INDEX

1 OVERVIEW OF TRANSPORT NETWORK, OFC LAYING PRACTICES

1.1 LEARNING OBJECTIVE

After reading this unit, you should be able to:

- Understand the basics of telecommunication and building blocks of transport network.
- Describe the different types of Transport Network
- Understand the OFC laying practices.

1.2 INTRODUCTION

The world today exchanges information in the form of digital voice and data and the transport network is used to carry this information from one place to another. Transport technologies use a media to carry this information. The increase in number of subscribers and the coverage area have mandated an evolution of the transport technologies. Earlier, the information was sent for shorter distances and the operators used copper as a media. The information-carrying capacity of these copper networks was very low. Also, these networks were prone to external disturbances. The fiber optic technology came into picture when the operators felt the need to send more and more voice information for longer distances with less or no external disturbances. In the course of time, subscribers started using more data-driven applications and their demand for bandwidth grew. The earlier networks which were optimized for only voice were proved to be inefficient while carrying video and data traffic. This chapter focuses on the evolution in the transport technology area and describes the OAM functions of transport network and application of the transport network by discussing a case study of mobile backhaul networks.

As a result of the tremendous growth in telecommunications demands during recent decades, much attention has been given to research in the field of telecommunications transport and this has made the telecommunication standard bodies to develop new technologies for transport that are able to carry voice, data and video. Some of these standard bodies and their work are briefed below-

- ITU – ITU's mission is to enable the growth and sustained development of telecommunications and information networks, and to facilitate universal access so that people everywhere can participate in, and benefit from, the emerging information society and global economy. ITU is active in the information and communication technology field by defining and adopting the globally agreed technical standards that have allowed industry to interconnect people and equipment seamlessly around the world.
- ETSI - ETSI produces globally-applicable standards for Information and Communications Technologies, including fixed, mobile, radio, converged, broadcast and internet technologies.
- Broadband Forum – The Broadband Forum has defined the core Digital Subscriber Line (DSL) technology and now involved in the delivery of the maximum effectiveness in broadband deployment and use. Best practices for auto-configuration, flow-through provisioning, equipment interoperability and other key facilitators of scalable, global, mass-market deployment of broadband, are developed by the Broadband Forum through a contribution based system and fast-tracked based on service provider market priorities.
- Metro Ethernet Forum - The MEF develops technical specifications and implementation agreements to promote interoperability and deployment of Carrier Ethernet worldwide.

1.3 CLASSIFICATION OF TRANSPORT NETWORK BY GEOGRAPHY:-

One traditional approach to classifying transport networks is in relation to their geographic scope. These classifications are illustrated in Figure 1. The access network is that portion of the network that connects the end users (subscribers) to the edge switching elements in the network. The metropolitan (metro) transport network is the network that interconnects central offices (COs) within an urban/suburban region. COs within a metro network are typically directly connected to both access networks and core long distance networks. These metro COs are typically owned by the same carrier, and in many cases either allow the carrier to centralize specialized services (e.g. ISDN or Ethernet routing) in just one CO, or to use different COs for back-up redundancy for each other (e.g., to take over switching functions in the event of a failure of the primary CO for that subscriber). The span lengths between metro COs are typically relatively short. The long distance core transport network provides the interconnection between metro networks, smaller community COs, service providers (e.g., Internet), and regional or international gateways. Higher bandwidth technology typically sees its first deployment in the core network since the longer facility lengths necessitate more efficient utilization of the facilities. The technology used in the core networks, however, typically eventually finds its way into the metro network as the cost of technology decreases and the bandwidth needs of metro networks increase. From the management, craft training, and equipment inventory perspectives, it is desirable to have as much commonality as possible between core and metro networks when they exist within the same carrier. LECs typically have both metro networks and core networks to provide interconnection within their region. IECs also typically have both metro and core networks since they often deploy metro networks in order to more efficiently reach their business/corporate subscribers.

As shown in Figure 1, both metro and core transport networks can consist of ring and mesh topologies. Rings have become increasingly popular since they provide inherent route diversity that can be exploited for protection switching. (See City 1 and upper portion of the core network.) Rings have also become increasingly popular in access networks (e.g., City 3). Traffic routing on rings is also more straightforward than in arbitrary mesh networks.

Ring topologies are not always convenient, however, due to such constraints as geography or having to use pre-existing right of ways. Arbitrary mesh networks are constructed in order to use convenient cable routings or, in some cases, allow more bandwidth-efficient protection schemes. Transport networks often consist of a mix of ring and mesh sub-networks, including interconnected rings. Traditionally, a sharp distinction was drawn between transmission and switching equipment. For the purposes of this white paper, however, transmission and switching are both considered as part of the transport network. The switches provide the automatic routing of voice (or data) traffic, while the transmission equipment handled the multiplexing and facility connections to carry the traffic between the switches. For example, a voice switch is the equipment to which a subscriber's telephone is connected that does the digit collection when the subscriber dials, and routes the call according to the number that was dialed. Typical transmission equipment includes SONET/SDH terminals. The distinction between transmission and switching has continued to blur over the past 20 years. Transmission networks have increasingly deployed digital cross connect systems (DCSs) that switch subscribers' traffic between the various DCS interfaces according to a provisioned route. DCS-type cross-connect capability has increasingly been integrated into add-drop multiplexers (ADMs).

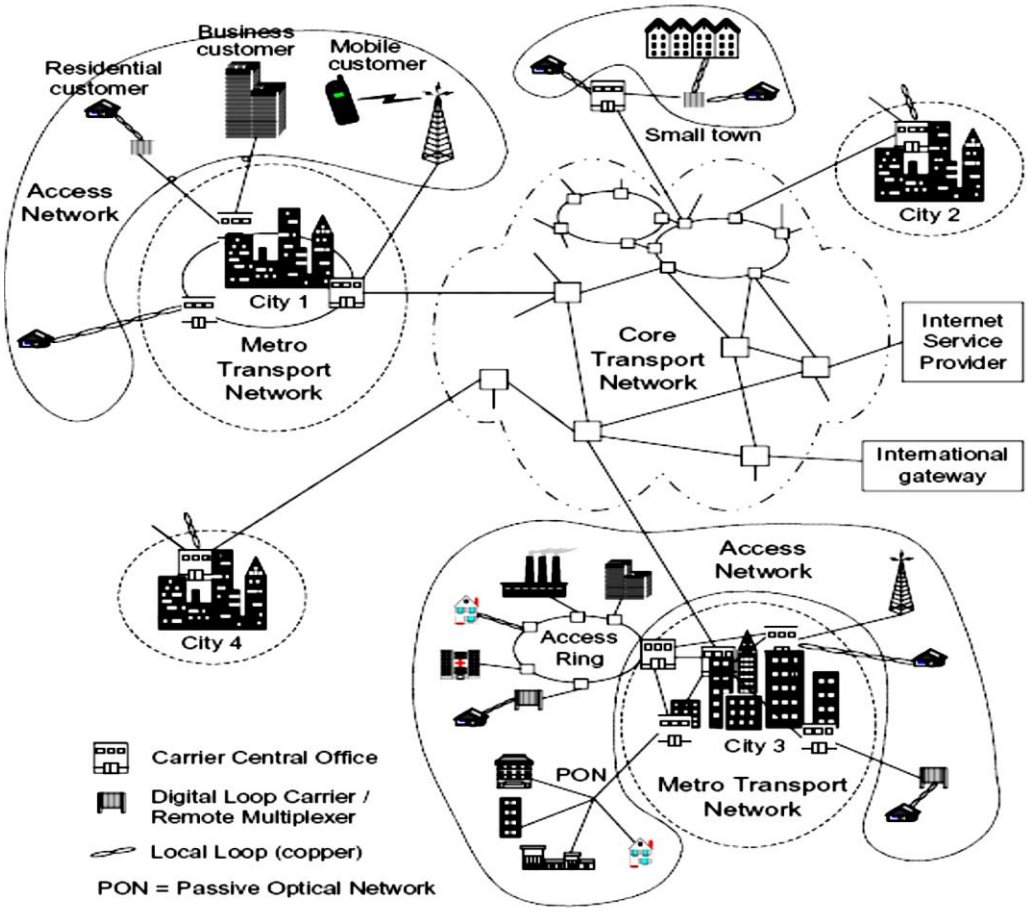


Fig:1 Illustration of a telecommunications network

1.4 TRANSPORT NETWORK AND THE ROAD ANALOGY

The transport network is analogous to any road network of a country as shown in Figure 1. The national highway of a country has a greater capacity for vehicle traffic than the state highway and the city roads. The state highway has less vehicle traffic-carrying capacity than the city road network. Analogous to this, the access part of a transport network has less capacity than the metro network and the metro part has less capacity than the core part of the transport network. The transport networks are deployed using different technologies in the different parts of the network. DSL is a popular technology deployed in the access network today. SDH/SONET technologies are widely being used for the deployment of the Metro network and DWDM is used for the core network.

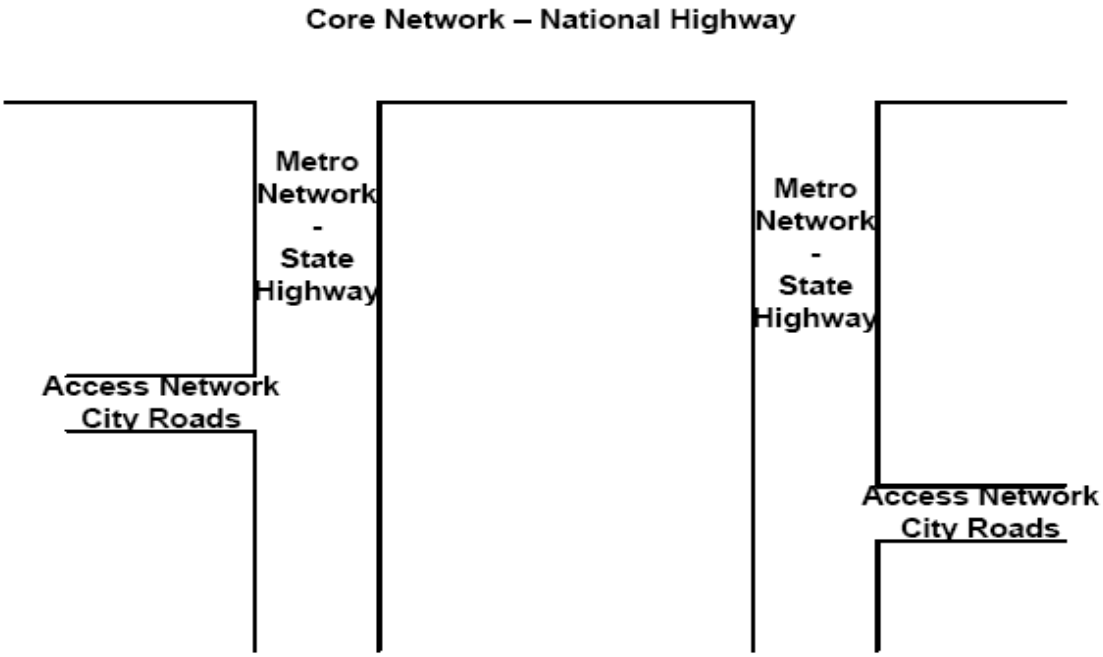


Fig:2 Transport Network and Road Analogy

The evolution of transport technology with the increase in bandwidth demand is shown in Figure 3.

The analog voice was digitized and the Plesiochronous Digital (PDH) techniques were discovered for the transportation of information. Though, these techniques were popular in the old days, the increasing demand for bandwidth proved that these techniques have many drawbacks. The highest data rate available in PDH is 140 Mbps and the hardware required for multiplexing and demultiplexing of the signal is much more than that of in SDH/SONET due to the Plesiochronous signals. All these drawbacks of the PDH techniques carved the way for today's SDH/SONET techniques for information transportation over the telecom networks. Both SDH and SONET techniques are widely used due to their efficiency and reliability. Today's metro area networks (MANs) are built on legacy SONET/SDH ring infrastructure and both the SDH & SONET are used to transmit data over voice-optimized SDH/SONET network resulting in the wastage of bandwidth. The SDH/SONET networks lack the dynamic functionality and rapid scalability needed to cope-up with the increasing volumes and unpredictable bandwidth demands. Also, due to the rigid multiplexing hierarchies in the SDH/SONET standards, the customer cannot avail the flexible data rates and has to pay more. The next available bandwidth in a SDH network after 10 Gbps is 40 Gbps. e.g. - A customer, who requires, says 20 Mbps, actually has to subscribe to a 45 Mbps service because of the rigidity in the multiplexing hierarchy, resulting in the wastage of bandwidth and ending up paying bill for 45 Mbps link.

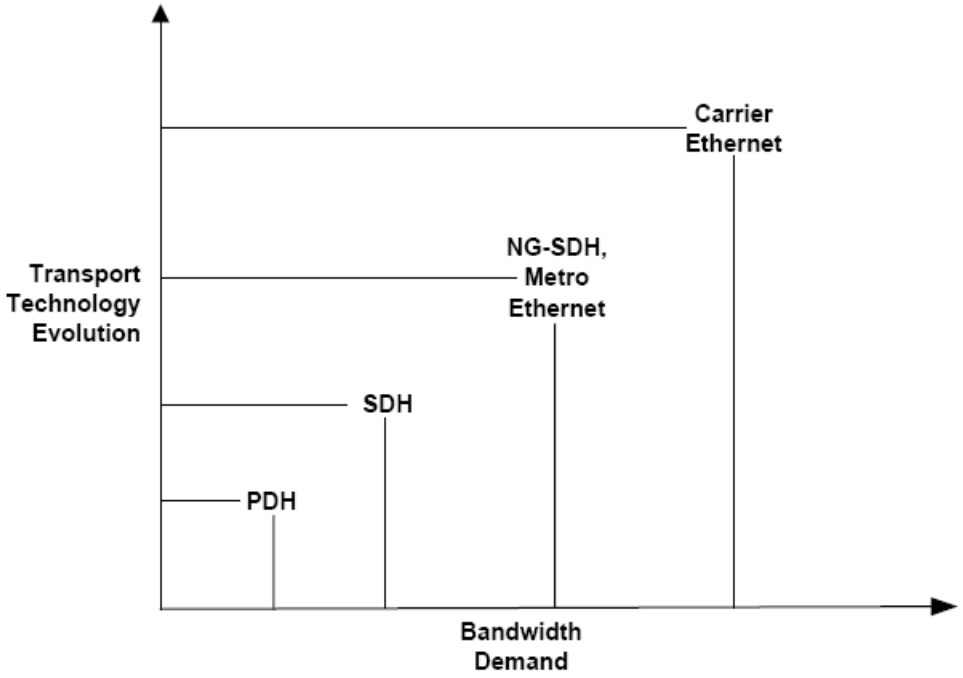


Fig:3 Transport Technologies Evolution

Also, customer may demand extra bandwidth for a limited period of time and may again switch back to a low bandwidth service. The service activation and service provisioning in both the cases should be quick enough to satisfy the customer's demands. The ports of SDH/SONET network elements are not programmable and the bandwidth offered by these ports cannot be changed dynamically. If a subscriber changes his bandwidth demand, the port from which he is getting the service needs to be changed physically. This is very time-consuming. e.g. – An enterprise customer is having a STM-4 connection initially and he needs to upgrade it to STM-16 for one month only. The service provisioning and service activation for this requirement should be quick enough to fulfill the requirement of the customer in minimum time so that his business is not affected and the customer enjoys the flexibility in the service. Also, the time required to revert back to the original low bandwidth requirement should be very less. Time required for designing, deploying and maintaining a separate voice and data network is very high. To isolate and diagnose the faults through a complex hierarchical network is a cumbersome task and the operational expenses to maintain these separate voice and data networks are very high as it needs a larger workforce.

Considering the limitations of SDH/SONET, what is needed are ways to manage data-service bandwidth dynamically in small increments, to provide a range of service guarantees, and to engineer traffic flows more efficiently. So to improve SDH/SONET into a new generation, while keeping its essential virtues, the main technological focus is on devising new client-service encapsulations and scrapping the traditional multiplexing/mapping scheme, replacing it with a more flexible alternative within the basic SDH/SONET framing.

1.5 TRANSPORT TECHNOLOGIES FOR NEXT GENERATION TELECOM NETWORKS

A solution to handle the increasing data traffic effectively can be building a brand-new data-based infrastructure. Carriers, however, have done significant investments in their existing SONET/SDH core infrastructures. This investment has run to hundreds of billions of dollars over a

significant period of time. Hence, throwing the existing infrastructure away and building a new one is not feasible.

1.5.1 MULTI-SERVICE PROVISIONING PLATFORM (MSPP)

One feasible approach to handle the continuously increasing data traffic can be to adapt the existing SDH/SONET based infrastructure for data. By replacing SONET/SDH add/drop multiplexers (ADMs) with multi-service provisioning platforms (MSPP) that support Ethernet and other packet-based protocols, as well as TDM and multiple optical wavelengths, carriers can achieve significant returns on their scarce investment dollars. This approach today is known as the Next-Generation SDH/SONET. It came into existence around 2002. MSPP has following advantages.

- Using MSPP, carriers can take the advantage of fiber optic capabilities to provide higher levels of service density.
- Legacy TDM and optical network support for all restoration techniques, topologies, and transmission criteria.
- No need to implement overlay networks.
- MSPP provides rapid end-to-end service provisioning and efficient OAM functions reducing the management overhead and expenditure by reducing the service deployment time.
- Cost-effective as a single box can take care of the TDM, packet as well as wavelength services.

1.5.2 METRO ETHERNET

Another approach is to use Ethernet in the metro networks, which is called as Metro Ethernet. Ethernet is a very popular technology and if combined with the fiber optic technology can be used to provide carrier-class services as well as traditional Ethernet services (10 Mbps, 100 Mbps, and/or 1 Gbps). With this approach, we can leverage the advantage of familiarity and ubiquity of Ethernet networking with the speed of optical transport. Using Ethernet can give the cost benefit to both, Service Providers and subscribers in the following two ways:

- The Ethernet interfaces itself are very less expensive due to its broad usage in almost all networking products.
- Many Ethernet services allow subscribers to add bandwidth in granular increments. Bandwidths are scalable from 1 Mbps to 10 Gbps and beyond, and subscribers can add bandwidth as needed and pay only for what the need.

Today, there are various Ethernet applications and services and several service technologies are used for metro Ethernet service delivery. The following metro Ethernet service delivery technologies can be used:

1.5.3 ETHERNET OVER SONET/SDH (EOS)

Ethernet over SONET/SDH is typically used for private line applications. It is a point-to-point service with a native Ethernet interface. EoS was developed as a packet data transport solution which would allow the use of the existing deployed SONET/SDH infrastructure.

Over the past several years, a series of new protocols such as Generic Framing Procedures (GFP), Virtual Concatenation (VACT), Link Capacity Adjustment Schemes (LCAS) have emerged that facilitate far more flexible, efficient provisioning of P2P Ethernet circuits over SDH. Some of the benefits of EoS are simple provisioning, high security and high availability due to SDH protection mechanism, high granularity and relatively low cost.

1.5.4 ETHERNET OVER DWDM (EOWDM)

EoW is a point-to-point Ethernet Private Line (EPL) service. It is used when carriers need to offer ultra-high bandwidth services (GigE level and up) to connect customers' data centers and allow large file transfers between corporate sites, such as storage network applications. It is also used for applications, such as video transport, and to provide high fiber relief. EoW is deployed using either DWDM or CWDM. EoW offers high potential resiliency by providing protection at less than 50 msec. Service providers can offer Ethernet over WDM service at 1 Gbps and 10 Gbps.

1.5.5 ETHERNET OVER FIBER (EOF)

EoF is primarily deployed in a point-to-point or mesh network technology, and used to deliver packet services over fibers. It is a connectionless technology. It is usually used for LAN or Internet access connectivity.

The main benefit of EoF is low cost. Even though EoF is very cost effective, it lacks the reliability, manageability, and scalability of a traditional SDH solution.

1.5.6 ETHERNET OVER RESILIENT PACKET RINGS (RPR)

RPR is a technology similar to SONET/SDH and optimizes the sharing of fiber optic rings for packet data traffic. RPR uses a single ring technology in order to overcome multi-drop limitations of the point-to-point nature of Ethernet. However, RPR supports only ring configuration and is a single ring protocol. It does not support mesh and star topology. Also, RPR is not competent with the low cost of the equivalent Ethernet products.

1.5.7 PROVIDER BACKBONE TRANSPORT (PBT)/PBB-TE

PBT is also known as Provider Backbone Bridge – Traffic Engineering (PBB-TE). It is a point-to-point Ethernet tunneling technology. PBT intends to offer SONET/SDH-like performance. PBT is more suitable for point-to-point business applications and MP2MP is not supported.

1.5.8 ETHERNET OVER MPLS (EOMPLS)

Multi-protocol label switching is a protocol that provides an efficient forwarding and switching of traffic flows through the network. MPLS technology enables service providers to build a cost-effective carrier-class Ethernet network over a new and/or existing SONET/SDH network, supporting any Ethernet-based applications and services. EoMPLS supports P2P and MP2MP service, P2MP hub and spoke service and rooted multicast. EoMPLS reduces CAPEX and OPEX and helps operators to build real converged networks. Metro Ethernet technologies, however pose many scalability and reliability challenges. The following are some of the issues that arise with Metro Ethernet networks:

- Restrictions on the number of customers
- Lack of Service monitoring
- Scaling the L2 backbone is almost impossible.
- Service provisioning
- Inter-working with legacy deployments

1.6 OTN TECHNOLOGY

The Optical Transport Network (OTN) standards, defined by the ITU-T G.709 standards committee, were developed to add SONET-like performance monitoring, fault detection, communication channels, and multiplexing hierarchy to WDM wavelengths. The primary benefits of OTN include:

- Enhanced OAM for wavelengths
- Universal container supporting any service type
- Standard multiplexing hierarchy
- End-to-end optical transport transparency of customer traffic
- Multi-level path OAM

1.7 ROADMS

Use of ROADM by the carriers is becoming popular. ROADM is nothing but Reconfigurable Add/Drop Multiplexers. It eliminates the pain associated with the legacy DWDM networks. DWDM falls short of scalability whenever there is a requirement to upgrade the DWDM network. ROADM provide an automated mechanism to flexibly add capacity, in terms of wavelengths, as it is needed, without interrupting the service.

ROADMs give network administrators the ability to select via software which of 32 DWDM channels to add, drop or pass-through at each site and dynamically provision an end-to-end, inter-office connection that can travel thousands of miles, across a DWDM SDH/SONET ring in their metro and access networks. This lets them seamlessly add services as end-user demand necessitates.

ROADM maps wavelengths from metro access through metro core using emerging generic multi-protocol label switching (G-MPLS) control plane standards. Eventually, it could take over all grooming of traffic above STM-1 (155 Mbps) speeds and push the SDH/SONET ADM's traditional job of grooming sub-wavelength E-1 and E-3 traffic out of the core toward the customer.

The concept of ROADM is still undergoing a lot of dramatic changes and the vendors are coming out with proprietary stuff.

1.8 CPAN TECHNOLOGY

CPAN (Converged Packet Access Network) is based on MPLS-TP Technology. It is used for MPLS-TP aggregation network and access network. CPAN is converged multi-service connection-oriented transport over packet technology of telecommunication system. It has combined feature of Packet network and SDH/SONET network.

Advantages of CPAN Technology:-

- .Efficient bandwidth utilization, sharing bandwidth between services
- Includes the benefits of RPR.
  a. SDH packet switching based on statistical multiplexing.
  b. 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
  a. Access to last mile connectivity bandwidth upto 100G capacity.
  b. bandwidth scalability -from 5G,40G to 100G
- OAM & Performance Monitoring-Proactive & Reactive
- resiliency-1:1,1+1;Linear & Ring.

1.9 OFC LAYING PRACTICES

Optical fibers are mechanically very different from copper and steel cables, and the techniques for installing them are therefore significantly different. Fibers are not only are extremely brittle, but also elastic to an extent. Fibers must be also be protected from tensile forces (axial),

compressive forces and bending. Different OFC laying practices are being used depends upon geographical areas.

1.9.1 INSTALLATION OF CABLES IN UNDERGROUND DUCTS

The traditional method of laying optical fibers still used in most developing countries is Ducting and Trenching. This involves creating a trench through manual or mechanized soil excavation. This approach is preferred in countries where manual labor is cheap. Some of the most difficult situations for the installation of optical fiber cables are in underground ducts. The condition and geometry of duct routes is of great importance. Where the infrastructure includes ducts in poor condition, contains excessive curvature, includes ducts already containing cables or access points with abrupt changes of direction, the maximum pull distance will be reduced accordingly.

Trench specifications are normally defined by local authorities and could be specified for each operator in countries with multiple operators. In BSNL the Optical Fiber Cable shall be laid through PLB HDPE Ducts buried at a nominal depth of 165cms.

The trenching process needs careful control to make sure the trench floor does not have any kinks and is uniform, and trenches do not have major bends.

Ducts are placed in the trenches and fiber is then blown through the ducts with specialized fiber blowers, using water or air. In Air Assisted Fiber Blowing, the blowers use compressed air to push fiber through ducts.

It is standard practice to lay conduits, then draw inner ducts through the conduits and finally blow the fibers through the ducts.

Fig:4 Cable ducts in open trench

1.9.2 INSTALLATION OF OFC WITH THE TRENCHLESS TECHNIQUE

Horizontal directional drilling is an excellent alternative to traditional utility installation methods. Unlike manual labor, trenching or excavation, the HDD process is highly suitable in urban areas or places where aboveground obstructions exist that are expensive, inconvenient or impossible to disturb for product installation. HDD machines install utilities under obstacles such as roads, rivers, creeks, buildings and highways — with little or no impact to the aboveground surface.

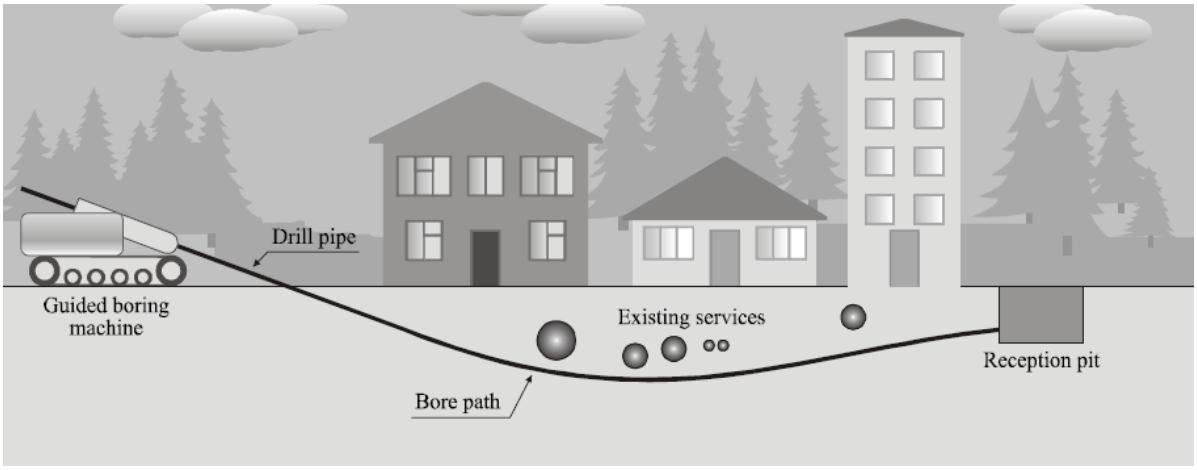


Fig:5 General scheme of the directional drilling technique: drilling the pilot hole

The trenchless techniques (or no-dig techniques) allow installation of underground optical cables minimizing or eliminating the need for excavation. These techniques create a horizontal bore below the ground in which the underground infrastructure (ducts, pipes or direct buried cables) can be placed. Trenchless techniques can reduce environmental damage and social costs and, at the same time, provide an economic alternative to open-trench methods of installation

From a general point of view, the trenchless techniques are very useful in the following situations:

- where road surface excavation is restricted or prohibited by administrative agencies, etc. (newly constructed roads, emergency vehicle entrances/exits, etc.);
- where the open-cut method cannot assure safety or would cause risks to traffic and pedestrians;
- where noise, vibration, dust and other pollution are caused by open-cut method;
- where the open-cut method may impede road traffic and thus hinder the business of nearby stores;
- where congested sections where open-cut method may damage the buried facilities of other companies or sections where the presence of buried objects causes significant lack of work efficiency;
- where conduits should be buried at deep locations and open-cut construction would greatly increase the amount of excavated soil;
- where road surfaces use high-grade material which would increase the cost of reinstatement after excavation;
- where road sections with high traffic volumes limit the work to the night-time hours (lower work efficiency, higher labour costs);
- where open-cut construction would involve extra costs to move historic remains or other items.
- normally 250cms depth is possible
- bore dia 100mm for 4 PLB or less pipes and for 5-8 PLB Bore dia 200mm.
- depth at the entry should be 165cms.
- depth, deviation and offset to be provided by machine automatically with graph.
- HDD is normally deployed in soft soil.
- GI route indicators at every 200 meter manhole and 30 cm above ground level

The choice of the most suitable technique to be adopted is related to each type of application, as outlined in the following.

- *Long installation lengths* can be achieved (several km) by dividing the work length into shorter sections (100-200 m as an average). The length of each section will depend on the characteristics of the machines and the design requirements. Boring/directional drilling (both fluid-assisted and dry boring) machines should be used for this particular application.
- River and railway crossings were the first applications of trenchless technology due to the fact that traditional digging techniques were not suitable. Surface-launched machines are often the best solution because obstacles can be crossed with a curved drilling path, thus avoiding the need to excavate deep launch and reception pits (especially in river crossings). It is possible to consider two different kinds of crossing with respect to the length and to the depth of the installed duct:

  i) **Road and railway crossings**: For both, the length of the drilling is normally not very long, so that both fluid-assisted and dry directional drilling machines can be used, or the use of micro-tunnelling systems depending on the duct diameter;

  ii) **River crossings:** The length and the depth of the bore normally required are very long and deep, and it is important to avoid the excavation of big launch and reception pits on the opposite sides of the river. For these situations the drilling is started directly from the surface using a fluid assisted directional drilling system.
- Urban environments are also very attractive for the application of trenchless technology because it could avoid, or drastically reduce, the troublesome drawbacks normally created by digging work in urban areas. Due to the small diameters of the ducts and the short distance of each drilling section (manholes or chambers are normally very close together), a small and dry directional rig is used, in order to reduce the overall dimension of the working site, and to avoid flooding of the drilling fluid along the drilling path and the use of micro-tunnelling systems, depending on the duct diameter.

1.9.3 INSTALLATION OF OFC WITH THE MINI-TRENCH TECHNIQUE

The so-called mini-trenching technique allows the installation (in small trenches) of underground optical cables in ducts. The advantages of this technique over conventional cable laying technologies lie essentially in its speed of execution, lower cost, significantly lower environmental impact and limited disruption to road traffic and, as a consequence of the previous items, easiness in obtaining permits for the taking over of public area.

