**DOTSOFT the IT TOOL used in BSNL**

**1. External/internal infrastructure**

* External infrastructure : Lines and cables ( U/G including OFC )
* Internal infrastructure : Battery, Power Plant, E/A, A/C plant, MDF, Switches ( C-DOT, OCB 283, EWSD, AXE etc ), Leased Lines ( MLLN ), Broad Band, MPLS VPN,

**2.** **Services offered by BSNL**

* WLL: CDMA Technology
* INTERNET
* BROAD BAND
* MANAGED NETWORK SERVICES
* MPLS VPN
* ISDN
* LEASED LINES
* VSAT
* IN SERVICES
* VALUE ADDED SERVICES
* ENTERPRISE SOLUTIONS
* TELEGRAPH
* EPABX
* DATA COMMUNICATIONS
* DSPT SERVICE

**3.** **BSNL Managed Network Services**

* End-to-end Turn key Implementation (including CPE)
* Proactive management through state of the art NoC
* Periodic reporting facilitating trend analysis
* Capability to provide VPN connectivity from any part of the country.
* Managed Firewall as well as IP Sec

**4.** **BSNL MPLS VPN**

* BSNL's IP Backbone using MPLS Technology:
* Keeping pace with the technological trend to provide latest and varied value added services to its customers, BSNL harnesses IP Infrastructure based on MPLS Technology to offer world class IP VPN services. MPLS is an acronym for "Multi Protocol Label Switching".
* MPLS VPN is a technology that allows a Service Provider like BSNL to have complete control over parameters that are critical to offering its customers service guarantees with regard to bandwidth throughputs, latencies and availability. The technology enables secure Virtual Private Networks (VPN) to be built and allows scalability that will make it possible for BSNL to offer assured growth to its customers without having to make significant investments. BSNL would now be geared to provide Bandwidth on demand, Video Conferencing, Voice Over IP (VoIP) and a host of other value added services that could revolutionize the way a corporate business works!.

**5.** **MPLS VPN advantages:**

* BSNL's primary objectives in setting up the BGP/MPLS VPN network
* (i)       Provide a diversified range of services (Layer 2, Layer 3 and Dial up VPNs) to meet the requirements of the entire spectrum of customers from Small and Medium to Large business enterprises and financial institutions.
* (ii)      Make the service very simple for customers to use even if they lack experience in IP routing.
* (iii)      Make the service very scalable and flexible to facilitate large-scale deployment.
* (iv)      Provide a reliable and amenable service, offering SLA to customers

**6.  ISDN**

* ISDN Has emerged as a powerful tool worldwide for provisioning of different services like voice, data and image transmission over the telephone line through the telephone network. ISDN is being viewed as the logical extension of the digitalization of telecommunication network and most developed countries are in different stages of implementingISDN.  
    
   An ISDN subscriber can establish two simultaneous independent calls (except when the terminal equipment is such that it occupies two 'B' channels for one call itself like in video conferencing etc.) on existing pair of wires of the telephone line (Basic rate ISDN) where as only one call is possible at present on the analog line /telephone connection. The two simultaneous calls in ISDN can be of any type like speech, data, image etc. The call setup time for a call between two ISDN subscribers is very short, of the order of 1 to 2 seconds. ISDN also supports a whole new set of additional facilities, called Supplementary Services.

**ISDN Services:**

* Normal Telephone & Fax (G3) Digital Telephone -with a facility to identify the calling subscriber number and other facilities. G4 Fax Data Transmission at 64 Kbps with ISDN controller card Video Conferencing at 128 Kbps Video Conferencing at 384 Kbps. (Possible with 3 ISDN lines)   
  [ATM (Asynchronous Transfer Mode) or PVC (Permanent Virtual Circuit)](http://www.bsnl.co.in/service/atm.htm)
* **Variety of supplementary Services supported by ISDN.**
  + Calling Line Identification Presentation (CLIP)
  + Calling Line Identification Restriction (CLIR)
  + Multiple Subscriber Number (MSN)
  + Terminal Portability (TP)
  + Call Hold (CH)
  + Call Waiting (CW)
  + User to User Signaling (UUSI)

**7. BSNL VSAT**

* VSAT is a **Very Small Aperture Terminal** , aligned towards a designated Satellite for up-linking and down-linking communication signals.
* Anywhere connectivity is made possible even at those locations, which can not be connected through conventional media like copper cable, optical fibre, radio, microwave and any other wire-line / wireless links. VSAT is a versatile solution, not only as a reliable primary link for non feasible areas, but also as a very successful alternate technology for back link. It also offers plethora of telecom services viz. data transfer, internet, voice, video etc.
* BSNL has footprints for supporting 512Kbps and above data rate anywhere in the main land and partly at the islands. Presently Express AM1 Satellite is in use for BSNL VSAT service. BSNL offers you the full advantage of satellite technology for non feasible areas and also seamlessly interconnect the existing MPLS-VPN and MLLN leased lines. Only BSNL has the unique capability to reach nook and corner of India.

**8. BSNL IN services**

* TOLL FREE PHONE SERVICE
* UAN
* VOICE VPN
* TELE VOTING
* ITC
* CALL NOW CARD
* PREMIUM RATE SERVICE

**Audio, Video, Web conference services**

* Audio Conferencing service allows multiple participants to converse with each other regardless of their location through the normal fixed line telephone or cellular phone.
* Video Conferencing service allows multiple participants to converse with each other regardless of their location through the video end-points or Personal computers. It involves Video and Audio communication. It's about connecting people. A video conference subscriber can add two or more video participants in a particular conference. The customers can schedule their video conferences through the Web. The video conferencing service can be availed by any user through IP or ISDN interface.

**9. Fleet Management Solution**

* ***"BSNL Network … keeping an eye on every movement; every moment"***
* **extract** An innovative on-line tracking system powered by BSNL to manage fleets comprising of  trucks, car carriers, trailers, tankers, containers or vehicles moving hazardous and specialty explosive chemicals etc. The extract vehicle tracking system uses vehicle-mounted, microprocessor-controlled device which sends periodic messages from the vehicle to a network command centre through SMS/GPRS. The received data is authenticated and forwarded to an application server which provides tracking information through an internet. Customers are provided a user name and password to access the fleet information on line. The user also has options to receive tracking information via e-mail, fax or SMS besides the facility of calling the customer support team on a toll-free telephone line.

**10.** **IP FUNDAMENTALS**

**Circuit-Switching:**

* In **circuit-switching**, this path is decided upon before the data transmission starts. the route is dedicated and exclusive, and released only when the session terminates..
* Normal telephone calls of OCB 283, EWSD,C-DOT,AXE etc.
* On PSTN customer phone to Switch (Exchange) is analog signal. Exchange to Exchange is Digital.
* ISDN is total digital.

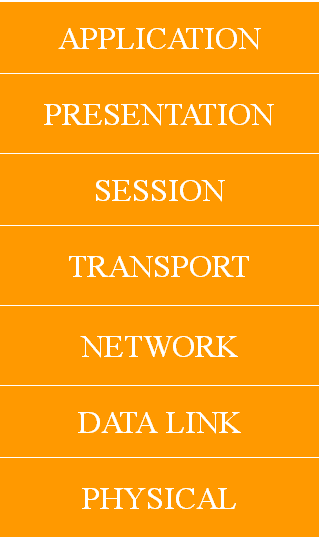
**Packet switching:**

* **Packet switching** is a digital networking communications method that groups all transmitted data – irrespective of content, type, or structure – into suitably-sized blocks, called *packets*. Packet switching features delivery of variable-bit-rate data streams (sequences of packets) over a shared network. When traversing network adapters, switches, routers and other [network nodes](http://en.wikipedia.org/wiki/Network_node), packets are buffered and queued, resulting in variable delay and throughput depending on the traffic load in the network.

**IP address:**

* IP address and associated mask are represented in 32 bit dotted decimal.
* Decimal value in the first octet determines the class of address.
* 1-126=CLASS A (0) 128-191=CLASS B(10) 192-223=CLASS C(110) 224-239= CLASS D(1110) 240-254= CLASS E(1111)
* CLASS A,B,C are used in internet CLASS D (multi casting and video conferencing )and CLASS E are for testing purpose.
* PRIVATE ADDRESSES
* 10.0.0.0 to 10.255.255.255,172.16.0.0 to 172.32.255.255 and
* 192.168.0.0 to 192.168.255.255 127 is reserved for loop back
* .PC loop back 127.0.0.1
* Some CLASS D multicast addresses are used by routing protocols. OSPF-224.0.0.5,224.0.0.6;RIPv2-224.0.0.9:EIGRP-224.0.0.10

**INTERNATIONAL STANDARDS ORGANIZATION - OPEN SYSTEM INTERCONNECTION(ISO-OSI):**



* **PHYSICAL LAYER**

It defines the characteristics of the interface between the devices and the transmission medium. It defines the type of xsn medium. DATA RATE, TRANSMISSION RATE, SYNCHRONIZATION OF BITS, TRANSMISSION MODE ( simplex, duplex, half duplex)

* **DATA LINK LAYER**

Framing, addressing (source, destination), flow control, error control, access control.

* **NETWORK LAYER**

This is responsible for the source to destination delivery of a packet possible across multiple network (link).If the two systems are connected to the same link there is usually no need of network layer, Logical addressing, routing.

* **TRANSPORT LAYER**

It is responsible for source to destination (end to end) delivery of the entire message.

NOTE: Network layer oversees end to end delivery of the packets. service point addressing, segmentation and reassembly, congesion control, flow control, error control.

* **SESSION LAYER**

First three layers are not sufficient for some processes.

It is the network dialog controller. It establishes, maintains and synchronizes the interaction between communicating systems.

* **PRESENTATION LAYER**

It is concerned with the SYNTAX and SEMANTICS of the information exchanged between two systems.

* 1. TRANSLATION (encoding methods),
  2. ENCRYPTION,
  3. COMPRESSION
* **APPLICATION LAYER**

It enables the user whether human or software to access the network. (Electronic mail, remote file access and transfer, shared data base management and other types of distributed

information services.

