technology) , Member Finance DoT, CMD BSNL, CDOT
- TAC(Technical Advisory Committee) under the chairmanship of Advisor to the Principal Advisor Scientific Advisor to PM, CDOT, BSNL, Railtel, Powergrid, USOF, NIC, TCIL.
- Advisory Body: MOC&IT, Shri Sam Pitroda, Dr. R Chidambaram, Sh Nandan Nilekani, Secretaries-DoT, DIT, Planning Commission, Health, Rural Development, Panchayati Raj DG NIC , USOF, and industries. etc.
- BSNL, Railtel, Powergrid: Executing Arm they will lay the OFC and lease the existing resources to NOFN/BBNL to optimally usage of resources .
- TCIL (Telecommunications Consultants India Ltd) :-Quality check and Project implementation scheme monitoring.
- C-DOT(Centre for Development of Telematics):-Technology provider and NMS (Network Management Service) Development.
- NIC (National Informatics Centre) :-GIS (geographic information system) Service provider and major user of the project

16.6 NOFN FEATURES

- GIS mapping of all BSNL OFC routes completed and validated once
- Detailed survey will be conducted by respective Circle through Nodal Unit created in each SSA of BSNL
- L-14 diagrams prepared for each OLT
- NMS by CDOT
- Estimate to be prepared by the SSA on the basis of detailed survey and plan
- Estimate will be sanctioned by BBNL
- NOFN shall be built using indigenous hardware e.g GPON (Gigabit Passive Optical Network) will be used for NOFN Project)
- NOFN shall have at least 1 Gbps capacity at the Panchayat level.
- NOFN shall provide at least 100 mbps at the panchayat level in exchange of right of way by states, with backhaul up to district level.
- NOFN shall be a 365x24 reliable, robust, scalable and available IP capable network to ensure continuous availability of services.
- NOFN Shall Lease Dark Fiber / Lambda (Launch Alien Lambda) / Bandwidth On Long term Lease (IRU) from BSNL, RailTel, PowerGrid and others as and

when necessary on the existing and available fiber.

- NOFN shall have a national network operating center (NOC) using NMS with full visibility of the network, all activities observable in real time, and controllable from a central location at element level.

16.7 PROGRESS OF NOFN PROJECT

- Govt of India has approved the project of NOFN
- 2.5 Lac Panchayats with minimum 100 Mbps speed
- Aimed at providing various E-Gov applications,
- Support Telecom operators to roll out services in rural areas thereby enabling access of best technologies to the rural population.
- Amount of Rs 25,000 crores have already been sanctioned by the Govt for this project which will be funded through USOF (Universal service obligation fund).

16.7.1 BSNL Infrastructure Provider for NOFN

- Bandwidth Provider
- User of NOFN are access operators (TSPs/ISPs/Cable TV Operators)
- Enable them to launch various access services
- B2B, No retailing ;Operator of operators (Carrier of Carriers)
- Non-discriminatory access to all licensed operators
- Seeks to trigger Ecosystem opening up new Rural markets
- Detailed survey conducted by respective Circle through Nodal Unit created in each SSA of BSNL
- BSNL has been asked by the government to meet 70% of the countrywide cable laying, trenching and ducting work to take high-speed internet to 2.5 lakh village blocks.
- The total project involves laying 5 lakh route kms of optic fibre cables.

16.8 CONCLUSION

Government of India has approved on 25-10-2011 for the setting up of National Optical Fiber Network (NOFN) to provide connectivity to 2.5 lakh Gram Panchayats (Village Govt Office) of the country using optical fiber, which would ensure broadband connectivity with adequate bandwidth. This is to be achieved utilizing the existing optical fiber and extending it to the Gram Panchayats (Village Govt Office) i.e. by bridging the gap in the Aggregation Layer.