The mini-trenching technique can be applied on routes that generally involve asphalted surfaces such as roads and sidewalks with a compact soil subgrade. It is not recommended that the technique be used on routes where the soil subgrade is sandy, gravelly or contains medium-sized cobbles (i.e., measuring 10 to 20 cm in diameter). If other underground utilities crossing a planned route already exist at a depth interfering with the depth of the mini-trench, this technology is not appropriate.

a) Traditional mini-trench (10 × 30 cm)

Mini-trenching is normally carried out by simultaneously cutting through the paving and digging a trench whose depth and cross-section vary in accordance with the number of ducts to be laid: depth is normally between 30 and 40 cm, while cross-section can vary between 7 and 15 cm. In order to guarantee a protection against impact resulting from road-repairing, the depth of the laid infrastructure shall be maintained constant at a known level that must be 5 cm deeper than the foreseen asphalt cutting depth normally specified for road surface repair works.

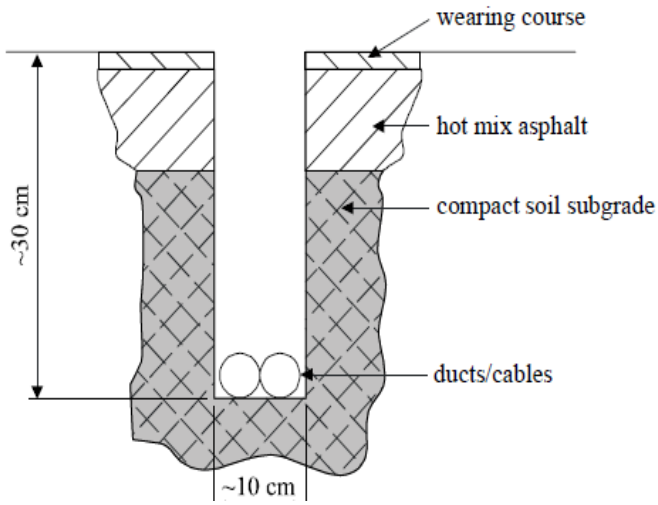


Fig:6 Example of mini-trenching installation configuration

In cases where the mini-trench is dug along a road with no curb or sidewalk, the excavation shall normally be located at distance of around one metre from the edge of the road (or, if possible, just on the external side of the lateral line). In special circumstances where this is not possible, the mini-trench may be dug in the shoulder at the edge of the asphalt. Any crossings through unpaved sections (which must in any case have a compact subgrade) should be carried out using the same technique.

b) The enhanced mini-trench

Further mini-trench technique development has resulted in a new solution in which all phases of duct/cable laying are simultaneous.

In details, the enhanced mini-trench is characterized by reduced dimensions of 5 cm wide and 30 cm deep (mini-trench 5 × 30), In the enhanced mini-trench 5 × 30 it is possible to lay one Ø 50 mm duct or two (one laid upon the other).

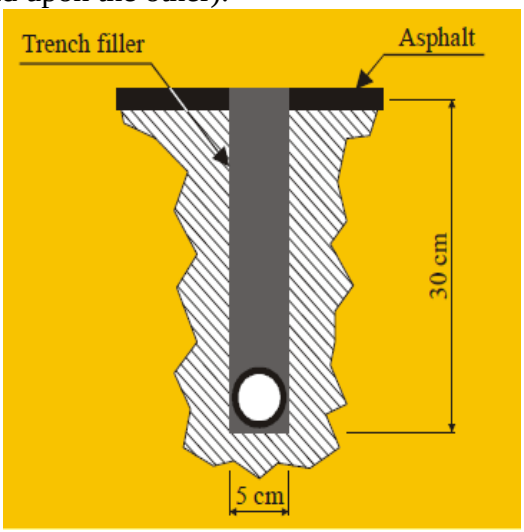


Fig:7 Example of mini-trench 5 × 30 cm configuration

The enhanced mini-trench allows one to operate with smaller machinery on narrow roads, producing a lower quantity of waste material and thereby reducing operating expense. So, this solution can operate both in urban and in non-urban environments**.**

Fig:8 Example of application of enhanced mini-trench 5 × 30 cm technology

c) Installation of OFC with the micro-trench technique

The micro-trenching technology can be applied on routes that involve asphalted surfaces, such as roads or sidewalks with a base of compact material (asphalt or concrete). Its advantages over conventional cable-laying technologies lie essentially in its speed of execution, major reduction in infrastructure deployment costs, and significantly lower impact on the environment and on road traffic. Protection against breakage from road reparation is not possible due to the shallow depths used in micro-trenching techniques. It is therefore essential to carefully plan the routes on which these techniques are to be used, in order to provide long-term stability of the routes.

Micro-trenching is normally carried out by cutting a shallow groove in the asphalt (better if not less than 7 cm), but without penetrating past the asphalt layer. Care must be taken to avoid cutting entirely through the asphalt, as this could cause the pavement along the sides of the groove to crack or split.

This precaution must be borne in mind in all cases where there is no lateral protection on one or both sides of the groove, which can prevent the asphalt layer from shifting, and particularly in cases where micro-trenching is performed along the edge of a road with no curb or sidewalk. In such cases, the groove shall normally be located at a suitable distance (e.g. at least one metre) from the edge of the road.

Groove width may vary (e.g. 10-15 mm) in accordance with the diameter of the cable laid. The optical fibres are preferably enclosed in a metallic (e.g. copper) tube filled with a suitable filling compound and surrounded by a polyethylene jacket.

Fig:9 Sharp change in route direction

1.9.4 INSTALLATION OF AERIAL CABLES

Optical aerial cable include the normal practices for both self-supporting cables (all dielectric or including a metallic element) and lashed cables (e.g. attached to a pre-installed tension strand). The mechanical stresses and, therefore, strain experienced during aerial cabling are generally less than those induced during underground placing and in a mixed underground/overhead route underground cable may, with care, be used for overhead sections.

In general, where end-pull or distributed pull methods are used, the various types of systems indicated in the above clauses to protect the cable from excessive strain during installation may be employed for aerial cable and it is good practice also to ensure that cable back-tension is always carefully controlled. Where lashing to pre-tensioned support wire or existing metallic cable is employed, the optical fibre aerial cable must be constructed to withstand lashing. The lashing-wire tension must also be carefully controlled. Great care must be exercised when handling cable in aerial route installations.

Provided the need to protect from overload and over-bending is borne in mind, most normal aerial cable installation winching equipment including end-pull winches, intermediate winches, controlled cable feeding devices, etc., can be used. For long length installations, where end-pull or distributed-pull systems are used, it is very important that proper guiding equipment is provided at positions where sharp changes of direction occur, and every effort should be made to ensure pulling-in at an even speed.

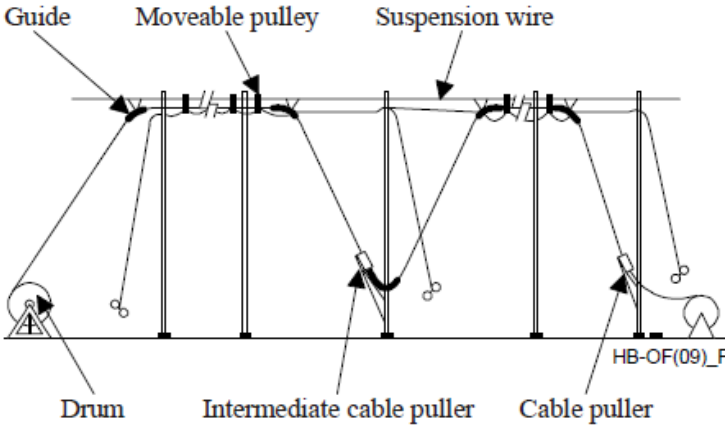


Fig:10 Aerial cable pulling through system

1.9.5 INSTALLATION OF BURIED CABLES

Normal buried cable installation methods, including ploughing (direct, vibratory or winched), trenching and moling, can, in general, be used for direct burial of optical fibre cable, provided the cable is specifically designed for this type of application. The same depth of cover as for metallic cables is usually adequate, but traffic capacity or other considerations of security may indicate a requirement for greater depth. Where a trench method is used, back filling materials and practices may require particular consideration so that fibre strain limits are not reached during this operation.

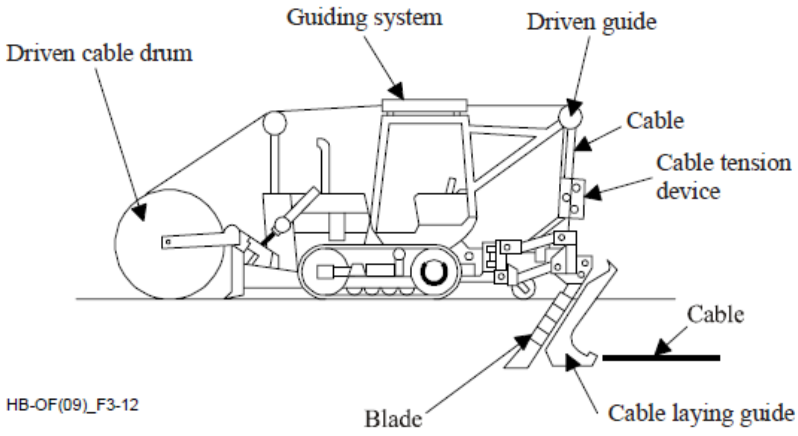


Fig:11 Installation by cable ploughing

When ploughing methods are used the design of the guiding equipment between the cable reel and the cable laying guide must take careful account of specified cable bending criteria and have a low friction value to prevent fibre overstrain. Cable overload protection systems are not normally necessary but, where a large ploughing machine is used and there are driven cable reels and guide wheels, a tension device can be incorporated.

In-service mechanical protection at road or service crossings or in situations of high vulnerability may be felt to be necessary.

1.9.6 INSTALLATION OF OPTICAL FIBRE CABLES OVER POWER LINES

Optical fibres are particularly suitable for use on the aerial power lines in high-voltage networks, because they are immune by electromagnetic influences.

Optical Fibre Cables for laying over Power Lines: These cables are installed on the overhead power distribution network. Following are the few types of the Optical Fibre Cable for laying over Power Line.

1. All-Dielectric Self-supporting (ADSS) Optical Fibre Cable for laying on power line alignments - To be installed on the overhead power distribution network up to 33 KV.

2. Optical Ground Wire (OPGW) Cable for laying on power lines) - To be installed on existing high voltage Power Line alignments beyond 33 KV, up to 400 KV. The cable may also replace the existing Ground Wire of the alignment.

1.9.7 INSTALLATION OF MARINIZED AND SUBMARINE OPTICAL CABLES

Underwater optical fibre cables are classified (according to the ITU-T Recommendations), in the three following categories:

- marinized terrestrial cable;
- repeater-less submarine cable;
- repeatered submarine cable.

Marinized terrestrial cables are generally used for crossing lakes and rivers. Repeater-less submarine cable is suitable for use in both shallow and deep waters for lengths up about 300 km. Repeatered submarine cables can be used in all underwater applications, mainly for deep waters on lengths that require the deployment of submerged repeaters.

Prior to any marinized /submarine system implementation a survey normally is conducted in order to find the optimum route and to give the cable the optimum protection along this route.

Usually a submarine cable is manufactured in cable plants close to the beach in order to facilitate the loading aboard of a vessel. For marinized cables to be installed in rivers or lakes, with

the cable to be delivered by terrestrial transportation, the loading method adopted is the same as that for terrestrial cables.

For the repeatered submarine cable systems, after the loading, the single elementary factory lengths are jointed to the submerged repeaters and to all the other submerged equipment in order to form on the cable ship the link to be laid without stopping the ship.

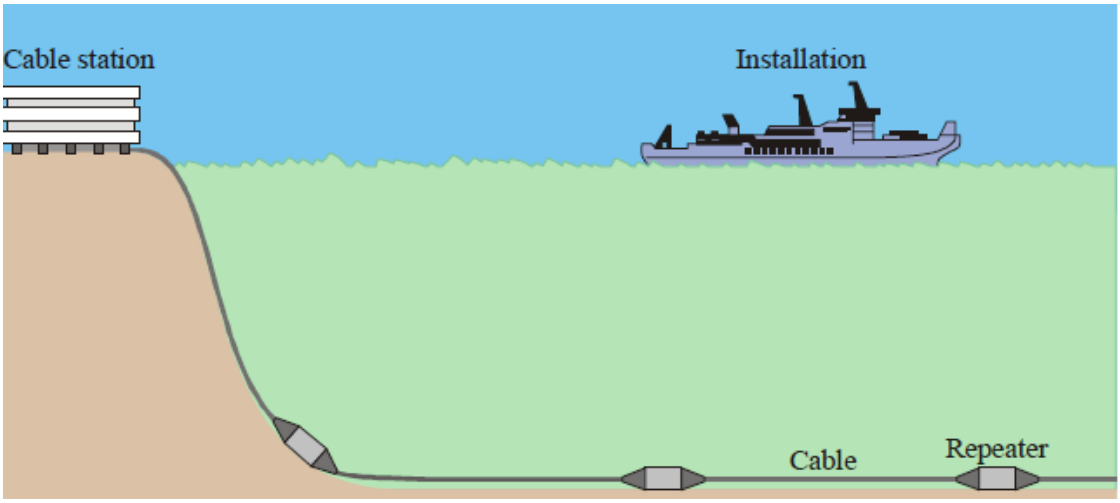


Fig:12 Laying of repeatered submarine cables

1.10 CONCLUSION

Optical Transport Networking is a telecommunication industry-standard protocol which provides a way of multiplexing different services onto optical light paths. It was originally designed to promote network evolution beyond SONET/SDH.. As network service providers tackle the ever-increasing issue of rapid user growth and increasing digital traffic, with such things as mobile apps, social media, cloud computing, VoIP and video calling, technological solutions such as OTN and CPAN are being adapted.

Optical fibre must be protected from excessive strains, produced axially or in bending, during installation and various methods are available to do this. The aim of all optical fibre cable installation methods and systems should be to install the cable with the fibre in, as near as possible, a strain free condition, ready for splicing.

Methods and practices used in the handling of optical fibre cables during installation can, without producing any immediately evident physical damage or transmission loss, affect their long term transmission characteristics.

2 NGSDH AND CPE

2.1 LEARNING OBJECTIVE

After reading this unit, you should be able to understand:

- Limitation of Legacy SDH signals.
- Concept of NGSDH.
- Features of NGSDH
- Key Technology

2.2 INTRODUCTION

Next Generation SDH enables operators to provide more data transport services while increasing the efficiency of installed SDH/SONET base, by adding just the new edge nodes, sometime known as Multi Service Provisioning Platforms (MSPP) / Multi Service Switching Platforms (MSSP), can offer a Combination of data interfaces such as Ethernet, 8B/10B, MPLS (Multi Protocol Label Switching) or RPR(Resilient Packet Ring), without removing those for SDH/PDH. This means that it will not be necessary to install an overlap network or migrating all the nodes or fiber optics. This reduces the cost per bit delivered, and will attract new customers while keeping legacy services. In addition, in order to make data transport more efficient, SDH/SONET has adopted a new set of protocols that are being installed on the MSPP/MSPP nodes. These nodes can be interconnected with the old equipment that is still running.

2.3 WHAT IS NEXT GENERATION SDH?

Following major issues that exist in the legacy SDH:

- Difficulty of mapping newer (Ethernet, ESCON, FICON, Fiber Channel etc) services to the existing SDH transport network.
- Inefficient use of the transport network in delivering data services.
- Inability to increase or decrease available bandwidth to meet the needs of data services without impacting traffic.

  Three mature technologies—
  - Generic Framing Procedure (GFP), ITU-T G.7041
  - Link Capacity Adjustment Scheme (LCAS), ITU-T G.7042
  - Virtual Concatenation (VCAT), ITU-T G.707

-together in Next generation SDH solved the above issues and adding three main features to traditional SDH:

- Integrated Data Transport i.e. Ethernet tributaries in addition to 2Mb, 140 Mb, STM-1,4,16 ----**GFP**
- Integrated non-blocking, wide-band cross connect (2Mb granularity) making the efficient use of the transport network in delivering data services ---**VCAT**
- Dynamic Bandwidth allocation, Intelligence for topology discovery, route computation and mesh based restoration------**LCAS**

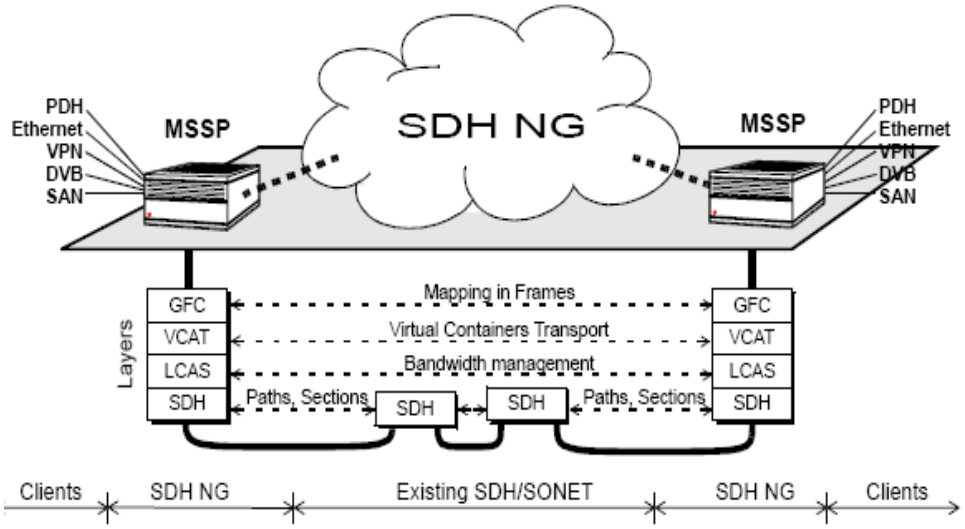


Figure 1: Block Diagram of NGSDH

Next Generation SDH is Packet Friendly and have IP router like capabilities. It does not matter if the client stream has constant or variable bit rates.

"VCAT provides more granularity, LCAS provides more flexibility and GFP efficiently transports asynchronous or variable bit rate data signals over a synchronous or constant bit rate".

Hence,

Next Generation SDH = Classic SDH + [GFP+VCAT+LCAS]

2.4 COMPONENTS OF NEXT GEN SDH

2.4.1 GENERIC FRAMING PROCEDURE (GFP):

Generic Framing Procedure (GFP), an all-purpose protocol for encapsulating packet over SONET (POS), ATM, and other Layer 2 traffic on to SONET/SDH networks. GFP is defined in ITU-T G.7041 along with virtual concatenation and link capacity adjustment scheme (LCAS) transforms legacy SDH networks to Next generation SDH networks.

GFP adds dynamism to legacy SDH. GFP is most economical way of adopting high speed services, constant bit rate and variable bit rate, in SDH networks and can provide basis for evolving RPR.

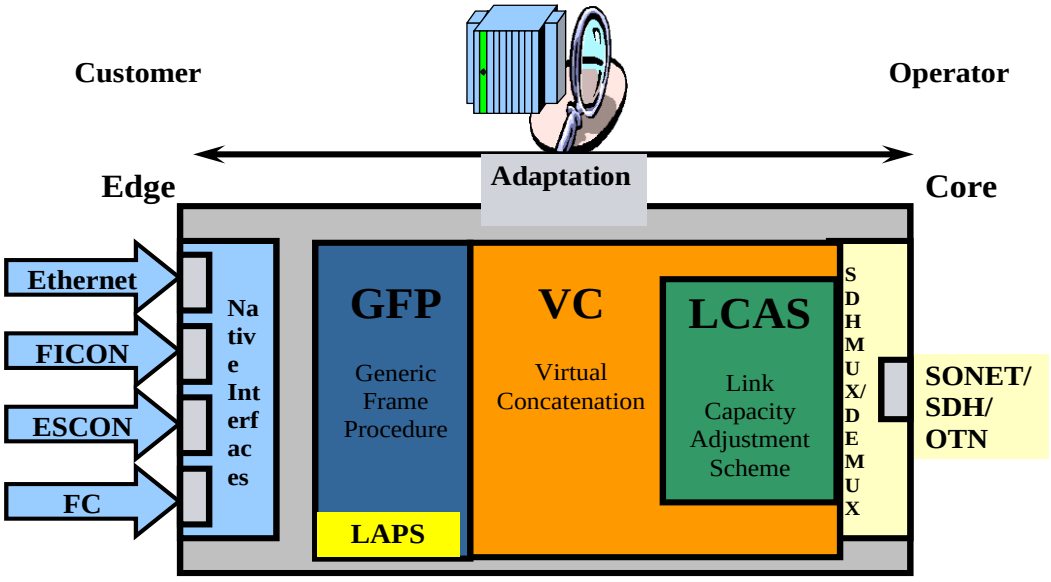


Figure 2: Functional Model of GFP

There are actually two types of GFP mechanisms ;-

1. PDU-oriented known as Frame mapped GFP (GFP-F)
2. Block-code-oriented known as Transparent GFP (GFP-T)

a) GFP-F: -

GFP-F (Framed) is a layer 2 encapsulation in variable sized frames. Optimised for data packet protocols such as DVD, PPP and Ethernet, MPLS etc Frame mode supports rate adaptation and multiplexing at the packet/frame level for traffic engineering. This mode maps entire client frame into one GFP frames of constant length but gaps are discarded. The frame is stored first in buffer prior to encapsulation to determine its length. This introduces delay and latency.

b) GFP-T:

GFP-T is useful for delay sensitive services. GFP-T (Transparent) is a layer 1 encapsulation in constant sized frames. Optimized f or traffic based on 8B/10B codification such as VoIP,DVB-ASI,1000BASE-T, SAN, Fibre Channel, and ESCON.

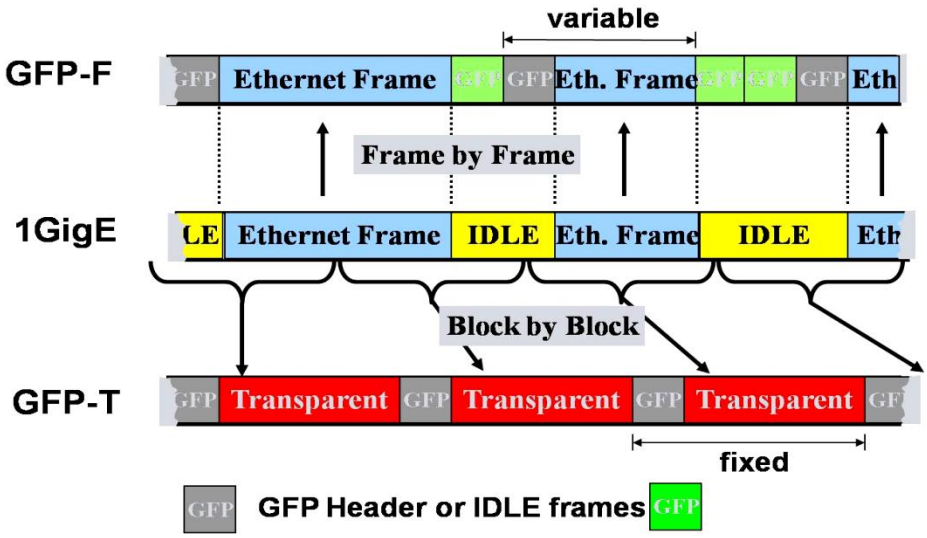


Figure 3: GFP-F & GFP-T

Transparent mode accepts native block mode data signals and uses SDH frame merely as a lightweight digital wrapper. GFP-T is very good for isocronic or delay sensitive protocols &SAN (ESCON). GFP-T is used for FC, Gigabit Ethernet etc.

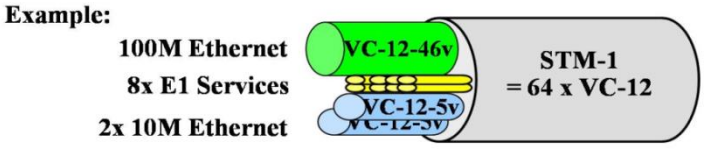
2.4.2 CONCATENATION (V-CAT & C-CAT) :

SDH concatenation consists of linking more than one VCs to each other to obtain a rate that does not form part of standard rates. Concatenation is used to transport pay loads that do not fit efficiently into standard set of VCs.

Two concatenation schemes are:

1. Contiguous concatenation
2. Virtual concatenation

Data Rates	Efficiency w/o VC	using VC
Ethernet (10M)	VC3 ⇨ **20%**	VC-12-5v ⇨ **92%**
Fast Ethernet (100M)	VC-4 ⇨ **67%**	VC-12-46v ⇨ **100%**
ESCON (200M)	VC-4-4c ⇨ 33%	VC-3-4v ⇨ **100%**
Fibre Channel (800M)	VC-4-16c ⇨ 33%	VC-4-6v ⇨ **89%**
Gigabit Ethernet (1G)	VC-4-16c ⇨ 42%	VC-4-7v ⇨ **85%**



More services integrated- by using VC!

Figure 4: VCAT Efficiency

c) Contiguous concatenation:

The traditional method of concatenation is termed as contiguous. This means that adjacent containers are combined and transported across the SDH network as one container. Contiguous concatenation is a pointer based concatenation. It consists of linking N number of VCs to each other in

a logical manner within the higher order entity i.e. VC4 and above. The concatenated VCs remain in phase at any point of network. The disadvantage is that it requires functionality at every N/E adding cost and complexity. Lower order VCs (VC-12, VC3) concatenation is not possible in contiguous concatenation as shown in Fig.

d) Virtual Concatenation:

Virtual concatenation maps individual containers in to a virtually concatenated link. Any number of containers can be grouped together, which provides better bandwidth granularity than using a contiguous method. It combines a number of lower/higher order VCs (VC-12, VC3 & VC4 payload) that form a larger concatenation Group, and each VC is treated as a member. 10 Mb Ethernet would be made up of five VC-12s, creating these finely tuned SDH pipes of variable capacities improve both, scalability and data handling/controlling ability as per SLA (service level agreement).

The transport capacity with or without VC is shown in Fig. 4

2. VCs are routed individually and may follow different paths, within the network, only the path originating and path terminating equipment need to recognize and process the virtually concatenated signal structure as shown in Fig. 5

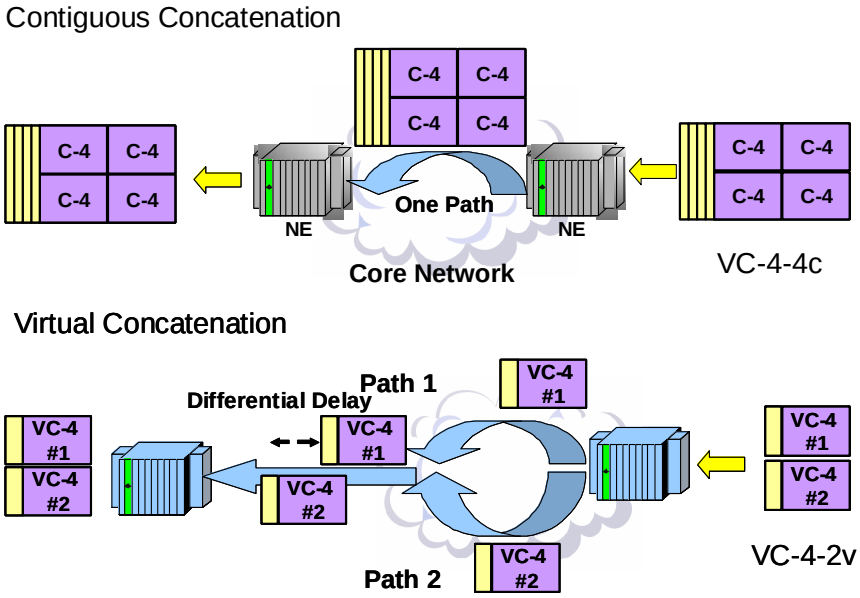


Figure 5: Virtual & Contiguous Concatenation

Virtual concatenation Benefits:

- Use the same core NEs, modify only edge NEs.
- Low investment and fast ROI (return on investment).
- Efficient & scalable i.e. fine granularity and multi-path capability.
- SDH gives best QoS, well engineered and reliable.

2.5 LINK CAPACITY ADJUSTMENT SCHEME(LCAS):

Link Capacity Adjustment Scheme (LCAS) is an emerging SONET/SDH standard and is defined in ITU-T G.7042 having capability to dynamically change the amount of bandwidth used in a virtually concatenated channel i.e. bandwidth management flexibility. LCAS is bi-directional signaling protocol exchanged over the overhead bytes, between Network Elements that continually monitors the

link. LCAS can dynamically change VCAT path sizes, as well as automatically recover from path failures. LCAS is the key to provide "bandwidth on demand".

LCAS enables the payload size of VCG (group of VCs) to be adjusted in real time by adding or subtracting individual VCs, from VCG dynamically, without incurring hits to active traffic. In LCAS, signalling messages are exchanged between the two VCs end points to determine the number of concatenated payloads and synchronize the addition/removal of SDH channels using LCAS control packets.

2.6 BENEFITS OF LCAS :-

A . Call by call bandwidth (Bandwidth on demand)

Customer

⇨ rents a 6Mb Internet connection (VC-12-3v)

⇨ calls to get additional 2Mb

Operator

⇨ will provision additional VC-12 path

⇨.and will hitless add it to existing connection via LCAS!

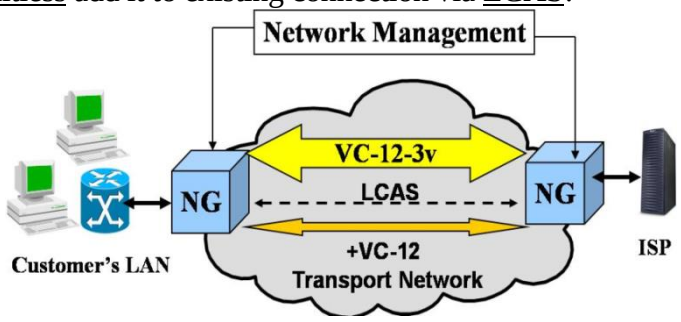


Figure 6: Bandwidth call by call

B. Bandwidth on Schedule

A customer is offered a fixed bandwidth of 100 Mb (VLAN) Ethernet, allotting 46 VC-12 (0ne VC12 = 2.176 Mb x 46 = 100.1 Mb). Every night for one hour additional 900 M ESCON service is provisioned by LCAS. New revenue opportunity at low traffic hours.

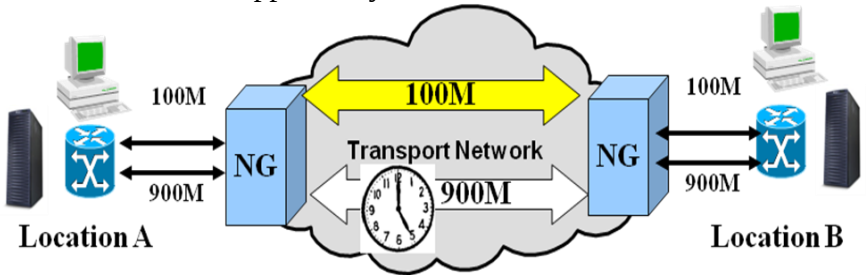


Figure 7: Bandwidth on scheduled Time

LCAS is not only used for dynamic bandwidth adjustment but also for survivability options for next generation SDH. LCAS is a tool to provide operators with greater flexibility in provisioning of VCAT groups, adjusting their bandwidth in service and provide flexible end-to-end protection options. LCAS is defined for all high and low order payloads of SDH.

2.7 STM-1(CPE)

Tejas Networks provide efficient solutions in this field using the TJ100 series products. TJ100 provides a full range of solution in this evolving field of NG SDH/SONET. TJ100 family provides the unique advantage of carrying both data and voice over SDH/SONET. In addition to the cheaper

solution provided by this family, these products have built in modularity, which allow easy upgradeability. This upgradeability feature allows the customer to evolve in "build-as-you-grow" concept.