**Physical layer interfaces & standards:**

* G.703 is an ITU-T standard for transmitting voice or data over digital carriers such as T1 and E1. G.703 provides specifications for pulse code modulation (PCM).
* **G.703** also specifies E0 (64kbit/s). For information about E0 audio.
* G.703 is typically transported over balanced 120 ohm twisted pair cables terminated in RJ48C jacks. Unbalanced (dual 75 ohm coaxial cables) wires, also allowed .
* HSSI:**High-Speed Serial Interface** (HSSI) is a differential ECL (emitter coupled logic) serial interface standard developed by Cisco Systems and primarily for use in WAN router connections. It is capable of speeds up to 52 Mbit/s with cables up to 50 feet in length.HSSI uses 50-pin connector cable with an impedance of 110Ω .

**Data link layer protocols:**

* DLC:**Data Link Control** (**DLC**) is the service provided by the [data link layer](http://en.wikipedia.org/wiki/Data_link_layer).
* [Network interface cards](http://en.wikipedia.org/wiki/Network_interface_card) have a **DLC address** that identifies each card; for instance, [Ethernet](http://en.wikipedia.org/wiki/Ethernet) and other types of cards have a 48-bit [MAC address](http://en.wikipedia.org/wiki/MAC_address) built into the cards' [firmware](http://en.wikipedia.org/wiki/Firmware) when they are manufactured.
* HDLC:**High-Level Data Link Control** (**HDLC**) is a [bit-oriented](http://en.wikipedia.org/wiki/Bit-oriented_protocol) [synchronous](http://en.wikipedia.org/wiki/Synchronous) [data link layer](http://en.wikipedia.org/wiki/Data_link_layer) [protocol](http://en.wikipedia.org/wiki/Communications_protocol) . HDLC provides both [connection-oriented](http://en.wikipedia.org/wiki/Connection-oriented_protocol) (reliable) and [connectionless service](http://en.wikipedia.org/wiki/Connectionless_protocol) (best effort) .

**NETWORK LAYER PROTOCOLS:**

* IP:IP is the primary protocol in the [Internet Layer](http://en.wikipedia.org/wiki/Internet_Layer) of the [Internet Protocol Suite](http://en.wikipedia.org/wiki/Internet_Protocol_Suite) and has the task of delivering distinguished protocol datagrams (packets) from the source host to the destination host solely based on their addresses. For this purpose the Internet Protocol defines addressing methods and structures for datagram [encapsulation](http://en.wikipedia.org/wiki/Encapsulation_(networking)). The first major version of addressing structure, now referred to as Internet Protocol Version 4. IP is a [connectionless protocol](http://en.wikipedia.org/wiki/Connectionless_protocol).
* RARP:Physical machine in a LAN can request to learn its IP address from gateway server’s ARP table.
* ICMP:IP uses ICMP module to send alert and diagnostic messages when a datagram could not be delivered. ICMP runs on the top of IP.ICMP reports error conditions.It does not make IP more reliable.

**TRANSPORT LAYER PROTOCOLS:**

* TCP: connection oriented. Reliable.TCP header size 20-60 octets with option(40 octets) field. Ethernet frame size less than 1500octets.Destination host rearranges as per sequence number ( 0-65535)
* UDP: Ideal for application programs (TFTP, DNS ) IP header number 17.connection less.unreliable.
* The physical/link layer envelops the ip layer header and data.
* If the physical layer is an Ethernet LAN the IP layer places its message (datagram) in the Ethernet (physical/link) frame data field.
* The transport layer places its message (segment) in the IP data field.
* The application layer places its data in the transport layer data field.
* Application layer and physical layer will not have headers. Data link layer will have trailer also.

**ROUTING PROTOCLS:**

* RIP: DISTACE VECTOR PROTOCOL. Uses Bellman ford algorithm. Routers share common data link. peridically send routing updates to all neighbors by broadcasting their entire routing table.
* OSPF: Link state routing protocol. Dijkstra’s shortest path first routing algorithm. Not proprietary. Fast convergence. OSPF send Hello packets ( 10 sec) to neighbors if agreed on certain parameters specified in respective hello packets ( keep alive messages). Link state advertisements for every 30mts. OS[F supports VLSM, CIDR.
* CONVERGENCE
* It is effected by update mechanism, size of the topology table, route calculation algorithm, media type.
* How link change is detected?
* 1.physical or data link layer fails to receive three consecutive keep alive messages (link down).
* 2.The network or transport layer fails to receive three consecutive hello messages of the routing protocols the link is considered to be down

**DNS, TELNET, FTP, SMTP, HTTP:**

* DNS: domain name system.Used by TCP/IP applications to map between hostnames and IP addresses. A hierarchical naming system. DNS primarily uses UDP on [port number](http://en.wikipedia.org/wiki/Port_number) 53. The TCP is used when the response data size exceeds 512 bytes.
* TELNET: Terminal network a network protocol. Remote log in facility via INTERNET.TOP of TCP.
* FTP: Provides facility to transfer/receive files. Control and data connections use TCP.
* TFTP: Designed to be implemented on the top of UDP.
* SMTP: Uses TCP port 25. PoP3 port:110.
* www: world wide web: *Uniform Resource Identifier* ([URI](http://en.wikipedia.org/wiki/Uniform_Resource_Identifier)), which is a universal system for referencing resources on the Internet, such as hypertext documents and images. [Uniform Resource Locator](http://en.wikipedia.org/wiki/Uniform_Resource_Locator) (URL) and [Uniform Resource Identifier](http://en.wikipedia.org/wiki/Uniform_Resource_Identifier) (URI); and the publishing language [Hyper Text Markup Language](http://en.wikipedia.org/wiki/Hypertext_Markup_Language) (HTML); and the [Hypertext Transfer Protocol](http://en.wikipedia.org/wiki/Hypertext_Transfer_Protocol) (HTTP).

**11. BROAD BAND**

Narrowband transceiver operates within 902-928 MHz ISM band

The industrial, scientific, and medical (ISM) Radio bands are reserved for non commercial use.

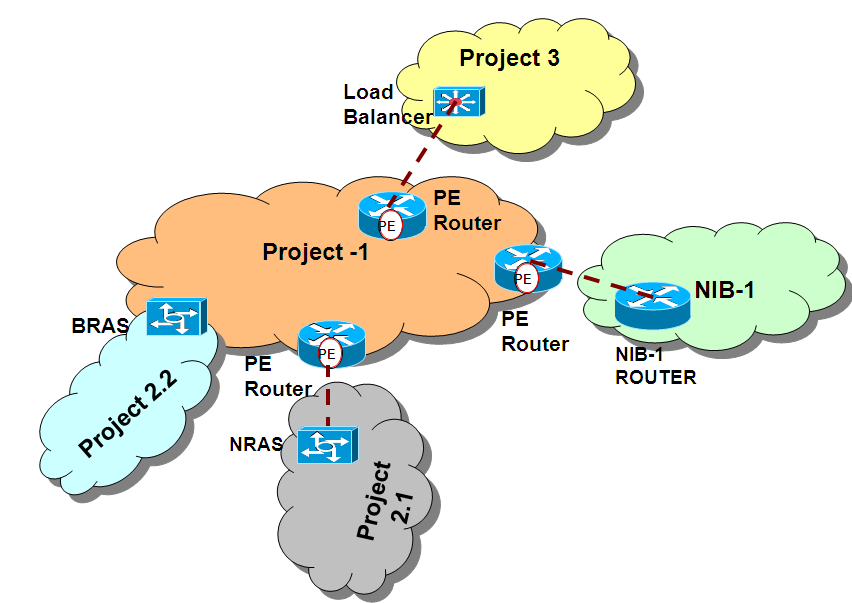
* 900 [MHz](http://en.wikipedia.org/wiki/MHz) band (33.3 cm wavelength)
* 2.4 [GHz](http://en.wikipedia.org/wiki/GHz) band (12.2 cm wavelength)
* 5.8 GHz band (5.2 cm wavelength)

IEEE 802.11b/g wireless ETHERNET also operates on the 2.4 GHz band.

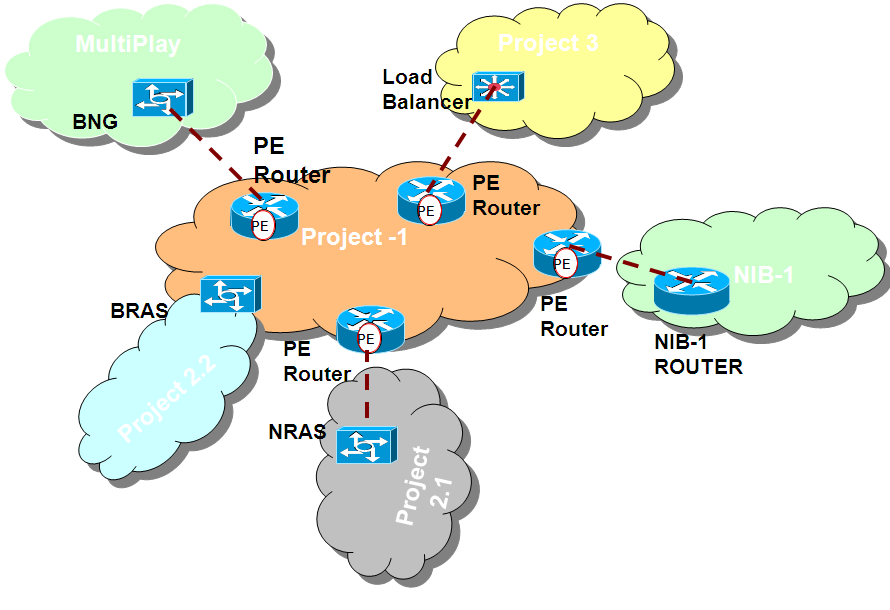
**11.1. Brief Functions of DSL Components**