Along with the TejEMS, the TJ100 family also provides the following features:

- Easy network manageability
- Lower cost per line
- Easy upgradeability
- Carrying both data and voice over SDH/SONET
- Higher reliability

2.7.1 ARCHITECTURAL DETAILS

Tejas-TJ100CPr4 operates at 1/2 x STM-1 (155.52 Mbps) aggregate level as per ITU-T Rec. G 957, and comes in multiple factory configured options as listed below:

- 8 x E1 and 2 x 10/100BaseT and 2 x 100BaseFX
- 21 x E1
- 1 x E3/DS3

The system supports SDH according to ITU-T standard G.707. Tejas-TJ100CPr4 can be configured in various topologies such as linear, or ring. Tejas-TJ100CPr4 uses SDH architecture, which by itself provide larger capacity, efficient use of fiber, quick provisioning, and a substantial saving in deployment and future maintenance cost.

2.7.2 KEY FEATURES

Tejas-TJ100CPr4 provides the following features:

1. **Multi-service platform:**

Tejas-TJ100CPr4 supports both data and voice traffic with E1/E3 and Ethernet respectively. In addition, it can support STM-1o interfaces.

2. **Ethernet over SDH (EoS):**

It complies with GFP framing standards. It allows Fast Ethernet ports to have VC-12Xv; X=1 to 46 lower order virtual concatenation and VC-3Xv where X is 1 to 3 higher order virtual concatenation. It supports LCAS Full/Half duplex and auto-negotiation.

3. **Flexibility:**

It can be configured in various topologies supporting both electric and optical interface. All interfaces are in front for easy access. Tejas-TJ100CPr4 supports ring, bus, linear and mesh topologies.

4. **Protection:**

Tejas-TJ100CPr4 provides protection features using sub-network connection protection (SNCP) and MSP with switching time less than 50 ms.

5. **Configuration:**

Tejas-TJ100CPr4 can be configured as add-drop multiplexers (ADM) and terminal multiplexers (TMUX). It can support diverse topologies like point-to-point, Bus topology and Ring topology.

6. **Cross-connect capability:**

Tejas-TJ100CPr4 provides a completely non-blocking 4x4 STM-cross-connect at VC-12 granularity (252x252 VC 12s). The equipment also supports local cross-connect capability between Tributary interfaces without having any interconnection with the main STM-1 signal. This is intended to permit remote provisioning of leased -line services. The equipment support various configurations of Cross-connect Matrix as specified in the ITU-T Rec. G.783.

7. Automatic Topology discovery:

Tejas-TJ100CPr4 has the ability to automatically discover nodes and trunks within the optical domain, then intelligently provision the circuit accordingly. This eliminates cumbersome operator intervention and substantially reduces costs.

8. Miniature size:

Tejas-TJ100CPr4 is one of the most compact STM-1 products available in the market, and provides an optimal solution for installation in 19 and 22-inch rack. Tejas-TJ100CPr4 is only 1U high and has a dense port configuration.

9. Synchronization:

The Stratum-3/G.813 option 1 compliant for timing and synchronization functions. The synchronization of the equipment is in accordance with ITU- T Rec. G.783.

10. Power Monitoring:

Power can be monitored through the optical interfaces

2.7.3 System Overview (CPE)

The Tejas-TJ100CPr4 Service Access Node is an ultra-compact and cost-effective customer premises bandwidth provisioning equipment designed to meet low or medium capacity bandwidth service demands. Tejas-TJ100CPr4 is part of a family of STM-1 Multi-Service Provisioning and Access Nodes from Tejas.

As with all products in Tejas family, the Service Access node also supports end-to-end provisioning and management of voice and data services across all the segments of the optical network - from the customer premises to the core. It combines innovative optical networking software with the intelligence of SDH to deliver a flexible solution to today's service providers.

1. Tejas-TJ100CPr4 Chassis

Tejas-TJ100CPr4 provides miniature size architecture. Tejas-TJ100CPr4 can be installed in both 19” and 23” rack with suitable adapters.

2. Base Unit

It includes aggregate interfaces, management functionalities cross connect and also the following option :

- ***8 x E1 and 2 x 10/100BaseT and 2 x 100BaseFX***
    - E1 is provided using wire wound interface. E1 interface has a bit rate of 2.048 +/- 50ppm and uses HDB3 coding. It is compliant to ITU-T G.703.
    - The Ethernet interface is compliant to G.704.1. It can support lower order virtual concatenation of VC-12Xv; X=1 to 46 and higher order virtual concatenation of VC-3Xv; X= 1 to 3. It supports link capacity adjustment scheme as per G.704.2 and uses RJ45 connector.

- ***E1/DS1 tributary card***

Tejas-TJ100CPr4 can be provided with 21 - port E1/DS1 card. This high-density card provides 2.048 +/- 50-ppm bit rate and complies with G.703. This interface can be used to provide the following services to customers:

  - Leased Lines
  - DIA – Direct Internet Access
  - BIA – Broadband Internet Access
  - E1 PRI
  - L3 VPN
  - POTS application

- ***E3/DS3 tributary card***

Tejas-TJ100CPr4 can provide 1 port E3/DS3 support. Tejas-TJ100CPr4 carries the E3 traffic in an AU4 mode. E3/DS3 ports can be software configured to E3 or DS3 independently on a per port basis. This interface can be used to provide the following services to customers:

  - Leased Lines
  - DIA – Direct Internet Access

3. Aggregate Interface

The aggregate interface can be a 1 or 2 port STM-1 optical interface. This has a built -in 4 x 4 STM-1 cross-connect at VC-12 granularity.

4. Craft, Modem and Ethernet Management Interface

It provides RS-232 craft port, V.24/V.28 modem and 10/100 BaseT Ethernet interface. The Ethernet port is used for NMS purpose. The management information is also provided via this port.

5. Diagnostic, Clock and Alarm

Tejas-TJ100CPr4 allows external 2MHz or 2 Mbps timing signal inputs for synchronizing the input. The synchronization references are in accordance with the ITU- T Rec. G.783. The SOH equipment Terminal multiplexer and Add/Drop Multiplexer has the provision of deriving the timing references from four types of inputs namely:

- Incoming STM-1 signal
- External clock at 2048 KHz as per ITU- T G. 703.
- External clock at 2048 Kb/s as per ITU- T G.703.
- Incoming Tributary carrying timing signal

Tejas-TJ100CPr4 supports potential free contacts for extending the alarms.

6. Synchronization and timing

Tejas-TJ100CPr4 can derive its clock from the following source

- **Line-timed mode**: In this mode Tejas-TJ100CPr4 derives its clock from any one of the E1 tributaries or STM-1 signals.

- **Externally timed mode**: In this mode an external 2048 KHz signal could be used as the clock source
- **Holdover mode**: In this mode, Tejas-TJ100CPr4 uses the stored timing data to control the output frequency for a short duration (of around 24 hrs). Beyond this, it uses its own internal oscillator in a free-running mode

7. Power Supply

Tejas-TJ100CPr4 is powered by a –48 V DC power supply or 230 V AC, which drives the various subsystems in it.

8. Protection features

Tejas-TJ100CPr4 provides the following protection features:

- VC-12 and VC-3 Path protection switching (LO/HO SNCP as per G.841)

  1+1 linear APS (as per G.841)

2.8 APPLICATIONS OF CPE

Tejas-TJ100CPr4 in various configurations like TMUX, ADM and DXC, can be used in the access network to provide Curb/Fibre to the building (FTTC/FTTB). This product is a highly reliable, easily manageable system, which comes at a real cheap price.

2.9 FTTC/FTTB

Tejas-TJ100CPr4 is an ideal platform to provide high-end data and voice requirement of clients. Tejas-TJ100CPr4 can be installed in customer's premise and can provide voice traffic requirement upto 21E1's. Tejas-TJ100CPr4 can provide Ethernet connectivity. In the figure 1. shown below, Tejas-TJ100CPr4 connect to the customer premise and carry the traffic through a STM-1 ring to be terminated in Tejas-TJ100CPr4. Tejas-TJ100CPr4 can then be connected to Central Office Terminal (COT) from where Tejas-TJ100CPr4 can be remotely configured. This architecture provides SNCP protection to the traffic.

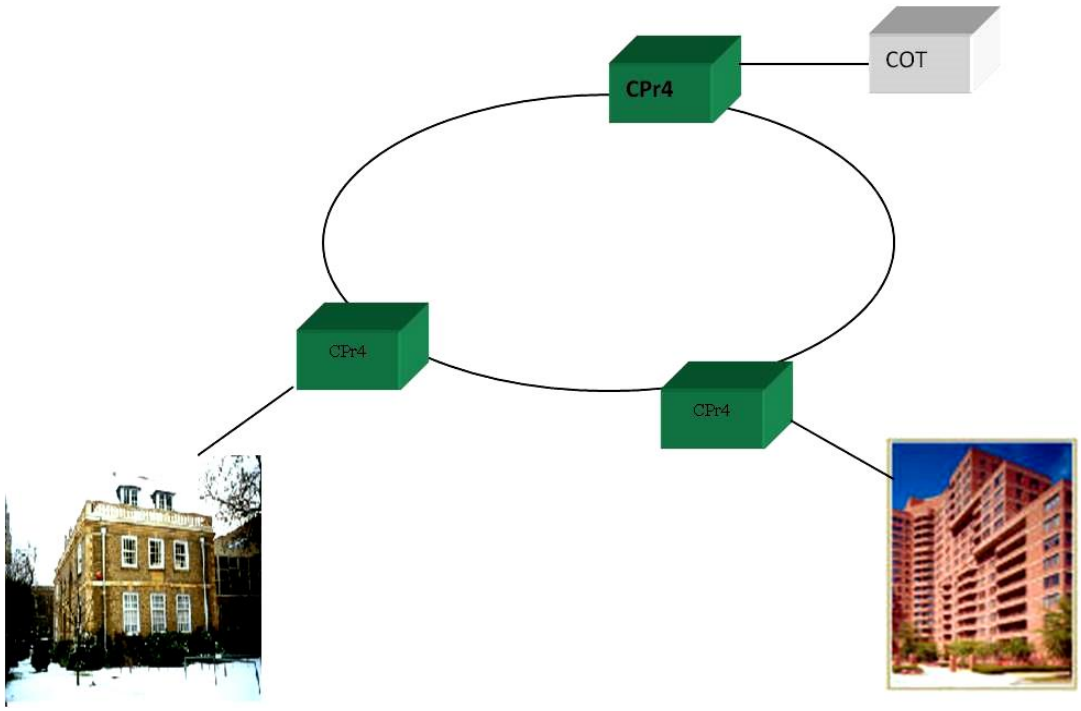


Figure 8: FTTC/FTTB Application

2.10 CELLULAR MOBILE NETWORK

The cellular mobile network is evolving at a very fast pace. To keep up with the rapid pace at which the cellular network is evolving, the underlying SDH network, which provide E1 connectivity to the base stations (BTS) should be able to upgrade at a very fast pace. Tejas-TJ100CPr4 provides the ideal platform for this evolution. From as low as 8 E1s, we could go up to 29 E1 terminations. Tejas-TJ100CPr4 transport the E1 signal reliably from BTS to Base Station Controller (BSC).

One critical feature for cellular networks is the need for precise timing and synchronization. Tejas-TJ100CPr4 allows the user to access timing information from the line, external clock or internal stratum-3 source. In a line-timed mode, it derives its clock from any one of the E1 tributaries or STM-1 signals. In an externally timed mode, an external 2048 KHz or 2 Mbps signal could be used as the clock source. If none of these sources are available, Tejas-TJ100CPr4 goes into a holdover mode when it uses the stored timing data to control the output frequency for a short duration (of around 24 hrs). Beyond this, it uses its own internal oscillator in a free-running mode. Tejas-TJ100CPr4 supports Synchronization Status Messaging (SSM) for timing reconfiguration information.

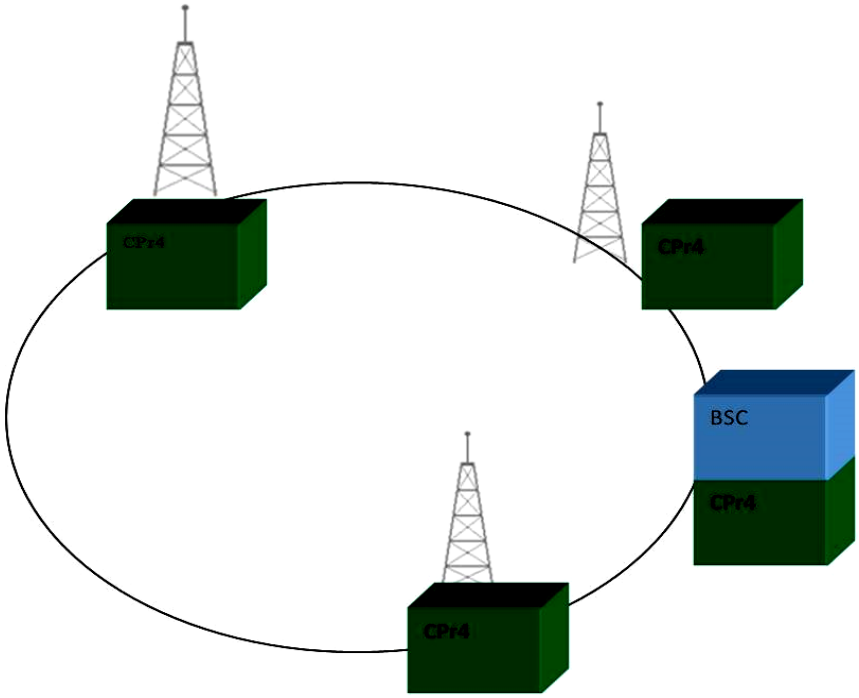


Figure 9: Cellular Mobile Application

The miniature size and low power consumption makes Tejas-TJ100CPr4, an ideal choice for remote integration to base station.

SPECIFICATIONS

e) Network Details

- Topology supported -Linear, Ring, Bus and Mesh

f) Element Configuration

- Terminal Multiplexers (TMUX)
- Add drop Multiplexers (ADM)
- Regenerator

g) Aggregate Interface

- 2 x STM-1 (1310/1550 nm)
- S 1.1, L1.1, L1.2

h) Base Card (Factory fitted)

- 21 x E1 (from the base module)
- 1 x E3/DS3 (from base module)
- 8E1 and 2 x10/100BaseT and 2 x 100BaseFX (from base module)

i) Cross-connect

- 252 x 252 VC-12
- Fully non-blocking

- Line to line, Line to Tributary, Tributary to Line, Tributary to Tributary

j) Timing and Synchronization

- G.813 complaint
- External 2 MHz source
- Internal and external timing interface (2 E1 BITS interface)
- Internal G.703 complaint stratum-3 oscillator
- SSM byte support

k) Protection

- SNCP

l) Maintenance

- Higher-order and lower order POH SDH alarms
- Performance monitoring as per G.826 and G.784
- Local and remote loop-back
- Remote software download

m) Power Supply

- .-48 V dc or 230V AC
- Consumption: < 37 W

n) Environmental

- Operating Temperature: 0° to 50° C
- Relative Humidity: 10 – 90 %, non-condensing

o) Physical dimension

- H x W x D: 44 mm x 432 mm x 300 mm
- 19” or 23” or 600 mm rack mountable

2.11 CONCLUSION

Traditionally, SDH was being used for providing high speed traffic due to its robust architecture and rapid protection schemes. As the traffic pattern changed, there was a need to support multiple services from the same equipment like integrated data transport, better network management etc. This necessitated evolution to Next-Generation SDH.

Next generation SDH/SONET has emerged as one of the most economical and technologically viable solution for transmitting both voice and data over carrier networks. This technology offers savings on investments, power and space to service providers. The latest Multi Service Switching Platforms (MSSPs) and Multi Service Provisioning Platforms (MSPPs) speed up the provisioning of new services and optimize network efficiency through better utilization of its network.

3 MADM AND CPAN

3.1 LEARNING OBJECTIVE

After reading this unit, you should be able to understand:

- MADM Application
- Features of MADM
- CPAN Technology

3.2 INTRODUCTION

The TJ100MC-16MADM belongs to a family of products aimed to provide multi-service aggregation and transport of client services over SDH networks. TJ100MC-16MADM is a 19U high product with integrated E1 services in the base and a hot-pluggable service slot, where users can insert an additional service card. It also has redundant power supply modules enabling power supply redundancy as well as power source redundancy.

3.3 MADM SYSTEM

Figure 1 shows the card slot view of TJ100MC-16MADM and Figure 2 shows the front view of TJ100MC-16MADM.

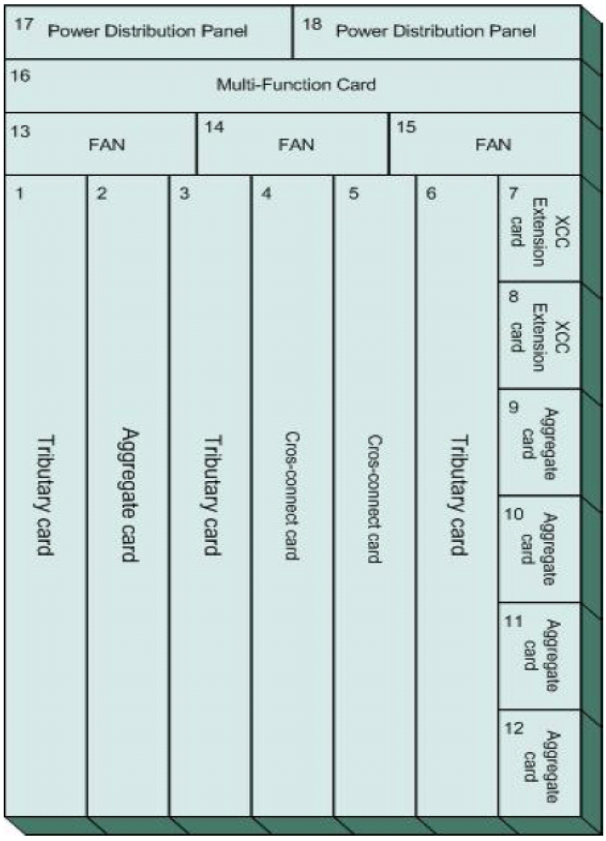


Fig:1 Card slot view of TJ100MC-16MADM

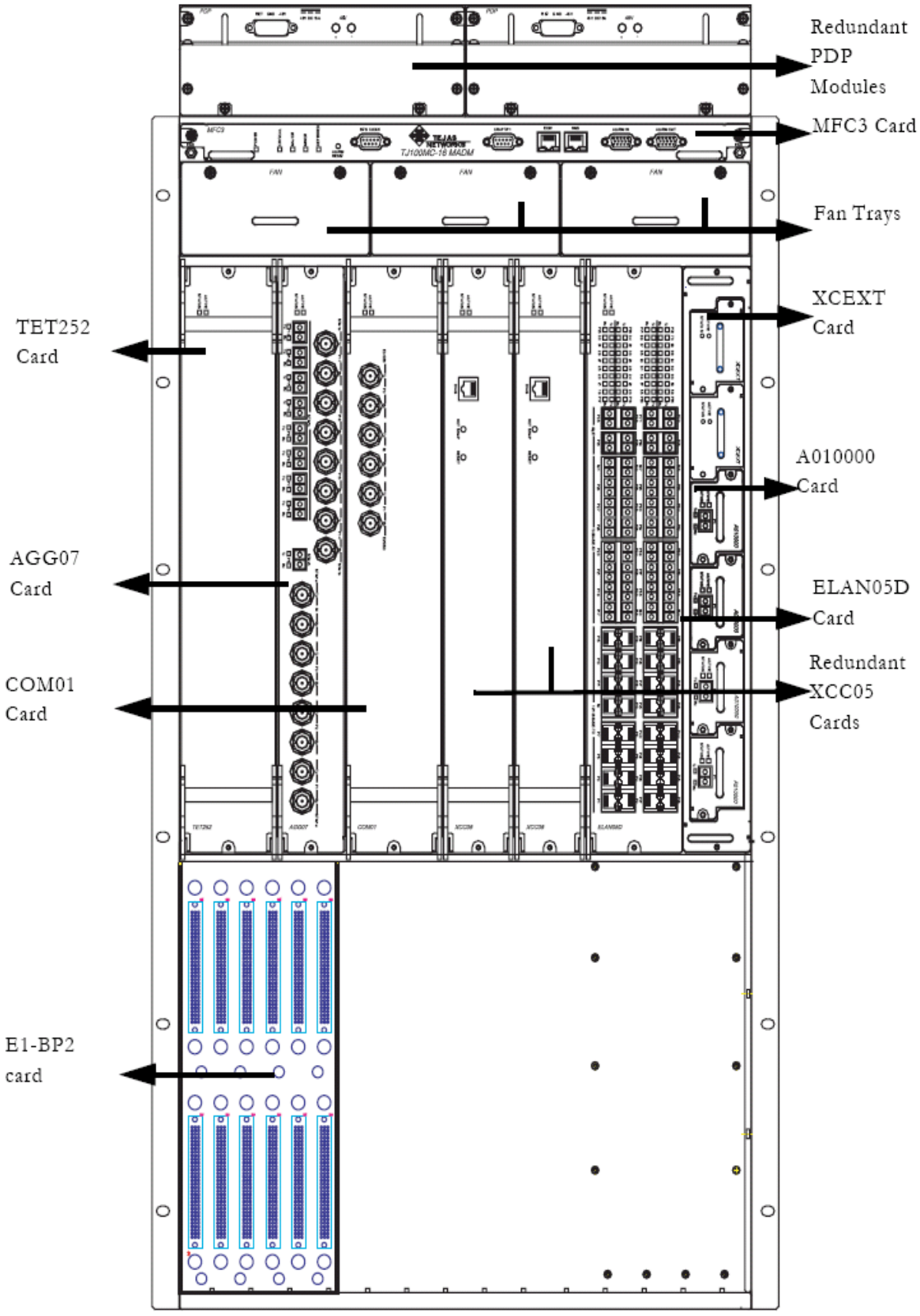


Fig:2 Front view of TJ100MC-16MADM

The power dissipation of fully loaded configuration of TJ100MC-16MADM system is around 500 Watts. TJ100MC-16MADM has redundant power filter units to supply power.

3.3.1 PHYSICAL SPECIFICATIONS

Table-1 gives the Physical specifications of TJ100MC-16MADM.

Table-1

Specification	Description
Chassis Height	930 mm
Chassis Depth	300.0 mm
Chassis Width (including mounting flanges)	482.5 mm
Chassis Width (excluding mounting flanges)	444.5 mm

3.3.2 CARD DETAILS

a) Multifunction Interface Card (MFC3)

The MFC3 in TJ100MC-16MADM is used to implement miscellaneous interfaces. This card supports the following interfaces along with the visual alarm indicators:

- Order-wire interface
- 10/100 Mbps NMS Ethernet interface
- One serial interface for craft/F1 interfaces
- One BITS (**Building Integrated Timing Supply)** clock interface
- Alarm input and output interfaces
- Reset alarm buzzer button

b) Cross-connect and Control Card (XCC05)

XCC05 card is cross-connect controller card designed to implement 20G VC-12/VC-3/VC-4 granularities cross-connects for TJ100MC-16MADM system. This card provides 20G strict sense non-blocking switch capacity. It also has the main processing power to perform APS/IBC routing/inter-card communication/node management etc. functions required for the TJ100MC-16MADM system. The TJ100MC-16MADM chassis has provision to use two of such cards to provide the cross-connect redundancy and processor redundancy. The XCC05 card also supplies system timings/system frame signals to all line cards in the system.

- The card is responsible for protection switching, alarm processing, EOW byte and other OH byte handling, provisioning, node management and disk handling in TJ100MC-16MADM system. TJ100MC-16MADM chassis has two slots for XCC05 to support the redundancy.
- TJ100MC-16MADM provides for a redundancy on the XCC05 card. The master and the slave card configuration can be forced using the hot-swap switch on the front panel of the XCC05. When the hot-swap switch is activated, the respective card renders the peer card as the master and takes over as a slave. The switch is functional only on the card that is active provided another card is available in the stand-by configuration

c) 252xE1, 3xE3/DS3 Card (COM01)

The COM01 card provides E1 interfaces for the TJ100MC-16MADM system. The card maps and demaps these 252xE1 and 3xE3/DS3 channels in SDH mode with AU4 mapping for the cross-connect card to do the cross-connection. The E3/DS3 channels are terminated on this card. The E1 is terminated on E1-BP2 card for which COM01 card provides the physical connectivity.

There are three E3/DS3 interfaces provided through BNC connectors on this card. There is no E1 interface on the front panel of the card. The E1s are connected through the backplane.

The COM01 card provides E1 interfaces to the TJ100MC-16MADM system. The card is used in conjunction with E1-BP2 cards. The Termination card, E1-BP2 provides the physical connectivity to the E1s from the DDF. The E1s are interfaced to the COM01 card through the backplane. The card has transformers to provide electrical isolation. The E1s are given to the onboard **Line Interface Units (LIU**). The E1s are mapped through E1 mappers to the telecom bus for interfacing with the XCC card. The card has its own generation system for clocks required on board. It receives the system timing signals from the XCC card through the backplane.

This card provides line interface to three E3/DS3 channels in both, add and drop directions. The E3/DS3 serial data terminates on LIUs via the transformers on the card. The LIU can be configured to take either E3/DS3 data. The LIU provides adaptive equalization. The data from LIU is passed on to the Mapper which maps E3/DS3 data into AU-4 frame. The Mapper also provides jitter attenuation feature.

d) 252xE1 Tributary Card (TET252)

The TET252 card provides E1 interfaces for the TJ100MC-16MADM system. The card maps and de-maps these 252 E1 channels in SDH mode with AU4 mapping for the cross-connect card to do the cross-connection. The E1 is terminated on E1-BP2 card for which TET252 card provides the physical connectivity. *The card has no traffic interfaces on the front panel*

The TET252 card provides E1 interfaces to the TJ100MC-16MADM system. The card is used in conjunction with E1-BP2 cards. The Termination card E1-BP2 provides the physical connectivity to the E1s from the DDF. The E1s are interfaced to the TET252 card through the backplane. The card has transformers to provide electrical isolation. The E1s are given to the onboard Line Interface Units. The E1s are mapped through E1 mappers to the telecom bus for interfacing with the XCC card. The card has its own generation system for clocks required on board. It receives the system timing signals from the XCC card through the backplane. The card has its local power supply unit to generate 3.3 V. The local power supply unit has input of 48 V.

e) 1xSTM-16 Aggregate Card (A010000) with XCEXT Card

The A010000 card provides one STM-16 interface to the TJ100MC-16MADM system. The optical ports have provision of small form-factor optics and are thus field configurable for the type of interface required. The card can be slotted in any of the line slots 9 to 12 of the TJ100MC-16MADM system. The XCEXT is the extended cross-connect card designed to provide the power, clocks and the control signals to the A010000 cards.

The A010000 provides one STM-16 interface for the TJ100MC-16MADM system. The optical ports have field replaceable SFP modules. This card does framing /de-framing, overhead processing and pointer processing.

• Drop-in replacements for STM-16 optics (S16.2, L16.1, L16.2) by different SFPs

- Complies with ITU-T G.825 specifications on jitter
- Laser ON/OFF control for safety requirements
- Laser optical power, bias, temperature monitoring
- Receiver for optical power monitoring
- Overhead termination
- Pointer processing, performance monitoring and POH termination
- Timing extraction
- Supports live insertion and hot-swap capability

f) 8xSTM-1o/e Aggregate Card (AGG06)

The AGG06 card provides eight STM-1o and eight STM-1e interfaces to the TJ100MC-16MADM system. The card is port configurable for STM-1e for the electrical ports. The optical ports have provision of small form-factor transceivers. There are eight STM-1 optical ports and eight STM-1 electrical ports on the front panel. The eight STM-1 e-interface is provided with BNC type connectors. The eight STM-1o interfaces are provided with LC **(Lucent Connector)** type connectors.

Long haul (L1.1) specifications

Output Power (Maximum)	0 dBm
Output Power(Nominal)	-2.5 dBm
Output Power (Minimum)	-5 dBm
Receiver Sensitivity	-34 dBm (error rate of 1 in 1010)
Receiver Overload	-10 dBm
Optical Path Penalty	1 dB
Section Loss	10-28 dB
Wavelength (Nominal)	1310 nm
Connector Type	LC

Long haul (L1.2) specifications

Output Power (Maximum)	0 dBm
Output Power (Nominal)	-2.5 dBm
Output Power (Minimum)	-5 dBm
Receiver Sensitivity	-34 dBm (error rate of 1 in 1010)
Receiver Overload	-10 dBm
Optical Path Penalty	1 dB
Section Loss	10-28 dB
Wavelength (Nominal)	1550 nm
Connector Type	LC

g) 1xSTM-4 + 8xSTM-1o/e Aggregate Card (AGG07)

The AGG07 card provides one STM-4, eight STM-1 optical and eight STM-1 electrical interfaces to the TJ100MC-16MADM system. The optical ports have provision of SFP optics. The card is port configurable for STM-1e operation for the electrical ports. The card can be slotted in slot 2 and slot 6 of the TJ100MC-16MADM system.

There is one STM-4, eight STM-1 optical ports and eight STM-1 electrical ports on the front panel. The optical interface is provided with LC type connectors for STM-4 and STM-1o ports.

The AGG07 card provides one STM-4 interface for the TJ100MC-16MADM system. The optical port has field replaceable SFP (Small **Form factor Pluggable)** module.

- Complies with ITU-T specifications on jitter
- Laser ON/OFF control for safety requirements
- Laser optical power, bias, temperature monitoring
- Receiver for optical power monitoring
- Overhead termination
- Pointer processing, performance monitoring and POH termination
- Timing extraction from line
- Supports live insertion

h) 16xFE, 16xFX, 4xGE (ELAN05S)

ELAN05S is a tributary interface card, which provides line interface to 16x10/100 Base-T (FE), 16x100 Base-FX (optical) and 4x1000 Base-LH (GE) Ethernet ports. ELAN05S is capable of switching at Layer 2 level.

ELAN05S supports sixteen 100Base-T electrical interfaces. The electrical interfaces are provided via RJ-45 connectors. The RJ-45 module has in-built LEDs.

ELAN05S supports sixteen 100Base-FX optical interfaces. The optical interface is provided via SFP.

Features of this interface are:

- Support for short range, intermediate range and long range optics by changing the SFP module
- Laser optical power, bias, temperature monitoring
- Receive optical power monitoring
- Hot pluggable optic modules

ELAN05S supports four 1000Base-LH optical interfaces. The optical interface is provided via SFP.

ELAN05S supports:

- Sixteen FE (10/100 Mbps) and sixteen FX Ethernet ports of 100Mbps.
- Four GE optical interface.
- Virtual concatenation for SDH, compensating for a maximum of 50ms of differential delay.
- Link Capacity Adjustment Scheme (LCAS) to allow dynamic hitless addition/deletion of bandwidth within a VCG to cater for on demand bandwidth applications.
- Both High order and Low order VCAT.
- ITU-T G.7041, Generic Framing Procedure (GFP) supporting GFP-F.
- Live insertion and hot-swap capability.
- This card maps and de-maps the Ethernet data into the virtual containers of different granularity (VC-12/VC-4) of the SDH frame.

Switching:

1. Basic switching features: 802.1Q, 802.1D, 802.1AD, VLAN (port based), spanning tree protocols

2. QOS features: Four Classes of Service (CoS) offered with
– configurable scheduling modes (SP, SP+WRR, SP+ WFQ)

– configurable queue management policies (tail drop)
– configurable “Trust Modes”(trust 802.1P, trust DSCP, IPTOS)
– ingress rate limiting
– egress rate shaping

3. Access Control Lists (IP, MAC)

4. Hardware based wire-speed Access Control List (ACL)

5. DiffServ (**Differentiated Services)** policies

6. Line rate switching for all packet sizes

7. VLAN de-taggability

8. Port mirroring

9. Supports 802.1
– 1S: multiple spanning tree protocol
– 1Q: simultaneous support for 4094 VLANs
– 1D: vanilla spanning tree protocol
– 1W: rapid spanning tree protocol

10. Advanced packet flow control
– Head of line blocking prevention
– Back pressure support
– Full duplex control IEEE 802.3x

i) 32xFE, 32xFX, 8xGE (ELAN05D)

ELAN05D is a tributary interface card, which supports a total of 64 FE ports which are split as 32x10/100Base-T ports and 32x100Base-FX ports. It also supports eight GE fiber ports (1000Base-LH) Ethernet ports. ELAN05D is capable of switching at Layer 2 level.

The system is divided into physically two separate cards: a base card (ELAN05S) and a daughter card (ELAN05DC).

The base card (ELAN05S) supports 16x100Base-T ports, 16x100Base-FX ports and four GE ports. The daughter card (ELAN05DC) supports the same number of ports as that on base card. The combination of the two cards is the ELAN05 system, which is referred to as ELAN05D.

ELAN05D supports 32x100Base-FX optical interfaces. The optical interface is provided via SFP.

Features of this interface are:

• Support for short range, intermediate range and long range optics by changing the SFP module
• Laser optical power, bias, temperature monitoring
• Receive optical power monitoring
• Hot pluggable optic modules

ELAN05D supports eight 1000Base-LH optical interfaces. The optical interface is provided via SFP. ELAN05D card is connected to the backplane through Xceed connectors.

ELAN05D supports:

• 32 FE (10/100 Mbps) and 32 FX Ethernet ports of 100 Mbps.

• Eight GigE optical interfaces.

• Virtual concatenation for SDH, compensating for a maximum of 50ms of differential delay.

• Link Capacity Adjustment Scheme (LCAS) to allow dynamic hitless addition/deletion of bandwidth within a VCG to cater for on demand bandwidth applications.

• Both high order and low order virtual concatenation.

• ITU-T G.7041, Generic Framing Procedure (GFP) supporting GFP-F.

• Live insertion and hot-swap capability.

• This card maps and de-maps the Ethernet data into the virtual containers of different granularity (VC-12/VC-4) of the SDH frame.

Note : *GE VCGs i.e.VCG-9 and VCG-10 support only VC-4. FE VCGs 1-8 have VC-12 granularity.*

• L2 Physical parameters supported: auto negotiation, flow control.

Switching:

1. Basic switching features: 802.1Q, 802.1D, 802.1AD, VLAN (port based), spanning tree protocols
2. QOS features: Four Classes of Service (CoS) offered with

   – configurable scheduling modes (SP, SP+WRR, SP+ WFQ)
   – configurable queue management policies (taildrop)
   – configurable “Trust Modes”(trust 802.1P, trust DSCP, IPTOS)
   – ingress rate limiting
   – egress rate shaping

3. Access Control Lists (IP, MAC)
4. Hardware based wire-speed Access Control List (ACL)
5. Line rate switching for all packet sizes
6. VLAN detaggability
7. Port mirroring
8. Supports 802.1

   – 1S: multiple spanning tree protocol
   – 1Q: simultaneous support for 4094 VLANs
   – 1D: vanilla spanning tree protocol
   – 1W: rapid spanning tree protocol

9. Advanced packet flow control
   – Head of line blocking prevention
   – Back pressure support
   – Full duplex control IEEE 802.3x

j) Fan Tray Unit (FTU7)

The Fan Tray Unit (FTU7) is used in the TJ100MC-16MADM network element to cool the equipment. There are two fans on this FTU7, one is work (default) and the other protect.

k) Alarm Display Panel (ADP)

The Alarm display panel (ADP) is used to implement consolidated display of alarms, audible indication of the alarms with a provision to reset/turn OFF. This alarm display panel supports for TJ100MC-16MADM system.

3.4 CPAN

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 l00o/o 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.

3.5 CPAN TECHNOLOGY

CPAN is based on MPLS-TP Technology. 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 oftwo 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.

3.6 PROPOSED CONFIGURATION OF CPAN EQUIPMENT IN BSNL:-

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)

3.6.1 DISTANCE BETWEEN TWO NODES:-

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

3.6.2 POWER SUPPLY:-

Type Al /A2- AC Type or DC Type.
Type Bl /B2- DC Type.
Type C- DC Type.

3.7 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 MPLS networks.

4 NGN AND CDOT MAX NG

4.1 LEARNING OBJECTIVE:

- Learn the Basic building blocks of MAX Family
- Requirement of MAX-NG
- Changes to be done while migration to MAX NG
- MAX-NG Components Core/Access and its function
- Learn Basics of NGN Architechture
- Components of NGN

4.2 INTRODUCTION

4.2.1 MIGRATION TO CDOT MAXNG

With the emergence of Voice-over-IP (VoIP) and convergence of services over internet, service providers need to migrate from their TDM based PSTN network to an all-IP network using IP/MPLS technology. Evolution path to next generation network (NGN) for most service providers worldwide is the creation of an optical network at the core. Converged voice, video and data services will be provided on the core network using IP based protocols. Service providers require migration from existing TDM based PSTN network to the all-IP network with minimum disruption in subscriber services.

As almost 50% BSNL's PSTN switching network is based on CDOT DSS technology, CDOT has developed cost effective MAXNG solution on the same line for migration of this entire legacy network to all IP network. The up-gradation approach is to evolve the CDOT DSS technology to Soft Switch controlled VoIP. The MAX DSS systems are being converted to VoIP based systems with minimal hardware replacement and ANRAX is connected to the core nodes of the MAXNG systems through V5AG. Maximum functionality is being implemented in firmware and software to ensure cost effectiveness of the solution. MAXNG solution retains the line termination circuits, which constitute a substantial portion of existing equipment cost, to reduce the migration cost for BSNL.

4.2.2 Introduction To CDOT MAXNG

MAXNG solution is based on de-linking call processing and service logic functions in the MAX DSS systems from media paths and moving them out to an external Soft Switch. The Soft Switch is modular. The Class 5 module implements Local Exchange functions, while the Class 4 module implements the Tandem functions. All calls are presented to the Soft Switch as SIP based calls. The Digital Trunk Media and the SS7 functionalities are also not retained in the switch and are performed by the specially defined NGN nodes viz Trunk Media Gateway and the Signaling Gateway. All the access nodes of MAXNG system interact with the centralized node- Soft switch, in standard SIP protocol. The media (data, voice & video) and its associated signaling messages are carried in the form of IP packets in the network.

In essence, the modifications in MAX hardware and software are confined to handling the

subscriber interface and the remaining call processing is carried out by the other NGN components of MAX-NG solution. This architecture permits retention of existing terminal units for only as long as they are necessary in the BSNL network without having to retain the associated back end processing modules.

CDOT MAXNG also supports ADSL interfaces which can be additionally added to the MAX and AN-RAX systems for providing broadband services at much higher bit rates to the existing fixed lined customers. The data and voice services are carried on the same local loop and are separated at customer premises and Exchanges by using Splitters. With this ADSL approach customer can have one high speed data access along with voice service on same telephone line.

In rural area, CDOT MAXNG solution provides wireless broadband service based on Wi-Max technology.

4.3 MAX NG ARCHITECTURE

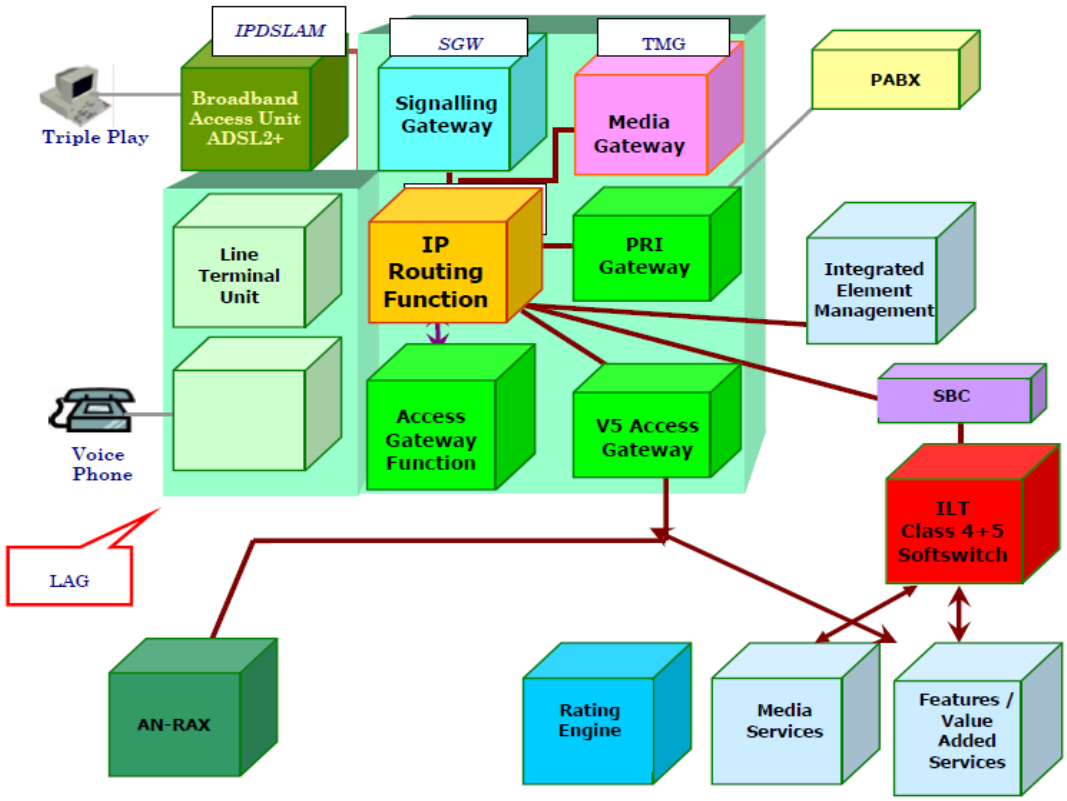
System Overview

The MAX-NG system is an up gradation of the C-DOT's DSS technology based switching systems existing in BSNL network. Switching and Control of call, the core functionality of telecommunication system, is moved to the centralized node, Soft Switch, which works in IP domain. The line access of MAX-NG system to the subscribers is provided by various gateways e.g. Line Access Gateway (LAG), V5 Access Gateway (V5AG), ISDN Gateway (PRIAG), which inters works between TDM domain and IP domain. The digital trunk and SS7 signaling functionality are provided by Trunk Media Gateway (MG) and Signaling Gateway (SG) respectively. All the Gateways are connected to Soft Switch through backbone IP network.

The nodes/components of MAX-NG system are as follows,

1. Soft Switch (Class IV)
2. Soft Switch (Class V)
3. Session Border Controller (SBC)
4. Signalling Gateway (SG)
5. Trunk Media Gateway (MG)
6. Line Access Gateway (LAG)
7. V5 Access Gateway (V5AG)
8. PRI Gateway (PRIAG)
9. Ethernet to E1 Bridge Main Card (EBM)
10. Rating Engine (RE)
11. IP-DSLAM
12. Integrated Element Management System (IEMS)
13. Router

The MAX-NG system and its components are depicted in the following diagram.



LAG	Line Access Gateway
TU	Terminal Unit
AN-RAX	Access Network Rural Automatic Exchange
SBC	Session Border Controller
SGW	Signaling Gateway
TMG	Media Gateway
IPDSLAM	IP Digital Subscriber Line Access Multiplexer

Figure 1: Components of MAX-NG system

4.4 SYSTEM INTERFACES

The components of MAX-NG system are listed in the previous section. Access Gateways generally inter work between the traditional TDM switching domain and packet based IP domain, where core nodes works on packet based IP domain. The physical and logical protocol interfaces of among various components of MAX-NG system is depicted as below,

S. No.	NG Component 1	NG Component 2	Interface
1.	Line Access Gateway	Soft Switch (C5)	SIP
2	Line Access Gateway	SBC	SIP
3	Soft Switch (C5)	SBC	SIP
4	Subscribers	Line Access Gateway	8Mbps TDMs
5	Soft Switch (C4)	Signaling Gateway	SIGTRAN (M3UA)
6	Soft Switch (C4)	Soft Switch (C5)	SIP
7	Soft Switch (C4)	Media Gateway	Megaco/H.248
8	Soft Switch (C4)	Media Server	Megaco
9	Soft Switch (C5)	Media Server	SIP
10	Soft Switch (C5)	Rating Engine / Billing Server	RADIUS
11	Soft Switch (C5)	Feature Server	SIP
12	IPDSLAM	Line Access Gateway	ADSL
13	IPDSLAM	AN-RAX (NG)	ADSL
14	V5 Access Gateway	Soft switch (C5)	SIP
15	V5 Access Gateway	SBC	SIP
16	AN-RAX	V5 Access Gateway	V5.2
17	PRI Gateway	Soft Switch (C5)	SIP
18	PRI Gateway	SBC	SIP
19	PRI Subscriber	PRI Gateway	ISDN

Table 1: List of MAXNG components and its interfaces

4.5 ACCESS GATEWAYS

a) Line Access Gateway Unit

The Line Access Gateway is implemented by upgrading on existing C-DOT MAX (Main Automatic Exchange) by connecting their Terminal Units (TU) to in-house developed NGTJ (NGN Gateway Card) module which shall act as Gateway (Line Access Gateway Unit) for interfacing to IP network. LAG module shall be capable of converting time division multiplexed (TDM) voice circuits to IP packets and vice-versa. These IP packets shall be delivered over Ethernet links to IP network for interconnection to other networks. The LAG hardware thus comprise of basically two major units. One is existing TU hardware and other one is NGTJ card working as LAGU.

The bulk part of existing DSS-MAX hardware is Terminal Unit (TU) hardware in which subscribers lines are connected. In the configuration of a single BM, 16 such Terminal Units (Four

PTUs with each PTU connected with three CTUs in daisy chain mode) are present. TU hardware part of existing MAX exchanges shall be retained.

The logical diagram of LAG is depicted below

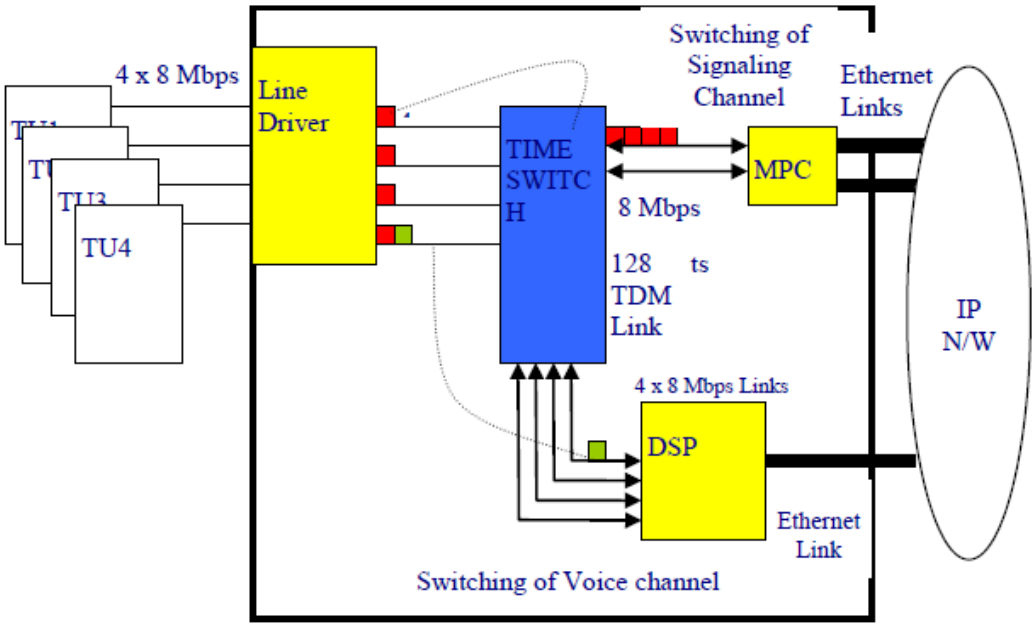


Figure 2: Components of LAG

b) Central Access Control Unit:

The MAX-NG Central Access Control Unit (CACU) Chassis is custom designed Telco grade Card Frame integrating all standalone units into single Chassis for easing the migration from MAX exchanges to MAX-NG and subsequent maintenance of the migrated nodes by the BSNL staff.

One CACU Chassis will be located in the existing MAX exchange racks and is powered from the same dual bus bars as other units in the MAX exchange.

Apart from the pair of redundant Shelf Management and Controller slots for housing the Shelf Manager (SLM) cards, there are 6 slots in the CACU Chassis as given below:

- Four Universal slots housing pair of NGTJ and EBM cards
- Two Aggregation slots for housing the MAX-NG Layer2 Switch (MLS) cards

The NGN Gateway Card is a flexible and versatile hardware designed to support gateway functionality between PSTN and IP networks. It has a processor that handles all signalling related information while the DSP supports various kinds of transcoding, voice packetisation, tone generation, detection etc.

The NGTJ card can be configured as single or multiple gateways amongst the followings:

- Signalling Gateway
- Trunk Media Gateway

- V5 Access Gateway
- PRI Access Gateway

a) Signalling Gateway

The SS7 unit on the trunk side of CDOT DSS is upgraded with signalling Gateway function. The signalling gateway function includes SS7 STP functionality. It serves as the gateway between the SS7 Signalling network and the nodes managed by the Soft Switch in the IP network, under the control of a gateway controller. The Signalling Gateway appears as an SS7 to Soft Switch, in a SS7 network. It handles only SS7 signalling.

C-DOT SG functionality is distributed in SGP (server) & SGL2 (line card) processes. SGP process (containing MTP3, M3UA & SCTP) will be running in active-standby mode that is why two SGPs will have to be run on two SG servers. The server will be deployed centrally at the MAX-NG core location, whereas the SGL2 will be deployed exchange wise in the NTGJ card. The SGL2 process (with MTP2 and MAC protocol layers) will be running in simplex mode, on the same NGTJ card where SGP is running or in different NGTJ card. E1 lines carrying the SS7 signalling messages terminate over the NGTJ card on which SGL2 process is running.

C-DOT signalling gateway line card is deployed in single NGTJ card in CACU, supporting 32 E1s. One circuit in the E1 is used for the signalling, with rest of 30 channels in the E1 utilized for MGW circuits. For every direction, two signalling links will be provided, distributed in two E1s in that direction, so that, if one E1 is down, the signalling will be done over the other E1 signalling link.

b) Trunk Media Gateway

On the trunk side of CDOT DSS, the trunk units are upgraded with media gateway function. Media Gateway is the translation unit between disparate Telecom Network such as PSTN, NGN, 2G, 3G, radio access network or PBX. It converts between different transmission and coding techniques. The C DOT Trunk Media Gateway has audio translation capacity between PSTN and IP. It will terminate channels from circuit switched network as well as streaming media from a packet switched network such as RTP streams in IP Network.

The Media gateway is connected to a PSTN exchange on one side and IP cloud on the other. The IP end of the media gateway can be connected to other Media gateway or other IP entities. Between the Media gateways voice is transmitted and received using RTP protocols. The MGC (Media Gateway Controller) controls the Media Gateway and H.248/Megaco is the protocol used between the MGC and the MG.

c) V5 Access Gateway

The V5 subscribers in AN-RAX architecture are connected through AN (Access Network), to MAX, where a standard protocol V5.2 works in between Access Network and CDOT MAX. The objective of the V5 Access Gateway is to transport the V5 signaling from TDM network to IP network. V5 Access Gateway has two logical / functional components:

- V5 Signaling Gateway
- Media Converter

The V5 Signaling Gateway transports V5 signaling from TDM network to IP network. The Media Converter is responsible for converting the TDM media into IP media (RTP) streams and vice-versa.

The figure below depicts the logical functionality of V5 AG in MAXNG network.

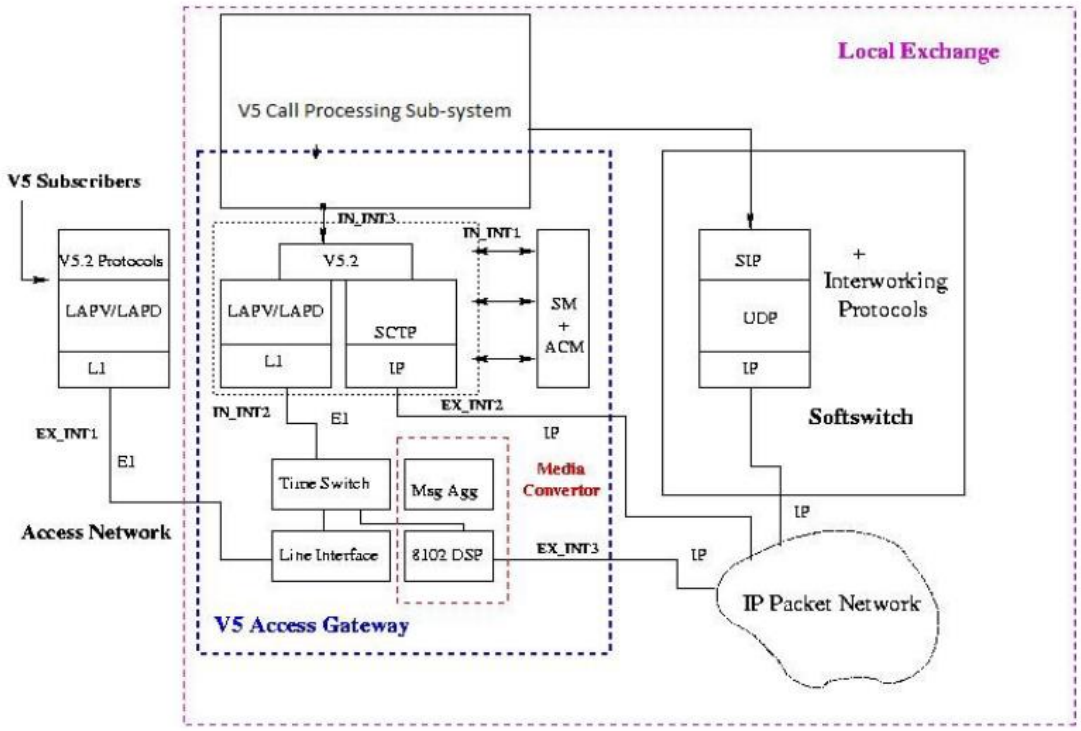


Fig 3: Block and interfaces of V5AG

d) PRI Access Gateway

PRI Access Gateway is used to support ISDN PRI calls in IP network. The PRI Access Gateway will be connected to ISDN PBX at one end and Soft

Switch at the other end. The ISDN PRI calls coming from the ISDN PBX to PRI Access Gateway will be forwarded to the Soft Switch and vice-versa. There will be 2.048 Mbps connectivity between an ISDN PBX and PRI Access Gateway. There will be IP connectivity between PRI Access Gateway and Soft Switch.

PRIAG converts the Q931 calls to SIP based calls and forwards them towards Soft Switch. The Media Converter is responsible for converting TDM media into IP media (RTP) Streams and vice-versa.

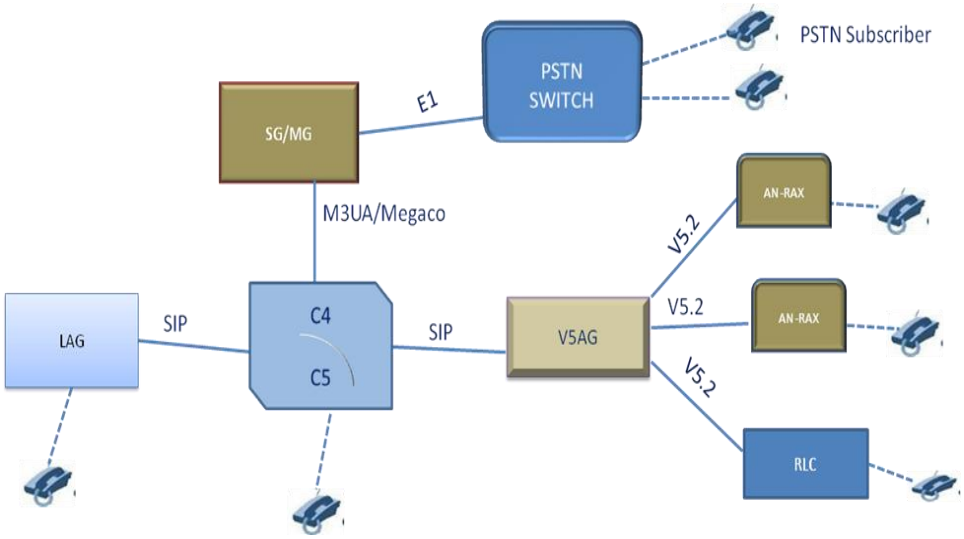


Figure 4: MAXNG Network

4.6 CORE COMPONENTS

4.6.1 Soft Switch

The call processing and service logic functions of the MAX DSS systems are moved out from media paths to an external Soft Switch. The Soft Switch is modular. The Class 5 module implements Local Exchange functions, while the Class 4 module implements the Tandem functions. All calls are presented to the Soft Switch as purely SIP calls.

Class-5 functionality: The Class 5 Soft Switch functionality can be broadly categorized as following:

- Basic call control and call session functionality
- Application server /Feature Server functionality (subscriber features, announcements)
- Intra and inter network call routing functionality.
- Media server functionality for mid call media related features.
- Accounting functionality
- Subscriber data base related functionalities
- Billing server functionality for CDRs and centralized billing.
- OSS agent functionality as an interface to 3-rd party OSS server.

Class-4 functionality: The Class 4 Soft Switch consists of trunk applications. The functionality canbe broadly categorized as the following:

- Switches trunk voice connections between local access switches (Class 5).
- Provides interconnection and call transport between circuit-switched voice networks that are using SS7 call signaling.

- It provides SIP to ISUP interworking.

4.6.2 Session Border Controller (SBC)

The Session Border Controller, as the name indicates, is placed at the border of a network to control call admission to that network. The main purpose of the SBC is to protect the network from overload and malicious call attacks. It also provides signaling protocol inter working, media bridging etc.

CDOT SBC can be logically divided into SBC-SIG (Signaling SBC) and SBC-MEDIA. The SBC-SIG controls access of VoIP signaling messages to the core of the network and manipulates the content of these messages.

The SBC-MEDIA controls access of media packets to the network provides differentiated services and QoS for different media streams and prevents service theft. It does this by acting as an RTP and RTCP proxy.

In the CDOT SBC solution, the SIG and MEDIA components are ported on a single hardware machine where the SIG and MEDIA communicate through internal interfaces. However, the SBC SIG and MEDIA Components can be deployed as individual entities at different hardware locations where they will communicate through a standard H.248 Protocol over the network.

4.6.3 Router

CDOT's MPLS Router a new-generation Edge Router built to address service provider challenges the edge of the Internet. It is designed to meet the data networking requirements of the high speed network. The router can be configured to act as a Very High-end Gigabit Router, High-end Gigabit Router, Low-end Gigabit Router, Aggregation and Access Router. The IP/MPLS Router is designed for a throughput of 80 Gbps and is scalable up to Gbps maximum throughput with Dual-Star switch architecture. CDOT MPLS Router architecture is based on Advanced Telecom Computing Architecture (ATCA) standard. In this architecture, the high availability feature requirements for the system is also taken care of.

The Router will be used mainly in the core network, as it is a very high end router. However, it can work as an edge router also .The Router supports both IPv4 and IPv6.

4.6.4 IPDSLAM (IP-Digital Subscriber Line Access Multiplexer)

CDOT IPDSLAM supports the Asymmetric Digital Subscriber Line - ADSL 2+ towards the subscriber and will use a Gigabit Ethernet interface towards the data backbone. It is used in the Central Office and has 48 ports subscriber line interface

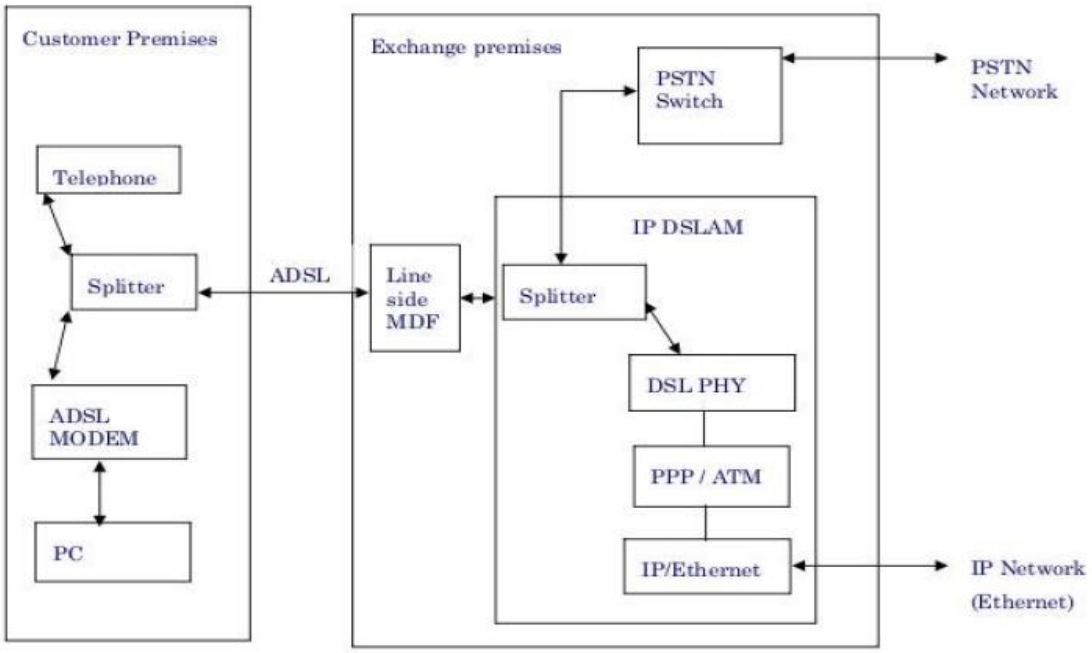


Figure 5: Various blocks of IP DSLAM

4.6.5 Rating Engine

The rating engine is a system used to determine the customer charge for each call. Call charges are normally based on the subscriber type (Normal, prepaid or PCO), type of the day, the time of day, the duration of the call, and any conditions specified in the contract between the subscriber and the carrier.

It receives the CDR (call detailed record) from CDOT Soft Switch and applies appropriate rates to the each call, producing a 'rated CDR'. The rated CDR is then sent on to the accounting systems (Billing Server) so the subscriber can be billed.

The rating engine will also authenticate or authorize Prepaid and PCO subscribers to make calls.