* **DSL CPEs**: At customer premises. On end it connects telephone cable coming from exchange. At the other end, it connects to PC through Ethernet and Telephone through RJ-45 connector
* **DSLAM**: called as DSL Access Multiplexer. It has a built in splitter which splits voice and data. While voice follows the normal conventional path through exchange, data is aggregated and up linked through Ethernet Port (Gigabit Ethernet for 480 port and Fast Ethernet for lower DSLAM)
* **LAN Switch**: For aggregating multiple DSLAM and providing a common uplink
* **BRAS**: called as Broadband Remote Access Server. First intelligent device in the whole chain. It terminates the customer session, authenticates, allott IP addresses and keeps track of user session for billing along with RADIUS
* **SSSS:** Called as Subscriber Service Selection System. When customer logs in he will be welcome with this customized screen from where he can select various range of service. This provides on demand service without manual intervention
* **RADIUS**: This in conjunction with BRAS authenticates customer, upload customer profile in the SSSS and keeps track of billing
* **LDAP**: It stores customer database viz username, password and the default services that it can subscribe to.
* **Provisioning:** This is the most critical components for ensuring quick delivery of service. It ensures end-to-end provisioning of service right from DSL CPEs to DSLAM to Switch to BRAS to LDAP

**11.2. Existing Network Topology:**



**Network Topology With Multiplay:**

****

**11.3. OC LAN SWITCH:**

* The OC LAN switch is deployed as Tier-2 Network Device in the BSNL Multi Play connecting the Tier-1 RPR to DSLAM in other cities. ZXR10 T64G MPLS 10G Routing Switch is deployed as OC-LAN Switch in BSNL Multi Play project. ZXR10 T64G is applicable to the core layer and convergence layer of the large-scale enterprise networks. The system features high reliability, high scalability, and powerful service capability. This product can be used to build the convergence layer and core layer of our network. Back plane bandwidth can reach 900 Gbps with switching capacity of 480 Gbps. It features with a packet-forwarding rate of 357 Mbps with L2/L3/L4 wire speed switching capability.
* The ZXR10 T64G MPLS 10G Routing Switch adopts modular design and a parallel processing mechanism based on multiple processors. T64G adopts Crossbar architecture. The key module adopts 1:1 redundancy backup. It supports a wide variety of interfaces, such as 10GE; GE, FE, and POS and can provide multiple service functions such as MPLS, NAT, QoS, and multicast and bandwidth control.
* **Capacity & Density**

**-** Compact footprint (7U)

-120 Gbps Full-Duplex Redundant Switching Fabric

-64k MAC table size

-1G or 10G RPR Ethernet line interface

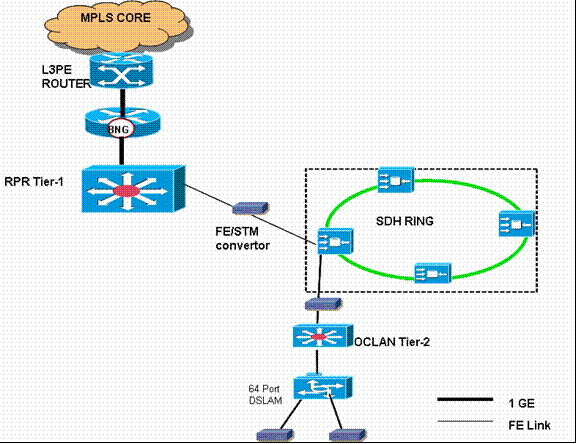
-Support 2x10G RPR Rings per chassis

-Support 2x1G RPR Rings per chassis

-Support 2x10G + 2x1G RPR Rings per chassis

* Dimension: 482.6(L)X308.3(H)X471.3(D) mm
* 19”/ETSI/ANSI rack mountable
* Max power consumption: 700W

**11.4. BB Multiplay OCLAN**



**11.5. Typical DSLAM Connectivity**

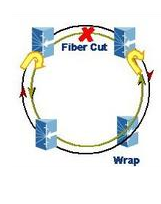
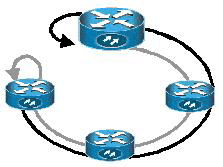
**11.6.Convergence Is a Reality**

**11.7.Network Topology for MPLS-based VPN**

**11.8. Protection:**

* RPR has the ability to protect the network from single pan failures. When a failure occurs, protection messages are quickly dispatched to all nodes in a ring.
* RPR has two protection mechanism.
  + Wrapping
  + Steering
* Wrapping:

Nodes neighboring the failed span will direct packets away from the failure by wrapping traffic around to the other fiber (ringlet). This mechanism requires that only two nodes participate in the protection event. Other nodes on the ring can send traffic as normal.

**11.9. BNG – REDBACK SMARTEDGE 800 MSER :**

* The Redback SmartEdge 800 Multi-Service Edge Router is deployed as Broadband Network Gateway (BNG) in BSNL Multi Play project. BNG act as Gateway of the broadband traffic towards the MPLS core.
* SmartEdge MSERs provide a comprehensive IP routing foundation required for the evolving Multi-Play broadband services. SmartEdge 800 MSER offers a diverse range of interface options: Ethernet, Packet over SONET (PoS) and channelized connections. All SmartEdge MSER interface modules are hot-swappable and highly resilient with full session and state redundancy in the event of a failure or replacement. Support for high-performance multicast is provided, including protocol independent multicasting (PIM), Internet group management protocol (IGMP) and multicast routing.
* With its high performance the SmartEdge 800 Multi-Service Edge Router (MSER) is a highly versatile platform, specifically architected and optimized to deliver Multi-Play services such as video, voice, data and interactive multimedia content.

**11.10. IPDSLAM IAN8k B1000:**

**High Bandwidth Applications-** with 1 Gbps of bandwidth per service slot, seems to provide sufficient capacity to meet all current and future subscriber requirements for both residential and business markets

**High Density Modular Architecture -** At a density of approximately 3000

subscribers per rack, the B1000 offers one of the highest density Access solutions in the industry.

**High Performance Switching -** With support for advanced L2 functions including VLAN Stacking and with future support of IPv6.

**Advanced Video Management Features -** With 1024 Multicast groups, sub 50ms Channel Zapping Delays, an efficient multi-layer multicast architecture and support for consumer oriented features like preview, channel black list etc.

**EPON for FTTB/FTTH Offering -** The B1000 integrates a 4-port GEPON OLT module enabling carriers to provide Fiber To The Building

(FTTB) services to businesses and Fiber to the Home (FTTH) services to residential customers from a single platform that simultaneously offers next generation DSL services.

**VoIP Support -** offers a simple solution for providing VoIP services using the iFXS module for low density applications or VPM for high-density applications

**Distributed BRAS Functionality -** offers an IP Service Module (ISM) for integrating Subscriber Management services (BRAS functionality). The ISM also enables termination or relay of protocols like PPPoE.

**11.11. BRAS:**

* Service control module: It is responsible for authentication and management of user access requests. It identifies legal users. It can extract and record the statistics of user data packets and online duration for implementing the traffic based or duration based accounting function.
* MA5200G sends the user’s accounting information to the RADIUS server.

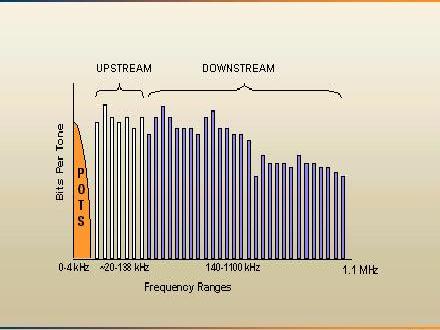
**11.12. BNG-Smart Edge 800:**

* The SmartEdge 800 MSER unifies edge routing, Ethernet aggregation, and subscriber management functionality into a single, multi-functional platform that delivers the comprehensive and proven IP-routing foundation required for world-class, multi-play.    
  Powered by programmable PPA ASIC technology and carrier-class software, the SmartEdge 800 MSER has 240 Gbps throughput capacity and supports 256,000 active subscribers. In addition, it:
* Offers robust support for a comprehensive range of interior and exterior gateway routing protocols.
* Integrates and delivers highly granular packet-level intelligence that virtualizes forwarding, transformation and IP packet services.
* Delivers a range of advanced network services that actively enhance packet delivery while simplifying operations.

**11.13. ADSL:**

* The distinguishing characteristic of ADSL over other forms of DSL is that the bandwidth is greater in the direction to the customer premises than the reverse, giving rise to is [asymmetric](http://en.wikipedia.org/wiki/Asymmetric) characteristic. Providers usually market ADSL as a service for consumers to connect to the [Internet](http://en.wikipedia.org/wiki/Internet) in a relatively passive mode: able to use the higher speed direction for the [download](http://en.wikipedia.org/wiki/Download) from the Internet but not needing to run servers that would require high speed in the other direction.
* With standard ADSL the band from 26.000 [kHz](http://en.wikipedia.org/wiki/KHz) to 137.825 kHz is used for upstream communication, while 138 kHz – 1104 kHz is used for downstream communication. Each of these is further divided into smaller frequency channels of 4.3125 kHz. These frequency channels are sometimes termed *bins*

**Frequency Spectrum of ADSL:**



* The ADSL transmit signal consist of a large number ( up to 256) of sub-carrier located at spacing of 4.3125 Khz.
* The channel 0 is for POTS , Channel 1-5 are not used to avoid interference between voice and data.
* POTS Channel - Separated by a POTS splitter
* Upstream/Downstream channels separated by either FDM using LPF/HPF or a combination of FDM and echo cancellation . Echo cancellation improves the BW through put in the downstream direction

**ADSL IMPAIRMENTS:**

What factors can effect ADSL circuit quality?

The factors adversely effecting the performance of a copper pair when dealing with the higher frequencies involved with ADSL.

• Return Loss

• Insertion Loss

• Longitudinal Balance

• Crosstalk

• Noise

**ADSL 2:**

* **ITU G.992.3** is an ITU ([International Telecommunication Union](http://en.wikipedia.org/wiki/International_Telecommunication_Union)) standard, also referred to as **ADSL2** or **G.DMT.bis**. It optionally extends the capability of basic [ADSL](http://en.wikipedia.org/wiki/Asymmetric_Digital_Subscriber_Line) in data rates to 12 [Mbit/s](http://en.wikipedia.org/wiki/Mbit/s) downstream and 3.5 Mbit/s upstream (with a mandatory capability of ADSL2 transceivers of 8 [Mbit/s](http://en.wikipedia.org/wiki/Mbit/s) downstream and 800 Kbit/s upstream). Actual speeds may reduce depending on line quality - usually the most significant factor in line quality is the distance from the [DSLAM](http://en.wikipedia.org/wiki/Digital_subscriber_line_access_multiplexer) to the customer's equipment.

**11.14.** **VDSL(Very high bitrate digital subscriber line )**

* Is a DSL technology providing faster data transmission (up to 52 Mbps downstream and 16 Mbps upstream) Second-generation [VDSL2](http://en.wikipedia.org/wiki/Very_High_Speed_Digital_Subscriber_Line_2) systems (ITU-T G.993.2 Approved in February 2006) utilize bandwidth of up to 30 MHz to provide data rates exceeding 100 [Mbit](http://en.wikipedia.org/wiki/Megabit)/s simultaneously in both the upstream and downstream directions. The maximum available bit rate is achieved at a range of about 300 meters; performance degrades as the loop attenuation increases. Currently, the standard VDSL uses up to 7 different frequency bands.

**VDSL2:**

* VDSL2 is the newest and most advanced standard of [DSL](http://en.wikipedia.org/wiki/Digital_subscriber_line) broadband wireline communications. Designed to support the wide deployment of [triple play](http://en.wikipedia.org/wiki/Triple_play_(telecommunications)) services such as voice, video, data, high definition television (HDTV) and interactive gaming. ITU-T G.993.2 (VDSL2) is an enhancement to G.993.1 ([VDSL](http://en.wikipedia.org/wiki/VDSL)) that permits the transmission of asymmetric and symmetric aggregate data rates up to 200 Mbit/s on twisted pairs using a bandwidth up to 30 MHz. VDSL2 deteriorates quickly from a theoretical maximum of 250 Mbit/s at 'source' to 100 Mbit/s at 0.5 km (1640 ft) and 50 Mbit/s at 1 km (3280 ft), but degrades at a much slower rate from there, and still outperforms [VDSL](http://en.wikipedia.org/wiki/VDSL). Starting from 1.6 km (1 mile) its performance is equal to [ADSL2+](http://en.wikipedia.org/wiki/ADSL2%2B).

**11.15. Wi-Fi**

* Wireless Technology is an alternative to wired Technology for connecting the devices in wireless mode. Wi-Fi refers to the IEEE 802.11 communication standard for wireless LAN.Wi-Fi network connect computers to each other to the internet and to the other wired networks.
* Wi-Fi networks use Radio Technologies to transmit & receive datea at high speeds.
* IEEE 802.11b
* IEEE 802.11a
* IEEE 802.11g
* IEEE802.11b:Operates at 2.4-2.4835 GHz radio spectrum.11Mbps speed (theoretical) with in 30m range.4-6 Mbps with in 100-159 feet range. Least expensive. Interference from mobile phone and bluetooth devices reduces Txmission speed.
* IEEE 802.11a: Operates at 5.725-5.850GHz.54 Mbps theoretical and 15-20 Mbps actual speed with in 50-75ft range. More expensive.
* IEEE 802.11g: operates 2.4-2.4835Ghz radio spectrum.54Mbps speed
* A Wi-Fi hotspot is created by installing an access point to the internet connection. Access point acts as a base station. When Wi-Fi enabled device encounters a hotspot the device can then connect to that network wirelessly. A single access point can support up to 30users and can function with in a range of 100-150ft indoors and up to 399 ft outdoors. Many access points can be connected to each other via Ethernet cables to create a single large network.
* Wi-Fi topologies: Ap-based, peer to peer, point to multipoint bridge.
* Security: Along with old security issues Eavesdropping( every thing is in clear text and can be tracked by network sniffers,protocol analysers,password collectors), Man in the middle attacks( spoofing and attacker advertises his own AP on a different channel using the real AP’s MAC address and attackers connects the real AP using victim’s MAC address, Denial of service ( Frequency jamming attack on MAC layer, Attack on TCP/IP( SYN flooding )
* SSID (Service set identifier, pre configured or advertised in beacon broadcast,), WEP ( Wired equipment privacy uses Rc4 encryption with pre shared keys with 24 bit initialization vectors, 64bit pre shared key,128bit pre shared key as WEP2), 802.1x access control, WPA ( Wireless protected Access increases more security, TKIP-Temporal key integrity protocol WPA-PSK & WPA enterprise), IEEE802.11i: AES ( audio engineering society) protocol is used

**Wi-Max-IEEE 802.16:**

* ***Worldwide Interoperability for Microwave Access. 40 Mbps in real world end-user throughput*** . WiMAX is a possible replacement for cellular phone technologies such as [GSM](http://en.wikipedia.org/wiki/GSM) and [CDMA](http://en.wikipedia.org/wiki/Code_division_multiple_access) . WiMAX supports the technologies that make triple-play service offerings possible (such as [Quality of Service](http://en.wikipedia.org/wiki/Quality_of_Service) and [Multicasting](http://en.wikipedia.org/wiki/Multicasting)). WiMAX will deliver 70 [Mbit/s](http://en.wikipedia.org/wiki/Bit_rate) over 50 kilometers .Frequency range 10-66GHz and 11GHz. 40km range. It consists of access point, BS ( base station ), SS ( subscriber station). All traffic goes through base station and it control and allocates bandwidth on the radio cannel )Wimax tower can provide cover over large area 8000km Wimax receiver-PCMCIA
* Three methods for data Txmission in an unreliable connection (air link )
* ARQ( automatic repeat request )
* FEC ( Forward error correcting )
* H-ARQ ( Hybrid ARQ = ARQ + FEC )

**12. IT TOOL USED IN BSNL**

**Why Computerization ?**

* Reduction in Paper Cost
* Reduced Cost
* Reduces the space requirement
* Reduces manpower requirement
* Increased ability to perform computations
* Management Information.

**Data Vs Information:**

* Data?

Data is raw material for data processing. data relates to fact, event and transactions.

* Information?

Information is data that has been processed in such a way as to be meaningful to the person who receives it. it is any thing that is communicated.

**12.1. Database Management Systems:**

* A system whose overall purpose is to record and maintain information.
* A database is a repository for stored data and programs to manipulate it.

**Advantages of DBMS:**

* + Centralized control.
  + No Data Redundancy
  + Data Consistency
  + Data can be shared
  + Security can be enforced
  + Integrity can be maintained

**Data Models:**

* A *data model* is a collection of concepts for describing data, relations, constraints etc.
* Types of Data Models : Hierarchical, Network and Relational Model
* The relational model is the most widely used model today

**Hierarchical DBMS:**

* Can not handle Many-Many relations
* Can not reflect all real life situations
* Anomalies in insert, delete and update operations.

**Network DBMS:**

* Data is represented by records and pointers
* Addresses Many-Many relations
* Insert,delete,update operations possible
* Complex in design.

**Relational DBMS:**

* Based on Relational Mathematics principles
* Data is represented in terms of rows and columns of a table
* Easy to design
* No anomalies for insert/delete/update.

**Structured Query Language:**

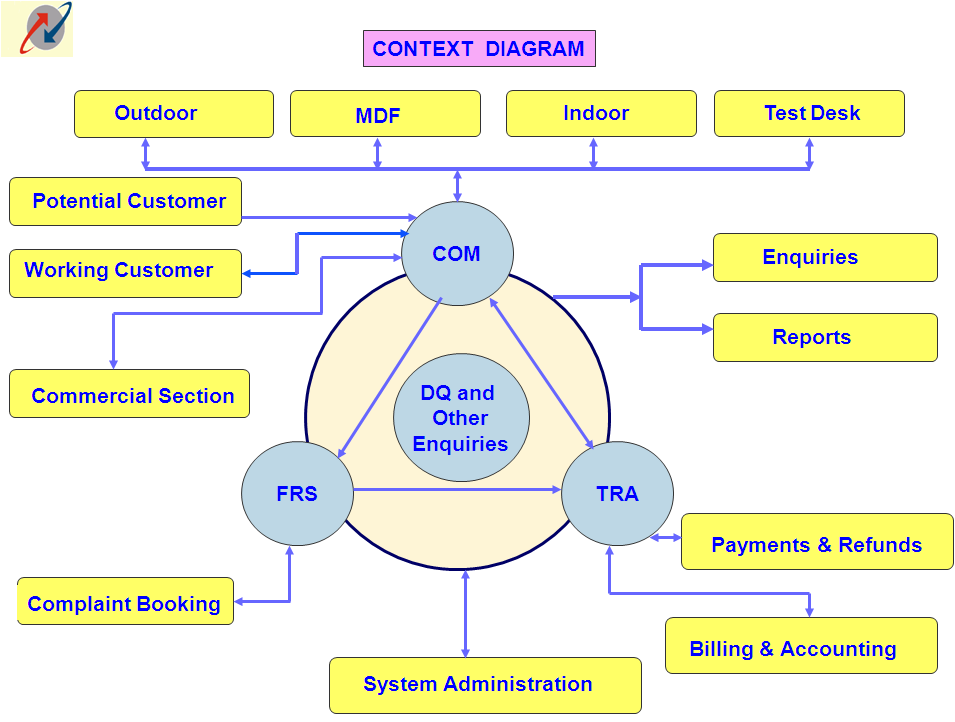
* DQL – Data Query Language
* DML – Data Manipulation language
* DCL – Data Control Language
* DDL – Data Definition Language