Rating Engine uses the following type data about a call:

- Amount of usage (Duration of call)
- Destination of the call (land line)
- Origin of call/ Location of the caller (land line)
- Special charges (subscriber features)
- Subscriber type (Normal, Prepaid, PCO)

4.6.6 Integrated EMS

The Integrated Element Management System will manage all the product components of the CDOT MAXNG solution. The framework for the element management system can be customized

for any telecom network solution. The IEMS software mainly consists of the following:

- Web based GUI at the operator domain (NGEMS operator interface)
- EMS at manager domain (Management Station)
- Agent at Managed object domain (NGEMS Management agent)

NE Operator Interface consists of GUI for element management and subscription management commands and personal web portal commands.

Management station consist of front end servers for interfacing with operator interface, back end servers/mediation servers for interfacing with management agent and management protocol conversions and database servers for EMS database management.

NGEMS Management Agent consists of XML agent for device management commands (Agent) and a web server for service and subscription management commands.

4.7 MAX CALL FLOW

4.7.1 Intra/inter access gateway (LAG/V5/PRI) call flow

After detection of call origination and collection of digits for called number, access gateways make SIP INVITE message and forward this INVITE message to SBC. SBC forwards this INVITE to C5 Soft Switch, after performing the security functionality. C5 analyses the called number and finds the IP address of access gateway of dialled number. Then C5 sends INVITE message to the terminating access gateway. The ring is fed to terminating subscriber by access gateway and it sends back 180 RINGING message to C5 when called subscriber is free. C5 sends back 180 RINGING message to the originating access gateway. Originating access gateway plays Ring Back Tone to calling subscriber. When called subscriber accepts the incoming call, then terminating access gateway sends back 200 OK SIP message to C5, which forwards it to originating access gateway and media path is established between the subscribers.

4.7.2 Call flow between access gateway and mobile or PSTN subscribers

The calling gateway sends SIP INVITE message to SBC, which in turn forwards the same message to C5. C5 forwards this SIP INVITE message to C4. C4 communicates with Signalling Gateway (SG) and Media Gateway (MG) of destined PSTN network. C4 converts SIP INVITE message into ISUP IAM message (Initial Address Message) and forwards the IAM message to destined SG. SG forwards the same IAM to TAX/IP-TAX and waits for the ACM (Address Complete Message). After receiving ACM, SG forwards it to C4, which converts this ISUP ACM to SIP “183 Session Progress”. This SIP “183 Session Progress” is sent to originating Access Gateway through C5.The Ring Back tone is fed to calling subscriber by the terminating PSTN/mobile network. On answer by terminating subscriber, TAX/IP-TAX sends ISUP ANM (Answer) message to SG which forwards same message to C4. C4 generates SIP “200 OK” & sends it to C5, which forwards it to the originating Access Gateway to indicate that the called subscriber has answered. A bi-directional voice path is established between the calling gateway subscriber and the called mobile/PSTN subscriber.

4.8 CORE SITE ARCHITECTURE

The NGN Core Network handles all Session Establishment, Call Processing and Service Delivery functions centrally. Services offered by the Core Network are accessible to subscribers only via the Access Network (AN). No end users or subscribers shall directly connect to the NGN

Core Network. The NGN Core network handles two types of calls – (a) SIP sessions over IP network and (b) Calls from the PSTN/PLMN .Call processing in the NGN Core is inherently based on SIP (for signaling) and Real Time Protocol (RTP) for media flows.

In the MAX-NG migration process the complete call control/Switching functionality will be moved out from every MBM system to centrally located Core Call Processing server in Core Network i.e. C-DOT Soft Switch. The Core Network is distributed across four zones, where each zone hosts a single cluster of Core Network. Each cluster in turn consists of two members which are two geographically redundant companion sites – (a) Main Site and (b) Disaster Recovery site. The details are depicted in the following table:

S. No.	Coverage Area of Cluster	Main Site Member Location	Disaster Recovery (DR) Site Member Location
1	North Zone	Gurgaon	Lucknow
2	East Zone	Kolkata	Cuttack
3	South Zone	Bangalore	Hyderabad
4	West Zone	Pune	Bhopal

Table -2

The NGN Core network is implemented as an independent MPLS Layer 2 Virtual Private network (L2VPN) on BSNL's existing National Internet Backbone (NIB-II). The VPN implements a distributed Domain Name Server (DNS) with integrated DHCP functionality for naming and addressing within the VPN. All equipment and voice only subscribers are allocated addresses from a pool of private IP addresses within the VPN

4.8.1 Core Network Architecture:

Each MAX-NG Core Network site is a cluster of 4 (four) Blade Server Chassis with each Chassis housing 12 Processing Blades. A total of 48 Blade Servers are equipped at each Core Site which includes spares. An additional spare chassis with no server cards equipped in it is also kept at each site.

All software installed at the Core Network Sites executes on standard off-the-shelf server platforms running Linux operating system.

a) Hardware:

For each core site following are the hardware to be installed:

- Four 19" 42U Racks
- Four Blade Centre Chassis –Telco Grade with KVM HP Blade Servers
- Forty Eight HP Blade Servers
- Two 1U Aggregation Switch with Optical Uplink

- Peripherals: One Network Printer, One Display Panel Monitor, Set of Five 19'' TFT Monitor, USB Standard Keyboard, USB 3-Button optical scroll mouse and mouse pad.

b) Software:

- Red Hat Enterprise Linux (RHEL) Software: To be delivered in one 1 media per Chassis.
- Core nodes Environment software CD/DVDs
- NGN Application Software including NOC (Bundled Software for Subscriber, Trunking and application Servers).

4.8.2 Processing In The NGN Core:

All circles in a zone are served by its processing cluster. Each member of the cluster is a scalable server farm consisting of multiple hardware modules that meets computational and processing requirements of all circles served by the corresponding cluster member. Every member site is equipped with four hardware modules. Each hardware module houses at least 12 servers or server modules. Each server module is configured in a 1+1 redundant mated pair configuration.

Under normal operating conditions, the two members in a cluster operate in load sharing mode i.e. each site in the cluster handles 50% of call processing load in the zone. On complete failure (or disaster) of one member, its load automatically migrates to the other operational member in the cluster. When the faulty member recovers, the migrated load is automatically restored to the originally serving member.

All sites are equipped with the identical server hardware and software release configurations.

The NOC sites will have one hardware module at each site for NOC specific functionality and the hardware module will be connected to the MPLS via the two 24-ports aggregators.

Apart from that there is a spare hardware module kept at each core site.

4.8.3 Call Routing In The Core:

All eight Core Network Sites are members of the MAX-NG VPN and are interconnected using the IP/MPLS network. NGN Core Network Sites handle only SIP/H.248 signalling traffic. Media flows do not come to the NGN Core sites and are routed directly between the end subscribers by the IP/MPLS Networks.

Intra-site calls are handled by the NGN Core Network Site with which the subscriber is registered (called 'Home Site') or automatically by companion cluster member of the Home Site in case of a disaster at the Core Site.

Intra-zone calls are handled collectively by the two companion member sites of forming the zonal cluster. Calls among two subscribers belonging to different member sites of the cluster forwarded directly to the companion member over SIP.

Inter-zone calls are handled collectively by any single pair out of the eight member sites forming the NGN Core network. Calls among two subscribers belonging to different sites in two

different clusters are forwarded directly to the other Core Network Site involved in the call over SIP protocol.

Calls destined for external IP networks e.g. IP-TAX network are directly routed by the Home Site to the external network over SIP-I protocol.

Calls destined for PSTN networks e.g. POI for Service Providers are routed directly by the Class 4 software module of the Home Site through the appropriate Trunk Media Gateway.

PLMN calls can also be handled directly on IP network provided existing MSC in the network have support of IP.

4.9 MAX NG NETWORK DIAGRAM

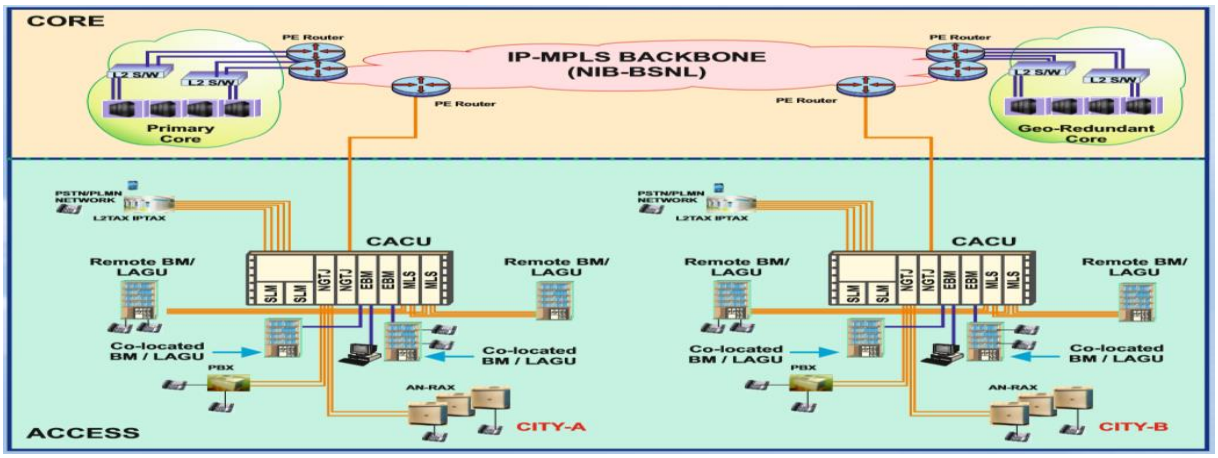


Figure 7: MAX NG Network

4.10 CONCLUSION

All the CDOT MBMs in the BSNL network will be migrated to MAX-NG platform under MAX-NG project. The two main components of MAX-NG system are CORE and ACCESS.

Core component consists of servers in 8 different geographic locations (Bengaluru,Hyderabad,pune,Bhopal,Gurgaon,chandigarh,Kolkata,cuttack).

Some examples of servers are C5 for subscriber data, C4 for trunking/routing data, SBC for firewall protection, Rater for Billing, LIS for lawful interception of calls, EMS for data management access, SSP for interface with SSTP/IP TAX.

Access components are the different Gateways spread across the network. In access components the two units are LAGU(Line Access Gateway unit) and CACU(Central Access Control Unit).

All the line Local BMs and Remote BMs where subscribers are terminated, will become LAGUs. In line BM and Remote BM, BPU and TSU will be removed and replaced by four slot chassis with mother board ie. LAGU. Existing 2 nos. of TSI cards in BM will be used in LAGU and LAGU has 2 nos. of NGTJ cards which convert TDM signals to IP packets. All the trunk BMs, CM/AM,IOP,ADP are not required after migration and are discarded.

One of the spare trunk BM cabinet will be used for fixing CACU chassis. CACU is 8 slot chassis with mother board. CACU provides four types of Gate ways ie. V5GW for terminating AN RAXes, PRIGW for terminating PRI subs, MGW/SGW for E1 termination from PSTN network. Please note that one CACU frame only will be installed per MBM. CACU consists of 2 no.s of NGTJ cards supporting 32 E1s each. Each of these trunks can be configured to function as different gateways as mentioned above. Remote BMs(RSUs) are terminated on CACU. CACU has 2 nos of

MLS cards with 24 ports each for aggregation and uplinking to 1GE port. CACU has 2 nos of EBM cards which terminate E1s from RBMs and do the job of E1 to Ethernet conversion and vice versa. RSU connectivity to CACU has two options ie. By E1 or Ethernet. If STM media provides end to end Ethernet connectivity, RSU to CACU will be on Ethernet and will get directly terminated on MLS Ethernet port for uplinking to MPLS network. If RSU can have only E1 connectivty to MBM site, E1s from RBM will be terminated on EBM card for Ethernet to E1 conversion.

4.11 INTRODUCTION TO NGN

Telecommunication industry is changing at a rapid pace. This change in the industry is basically driven by demand of new services from subscriber's side and urge to reduce CAPEX (Capital Expenditure) and OPEX (Operational Expenditure) from carrier side. Today All most all telecommunication giants are maintaining at least three kinds of basic Network.

PSTN: Public Switch Telephone Network was basically developed and engineered for giving voice connectivity to the wire line subscribers. The network consists of Local exchange/RSU as a part of Access Network and TAXs as a part of core Network. Already huge amount of money has been invested in PSTN setup. Because of tough competition from Mobile & Voice over IP, it is becoming white elephant day by day for the operators. Another fact about PSTN is that most of its equipment are going to exhaust their lives in coming years.

PLMN: (Public Land Mobile Network): PLMN has been developed to provide voice services for wireless subscribers, though in recent times SMS has emerged as killer application for mobile. PLMN includes BTS/BSC as access network and MSC as a core Network.

Data Network: This network was basically designed for accessing remote files and servers for defense people and universities but nowadays nobody can think of living without data network services. The basic and most popular application of data networks is Internet. Other applications include E-commerce, online banking, online gaming, E-shopping, IPTV Video on demand and many more. Data network is an assembly of routers, which are responsible for forwarding information from one end to other.

The interesting fact about the current generation is that these networks have been developed during different time zones. That’s why they are separate network infrastructure. There is no sharing of infrastructure among them. However some gateways are available for inter network communication.

Another disadvantage of the current scenario is that all the three networks are having their own service platforms in other words services are tightly coupled with their networks because of that carrier or operators have to introduce service separately for separate networks.

Because all the three networks are having separate access transport and switching network

service provider has to invest in all the three networks separately. Hence CAPEX increases on the other hand for maintenance of three different networks operational cost also increases. Manpower of the company has to have knowledge of multiple technologies.

NGN Vision: Next Generation Network is the framework where operator will have a common transport network based on Internet Protocol for providing all kinds of telecommunication services. Hence operators will have to install and maintain only a single network which will reduce its CAPEX and OPEX significantly. Moreover service provisioning will become easier because of the introduction of new and intelligent servers. NGN is able to provide Vendor independence because of the standard protocols it uses for interaction with network elements.

4.12 NGN Definition

A Next Generation Network (NGN) is a packet-based network able to provide Telecommunication Services to users and able to make use of multiple broadband, QoS-enabled transport technologies and in which service-related functions are independent of the underlying

transport-related technologies. It enables unfettered access for users to networks and to competing service providers and services of their choice. It supports generalised mobility which will allow consistent and ubiquitous provision of services to users.

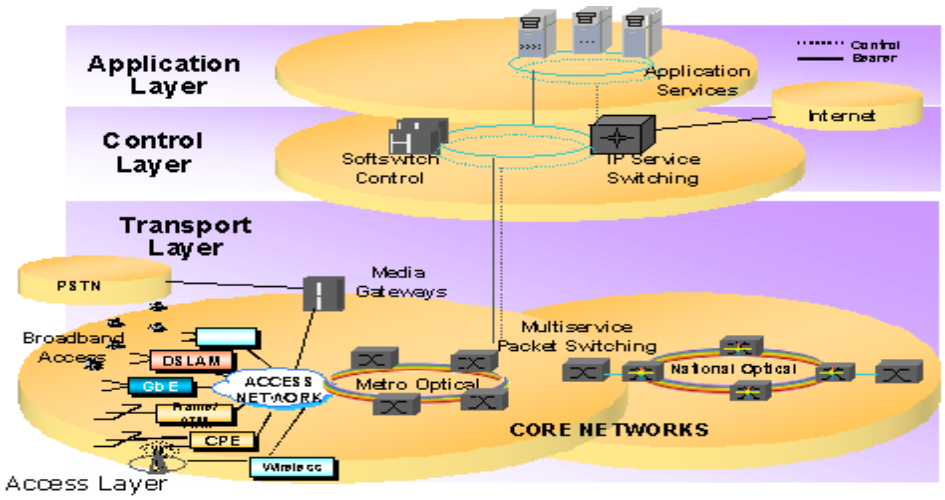
[ITU-T Recommendation Y.2001 (12/2004) - General overview of NGN] Generalised mobility:

At present subscribers are enjoying terminal mobility where network identification system is available in the form of SIM and the same is inserted in the terminal. If user is having that terminal he will be mobile with the identity of the SIM.

In NGN subscriber can have Generalised mobility. Here each individual will have its own network identity in the form of "SIPURL: xyz @ domain name.com". Users have to make registration from his devices against the given URL. Registrar servers of the company will maintain bindings with URL and physical location of registered devices. Users can register for more than one device at a time. With this subscribers need not to depend upon terminal they can login with any device enabled with required protocols (SIP) if they want and call will come to that device.

4.13 NGN ARCHITECTURE

NGN is a layered architecture consisting of transport, access, control and application layer. It is important to note that all the layers are independent from each other. Change in one layer should not affect other layers. **Figure 8 NGN Architecture**



4.13.1 Access Layer:

Access Layers is responsible for direct subscriber attachment function. NGN can support all kind of existing access as well as upcoming access. In fact NGN does not matter about type of access. NGN is capable of processing traffic originated from PSTN, GSM, CDMA, xDSL, WiMAX or any other access system. Depending upon the type of access, protocol conversion and/or media conversion may be required at the NGN Gateways.

Access Layer consists of Gateways. Examples of gateways are media Gateway, Access gateway and Signalling gateway.

Media gateway terminates media, coming from PSTN/PLMN in E1 / STM. Here it is responsible for packetisation of media under the instruction of control layer. After packetisation of information it throws packets to the transport Network. Subscriber can directly be terminated in Access Gateway. All the required configuration of such subscribers should be done at control layer. Access Gateway and Media Gateways are responsible for carriage of Media whereas Signalling gateway is carrying signalling generated by PSTN and informs Control Layer about the signalling in required format.

a) Media Gateway :

The *media gateway* (MG) supports packetized voice and the interface to whatever medium the voice is to be transported on. The MG performs the task of packetizing voice and providing connections from switched circuits (TDM) to packetized circuits (IP, Frame Relay, or ATM). The MG does not necessarily reside at a subscriber premise, but interfaces to equipment located at the subscriber premise. The MG is responsible for media conversion, resource allocation and resource management, and event notifications. It is responsible for reporting events to the *media gateway controller* (MGC) within its zone. Between Media Gateways (MGs) and Media Gateway Controllers (MGCs) the protocol used is **Megaco/H.248**. RTP protocol is used between two MGs for packetized bearer traffic. The purpose of this protocol is to provide communications for call control and call signaling.

Following functions are performed by Media Gateway:

- **Media Conversion**

The MG must be able to provide conversion from TDM circuit-switched connections to ATM, IP, or Frame Relay connections. This includes the packetization of the voice itself. Media processing includes transcoding, conferencing, interactive voice recognition, and other audio resource functions.

- **Resource Allocation**

Resource allocation includes the reservation and release of all resources. It is important to understand that although the MG is responsible for resource allocation and management, it does so under the direction of the MGC. The MGC holds the ultimate responsibility of defining what resources are to be allocated for a call. The MG is capable of providing either point-to-point connections or point-to-multipoint connections (such as in a conference call). The MG must also support voice, data, video, and facsimile.

- **Event Notification** The MG must also maintain the state of all resources and report the state to the MGC. If a particular resource fails, the MG reports the failure to the MGC.

The MGC maintains a state table for all resources within the MGs in its zone.

b) Signaling gateway :

The IETF defines the *signaling gateway* (SG) as being the bridge to the PSTN. It supports STP functions to the network. The SG should be capable of providing conversions between SS7 addresses (point codes) and IP addresses. The addressing in IP signaling networks provides far more flexibility than in conventional SS7 networks. All entities in the SS7 environment are addressed through the use of point codes. The point code administrator in each country issues point codes. When a carrier uses an IP network, the entities in the IP network are addressed by IP addresses rather than point codes. This requires the use of an SG to resolve the addresses from the SS7 network to the addresses in the IP network. For transporting CCS7 signaling information within NGN **SIGTRAN** architecture is used between SGW and MGC.

The routing is based usually on a destination point code and, in the case of ISUP messages. When a database requires additional servers to increase capacity, an additional point code is not required (as is the case in conventional SS7 networks). The new server can be added using IP addressing, and the routing assignments can be made in the SG to ensure load sharing and subsystem management. One of the biggest advantages of launching services in IP networks is the flexibility provided to the carrier. Carriers can develop their own applications deployed on carrier-grade servers. Already many carriers have begun developing creative new services themselves, rather than depending on vendors. This factor alone will greatly enhance the concept of IP networking and provide great benefits to new carriers looking to differentiate themselves from the competition.

c) Announcement server :

Announcement server is within the IP domain itself and contains all the announcements required for various purposes.

d) Access Gateway :

Performs the functions of Media conversion , Codec Negotiation and termination of line side interfaces like phones, devices and PBXs.

4.13.2 Transport Layer

Transport Layer of NGN is based on IP. It can utilize the advantage of MPLS. Transport Layer forms the core of the Network. It basically consists of Routers, which are responsible for carrying traffic originated by access layer. As the same core network is going to be used for all kinds of subscribers enjoying different kind of real time and non real time services, it should be able to make use of band width policies and Qos policies. Operator has to think of managed Network for its subscribers.

It is basically an assembly of routers connected with optical network. Traffic coming from gat ways is properly routed by those routers.

4.13.3 Control Layer

It is responsible of call setup, routing and charging policies and other controls in NGN environment. It consists of call servers where all information of the network resides. These call servers are responsible for setting up, modifying, charging and tear down of the calls.

NGN may work on soft switch principle. It consists of MGC (Media Gateway Controller) as an overall controller and MGs (Media Gateway) for termination of traffic. MGC is basically a server and it is having all the necessary information of network MGC instructs MGs for establishing the call. SIP (Session Initiation Protocol) is used for communication between two MGCs and between a SIP enabled user terminal and MGC.

Under the control of MGC, MG performs different call related tasks such as connection, modification and termination of media streams, packetisation of media etc.

Softswitch (Media gateway controller) :

The MGC is responsible for controlling all the MGs within its zone. As previously mentioned in the description of the MG, the MGC performs a number of call control functions that are typically found in the call control portion of a legacy switch. This includes determining and controlling signals used on specific circuits, such as ringing and busy tones. The MGC also determines the QoS required for any one connection at the MG. In short, the call handling is performed at the MGC, rather than at the MG itself. This enables carriers to deploy less expensive equipment at the edge of their networks.

4.13.4 Application Layer

It is responsible for OSS/BSS. Enhanced services to the subscribers will be provided with the help of application servers. It may include prepaid servers, announcement servers, Service servers etc. Hence NGN is making service separation from Network. Any service can be introduced with the help of server at any time without any modifications in the control, transport or access.

Application Server (or Feature Server):

Provides service logic and user (or customer) services that are not directly hosted on Softswitch. Due to open architecture and standards it can be a third party product.

4.14 PSTN VERSUS NGN:

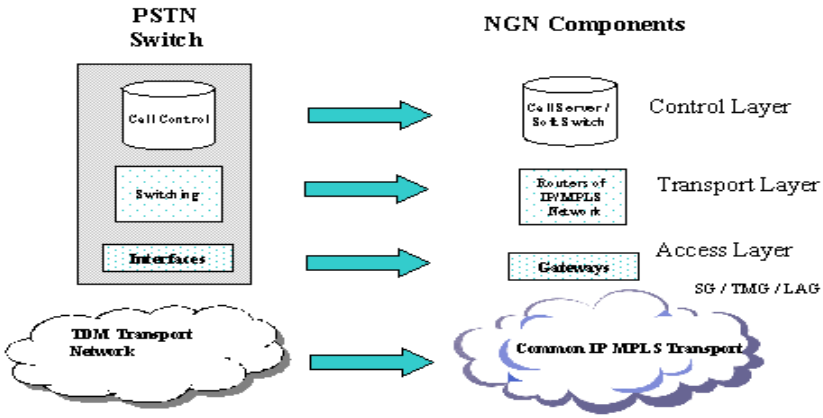


Figure 9: PSTN versus NGN

- As shown in above figure PSTN Switch consists of interface, Switching and call control. All the functional entities are shown in one box that means they are interacting with each other using proprietary protocol. Where as in NGN model entities are interacting using standard protocols.
- In PSTN each node should have call control separately whereas NGN may have centralised call control
- PSTN is dedicated network for providing voice services to the subscribers whereas NGN is developing with the idea of carrying all kind of traffic over it.
- PSTN is working on circuit switched principle whereas NGN is working on Packet switching.

- PSTN provides excellent quality of voice and it is tested in all conditions whereas NGN will provide good quality of voice and it is to be tested in adverse network conditions.
- In PSTN service integration is very difficult and because of vendor dependent technologies it is difficult to introduce services easily. Whereas NGN shall be able to provide separate service platform for introduction of services without depending upon underlying network related technologies.

It is very much clear that NGN is a network, which can help operators for their needs. But at the same time operators have to invest in NGN wisely because of the fact that some past technologies like ISDN made so many promises but could not meet them properly. Same should not happen to NGN. Instead of depending upon any specific model (like Softswitch or IMS), NGN should be treated as an approach towards complete IP communication. Operators should have flexibility for implementing any kind of model on need basis.

4.15 PSTN TO NGN MIGRATION

PSTN is a circuit-switched based telephone network, which has been evolving over the last 50 years. Today majority of service providers around the world are using PSTN for providing telecommunication services. Success of Internet has led to the deployment of huge packet-switched networks worldwide to carry voice, data and video resulting in OPEX and CAPEX savings. Next generation network (NGN) is the future network for all types of communication services. The necessity of migration from PSTN to NGN is for:

- Network convergence – single network for voice, data and video
- OPEX and CAPEX savings
- New service opportunities

Migration from PSTN to NGN should be based on maximum possible reuse of existing equipment and replacement of components which are near the end-of-life.

Migration from PSTN to NGN involves:

- Replacement of TDM network elements in a phased manner
- Maximum reuse of existing resources
- Use of open and mature standards
- Convergence of access and backbone network
- Continuation of existing network capabilities and services with same or comparable QoS and security
- Interworking between different types of networks
- Addition of new services

It is true that NGN can provide operators, a better solution for their revenue models. But it is not possible for incumbent to replace their existing network overnight and installed NGN. It will take time to migrate from PSTN to NGN. During that period of time both the networks will coexist. Operators have to follow some strategies to implement NGN in their network. First of all we will take a closer look to PSTN and NGN model. Different phases for migration of PSTN to NGN are given below. However, the sequence of implementation depends on the business and strategic needs of a service provider. Different phases can be combined for implementation.

4.15.1 Phase – I : Migration of TAX :

In first phase of implementation operators can replace their transit network with softswitch architecture. Operators can make use of the SoftSswitch architecture for the National Long Distance calls.

At present Local Exchanges (LE) are connected with TAX for Long Distance Calls in turn TAX is connected with PSTN backbone which is carrying the traffic originated by subscribers of Local Exchanges. The setup of TAX and PSTN take care of signaling as well as voice media originated from LE subscribers.

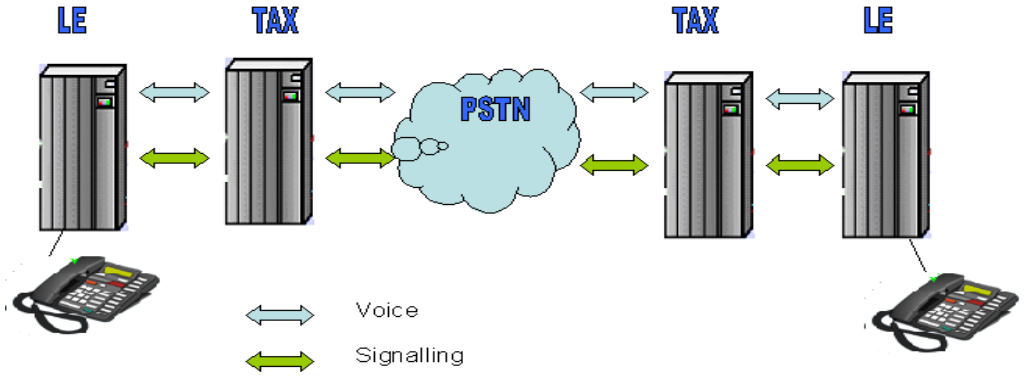


Figure 10: Current Setup for PSTN

In first phase of migration as discussed TAXs can be replaced by NGN components. For that Local Exchanges have to be connected to Trunk Media Gateways for transportation of Media and will be connected to Signalling Gateway for signaling transport.

Here:

- Normal analog or ISDN subscriber dials the called party number
- PSTN creates CCS#7 Signalling and sends it towards Signalling Gateway.
- Signalling Gateway converts CCS#7 messages to compatible SIGTRAN messages and sends it towards Media Gateway Controller or SoftSwitch.
- After receiving signaling from SG, MGC instruct concerned originating and terminating media gateways to prepare connection for the desired call and at the same time through SG of destination PSTN side MGC / SS inform the destination PSTN exchange about the call. When all the condition for the call is met, MGC instruct concerned originating and terminating media gateways for finally maturing the two communications. Both the MGs convert received TDM voice to packets using Real Time Protocol and vice versa. All the communication between MGC and MG is in H.248 protocol.
- The disconnection of the call is informed by the concerned SG to MGC/SS and then MGC/SS instructs both the MGs to disconnect the RTP link.

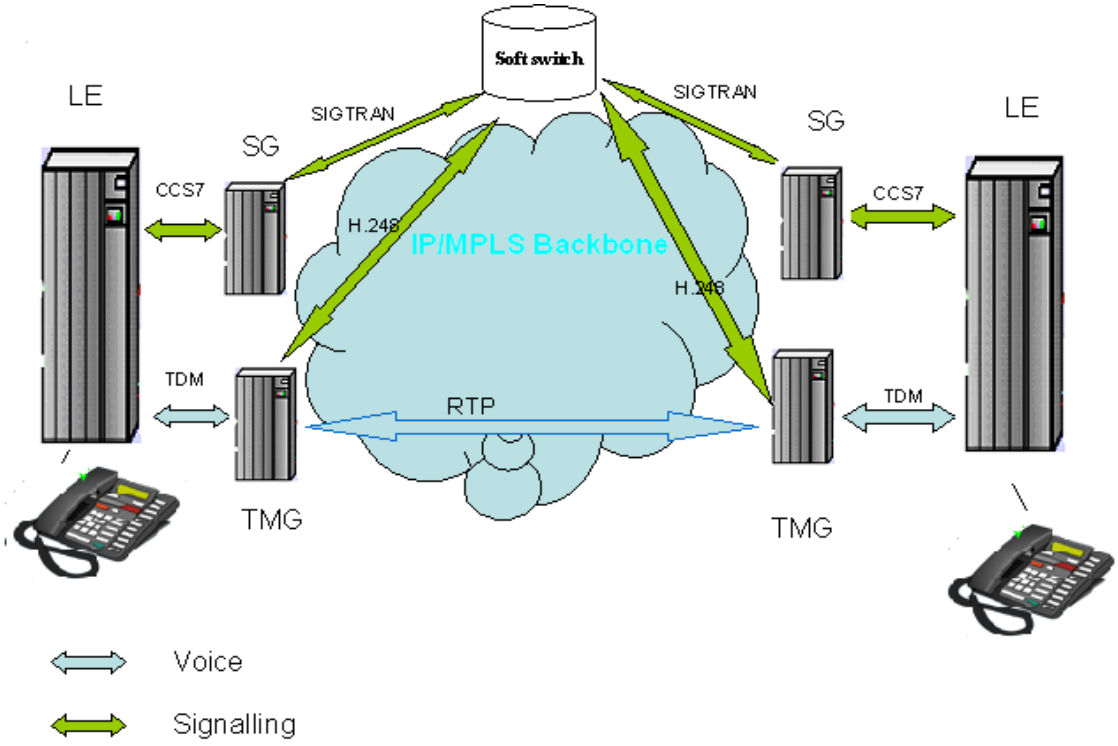


Figure 11: Phase I – Migration to NGN using TAX replacement

4.15.2 Phase II: Migration of Local Exchanges

In this phase Local Exchanges (LEs) are replaced by the Softswitch and Access Gateways (AGW) with same services. Softswitch with local features will be used as a common control element for class 5 applications. Access Gateways (AG) provide various types of access to the subscribers (e.g. PSTN, ISDN, V5.2, xDSL etc.) and connects them to IP core network. AGs may be configured for various class 5 applications depending on end user topology, density, service requirements, etc. Depending upon the size of the network, a single softswitch with class 4 and class 5 applications may be planned.