**Integrity Constraints:**

* Primary key (PK)
* Foreign Key (FK)
* Unique key (UK)
* Not Null
* Check

**12.2. BSNL IT Tool:**

* BSNL Working Environment
* IT Tool used in BSNL



**12.3. DOTSOFT**

* DotSoft is the first integrated telecom software application in BSNL comprising of commercial, billing, accounting, fault repair service and directory enquiry services.
* It has been conceptualised, designed and developed entirely by the core group of the Software Development Centre of the O/o CGMT, Andhra Pradesh Telecommunications Circle, Hyderabad.
* It is based on the latest software technologies running on a WAN and is the first of its kind in BSNL in the field of information technology.
* First it was tested and implemented in Guntur SSA in 1997. It has been successfully implemented in 171 SSAs across the country. All the SSAs of Andhra Pradesh, Tamilnadu, Karnataka, Assam, Punjab, Chattisgarh and Gujarat Telecom circles.
* Rest of SSAs are from states of Maharastra, Madhya Pradesh, Uttar Pradesh, Rajasthan, J&K and Haryana.
* The nodes in the customer service centre service all the subscriber requests which flow to the commercial and accounts sections as the case may be.
* After validation and approval from the the concerned sections the work orders flow to the different field units depending on the activity.
* After the completion of the work orders the commercial and billing data of the subscriber gets updated.
* It has been approved by the Telecom Commission for implementation all over India. Dotsoft ensures better customer satisfaction and transparency in BSNL service.
* DoTSoFT is an enterprise wide telecom database system that revolutionizes the operation and supervision of customer services by enabling all the personnel to work online.
* The central server contains the complete database to which all the nodes anywhere in the district log in. The database is accessed using application software residing in the nodes which have GUI interface.
* DoTSoFT is one of the first steps towards the bold and ultimate goal of E-Governance and paperless offices.
* All the work is done online which results in excellent customer service, non duplication of work, total supervision, complete transparency, better planning and with a facility of instant reports.
* Single window concept introduced for the first time.
* Concept of request registration number introduced through which the status of the request can be tracked and inquired.
* Signature warehousing to be included for online verification purpose.
* Instant electronic flow of data between the offices and field units with facility to print wherever required.
* Various intimation letters to subscribers automatically generated.
* Priority execution of advice notes.
* Messaging system between CO and Field units.
* Dotsoft mail system between all users.
* Complete history of subscriber’s activities available online.
* Details of subscriber records & requests, bills, demand notes, wait list, payments and work orders available online.
* Variable billing cycle, ISDN billing, Group billing(fortnightly, monthly ,bi-monthly).
* Centrex,Corporate billing, PT billing and WLL billing.
* NPC advice notes once completed online are billed in the next schedule.
* Directory Enquiry shows the status at the moment of enquiry. It can query on any of the subscriber’s details in part or in full.
* Complete managerial supervision is possible about the activities happening anywhere in the district.
* Statistical data is generated to find out activity, usage and payment patterns to facilitate better customer service.
* **OS : Linux**
* **Front end : Forms 6i**
* **Back end Database : Oracle 9i**
* **Client Server Model – 2 layer architecture**

**12.4. DOTSOFT - Network Elements**

* Hub
  + A Layer 1 (Physical Layer of OSI Model) device
  + Enables transit of packets within a LAN.
  + The signal amplification is done.
  + The data from the data link layer is converted into electrical signals and sends on physical media.
* Modem
  + For conversion of different protocols. For example Ethernet to Serial Interface (PPP protocol).
* Router
  + A Layer 3 (Network Layer of OSI Model) device
  + Enables transit of packets between two LAN's.
  + Traffic can be monitored, administered from the Router.
* Swtich
  + A Layer 2 (Data Link Layer of OSI Model) device.
  + Enables transit of packets within a LAN.
* Flow control / Error Detection / Signal amplification of frames is done in the switch

**12.5. CONCISE DESCRIPTION OF DOTSOFT**

* Bill generation is absolutely easy and totally secure.
* Payments are faster and completely hassle free for the customer and the counter personnel because of the use of bill scanners.
* Revenue accounting and ledger reports are available immediately at the end of the month.
* The system can generate any kind of detailed as well as statistical reports.
* Online enquiry is available for supervision and queries.

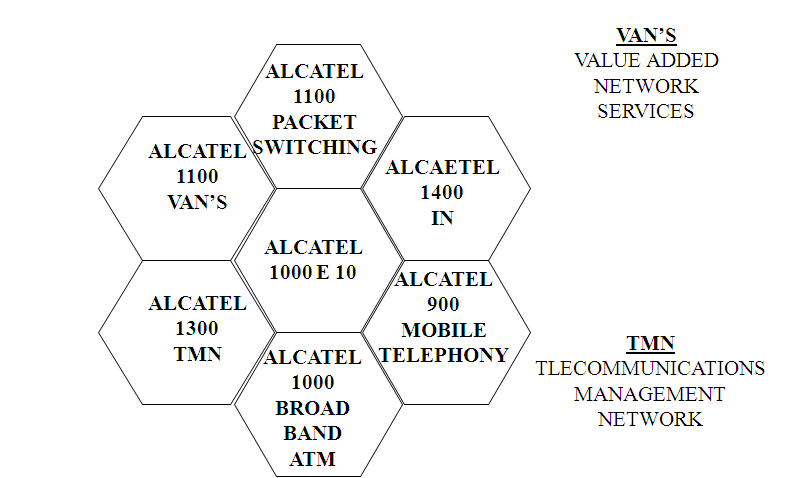
**13. OCB-283**

* DEVELOPED BY CIT ALCATEL OF FRANCE .
* HAS GOT SIMILARITIES WITH ITS PREDECESSOR E-10B ALSO KNOWN AS OCB-181 IN FRANCE.
* FIRST OCB-283 EXCHANGES OF R11 VERSION WERE COMMISSIONED IN BREST (FRANCE) AND BEIJING (CHINA) IN 1991.
* FIRST OCB283 EXCHANGE CAME TO INDIA IN 1993.
* UPGRADED AND VERSION R-20 WAS VALIDATED IN JAN 1994.
* THE EXCHANGES SUPPLIED TO INDIA BELONG TO R-21 VERSION.
* R-22 &R-23 FAILED.PRESENTLY R-24 IS WORKING.

**SALIENT FEATURES:**

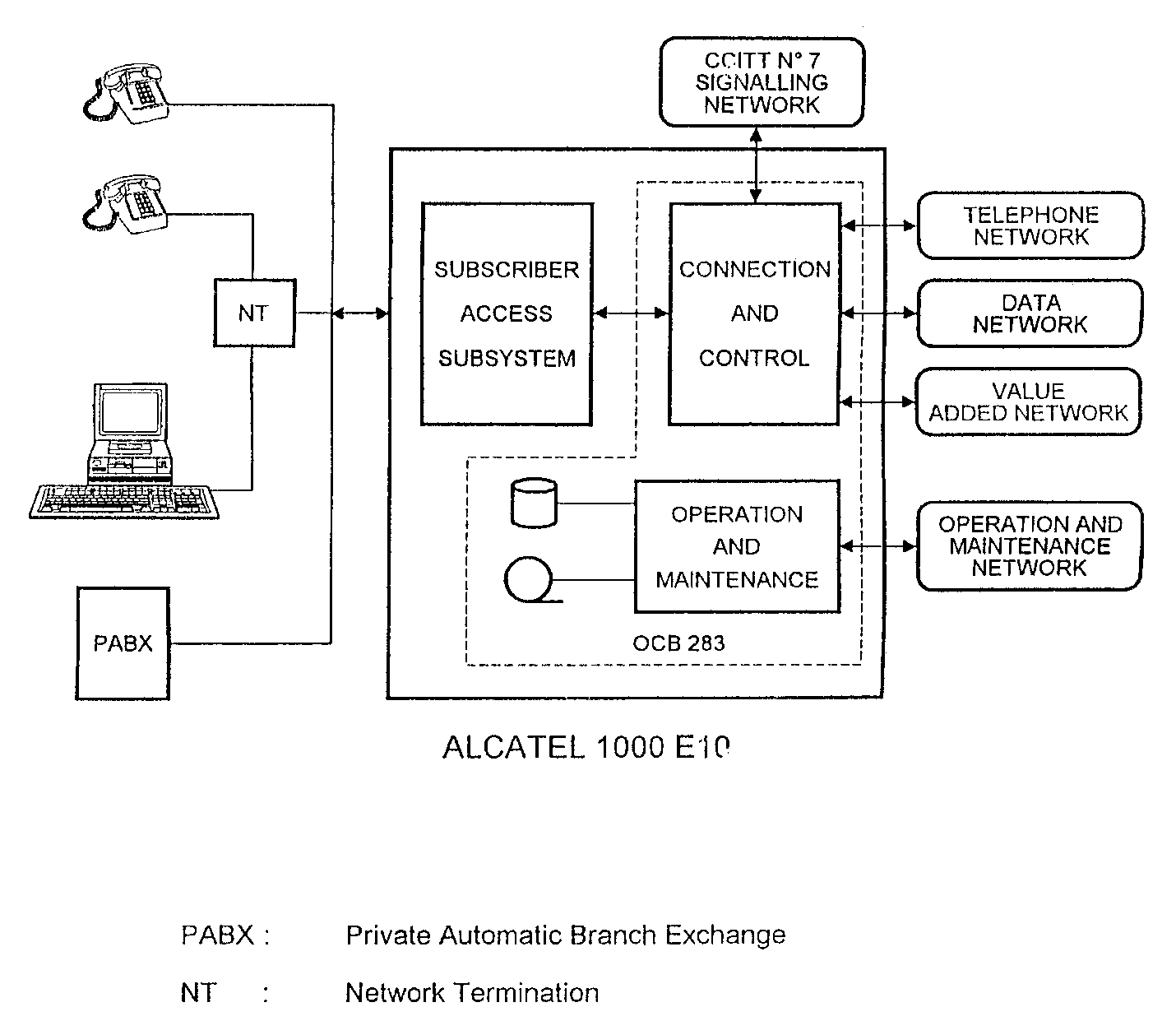
* IT IS A DSS WITH SINGLE ‘T’STAGE SWITCH.
* A MAX OF 2048 PCMs CAN BE CONNECTED.
* SUPPORTS MFR2,CAS AND CC#7 SIGNALLING SYSTEMS.
* PROVIDES BASIC TELEPHONY,ISDN,DATA COMMUNICATION, CELLULAR AND OTHER VALUW ADDED SERVICES.
* SYSTEM HAS AUTOMATIC RECOVERY FEATURE.
* WHEN A SERIOUS FAULT OCCURS IN A CONTROL UNIT ,IT GIVES A MESSAGE TO SMM (O&M UNIT). THE SMM PUTS THIS UNIT OOS,LOADS THE S/W OF THIS UNIT IN A BACK-UP UNIT AND BRINGS IT INTO SERVICE.DIAGNOSTIC PROGRAMMES ARE RUN ON THE FAULTY UNIT AND REPORT IS PRINTED .