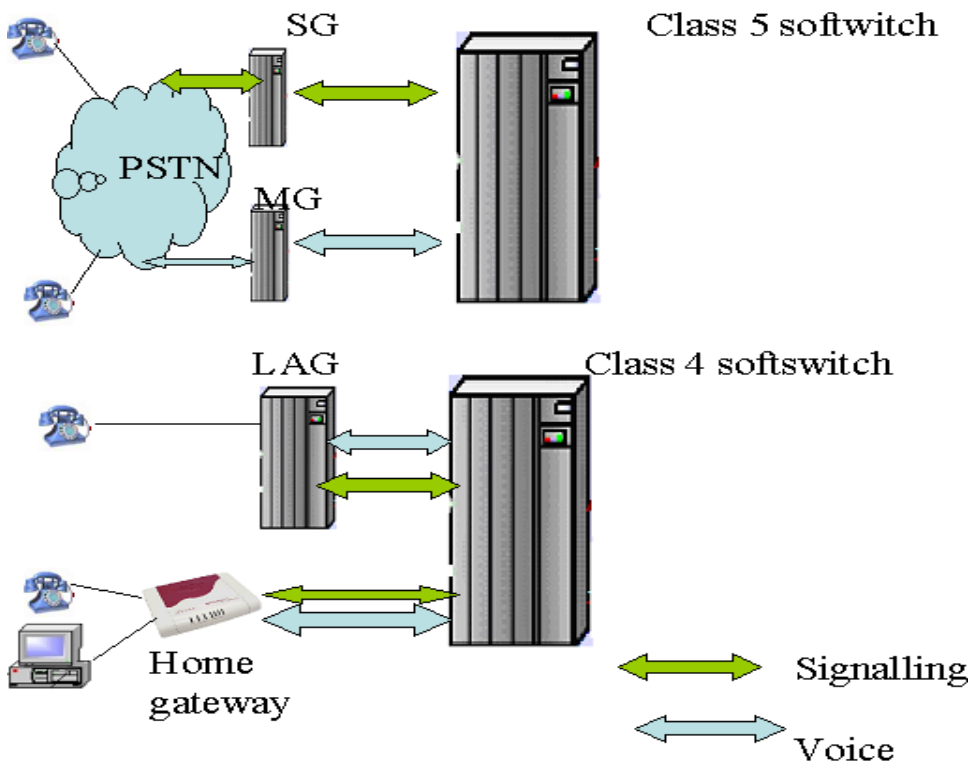


Figure 12: Phase II: Migration of Local Exchanges

4.15.3 Migration of Services

While migrating from PSTN to NGN, all PSTN services with same equipment, same look and feel should be provided. Two PSTN networks connected via NGN transit network should be able to provide transparency to all bearer services. The existing IN services are provided though SCP. The softswitch interacts with SCP through Signalling Gateways, using Intelligent Network Application Protocol (INAP). In future, new IN and value-added services may be implemented using Application Servers (AS) which will be accessed by softswitch via Session Initiation Protocol (SIP).

During the migration process new applications may be developed. These new applications along with existing IN services (including prepaid and number portability) will be given by Application Servers in near future.

It is possible to have complete migration to NGN where end to end traffic will be IP and this migration may use another alternative approach which is known as IP Multimedia Subsystems (IMS).

This process of migration depends upon many factors one of the factor is Availability of efficient IP backbone network. Operators have to build a redundant and bandwidth efficient IP backbone network for NGN. Because all kinds of traffic including voice, data and video is going to be transported using IP network, it should be ensured that IP network is available for all the time and it can provide QoS based on applications used by subscribers.

4.16 CONCLUSION:

It is understood that in near future operators will migrate to complete IP communication. But it is to be ensured that during this migration should be smooth. At present there should not be any hurry to implement NGN immediately. Operators first work out for building reliable IP backbone and then process of migration can be started.

5 VSAT AND DSPT

5.1 LEARNING OBJECTIVE

After reading this unit, you should be able to understand:

- Concept of VSAT
- Network Architecture of VSAT
- Advantages of VSAT
- Application areas of VSAT
- DSPT Services and Architecture

5.2 INTRODUCTION

Volatility and speed of communications is one of the challenges currently facing thousands of companies operating in remote or hard-to-reach places. Because of this, it is common today that many companies choose to implement in their process flow, satellite systems that allow them to have an agile and independent communications network; for this reason, there are endless solutions for this need in the market

VSAT broadband is similar to cable and DSL services for your computer which provides high performance two-way connectivity for Broadband access as well as offers value added satellite based services (content delivery) with the added advantage to serve remote and inaccessible areas of country and a cost-effective networking solution for Corporate bodies, Training Centers, Hospitals, Stock exchanges, Banks, Technical institutions, Government, military etc. with high level functionality and hence VSAT broadband is another option for a high-speed Internet connection that is considered to be one of the best technologies available today.

VSAT (Very Small Aperture Terminal) consists of a terminal with very small dimensions which is able to provide bi-directional communication connectivity. The VSAT technology provides value added satellite connectivity able to transport data for Internet/Intranet applications, Video and Voice over IP, and in general public or private networks.

5.3 WHAT IS V-SAT?

VSAT stands for Very Small Aperture Terminal. VSAT is a device (also known as an “earth station”) that is used to send and receive wireless transmissions by satellite. Millions of VSATs are in use around the world, allowing people to send and receive two-way data, voice or video transmissions by bouncing signals off of satellites in orbit.

The "very small" component of the VSAT acronym refers to the size of the VSAT “antenna” or “dish” - typically about 2 to 5feet (0.55-1.8 meters) in diameter for Ku-band systems - that is mounted on a roof, attached to a wall or placed on the ground and is capable of both receiving and sending satellite signals. VSAT systems can be designed to serve both broadcast and interactive applications whether data, voice or video, which are now being served by terrestrial lines and can be operated in either single or multi-user environment

VSAT Equipment is mainly consist of-
ODU (Outdoor Unit)
IDU (Indoor Unit)

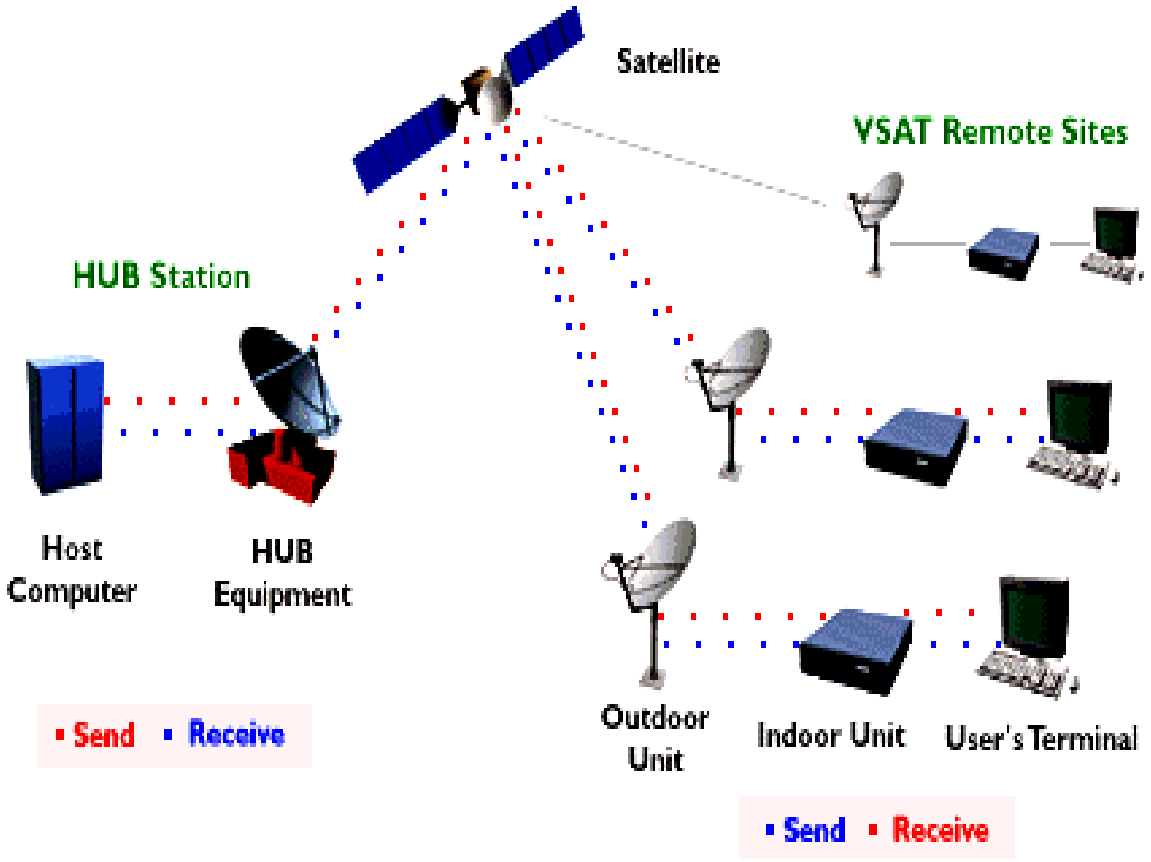


Figure 1: VSAT Network

5.3.1 OUTDOOR UNIT (ODU):

The outdoor unit system is specifically optimized for use with the Indoor Unit and consists of:

- Transmit / Receive Dish (Antenna) (0.75m - 1.8m)
- Block Up-converter (BUC) (1W-2W)
- Low Noise Block-Down-converter (LNB)
- Feed Assembly

BUC: - Block up-converter converts incoming I.F. (from IDU) to R.F. transmitting frequency, amplifies it and passes it to feed.

LNB: - LNB amplifies incoming R.F.(Radio Frequency) from feed using low noise amplifier, converts it to I.F. and passes it to IDU

5.3.2 IDU (INDOOR UNIT):

On receiving side, converts I.F. (Intermediate Frequency) from ODU to base band signals which may be data, video or voice. On transmitting side, converts base band signals to I.F. and passes them to ODU. I.F. is generally in L band. R.F. can be in C, Ku or Ka bands.

The indoor unit may be a small desktop box, or it may be (as in this case) a network module integrated with a router providing VSAT network connectivity just as any other network module and provide flexible Interfaces like Ethernet 10/100 BaseT (RJ45), USB with maximum download speed of up to 4 Mbps and maximum upload speed of up to 2 Mbps.

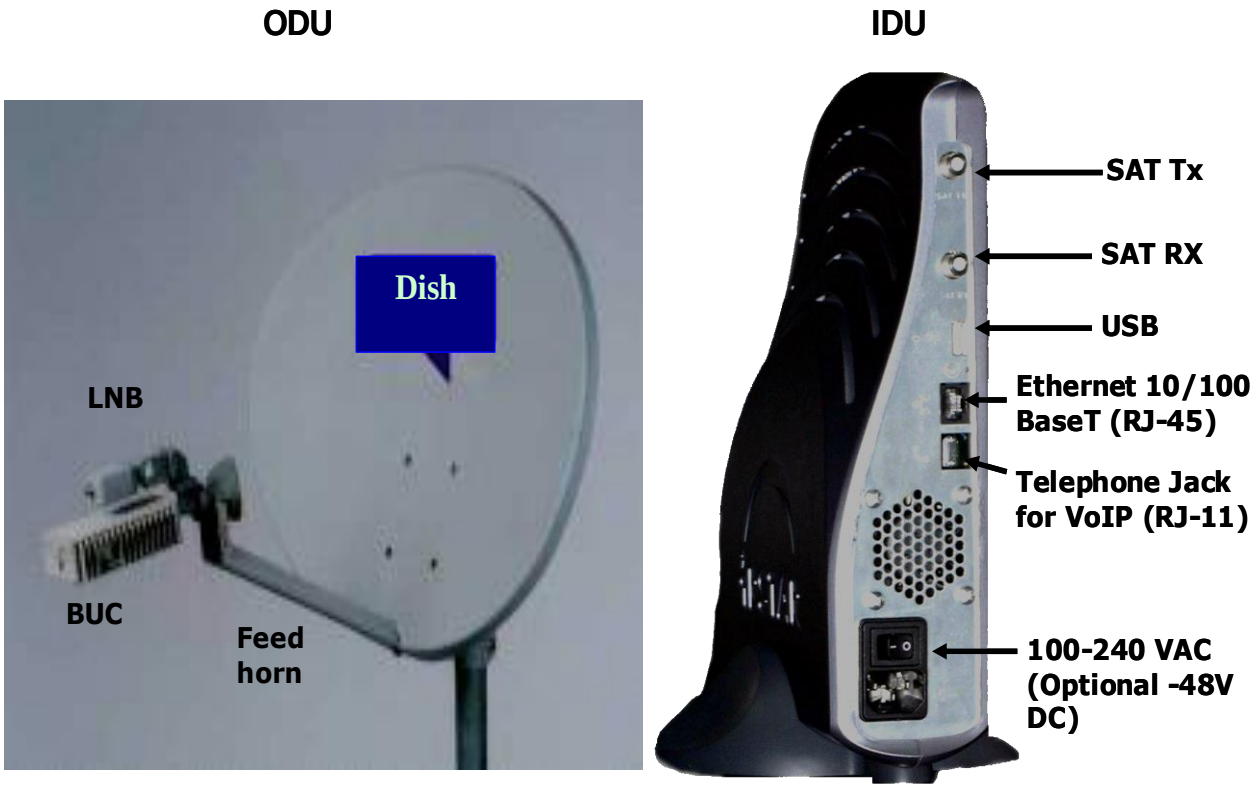


Figure 2: ODU & IDU

5.4 WHY V-SAT BROADBAND NETWORKING?

V-SAT is generally a very cost-effective medium for broadband data communications, and has particularly strong advantages in ubiquity (VSAT is available at any location) and multicast support (sending the same data to tens or thousands of locations at once). One key advantage of VSAT broadband connections is that service availability is not limited by the reach of terrestrial telephone or cable infrastructure. A VSAT earth station can be placed anywhere - as long as it has an unobstructed view of the satellite. This type of Internet connection is great for areas that are rural or are perhaps underserved by reliable Internet Service Providers. In areas like this, new Internet service capabilities are often not cost-effective. Many of these areas cannot afford to have Internet service that does not have outages. Internet services in these types of areas can also be expensive and the ISPs do not often have the latest technology to offer to their subscribers. VSAT broadband is a way to have the latest technology without having to go through a local ISP. This also serves to make VSAT an ideal choice for WAN backup and disaster recovery. Because VSAT completely avoids the local area wire-line infrastructure, it is effectively able to avoid even large-scale local outages or disasters.

A satellite network can be installed and made operational within a week since miles of cable need not be installed. And V-SATs are available in remote locations since it dose not need the infrastructure of a telephone exchange to be present.

“Suppose a Railway department needs to expand its business by deploying 100 new reservation counter within a week, can you imagine the time it will take to wait for leased lines? In such case, V-SAT Broadband connectivity is the best Option.”

5.5 FEATURES BROADBAND V-SAT SYSTEM OF BSNL:-

- Maximum Trans / Receive Data up to 2 Mbps / 4 Mbps with 10/100 Mbps Base-T Ethernet interfaces.
- Supports all IP V4 protocols
- Shared and customized Bandwidth for customers requirements (i.e. dedicated or shared Bandwidth)
- Supports Video Conferencing
- Built in GRE Tunneling
- Dynamic Link Allocation (DLA) technology which automatically adjusts modulation, coding, and gain based on the link environment (such as during rain) to achieve maximum availability
- VPNs can be created with VSAT Network, MLLN nodes, MPLS nodes of BSNL
- VoIP telephony with add on ATA (Analog Telephone Adaptor)
- Transparent to IP Sec protocols
- Embedded CPU Turbo Product Coding
- Dynamic Link Allocation (DLA) Support (unique to BSNL Gateway, which no other VSAT service provider can support in India as on date)
- Connectivity to Broadband Internet

5.6 BROADBAND V-SAT ARCHITECTURE:

V-SAT networks can be arranged in point to point, star, mesh, star/mesh, and broadcast configurations. The preferred arrangement depends on the kind of information flow the network will service. A point to point network allows two-way communications between two VSAT sites. A star network allows any number of VSAT sites to have two-way communication with a central hub. A mesh network allows two-way communications between any VSAT sites in a network. A central hub is not necessary. Each site communicates to another site with a single satellite hop.

VSAT Broadband (Ku band VSAT) networks of BSNL designed in a hub-and-spoke fashion as shown in fig. 3, with customer locations connecting directly over the air to a central “hub” facility. The equipment at a customer site is a VSAT receiver/router (similar to a DSL or cable modem), attached to a small dish mounted on top of or outside the building. At the central hub facility, a large dish and sophisticated hub RF components receive and transmit to the remote sites, and route information to and from the Internet or private networks via leased line.

Internet router is connected to BSNL National Internet Backbone using multiple 2 Mbps leased line. All Remote VSAT locations are having private IP so that remote VSAT users can connect to Internet.

MLLN customers will connect directly to this routers using lease line and they will be able to access the VSAT remote terminals. Customers may take 64 kbps or multiple of it for their main office connectivity.

MPLS: It will be connected to BSNL MPLS cloud using multiple 2 MB lease lines. MPLS router will work as CE routers for the MPLS cloud.

BSNL’s Ku Band HUB (Earth Station) at BANGALORE consists of :
Satellite antenna of 8.1 m – Cassegrain feed type.
Ku Band RF equipment and its control systems.

GATEWAY Networking Equipment with interfaces to Terrestrial Networks like MLLN, MPLS and NIB.

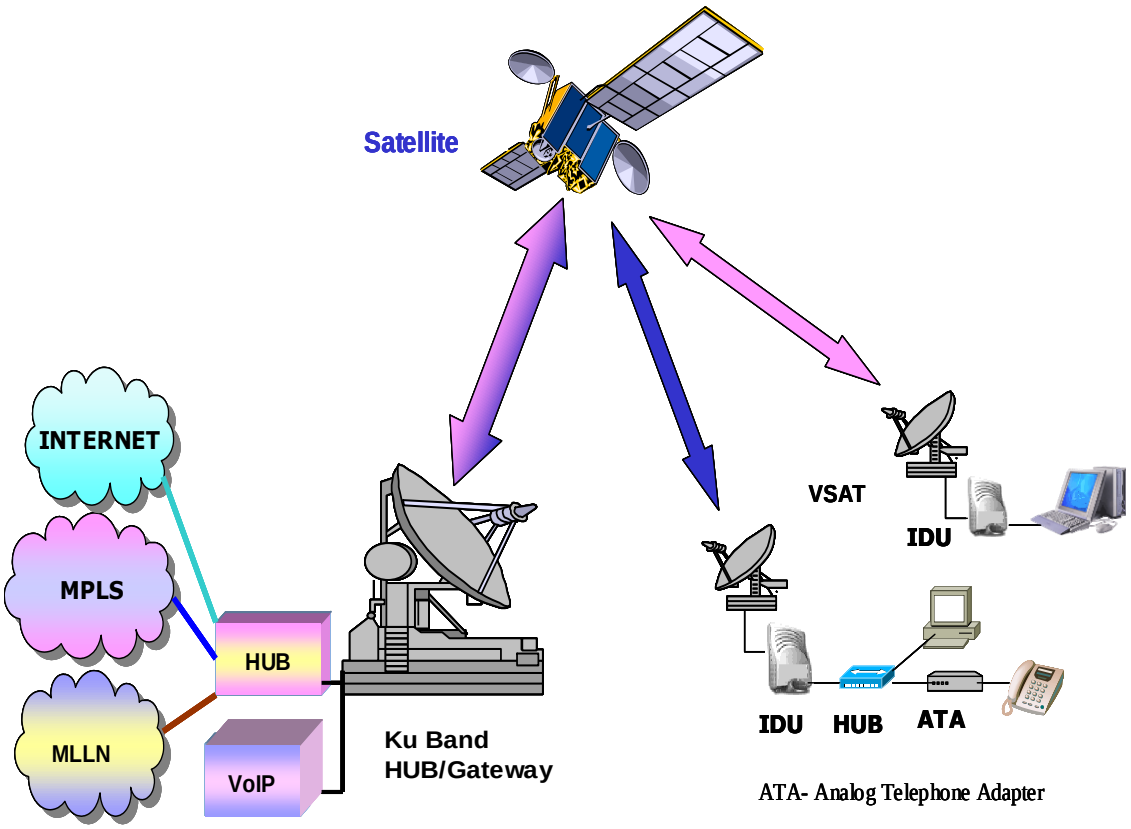


Figure 3: Ku band V-SAT ARCHITECTURE

5.7 V-SAT SERVICES OFFERED

The V-SAT Broad VSAT network allows secure, reliable and cost effective data, voice and video transmission and enables an organization to deploy nationwide different services over IP using the shortest time span.

- LEASED LINES Through V-SAT on IP PLATFORM: 4Kbps onwards
- High speed Broadband Internet
- VPN Networking
- VOIP Telephony
- Facsimile
- Telemedicine
- E-learning
- IP multicasting
- Video conferencing
- Video streaming
- Facsimile
- Distance Education
- Banking
- E-learning
- On-demand services for WAN backup/disaster recovery etc.

5.8 ARCHITECTURE FOR HIGH SPEED BROADBAND ACCESS USING KU BAND VSAT

As shown in fig. 4 V-SAT (User Terminals) are capable to provide similar broadband and high speed Internet capabilities available on terrestrial lines anywhere in India i.e. download speed of up to 4 Mbps and maximum upload speed of up to 2 Mbps.

It delivers bandwidth on demand allowing efficient use of bandwidth making it ideal for broadband access rollout to Small and Medium Enterprises, Internet Cafes, apartments and individual users. It allows dedicated or shared bandwidth to match the user's requirement. It fully supports standard Internet connection and any IP applications. VSAT broadband offers top of the line VPN encryption for the security of your personal information and data. They also offer full services for things like web hosting, net meeting, etc. A public IP address is assigned to both the VSAT network module and the router satellite interface. Network Address Translation (NAT) is implemented on the Ethernet interface of the router, so that multiple clients can be connected and use the service.

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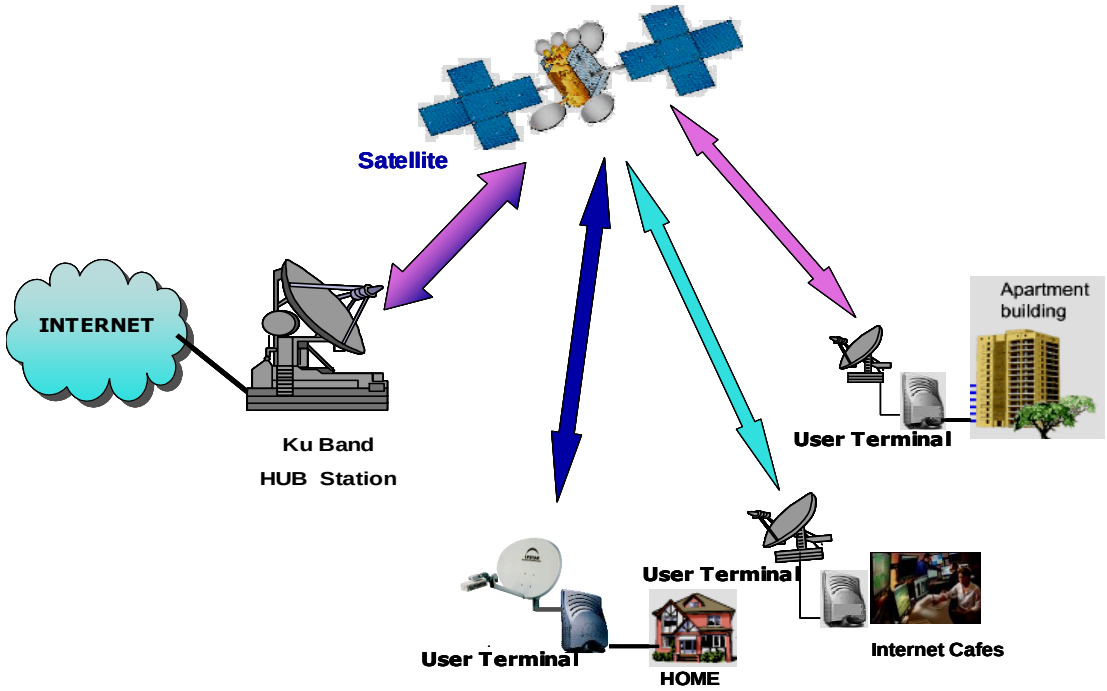


Figure 4: Architecture for High Speed Broadband Access

5.9 Advantages of VSAT

Availability: VSAT services can be deployed anywhere having a clear view of the Clarke Belt

Diversity: VSAT provides a wireless link completely independent of the local terrestrial/wire line infrastructure - especially important for backup or disaster recovery services

Deployability: VSAT services can be deployed in hours or even minutes.

Homogeneity: VSAT enables customers to get the same speeds and service level agreements at all locations across their entire network regardless of location

Acceleration: Most modern VSAT systems use onboard acceleration of protocols such as TCP ("spoofing" of acknowledgement packets) and HTTP (pre-fetching of recognized HTTP objects); this delivers high-quality Internet performance regardless of latency (see below)

Multicast: Most current VSAT systems use a broadcast download scheme (such as DVB-S) which enables them to deliver the same content to tens or thousands of locations simultaneously at no additional cost

Security: Corporate-grade VSAT networks are private layer-2 networks over the air

5.10 Disadvantages

Latency: Since they relay signals off a satellite in geosynchronous orbit 36,000 km (22,300 miles) above the Earth, VSAT links are subject to a minimum latency of approximately 500 milliseconds round-trip. This makes them a poor choice for "chatty" protocols or applications such as online gaming

Encryption: The acceleration schemes used by most VSAT systems rely upon the ability to see a packet's source/destination and contents; packets encrypted via VPN defeat this acceleration and perform slower than other network traffic

Environmental concerns: VSATs are subject to signal attenuation due to weather ("Rain Fade"); the effect is typically far less than that experienced by one-way TV systems (such as Direct TV, DISH TV etc) that use smaller dishes, but is still a function of antenna size and transmitter power and frequency band

Installation: VSAT services require an outdoor antenna installation with a clear view of the sky; this makes installation in skyscraper urban environments or locations where a customer does not have "roof rights" problematic

5.11 DIGITAL SATELLITE PHONE TERMINAL (DSPT)

Digital Satellite Phone Terminal System (DSPT system or DSPS) project involves setting up a VSAT (Very Small Aperture Terminal) Based network for BSNL. The system consists of HUB Station and Remote Digital Satellite Phone Terminals working in Ku-Band (Transmit Frequency is 13.75-14.5 GHz and Receive is 10.7-12.75 GHz). DSPT Network provides PSTN connectivity to rural, remote, inaccessible and hilly areas via INSAT (Indian National Satellite) or leased transponder for DTS network. The VSAT system works in a star topology using DAMA (Demand Assigned Multiple Access) technology. For BSNL VSAT network the Hub shall be located at Sikanderabad (U.P.), adjoining Delhi, in Uttar-Pradesh and there shall be 15000 DSPT remotes located over several states in India with higher proportions being in North, North East and East states.

5.12 OVERVIEW OF DSPT HUB:

The Hub of DSPT system will be composed of Indoor and Outdoor facilities. The outdoor facility is a complete Antenna and RF path while the indoor comprises the Hub Base-

band and the other equipment's: The Hub of DSPT system comprises of Indoor facilities and Outdoor facilities.

Indoor facilities: Indoor facilities has following components,

a. Hub Base-band

b. Transit switch.

In the Indoor facility consists of redundant Hub-base band unit, a Transit switch to provide connectivity to PSTN network, associated Data-Base servers, Billing system consisting of Billing system Hardware and software, the data networking equipment consisting Firewall, web-server, Authentication server and router to provide backend connectivity to the Internet. The base-band and remotes have a NMS and its database to configure and manage the entire VSAT-based network.

Outdoor facilities:

a. Antenna (8.1 Meter antenna assembly)

b. RF path: RF path consists of Transmit chain and Receive chain.

Transmit chain consists of

- -ULPC (Up Link Power Control),
- - Up Converter and
- - SSPA (Solid State Power Amplifier) and

Receive chain consists of

- - Trance reject filter,
- - Radar reject filter,
- - LNA (Low Noise Amplifier),

- Power divider and Down converter.

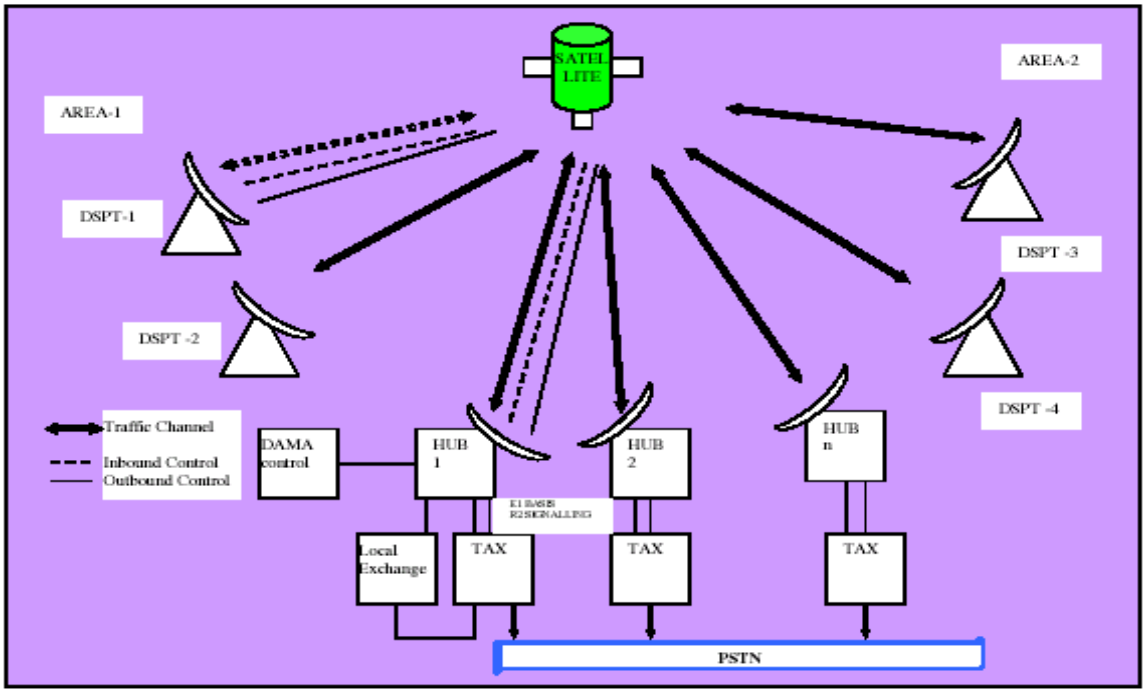


Figure 5: Typical Network Configuration of DSPT system

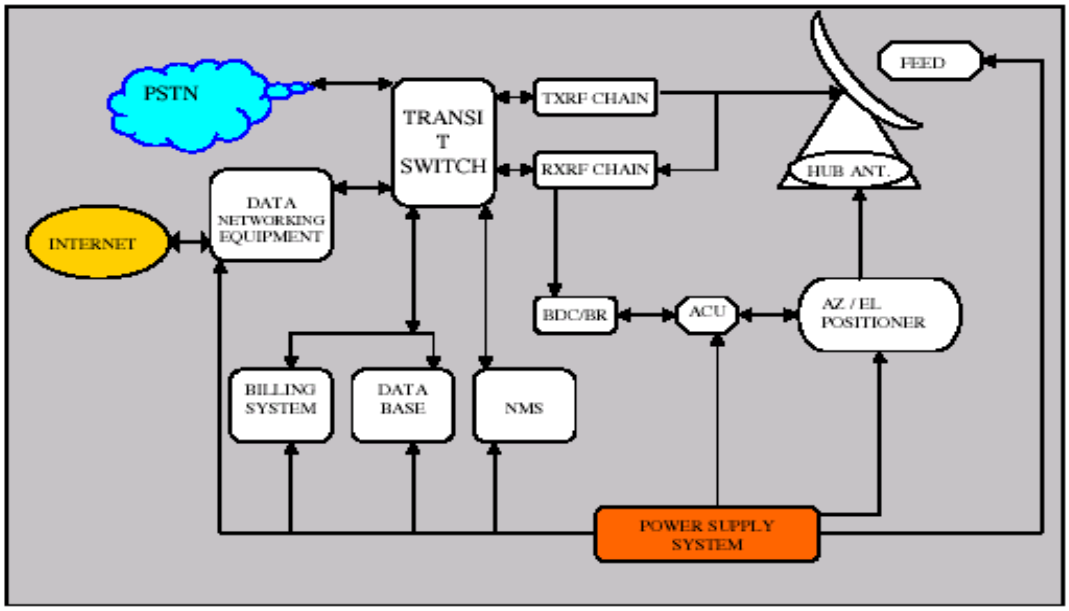


Figure 6: Overview of DSPT HUB

5.13 CONCLUSION

VSAT technology is a secure and reliable medium to connect geographically dispersed locations and represents a cost effective solution for users seeking an independent communication network connecting to the global network. In a situation where other connectivity options are not feasible, broadband VSAT of BSNL (operating in Ku band of electromagnetic spectrum i.e. 11 to 18 GHz) offer value added satellite based services capable of supporting- Broadband internet access, VOIP, video conferencing, IP multicast, Local Area Network, voice, Fax and can also provide powerful dependable private communication solutions.