**THE ALCATEL FAMILY:**



**FUNCTIONAL ARCHITECTURE:**

* **X-GE HAS GOT THREE BASIC SUBSYSTEMS:**
  + SUBSCRIBER ACCESS SUBSYSTEM
  + CONNECTION & CONTROL SUBSYSTEM
  + OPERATION & MAINTANENCE SUBSYSTEM
* **SUBSCRIBER ACCESS SUBSYSTEM:**
  + TREATED AS AN INDEPENDENT ENTITY
  + EVERY SUBSCRIBER CONNECTING EQUIPMENT RACK IS GIVEN A SIGNALLING POINT NUMBER TO OPERATE IN COMMON CHANNEL SIGNALLING MODE WITH REST OF THE EXCHANGE SUBSYSTEMS.



**CONNECTION UNITS:**

|  |  |  |
| --- | --- | --- |
| **THESE PROVIDE FACILITY TO CONNECT SUBSCRIBERS OR CIRCUITS FROM AN EXTERNAL PCM AND TRANSFER THESE SPEECH SAMPLES ON TO SELECTED TIME SLOTS CALLED VOICE CHANNELS ON A LR LINK TOWARDS SWITCHING MATRIX AND VICE-VERSA.** | | |
| **S.NO** | **NAME** | **FUNCTIONAL NAME** |
| **1** | **SUBSCRIBER CONNECTION UNITS** | **CSNL,CSND,CSED** |
| **2** | **CIRCUIT CONNECTION UNITS** | **SMT (URM)** |
| **3** | **FREQUENCY GENERATOR,SENDER,RECEIVER** | **SMA (ETA)** |
| **4** | **COMMON CHANNEL SIGNALLING PROTOCOL HANDLER** | **SMA (PUPE)** |

**CONTROL UNITS:**

* THESE UNITS PROVIDE CONTROL OF CALLS ON THE BASIS OF STORED PROGRAMMES.
* THEY PROCESS THE CALLS ON THE RECEPTION OF DIALLED DIGITS FROM CALLING SUB/CKT AND TAKE PART IN HANDLING OF CALL SET-UP AND RELEASE BY :
* PROCESSING
* MONITORING
* MEASURING CHARGING OF CALLS AND
* ALL OTHER CONTROL FUNCTIONS NEEDED FOR WORKING OF A X-GE.

**CONTROL UNITS:**

|  |  |  |
| --- | --- | --- |
| **CONTROL UNITS COMPRISE OF THE FOLLOWING FUNCTIONS** | | |
| **MR** | **MULTIREGISTER** | **CALL HANDLER,SET-UP & RELEASE OF CALL** |
| **TR** | **TRANSLATOR** | **TRANSLATION OF DIGIT,DATABANK OF SUBS & CKTS IN FILES** |
| **MQ** | **MARKER** | **MESSAGE DISTRIBUTION BETWEEN COMMON CONTROL AND CONNECTION UNITS** |
| **TX** | **CHARGER** | **COMPUTING THE CHARGE OF A CALL , KEEPING METERS** |
| **GX** | **MATRIX SYS HANDLER** | **PROCESSES AND MAKES CONNECTIONS IN SWITCHING MATRIX ON THE ORDERS FROM MR OR MQ.** |
| **PC** | **CCS N/W CONTROLLER** | **MANAGE THE CCS#7 N/W FOR SIGNALLING.** |

**14. Overview of Telecommunication Networks**

In this, we will learn to:

* Describe the growth of telecommunications technology since the early 20th century
* Facilities provided to subscribers, Administration and Maintenance personnel.
* Concepts of local and Trunk Networks
* Call routing
* Functions of a typical Telephone Exchange.
* Conclusion

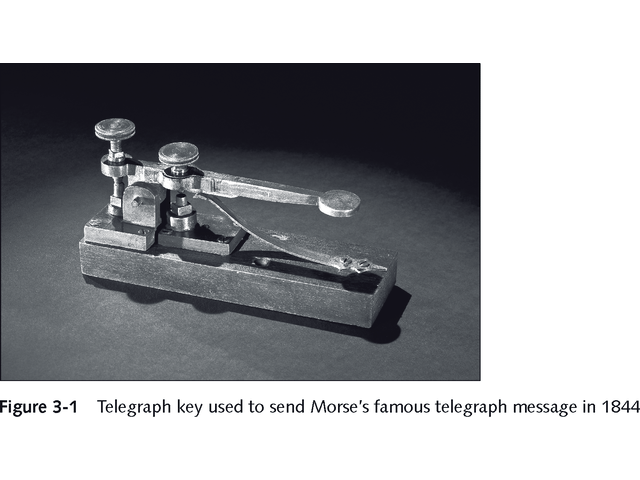
**Evolution of Telecom Technology:**

* Today’s telecommunication technologies have evolved from the earliest smoke signals to almost instant global transmission of large amounts of data.

**Early Signaling and Telegraphy:**

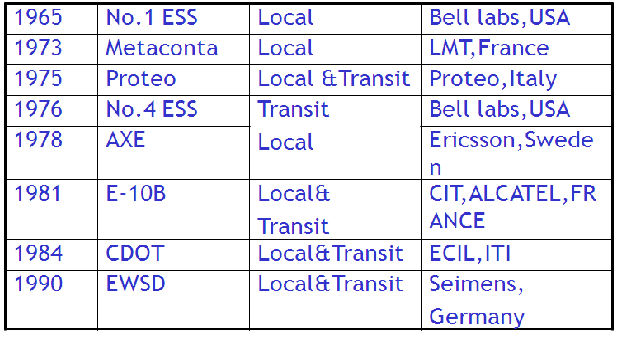
* **Semaphore** - a type of signaling, in which visual cues represent letters or words.
* **Morse code** - the transmission of a series of short and long pulses (dots and dashes) that represented characters.
* **Duplexing** - simultaneously transmitting a signal in both directions along the same wire.
* **Multiplexing** - simultaneously transmitting of an indeterminate number of multiple signals over one circuit.
* 1856 - Western Union Telegraph Company was founded.
* 1861 – Over two thousand telegraph offices operated across the United States.

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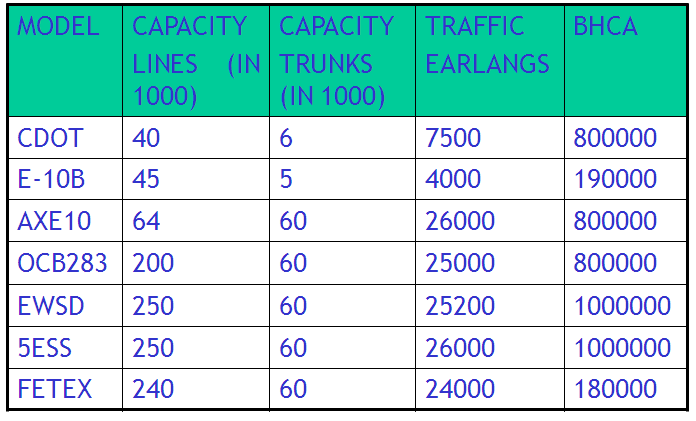
**Evolution of Telephone exchanges:**

* 1. Manual Exchange
  2. Automatic Exchange: Strowger, Cross bar
  3. Electronic Exchange.

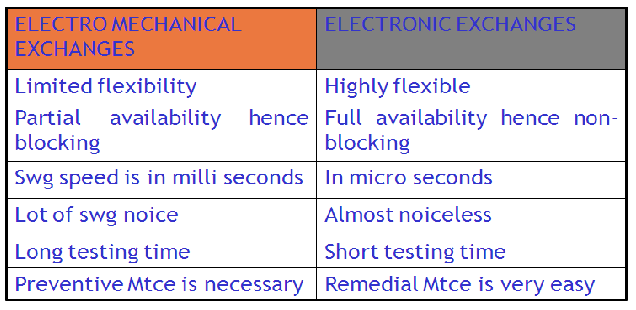
**Chronological Development of Electronic Exchanges:**



**Digital Exchange Capacities:**

****

**ADVANTAGES OF ELECTRONIC EXCHANGES:**



**Facilities extended from Electronic exchanges:**

1. Reminder Call/ Alarm Services
2. Hot Line (With and without Time-out)
3. Subscriber Controlled Call Restriction Services.
4. Queuing Service
5. Priority Subscriber
6. Distinctive Ringing for Long Distance Calls
7. Call forwarding
8. Call waiting
9. Conference call
10. CLIP(Calling Line Identification Presentation)

**Constraints of Electronic exchanges:**

* Total protection from dust
* Stable power supply
* Temperature & Humidity control
* PCB Repair
* And Faster obsolescence

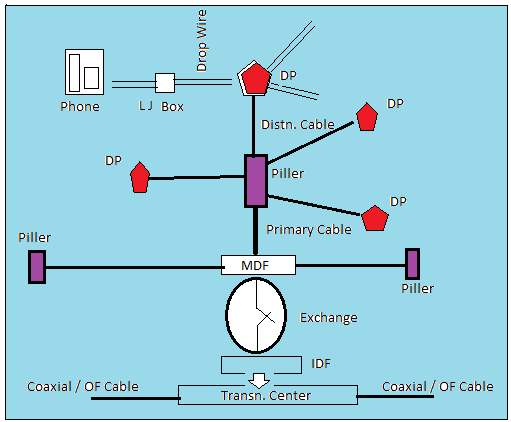
**PILLARS:**

* One exchange can have any number of pillars that are necessitated based on the topography of that exchange external plant
* U/G cables that connect the MDF and pillars are called as Primary cables.
* U/G cables that connect the pillar and the DPs in that pillar area are called as Distribution cables.

**Photograph of a Pillar:**

****

**Telephone Network:**



**External Plant of an Exchange:**

* MDF WILL HAVE TWO SIDES-
* LINE SIDE and EXCHANGE SIDE
* ON LINE SIDE,100pr ARE TERMINATED PER TAG BLOCK
* ON EXCHANGE SIDE, NUMBER OF PAIRS VARIES AS PER SWITCH’S TECHNOLOGY.

**DP:**

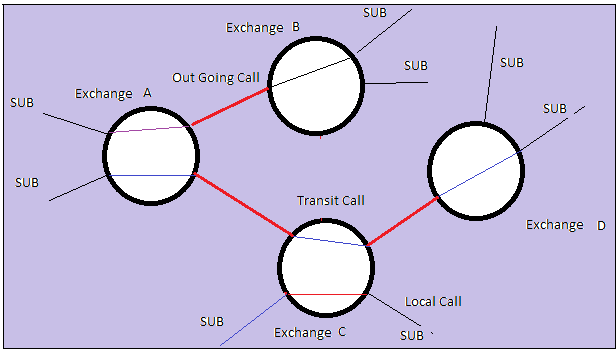
* A DP’s capacity can be 1,2,5,10,20 or 50 pairs.
* Each DP is given a 4 digit number, in which the first 2 digits indicate the pillar number in which that DP is working.
* Through a Drop wire, the connection is extended into customer premises.

**Types of Telephone Calls:**

* Local Call(Intra exchange call): Origination and Destination subscribers are in same exchange
* Outgoing Call: Destination Subscriber is outside the exchange
* Incoming Call: Origination Subscribers is outside the exchange
* Transit Call: Both subscribers are outside the exchange.

**Local & Trunk Network:**

* A call is called a local call if the calling and called subscribers are within the same SDCA.
* Inter SDCA calls are called as Trunk calls, which generally pass through the TAX exchange.
* A call is called a local call if the calling and called subscribers are within the same SDCA.
* Inter SDCA calls are called as Trunk calls, which generally pass through the TAX exchange



Local and trunk calls

**Main sub-systems of Electronic exchange:**

* Terminal equipment
* Switching network
* Switching processor
* Switching peripherals
* Signaling interfaces
* Data processing peripherals.

**Basics of Switching:**

It must be possible for every telephone in the world to be connected to every other telephone, through some type of switch.

**Customer Premise Equipment (CPE):**

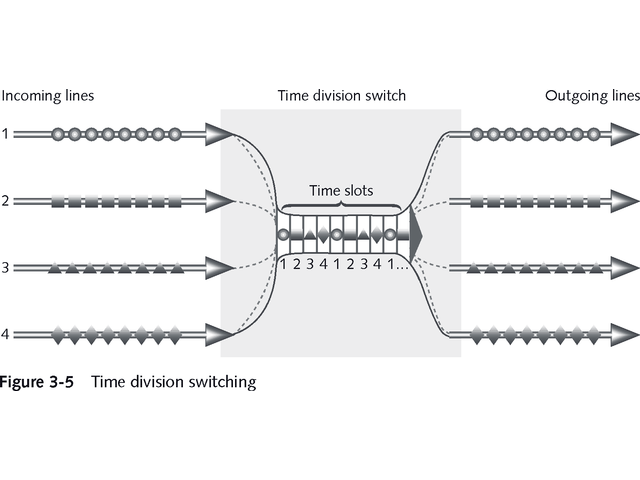
* Customer Premise Equipment (CPE) is the term used to denote the station equipment the customer uses to interface with the PSTN.
* It is a generally used term and covers any equipment the customer uses when calling on the PSTN.
* There are many services available on the PSTN and many different varieties of CPE.

**SPACE DIVISION SWG:**

* Space division switching where each call is allocated a physical path through a sequence of switches in the exchange.
* This is an analogue technique.
* It is relatively old, and no new installations use this technique.

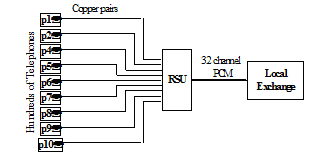
**TIME DIVISION SWG:**

* Time division switching, where each side of a call is allocated a time slot every 125μs into which the 8 bit PCM coded sample is inserted at each switch point.
* The call is not allocated a path through the exchange, but only a sequence of time slots.
* All new exchanges since about 1980 use this technique.



**RSU CONCEPT:**

* In some cases a telephone is not connected directly into an exchange, but instead all the telephones in an area or business estate are connected back to a Remote Subscriber Unit (RSU) or concentrator, which in turn is connected to an exchange by means of a 2.048 Mbit/s, 32 channel PCM link.
* The concentrator does no switching; this is all done in the Main exchange, even for a call between neighbours.
* The main saving here is in the cost of underground cabling.

****

**Wireless Technology:**

* Telegraphs and telephones are examples of wireline, or wire-bound technology, because they rely on physically connected wires to transmit and receive signals.
* **Wireless technology** - relies on the atmosphere to transmit and receive signals.
* Examples of wireless technology
  + Phones
  + Radios
  + Televisions
  + Satellite communications.

Wireless Technology is used for Inter exchanges through

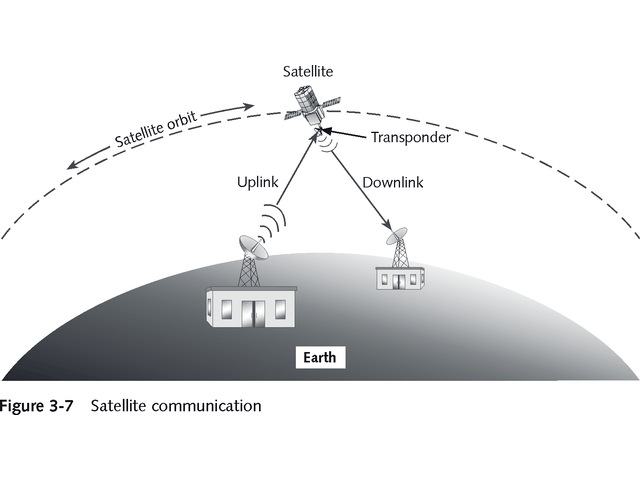
* UHF
* VHF
* Micro Wave
* Satellite

Wireless Technology is used for Intra exchanges (Wireless in Local Loop) through

* GSM
* CDMA
* VSAT

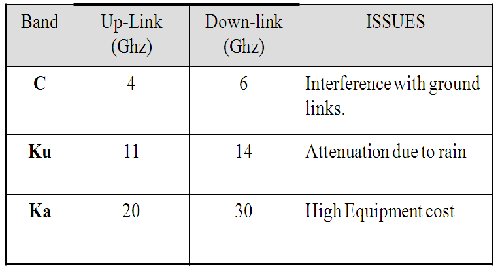
**Wireless Technology for Satellite:**

* **Geosynchronous** - means that satellites orbit the earth at the same rate as the earth turns.
* **Uplink** - a broadcast from an earth-based transmitter to an orbiting satellite.
* At the satellite, a **transponder** receives the uplink, then transmits the signals to another earth-based location in a **downlink**.



**Satellite Communication:**

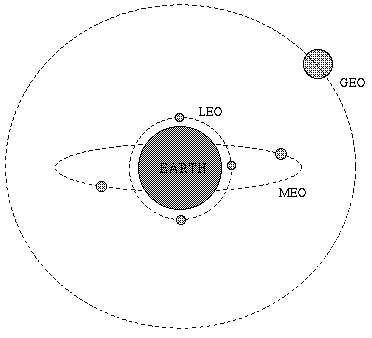
* Satellite is a microwave repeater in the space.
* There are about 750 satellite in the space, most of them are used for communication.
* They are:
  + Wide area coverage of the earth’s surface.
  + Transmission delay is about 0.3 sec.
  + Transmission cost is independent of distance.
* Satellite up links and down links can operate in different frequency bands:



* The up-link is a highly directional, point to point link
* The down-link can have a footprint providing coverage for a substantial area "spot beam“.

**Orbits:**

* LEO: Low Earth Orbit.
* MEO: Medium Earth Orbit
* GEO: Geostationary Earth Orbit
* At the Geostationary orbit the satellite covers 42.2% of the earth’s surface.
* Theoretically 3 geostationary satellites provides 100% earth coverage



**MAC(Media Access Control) protocols for satellite links:**

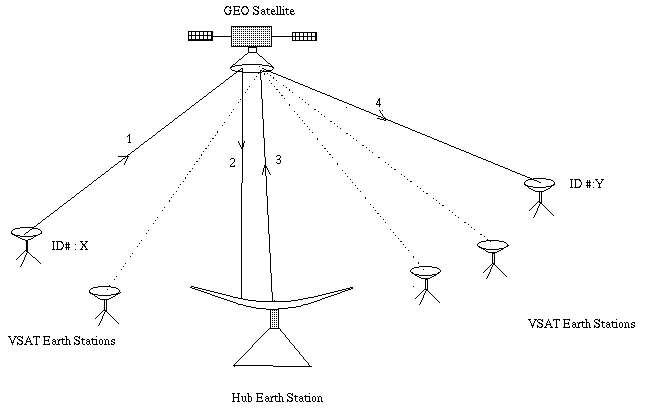
* ALOHA:
  + - Every station can transmit any time
    - Very low efficiency 18- 36 %.
* FDMA (Frequency Division Multiple Access)
  + - It is the oldest and most common.
    - the available satellite channel bandwidth is broken into frequency bands for different earth stations.
* TDMA (Time Division Multiple Access)
  + - channels are time multiplexed sequentially
    - Each earth station gets to transmit in a fixed time slot only.
    - More than one time slot can be assigned to stations with more bandwidth requirements.
    - Requires time synchronization between the Earth Stations.
* CDMA : (Code Division Multiple Access)
  + - Combination of time/frequency multiplexing

( a form of spread spectrum modulation).