6 OVERVIEW OF MPLS VPN

6.1 LEARNING OBJECTIVE:

The learning objectives of this chapter is

- To describe the MPLS VPN
- To understand the VPN Categories
- To understand the MPLS-VPN Architecture and Terminology
- MPLS-VPN Routing Model
- VRF
- Route Distinguisher, Route Target N

6.2 MPLS VPN OVERVIEW:

MPLS technology is being widely adopted by service providers worldwide to implement VPNs to connect geographically separated customer sites. Previous chapters introduce the basic concepts of MPLS and its operation, as well as configuring MPLS for data forwarding. This chapter builds on that foundation and shows how to use MPLS to provide VPN services to customers. This chapter also presents the terminology and operation of various devices in an MPLS network used to provide VPN services to customers.

The following topics will be covered in this chapter:

- Overlay and peer-to-peer VPN models
- Overview of MPLS VPN components and architecture
- VRFs, route distinguishers, and route targets
- MP-BGP operation and interaction

6.3 VPN CATEGORIES

VPNs were originally introduced to enable service providers to use common physical infrastructure to implement emulated point-to-point links between customer sites. A customer network implemented with any VPN technology would contain distinct regions under the customer's control called the *customer sites* connected to each other via the *service provider (SP)* network. In traditional router-based networks, different sites belonging to the same customer were connected to each other using dedicated point-to-point links. The cost of implementation depended on the number of customer sites to be connected with dedicated links. A full mesh of connected sites would consequently imply an exponential increase in the cost associated.

Frame Relay and ATM were the first technologies widely adopted to implement VPNs. These networks consisted of various devices, belonging to either the customer or the service provider, that were components of the VPN solution. Generically, the VPN realm would consist of the following regions:

- **Customer network**— Consisted of the routers at the various customer sites. The routers connecting individual customers' sites to the service provider network were called *customer edge (CE)* routers.

- **Provider network**— Used by the service provider to offer dedicated point-to-point links over infrastructure owned by the service provider. Service provider devices to which the CE routers were directly attached were called *provider edge (PE)* routers. In addition, the service provider network might consist of devices used for forwarding data in the SP backbone called *provider (P)* routers.

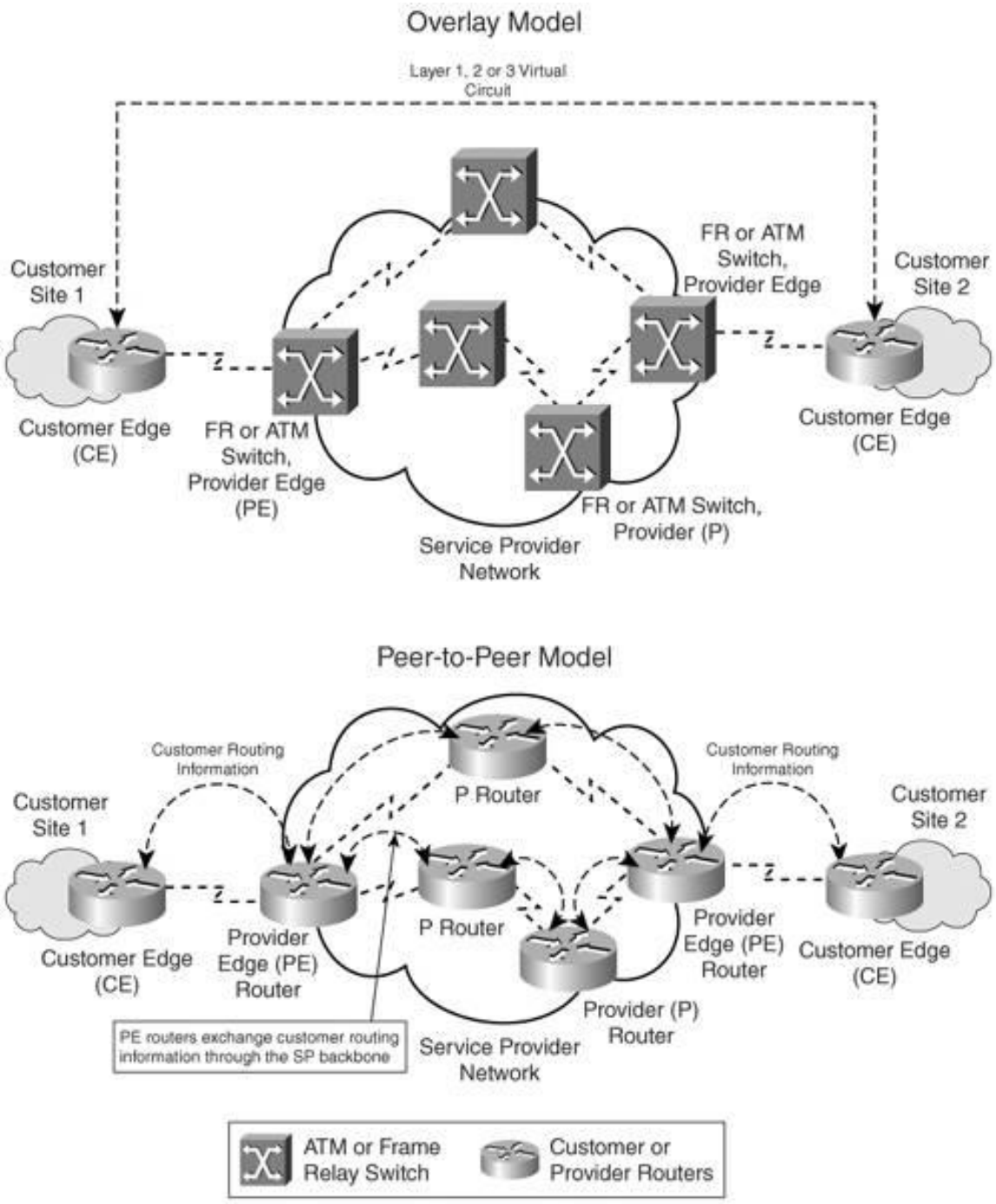
Depending on the service provider's participation in customer routing, the VPN implementations can be classified broadly into one of the following:

- **Overlay model**
- **Peer-to-peer model**

When Frame Relay and ATM provided customers with emulated private networks, the provider did not participate in customer routing. The service provider was only responsible for providing the customer with transport of customer data using virtual point-to-point links. As a result, the service provider would only provide customers with virtual circuit connectivity at Layer 2; this implementation was referred to as the *Overlay model.* If the virtual circuit was permanent or available for use by the customer at all times, it was called a permanent virtual circuit (PVC). If the circuit was established by the provider on-demand, it was called a switched virtual circuit (SVC). The primary drawback of an Overlay model was the full mesh of virtual circuits between all customer sites for optimal connectivity (except in the case of hub and spoke or partial hub and spoke deployments). If the number of customer sites was N, N(N-1)/2 was the total number of circuits that would be necessary for optimal routing.

Overlay VPNs were initially implemented by the SP by providing either Layer 1 (physical layer) connectivity or a Layer 2 transport circuit between customer sites. In the Layer 1 implementation, the SP would provide physical layer connectivity between customer sites, and the customer was responsible for all other layers. In the Layer 2 implementation (depicted in Figure 1), the SP was responsible for transportation of Layer 2 frames (or cells) between customer sites, which was traditionally implemented using either Frame Relay or ATM switches as PE devices. Therefore, the service provider was not aware of customer routing or routes. Later, overlay VPNs were also implemented using VPN services over IP (Layer 3) with tunneling protocols like L2TP, GRE, and IPSec to interconnect customer sites. In all cases, the SP network was transparent to the customer, and the routing protocols were run directly between customer routers.

Fig 1. Overlay and Peer-to-Peer Models

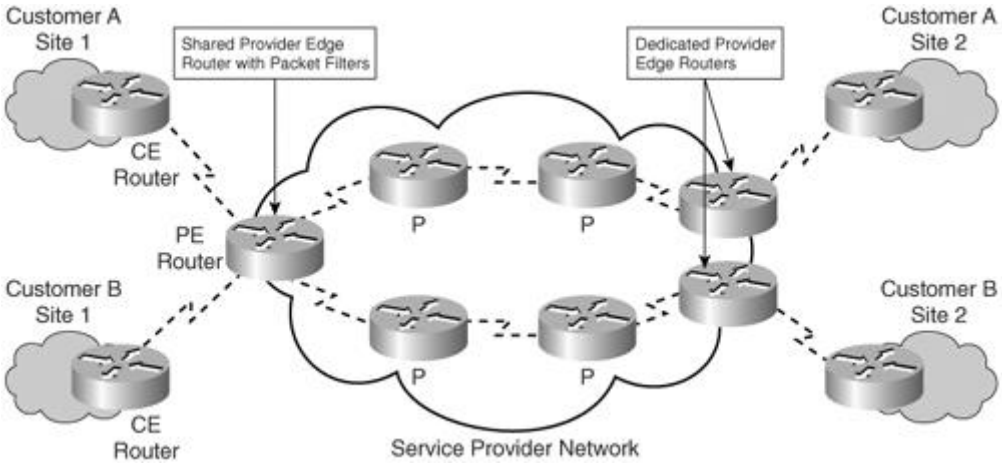


The *peer-to-peer model* was developed to overcome the drawbacks of the Overlay model and provide customers with optimal data transport via the SP backbone. Hence, the service provider would actively participate in customer routing. In the peer-to-peer model, routing information is exchanged between the customer routers and the service provider routers, and customer data is transported across the service provider's core, optimally. Customer routing information is carried between routers in the provider network (P and PE routers) and customer network (CE routers). The peer-to-peer model, consequently, does not require the creation of virtual circuits. As illustrated in Figure 1, the CE routers exchange routes with the connected PE routers in the SP domain. Customer

routing information is propagated across the SP backbone between PE and P routers and identifies the optimal path from one customer site to another.

Separation of customer-specific routing information is achieved by implementing packet filters at the routers connecting to the customer network. Additionally, IP addressing for the customer is handled by the service provider. This process is also referred to as the shared PE peer-to-peer implementation. Figure 2 depicts the various implementations of the peer-to-peer model.

Fig 2. Peer-to-Peer Model Implementations



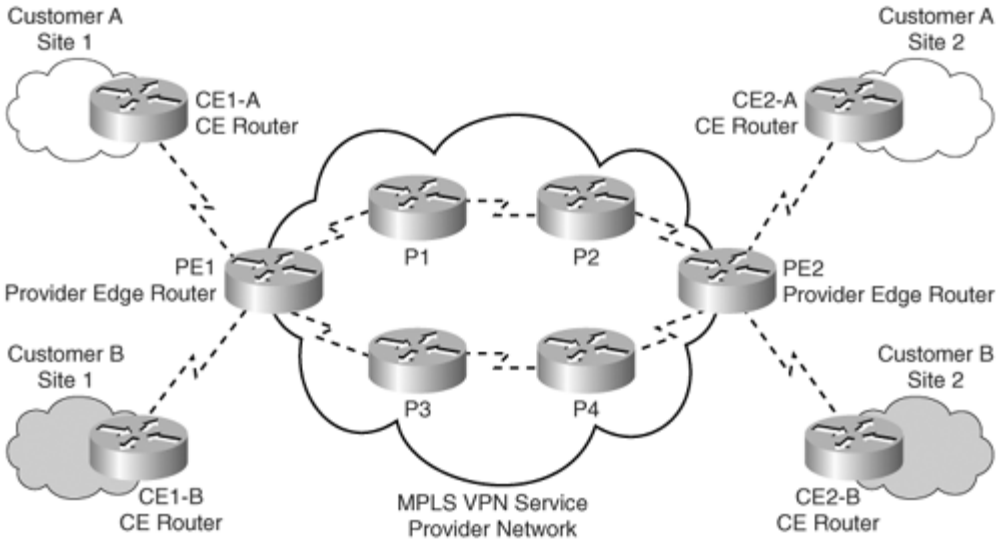
Controlled route distribution was another method of implementing the peer-to-peer model; routers in the core of the service provider's network contained network layer reachability information for all customers' networks. The PE routers (connecting customer network to provider network) in the provider network would contain only information pertaining to their connected customers. A *dedicated* PE router was required for each customer's site connecting to the provider network, and controlled route distribution would occur between P and PE routers in the SP backbone network. Only pertinent customer these routes would be propagated to PE routers that were connected to sites belonging to a specific customer. BGP with communities was usually used in the SP backbone because it offered the most versatile route-filtering tools. This implementation is often referred to as the *dedicated PE peer-to-peer model*. This implementation, however, did not prove to be a viable operating business model due to the higher equipment costs that were incurred by the provider to maintain dedicated edge routers for customer sites connecting into the provider backbone. A need arose for deploying efficient VPN architectures that could implement a scalable peer-to-peer model.

6.4 MPLS VPN ARCHITECTURE AND TERMINOLOGY

In the MPLS VPN architecture, the edge routers carry customer routing information, providing optimal routing for traffic belonging to the customer for inter-site traffic. The MPLS-based VPN model also accommodates customers using overlapping address spaces, unlike the traditional peer-to-peer model in which optimal routing of customer traffic required the provider to assign IP addresses to each of its customers (or the customer to implement NAT) to avoid overlapping address spaces. MPLS VPN is an implementation of the peer-to-peer model; the MPLS VPN backbone and customer sites exchange Layer 3 customer routing information, and data is forwarded between customer sites using the MPLS-enabled SP IP backbone.

The MPLS VPN domain, like the traditional VPN, consists of the customer network and the provider network. The MPLS VPN model is very similar to the dedicated PE router model in a peer-to-peer VPN implementation. However, instead of deploying a dedicated PE router per customer, customer traffic is isolated on the same PE router that provides connectivity into the service provider's network for multiple customers. The components of an MPLS VPN shown in Figure 3 are highlighted next.

Fig 3. MPLS VPN Network Architecture



The main components of MPLS VPN architecture are

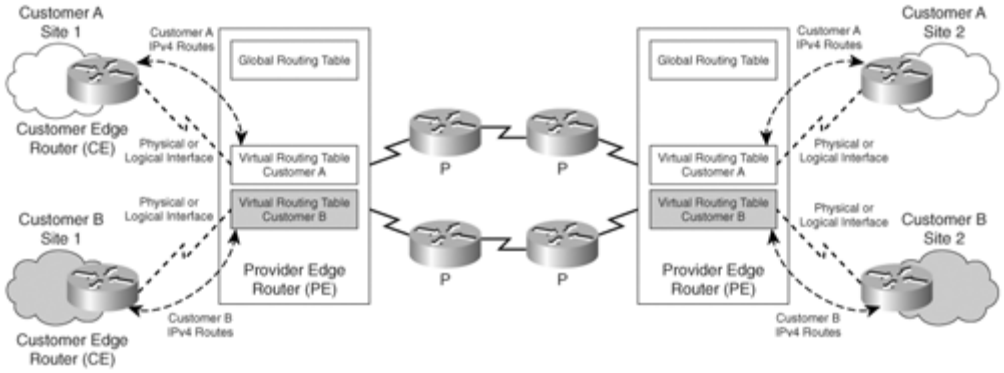
- **Customer network**, which is usually a customer-controlled domain consisting of devices or routers spanning multiple sites belonging to the customer. In Figure 3, the customer network for Customer A consists of the routers CE1-A and CE2-A along with devices in the Customer A sites 1 and 2.
- **CE routers**, which are routers in the customer network that interface with the service provider network. In Figure 3, the CE routers for Customer A are CE1-A and CE2-A, and the CE routers for Customer B are CE1-B and CE2-B.
- **Provider network**, which is the provider-controlled domain consisting of provider edge and provider core routers that connect sites belonging to the customer on a shared infrastructure. The provider network controls the traffic routing between sites belonging to a customer along with customer traffic isolation. In Figure 3, the provider network consists of the routers PE1, PE2, P1, P2, P3, and P4.
- **PE routers**, which are routers in the provider network that interface or connect to the customer edge routers in the customer network. PE1 and PE2 are the provider edge routers in the MPLS VPN domain for customers A and B in Figure 3.
- **P routers**, which are routers in the core of the provider network that interface with either other provider core routers or provider edge routers. Routers P1, P2, P3, and P4 are the provider routers in Figure 3.

6.4.1 MPLS VPN ROUTING MODEL

An MPLS VPN implementation is very similar to a dedicated router peer-to-peer model implementation. From a CE router's perspective, only IPv4 updates, as well as data, are forwarded to the PE router. The CE router does not need any specific configuration to enable it to be a part of a MPLS VPN domain. The only requirement on the CE router is a routing protocol (or a static/default route) that enables the router to exchange IPv4 routing information with the connected PE router.

In the MPLS VPN implementation, the PE router performs multiple functions. The PE router must first be capable of isolating customer traffic if more than one customer is connected to the PE router. Each customer, therefore, is assigned an independent routing table similar to a dedicated PE router in the initial peer-to-peer discussion. Routing across the SP backbone is performed using a routing process in the global routing table. P routers provide label switching between provider edge routers and are unaware of VPN routes. CE routers in the customer network are not aware of the P routers and, thus, the internal topology of the SP network is transparent to the customer. Figure 4 depicts the PE router's functionality.

Fig 4. MPLS VPN Architecture



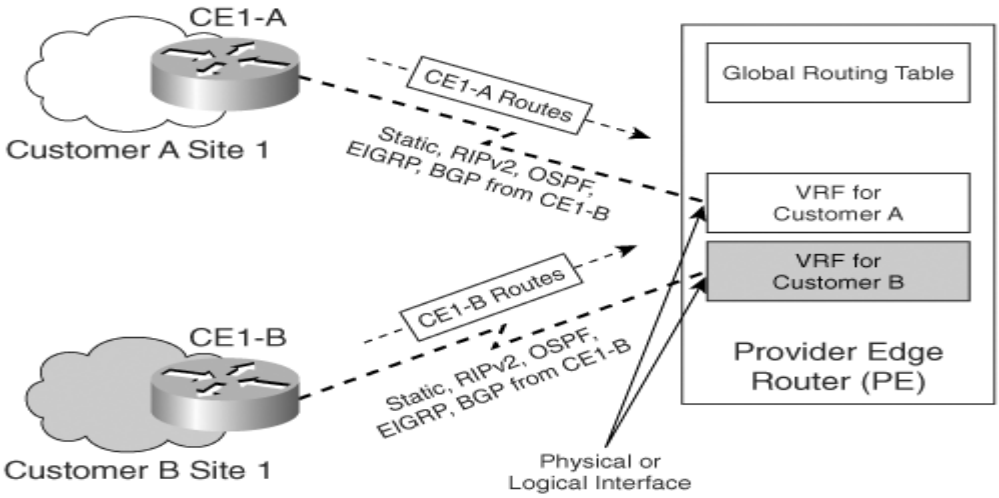
The P routers are only responsible for label switching of packets. They do not carry VPN routes and do not participate in MPLS VPN routing. The PE routers exchange IPv4 routes with connected CE routers using individual routing protocol contexts. To enable scaling the network to large number of customer VPNs, multiprotocol BGP is configured between PE routers to carry customer routes.

1. VRF: Virtual Routing and Forwarding Table

Customer isolation is achieved on the PE router by the use of virtual routing tables or instances, also called virtual routing and forwarding tables/instances (VRFs). In essence, it is similar to maintaining multiple dedicated routers for customers connecting into the provider network. The function of a VRF is similar to a global routing table, except that it contains all routes pertaining to a specific VPN versus the global routing table. The VRF also contains a VRF-specific CEF forwarding table analogous to the global CEF table and defines the connectivity requirements and protocols for each customer site on a single PE router. The VRF defines routing protocol contexts that are part of a specific VPN as well as the interfaces on the local PE router that are part of a specific VPN and, hence, use the VRF. The interface that is part of the VRF must support CEF switching. The number of interfaces that can be bound to a VRF is only limited by the number of interfaces on the router, and a single interface (logical or physical) can be associated with only one VRF.

The VRF contains an IP routing table analogous to the global IP routing table, a CEF table, list of interfaces that are part of the VRF, and a set of rules defining routing protocol exchange with attached CE routers (routing protocol contexts). In addition, the VRF also contains VPN identifiers as well as VPN membership information (RD and RT are covered in the next section). Figure 5 shows the function of a VRF on a PE router to implement customer routing isolation.

Fig 5. VRF Implementation on PE Router



As shown in Figure 5, Cisco IOS supports a variety of routing protocols as well as individual routing processes (OSPF, EIGRP, etc.) per router. However, for some routing protocols, such as RIP and BGP, IOS supports only a single instance of the routing protocol. Therefore, to implement per VRF routing using these protocols that are completely isolated from other VRFs, which might use the same PE-CE routing protocols, the concept of routing context was developed.

Routing contexts were designed to support isolated copies of the same VPN PE-CE routing protocols. These routing contexts can be implemented as either separated processes, as in the case of OSPF, or as multiple instances of the same routing protocol (in BGP, RIP, etc.). If multiple instances of the same routing protocol are in use, each instance has its own set of parameters.

Cisco IOS currently supports either RIPv2 (multiple contexts), EIGRP (multiple contexts), OSPFv2 (multiple processes), and BGPv4 (multiple contexts) as routing protocols that can be used per VRF to exchange customer routing information between CE and PE.

Note that the VRF interfaces can be either logical or physical, but each interface can be assigned to only one VRF.

2. Route Distinguisher, Route Targets, MP-BGP, and Address Families

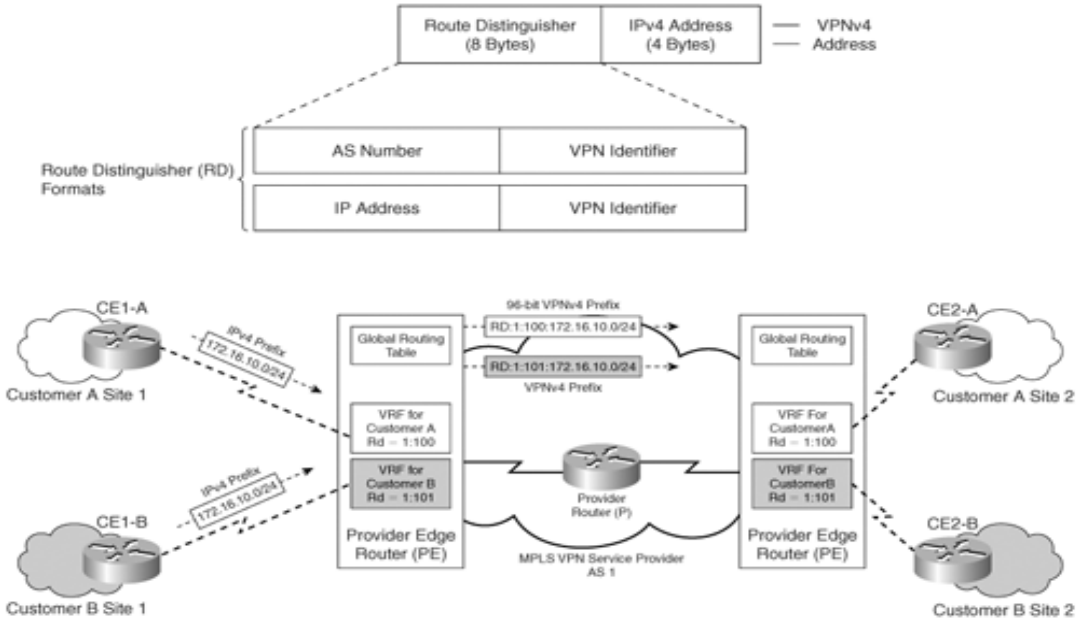
In the MPLS VPN routing model, the PE router provides isolation between customers using VRFs. However, this information needs to be carried between PE routers to enable data transfer between customer sites via the MPLS VPN backbone. The PE router must be capable of implementing processes that enable overlapping address spaces in connected customer networks. The PE router must also learn these routes from attached customer networks and propagate this information using the shared provider backbone. This is done by the association of a route distinguisher (RD) per virtual routing table on a PE router.

A *RD* is a 64-bit unique identifier that is prepended to the 32-bit customer prefix or route learned from a CE router, which makes it a unique 96-bit address that can be transported between the PE

routers in the MPLS domain. Thus, a unique RD is configured per VRF on the PE router. The resulting address, which is 96-bits total (32-bit customer prefix + 64-bit unique identifier or RD), is called a *VPN version 4 (VPNv4) address.*

VPNv4 addresses are exchanged between PE routers in the provider network in addition to IPv4 (32-bit) addresses. The format of an RD is shown in Figure 6. As shown in Figure 6, RD can be of two formats. If the provider does not have a BGP AS number, the IP address format can be used, and, if the provider does have an AS number, the AS number format can be used. Figure 6 also shows the same IP prefix, 172.16.10.0/24, received from two different customers, is made unique by prepending different RD values, 1:100:1 and 1:101, prior to propagating the addresses as VPNv4 addresses on the PE router.

Fig 6. RD Operation in MPLS VPN

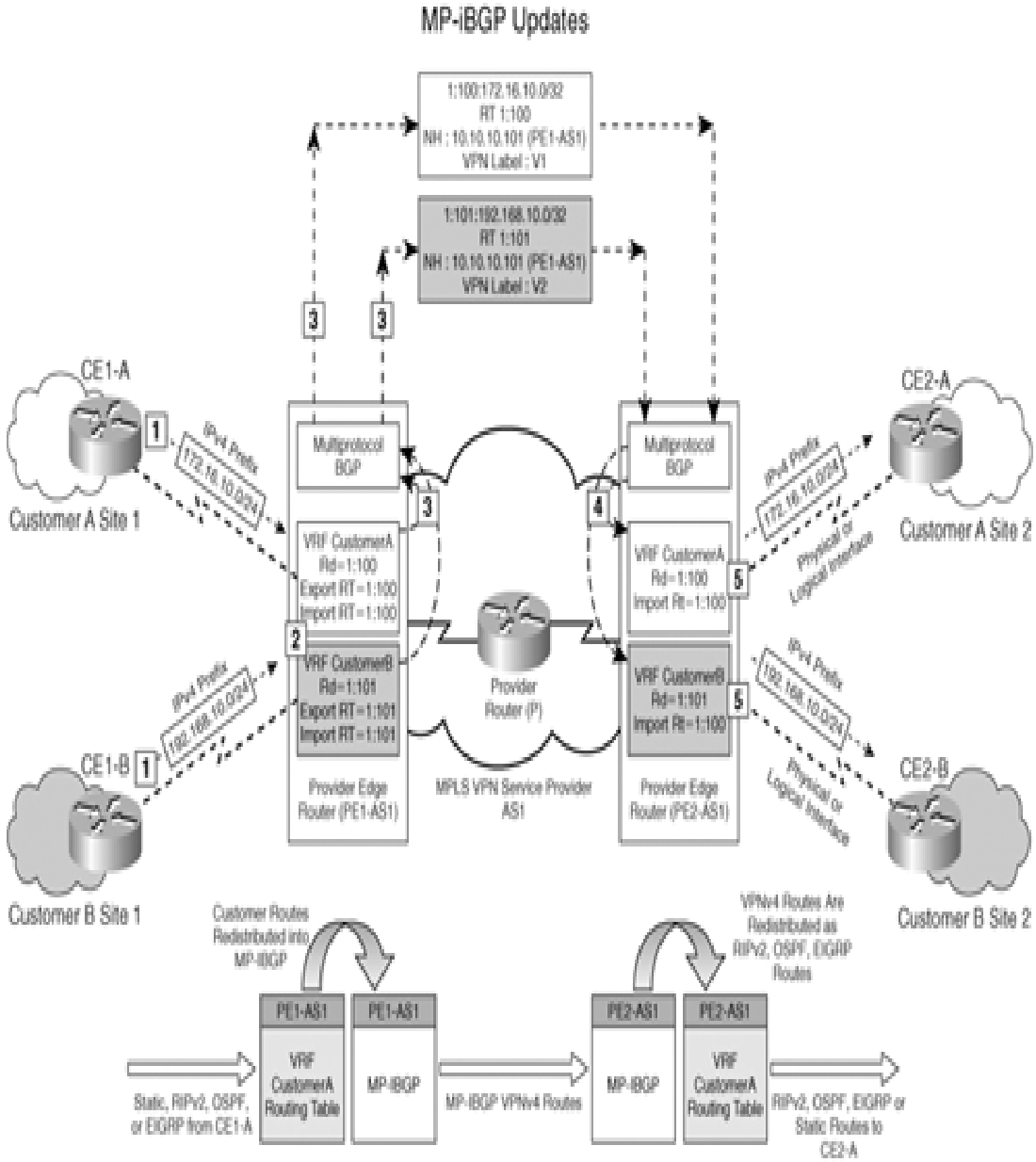


The protocol used for exchanging these VPNv4 routes between PE routers is *multiprotocol BGP* (MP-BGP). BGP capable of carrying VPNv4 (96-bit) prefixes in addition to other address families is called MP-BGP. The IGP requirement to implement iBGP (internal BGP) still holds in the case of an MPLS VPN implementation. Therefore, the PE router must run an IGP that provides NLRI information for iBGP if both PE routers are in the same AS. Cisco currently supports both OSPFv2 and ISIS in the MPLS provider network as the IGP. MP-BGP is also responsible for assignment of a VPN label. Packet forwarding in an MPLS VPN mandates that the router specified as the next hop in the incoming BGP update is the same router that assigns the VPN label. Scalability was a primary reason for the choice of BGP as the protocol to carry customer routing information. In addition, BGP enables the use of VPNv4 address in an MPLS VPN router environment that enables overlapping address ranges with multiple customers.