* + - It provides a decentralized way of providing separate channels without timing synchronization. It is a relatively new scheme but is expected to be more common in future satellites.

**VSAT Network:**

* At the Very Small Aperture Terminal a lower performance microwave transceiver and lower gain dish antenna (smaller size) is used.
* VSAT networks are arranged in a star based topology.
* Ideal for centralized networks with a central host (Banking institutions with branches all over the country).
* Use the S-ALOHA and TDMA



**DirecPC services:**

* One of the most useful applications of VSAT networks
* Comes with an ISA computer card, a RF dish antenna (2 ft dia) equipped with an LNA, and supporting software.

**Supporting two kinds of services**

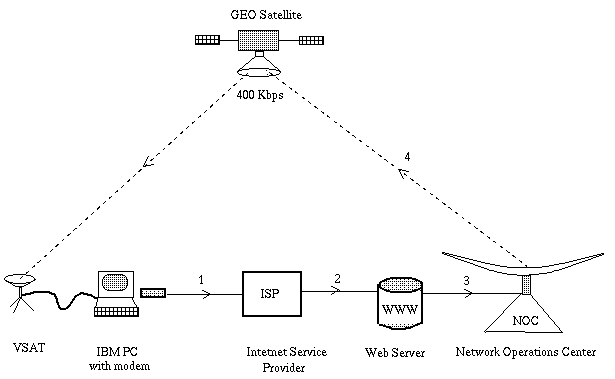
1. Digital Package Delivery
2. Turbo Internet

**1**.**Digital Package Delivery:**

* Downloading files at a speed 100 times faster than that supported by public telephone network.
* Large files can be received by multiple DirecPC end points.
* The download requests are made using the standard analog modem over telephone lines.

**2.** **Turbo Internet:**

* The end user overcomes the telephone line barrier and is capable of receiving data at 400 kbps.
* A connection is setup with the local ISP (internet server provider) using the analog telephone line modem.
* All mouse and keyboard actions in the web browser are communicated to the web server on the other end using this link.



###### 15. WORKING PRINCIPLE OF SMPS POWER PLANT

**SMPS**

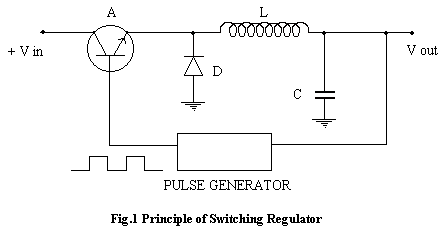
**What is SMPS ?**

SMPS means Switch Mode Power Supply. This is used for D.C to D.C conversion. This works on the principle of switching regulation. The SMPS system is highly reliable, efficient, noiseless and compact because the switching is done at very high rate in the order of several KHz to MHz.

**Necessity**

The SMPS regulators are used in B.S.N.L at various locations like CDOT, E10B Transmission systems etc.

**Principle of Switching Regulator**



A pulse train drives the base of ‘switching or pass transistor’. When the voltage to the base is high, the transistor saturates, when the voltage is low, the transistor turns off. Here the transistor functions as a switch. When the transistor is ON, load current is drawn through the transistor and choke L. When the transistor is OFF the load current is maintained by the energy stored in the choke L. The current flows through earth, Diode D, choke, load and earth. Hence this diode is called ‘*Retrieval Diode’*.

Duty cycle of the Transistor = On Time = D

On Time + Off Time

(one cycle time)

The output voltage = Input voltage x D

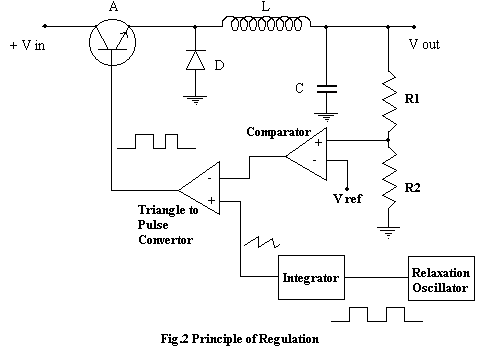
For example

If I/P voltage is 200 volts and D=0.25

O/P voltage = 200 x 0.25 = 50V.

Regulation is achieved by modifying the Duty cycle. Duty cycle depends on onetime of transistor, which in turn depends on the width of the pulse applied to the base of the transistor, which is controlled by ‘Pulse width modulation’ by regulator circuit.

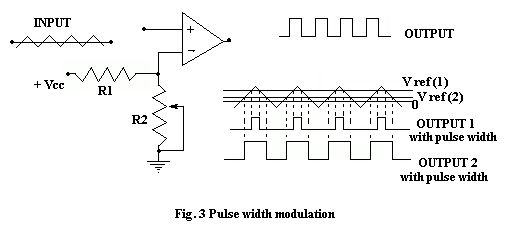
**Principle of Regulation**



The relaxation oscillator produces a square wave. The square wave is integrated to get a triangular wave, which drives the non-inverting input of a triangular to pulse converter. The pulse train out of this circuit then drives the Pass Transistor. The output is sampled by a voltage divider and fed to a comparator. The feed back voltage is compared with a reference voltage. The output of the comparator then drives the input of the triangular to pulse converter.

If the output voltage tries to increase the comparator produces a higher output voltage which raises the reference voltage of the triangular- to pulse converter. This makes the pulse that drives the base of the switching transistor narrower. That means duty cycle is reduced. Since the duty cycle is lower the output becomes less which tries to cancel almost all the original increase in output voltage.

Conversely, if the regulated output voltage tries to decrease, the output of the comparator decreases the reference voltage of the triangular -to pulse converter. This makes the pulse wider and the transistor conducts for larger time and more voltage comes out of the L.C.filter. This cancels out the original decrease in output voltage.



For maximum efficiency the duty cycle should be less than 0.5. As long as the triangular voltage exceeds the reference voltage, the output is high. Since Vref is adjustable, we can vary the width of the output pulse and hence the duty cycle.

Switching regulators are more efficient than conventional regulators as the power loss in the switching element is reduced to minimum as it conducts only for a fraction of a cycle.

Now a days SMPS technology is extended to power plants also. Power plants upto 2000A capacity have been developed using SMPS principle.

**Specification of SMPS Power Plant**

1) Input Voltage 320 V to 480 V

Frequency 45 Hz TO 65 Hz

2) Output Voltage

in Float Mode -54.0 ± 0.5 V. adj range -48 V to -56V

in charge mode : -55.2 V ± 0.5V

3) Input power factor >0.95 Lag with 25% to 100% load at nominal input.

ITI’s 50V – 2000A POWER PLANT (Multi Rack Type)

Suitable for VRLA Batteries with 100A SMPS Rectifier Modules

Introduction

The power system is intended primarily to provide uninterrupted DC power to Telecom equipments and current for charging the batteries in the presence of AC Mains. The system works from commercial AC mains which is rectified and regulated to –50V DC and is fed to the equipment (exchange). The system has provision to connect three sets of VRLA batteries and facility to charge them simultaneously to ensure that uninterrupted DC power supply is always available to the exchange.

The power system –50V, 2000A has the following features :

1. Multi-rack configuration.
2. Facility to parallel a maximum of 21 nos. (or 22 nos.) of 100A (5600W) Rectifier modules operation from three phase, 400V, 50Hz AC input.
3. Termination for three sets of VRLA batteries and exchange.
4. System input : Three phase, 4-wire, 50 Hz supply.

The power system has a single DC bus called auto float/charge bus. Depending upon the status of the batteries, the output DC voltage is maintained at 54.0 + 0.5 V under auto float condition. During auto charge the maximum DC voltage reached across the bus is 55.2 volts. The exchange battery and rectifier modules are connected in parallel.

The system employ natural convection cooling and has AC input distribution, DC output distribution, protection and alarm circuitry for rectifiers, battery and equipment.

Technical Specification

For Module

(1) Input Voltage :

1. 320V to 480V r m s three phase (Nominal Voltage – 400V).
2. Frequency : 45 Hz …. 65 Hz.

(2) Output Voltage :

**Float mode :**

Nominal voltage : -54.0 + 0.5V,

Adjustment range : -48.0 to –56.0 V

**Charge mode Voltage** : -55.2 + 0.5 V

(3) Rated current : 100 Amps.

(4) Psophometric noise :

Less than 4 mV without battery floated.

Less than 2 mV with battery floated.

(5) Input power factor :

Greater than 0.95 lag with 25% to 100% load at nominal input.

(6) Efficiency :

Greater than 90% at full Load and nominal input.

(7) Protection :

1. Short circuit protection.
2. Input over/under voltage protection.
3. Output over voltage protection.
4. Constant current features settable from 80 Amps. to 110 Amps. In auto float/charge mode.

(8) Alarms and indicating lamps :

1. FR/BC on Auto Float/Charge : Green LED
2. Rectifier module over voltage : Red LED
3. DC output fail/Under voltage : Red LED
4. FR/BC Over Load (Voltage Drop): Amber/Yellow LED
5. Mains Available : Green LED

For System

(1) Input Voltage :

1. 3 Phase, 4 Wire, 50 Hz (Range – 320V to 480V RMS)
2. Frequency : 45 Hz …. 65 Hz.

(2) Output Voltage :

Float mode Voltage : -54.0 + 0.5V

Charge mode Voltage : -55.2 + 0.5V

(3) Rated Current :

Equipment : 1100 Amps.

Batteries : 300 Amps. Each

(4) Protection

1. Short circuit/Over load protection.
2. Input over/under voltage protection.
3. Battery/Equipment over voltage protection.