An MP-BGP session between PE routers in a single BGPAS is called an MP-iBGP session and follows rules as in the implementation of iBGP with regards to BGP attributes. If the VPN extends beyond a single AS, VPNv4 routes will be exchanged between AS at the AS boundaries using an MP-eBGP session.

Route targets (RTs) are additional identifiers used in the MPLS VPN domain in the deployment of MPLS VPN that identify the VPN membership of the routes learned from that particular site. RTs are implemented by the use of extended BGP communities in which the higher order 16 bits of the BGP extended community (64 total bits) are encoded with a value corresponding to the VPN membership of the specific site. When a VPN route learned from a CE router is injected into VPNv4 BGP, a list of VPN route target extended community attributes is associated with it. The *export route target* is used in identification of VPN membership and is associated to each VRF. This export route target is appended to a customer prefix when it is converted to a VPNv4 prefix by the PE router and propagated in MP-BGP updates. The *import route target* is associated with each VRF and identifies the VPNv4 routes to be imported into the VRF for the specific customer. The format of a RT is the same as an RD value. The interaction of RT and RD values in the MPLS VPN domain as the update is converted to an MP-BGP update is shown in Figure 7.

Fig 7. RT and RD Operation in an MPLS VPN



When implementing complex VPN topologies, such as extranet VPN, Internet access VPNs, network management VPN, and so on, using MPLS VPN technology, the RT plays a pivotal role. A single prefix can be associated to more than one export route target when propagated across the MPLS VPN network. The RT can, as a result, be associated to sites that might be a member of more than one VPN.

The following processes occur during route propagation in an MPLS VPN, as shown in Figure 7:

- The prefix 172.16.10.0/24 is received from CE1-A, which is part of VRF CustomerA on PE1-AS1.

- PE1 associated an RD value of 1:100 and an export RT value of 1:100 as configured in the VRF definition on the PE1-AS1 router.

- Routes learned from connected CE routers CE1-A are redistributed into the MP-BGP process on PE1-AS1 where the prefix 172.16.10.0/24 is prepended with the RD value of 1:100 and appended with the route target extended community value (export RT) of 1:100 prior to sending the VPNv4 prefix as part of the MP-iBGP update between PE routers.

  The VPN label *(3 bytes)* is assigned for each prefix learned from the connected CE router's IGP process within a VRF by the PE router's MP-BGP process. MP-BGP running in the service provider MPLS domain thus carries the VPNv4 prefix (IPv4 prefix + prepended RD) in addition to the BGP route target extended community. Note that although the RT is a mandatory configuration in an MPLS VPN for all VRFs configured on a router, the RT values can be used to implement complex VPN topologies in which a single site can be a part of more than one VPN. In addition, RT values can also be used to perform selective route importing into a VRF when VPNv4 routes are learned in MP-iBGP updates. The VPN label is only understood by the egress PE (data plane) that is directly connected to the CE router advertising the prefix. Note that the next hops on PE routers must not be advertised in the BGP process but must be learned from the IGP for MPLS VPN implementation. The VPN label has been depicted by the entries V1 and V2 in Figure 7.

- The MP-BGP update is received by the PE router PE2, and the route is stored in the appropriate VRF table for Customer A based on the VPN label.

- The received MP-BGP routes are redistributed into the VRF PE-CE routing processes, and the route is propagated to CE2-A.

In addition, other BGP extended community attributes such as *site of origin (SoO)* can also be applied to the MP-iBGP update prior to propagation. The SoO attribute is used to identify the specific site from which the PE learns the route and is used in the identification and prevention of routing loops. The SoO extended community is a BGP extended community attribute used to identify routes that have originated from a site so that the re-advertisement of that prefix back to the source site can be prevented, thus preventing routing loops. The SoO extended community uniquely identifies the site from which a PE router has learned a route. SoO enables filtering of traffic based on the site from which it was originated. SoO filtering manages MPLS VPN traffic and prevents routing loops from occurring in complex and mixed network topologies in which the customer sites

might possess connectivity across the MPLS VPN backbone as well as possess backdoor links between sites.

The implementation of a MPLS VPN in which all VPN sites belonging to a customer can speak to all other sites in the same customer domain is called a simple VPN implementation or *intranet VPN*. As mentioned earlier, RTs can be used to implement complex VPN topologies in which certain sites that are part of one customer's domain are also accessible by other customers' VPN sites. This implementation is called an *extranet VPN*. In addition, variants of extranet VPN, such as network management VPN as well as central services VPN and Internet access VPN, can also be deployed.

It is important to understand the concept of address families and their place in the operation of MP-BGP to enable the transport of VPNv4 routes with extended community attributes. Prior to RFC 2283, "Multiprotocol Extensions for BGP-4," BGP version 4 was capable of carrying routing information only pertaining to IPv4. RFC 2283 defines extensions to BGP-4 that enable BGP-4 to carry information for multiple network layer protocols. RFC 2283 states that to enable BGP-4 to support routing for multiple network layer protocols, the additions to BGP-4 must account for the ability of a particular network layer protocol to be associated with a next hop as well as the NLRI (network layer reachability information). The two new attributes that were added to BGP were Multiprotocol Reachable NLRI (MP_REACH_NLRI), and Multiprotocol Unreachable NLRI (MP_UNREACH_NLRI). MP_REACH_NLRI carries the set of reachable destinations together with the next-hop information to be used for forwarding to these destinations. MP_UNREACH_NLRI carries the set of unreachable destinations. Both of these attributes are optional and nontransitive. Therefore, a BGP speaker that does not support these multiprotocol capabilities will just ignore the information carried in these attributes and will not pass it to other BGP speakers.

An *address family* is a defined network layer protocol. An address family identifier (AFI) carries an identity of the network layer protocol associated with the network address in the multiprotocol attributes in BGP. (Address family identifiers for network layer protocols are defined in RFC 1700, "Assigned Numbers.")

The PE router, in essence, is an Edge LSR and performs all the functions of an Edge LSR. The PE router requires LDP for label assignment and distribution as well as forward labeled packets. In addition to the functions of an Edge LSR, the PE implements a routing protocol (or static routes) with connected CE routers per virtual routing table and requires MP-BGP to propagate prefixes learned from CE routers as VPNv4 prefixes in MP-iBGP updates to other PE routers along with the VPN label.

The P router's requirements are to run an IGP (either OSPF or ISIS) as well as have MPLS enabled to forward labeled packets (data plane) between PE routers. The IGP is used to provide, as well as propagate, NLRI to connected P and PE routers to implement an MP-iBGP session between PE routers (control plane).

6.5 CONCLUSION

MPLS VPN is a popular technique to build VPNs for customers over the MPLS provider network. The better understanding of MPLS – VPN facilitates the participants to better handle the O and M of MPLS network in real time scenario.

7 MINI-LINK

7.1 LEARNING OBJECTIVE

After reading this unit, you should be able to understand:

- Concept of mini-link
- Components of Mini-Link
- Application areas

7.2 INTRODUCTION

MINI-LINK is the world's most deployed microwave transmission system. The demands for mobile and fixed broadband services are justifying the technology, topology and business model innovations being implemented today. Moving into unified IP packet networks and end-to-end network management allows you to offer premium services including conventional voice service over packet as well as sharing or reselling your backhaul bandwidth.

7.3 MINI-LINK (IPASOLINK 400)

iPASOLINK is NEC's most advanced and comprehensive optical and radio converged transport product family, providing solution for backhaul optimization and transformation to help you achieve your business objectives such as cost efficient integration of both TDM and carrier-class Ethernet network and versatile and smooth migration from TDM to IP next generation network.

The iPASOLINK 400 provides up to 620 Mbps transmission capacity per link and advanced adaptive modulation scheme operating in 6, 7, 8, 10, 11, 13, 15, 18, 23, 26, 28, 32, 38, 42 and 52 GHz bands.

The iPASOLINK 400 consists of antennas, outdoor units (ODU) and 19 inch one indoor unit (IDU) and accedes to very high performance in very compact units and ultra-high reliability.

IDU (with some optional cards)

ODU with 0.3m antenna

Fig:1 iPASOLINK 400

The traffic interface of iPASOLINK 400 is a basic D/I (Data-in) interface card and four (4) front access universal card slots which are connected to TDM cross connect interfaces and packet switch interfaces with interface buses. These card slots are provided for radio interface (modem) and additional interface to satisfy various D/I topology requirements. Versatility of the iPASOLINK 400 is thus obtained. As the basic D/I interface configuration, iPASOLINK 400 can be configured up to four 1+0, two 1+1 twin path, hot standby, diversity radio links or most advanced cross polarization interference canceling techniques, double the transmission capacity up to 1240 (620x2) Mbps utilizing both polarizations within the same cost and limited licensed radio frequency channel.

7.4 SYSTEM OVERVIEW

ODU-IDU separate mount type. The connection line is only one coaxial cable.

- No protection or protection system is available using common ODU and IDU.
- Flexible configuration for ODU and antenna, direct mount/ remote mount/ 1+0 (non
- redundant)/ 1+1 hot stand-by/ 1+1 space diversity/ 1+1 frequency diversity (twin path), 2+0.
- 19 inches one rack unit size compact IDU,

Fig:2 IDU Outline

Small and light weight ODU for easy handling and installation.

Fig:3 GHz ODU and 0.3m direct mount antenna and 6 - 11GHz ODU

Wide temperature range of ODU and IDU
DC input voltage nominal rating: -48 VDC

IDU BLOCK DIAGRAM

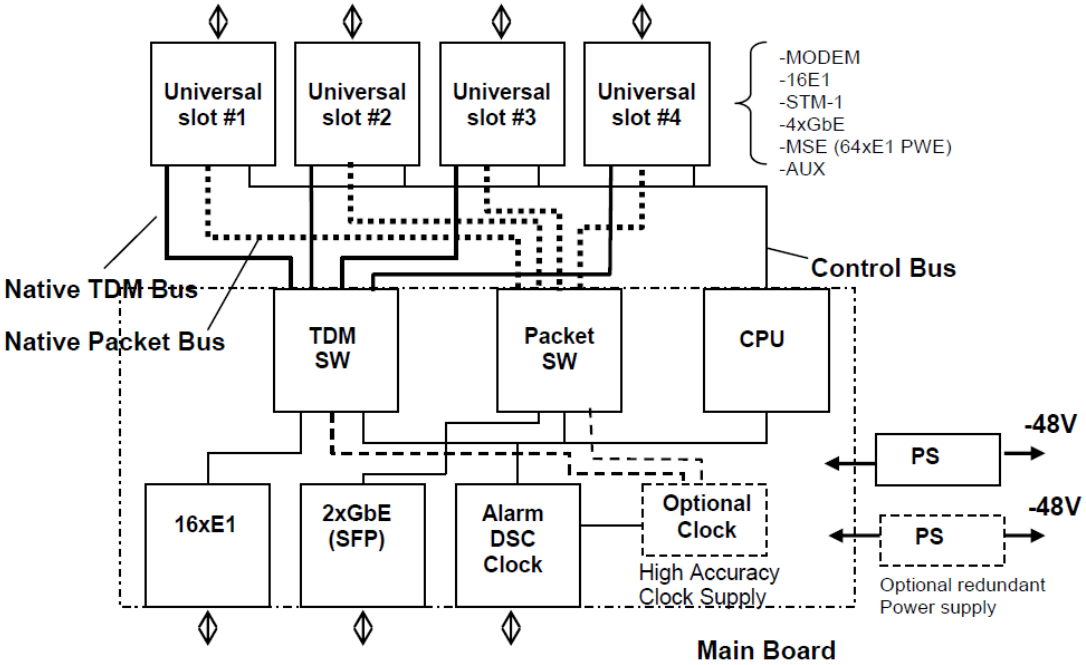


Fig:4 IDU block diagram

ODU BLOCK DIAGRAM

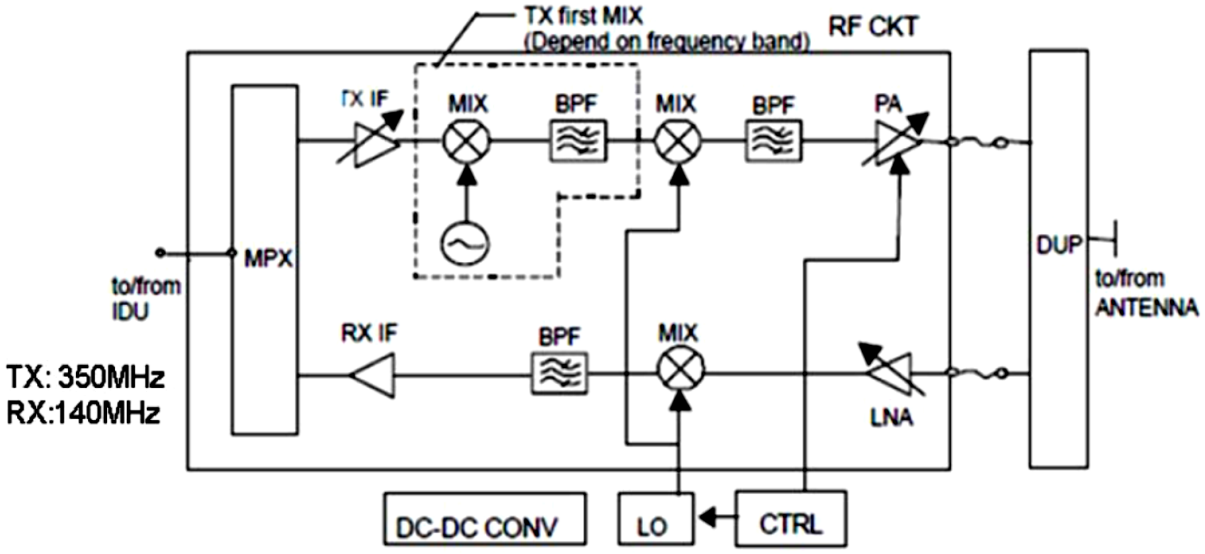


Fig:5 ODU block diagram

7.5 FLEXIBLE ODU MOUNTING CONFIGURATION

Suitable configuration can be selected from various ODU mounting styles.

Direct Mounting on Antenna

Separate Mounting with Antenna using Waveguide or Coaxial Cable

1+1 system with Hybrid Combiner / Divider

2+0 system with Dual Pol. Antenna

1+0 SYSTEM

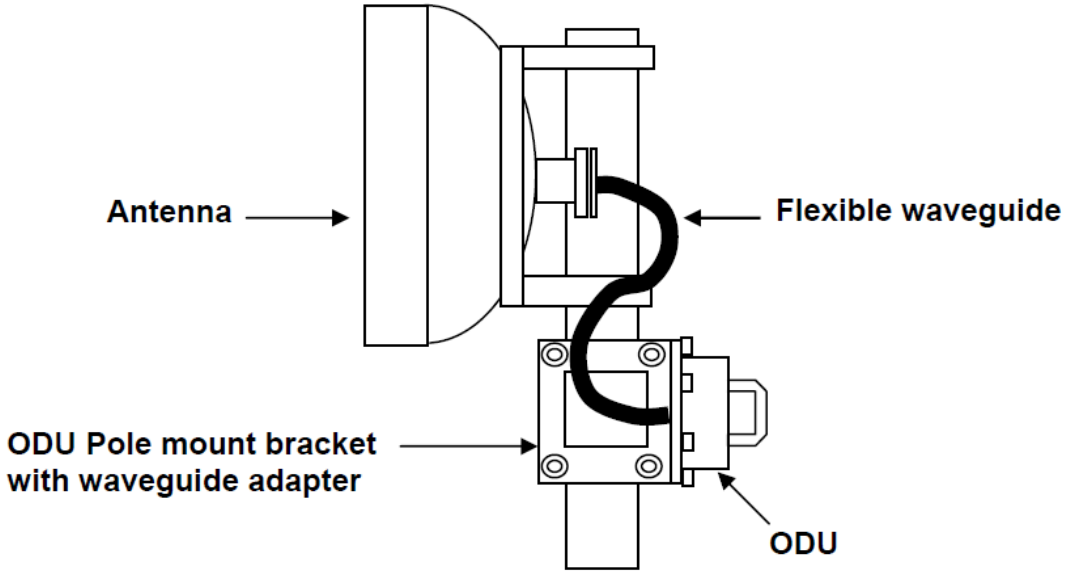


Fig:6 - 38 GHz Remote mounting of 1+0

1+1 SYSTEM

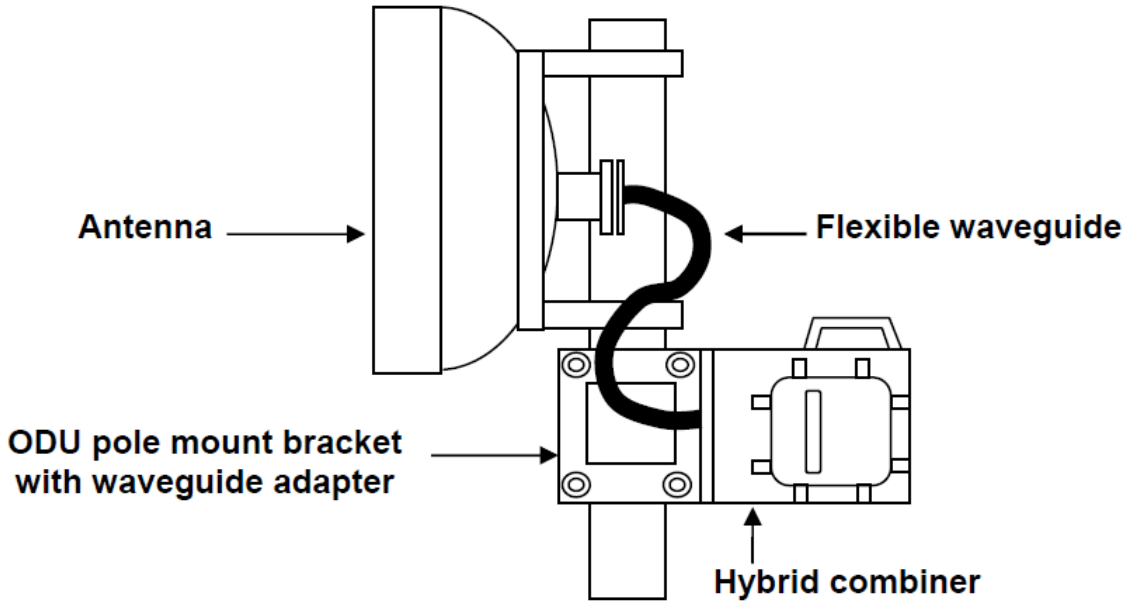


Fig:7 - 38 GHz Remote mounting of 1+1 ODU with hybrid combiner

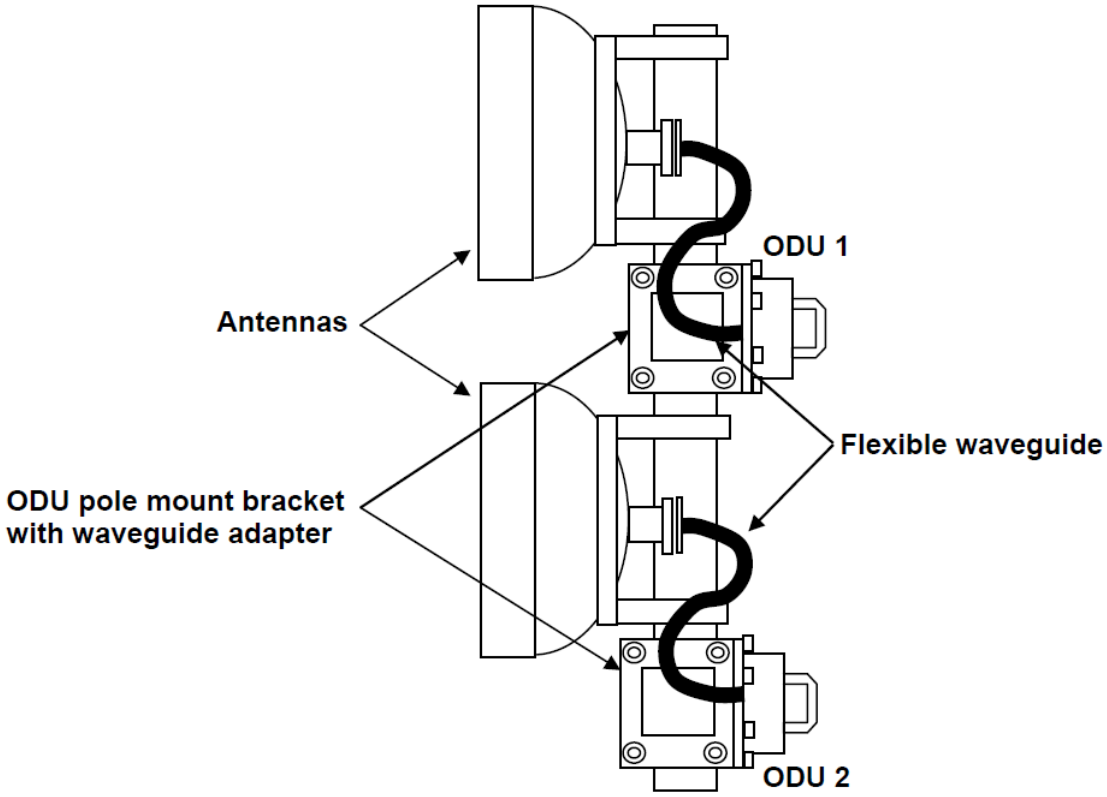


Fig:8- 38 GHz Remote mounting of 1+1 ODU with two antennas for Space Diversity

2+0 SYSTEM

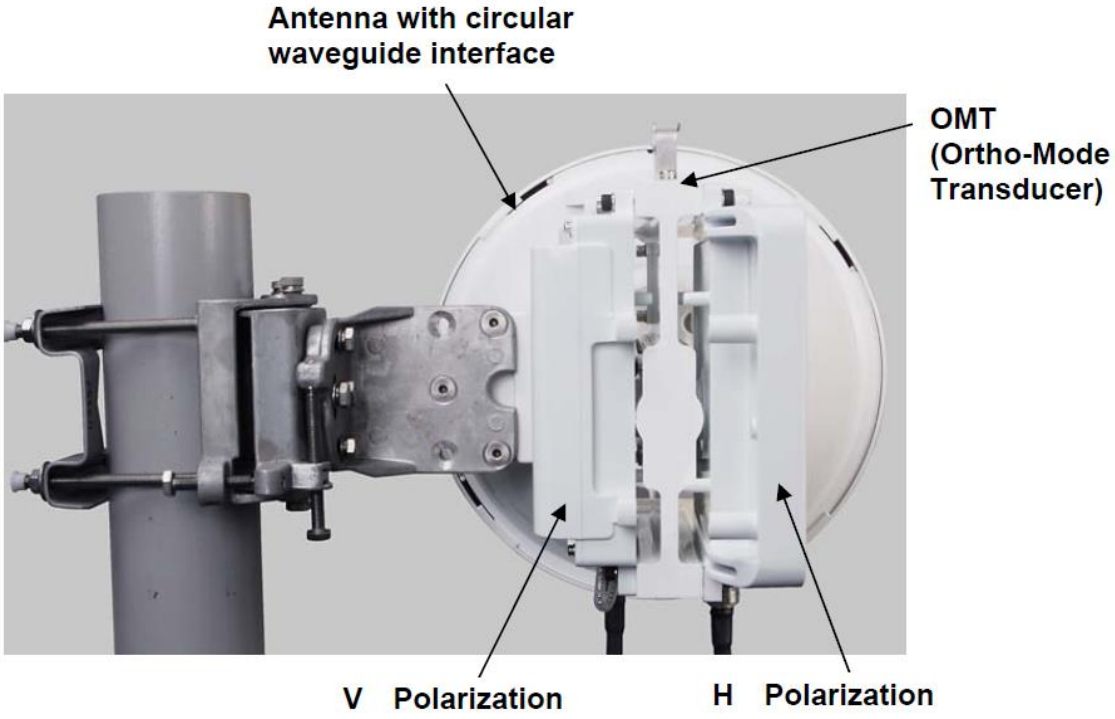


Fig:9 11 - 42 GHz Direct mount dual pol. System

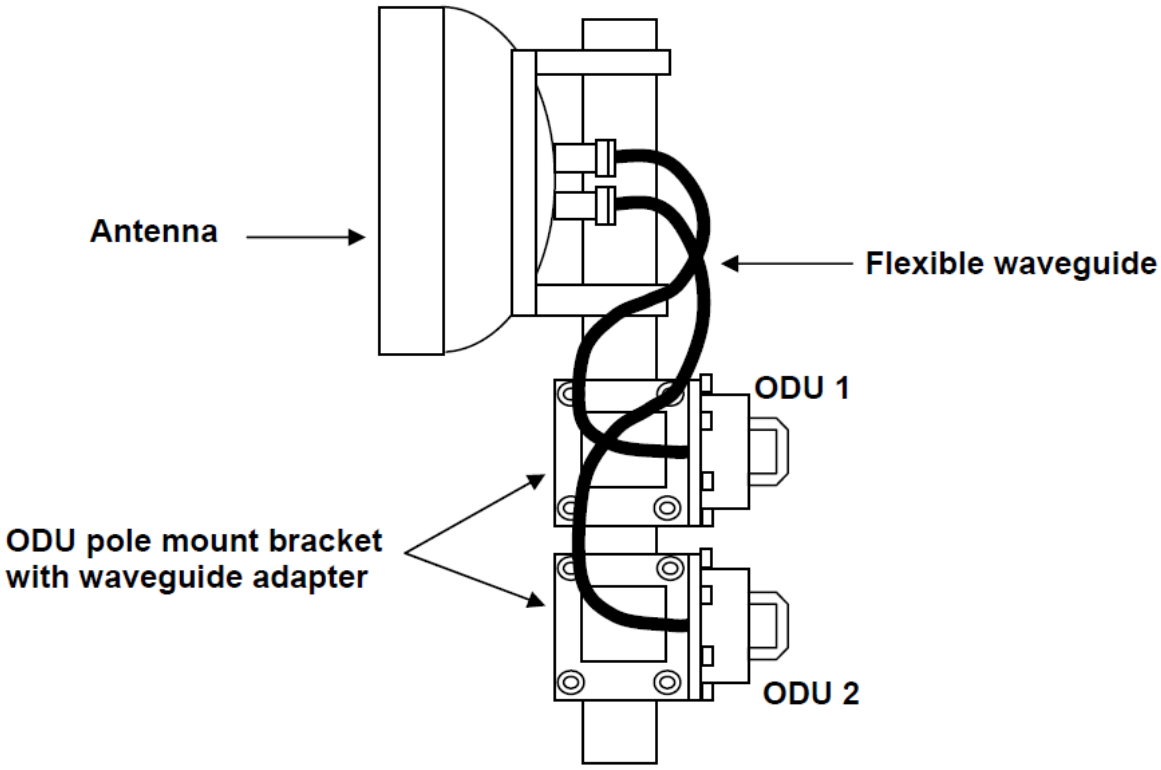


Fig:10 6 - 38 GHz Remote mount dual pol. system

7.6 ADVANTAGES OF IPASOLINK 400

- Native TDM and native packet transmission enabling to migrate into carrier-grade full packet radio with scalable throughput capability.
- Front access universal card slots configuration enabling you to meet full range of your transmission interface and interface changeover needs.
- Easy addition of functionality with "pay-as-you-need" upgrade concept on the same hardware. As an example, you can double the transmission capacity up to 1240 Mbps over a single radio frequency utilizing both polarizations without any requirement of neither additional outdoor foot prints nor indoor mounting spaces.
- Full range of synchronization (TDM, Synchronous Ethernet, and External Clock)
- Multi-service support with TDM PWE (SAToP)
- Independently support TDM and Ethernet ring protection for radio interfaces
    - TDM E1 ring recovery < 50 msec,
    - Ethernet ring recovery <50msec. (ITU-T G.8032 or MSTP), < 1 sec. (RSTP)
- Ethernet OAM (IEEE802.1ag and ITU-T Y.1731)
- Link aggregation (802.3ad)
- Radio traffic aggregation on physical layer (up to 2 channels)
- Hitless AMR up to 2048QAM with intelligent adaptive QoS, TDM and packet prioritization.

7.7 FEATURES IPASOLINK 400

7.7.1 VERSATILE PLATFORM CONFIGURATIONS

- The following protection combinations are available on a single IDU in radio application:
    - Up to four links of non-protected (1+0),
    - Up to two links of protected (1+1) with hot standby / space diversity / twin path with hitless switch, or Dual the capacity with XPIC 2x(1+0)
- Air capacity: Up to 620 Mbps by single polarization and 1240 Mbps by dual polarizations for Ethernet packet transmission applications.
- Basic interface: 2 x 10/100 Base-T(X) (IEEE802.3i/IEEE802.3u), 2 x 1000 Base-SX/LX SFP (IEEE802.3ab/IEEE802.3z) and 16E1s.
- Front access universal card slot interface meets various platform configuration needs
- Additional interface*: The combination of 16xE1s, STM-1 (1xRST or 1xch-STM-1 with APS, optical or electrical), 4xGbE (2 x 1000 Base-T/ SX/LX SFP + 2x10/100/1000 BASE-T RJ-45) or MSE (Multi service Engine card, up to 64xE1 any service any port PWE card is available)

7.7.2 VERY COMPACT HIGH RELIABILITY ECO PLATFORM

- Very compact and light platform for easy installation: 1U IDU and approx. 2 Kg ODU (above 13 GHz) or 3 Kg ODU (6 to 11 GHz) and GUI (Graphical User Interface) is provided for easy setting and monitoring.
- High reliability and quality backed by excellent field proven MTBF.
- Low power consumption: Incorporation of energy save integrated digital processing techniques and adoption of high efficiency RF components.
- Power Saving Mode, which correlates with AMR and ATPC, achieves approx. 20% reduction of ODU power consumption

.

7.7.3 FLEXIBLE PLATFORM FOR BOTH TDM AND ETHERNET PACKET TRANSMISSION

iPASOLINK has flexible capability of TDM / Ethernet / Hybrid transmission and meets the customer demand of network configuration. The transmission methods are as follows:

1 Hybrid Radio (Native Ethernet + Native TDM)
2 Packet Radio (with TDM PWE)
3 Hybrid + Packet Radio (with TDM PWE)

TDM PSEUDO WIRE EMULATION (PWE)

- PWE is a technique to emulate TDM/ATM service over packet network.
  - TDM/ATM traffic is encapsulated and transmitted to the packet network.
- PWE enables transport of non-IP based services over IP network, resulting in cost reduction and network consolidation.

LINK AGGREGATION (L2 OR L3/L4 BASED)

Link Aggregation achieves high capacity and resiliency transport with bundling several radio links. The distribution algorithm distributes the packet according to:

- L2 based: Source & Destination MAC, VLAN ID, Ethernet type, Physical Port ID

- L3&L4 based: Source & Destination IP, Source & Destination TCP/UDP Port Number

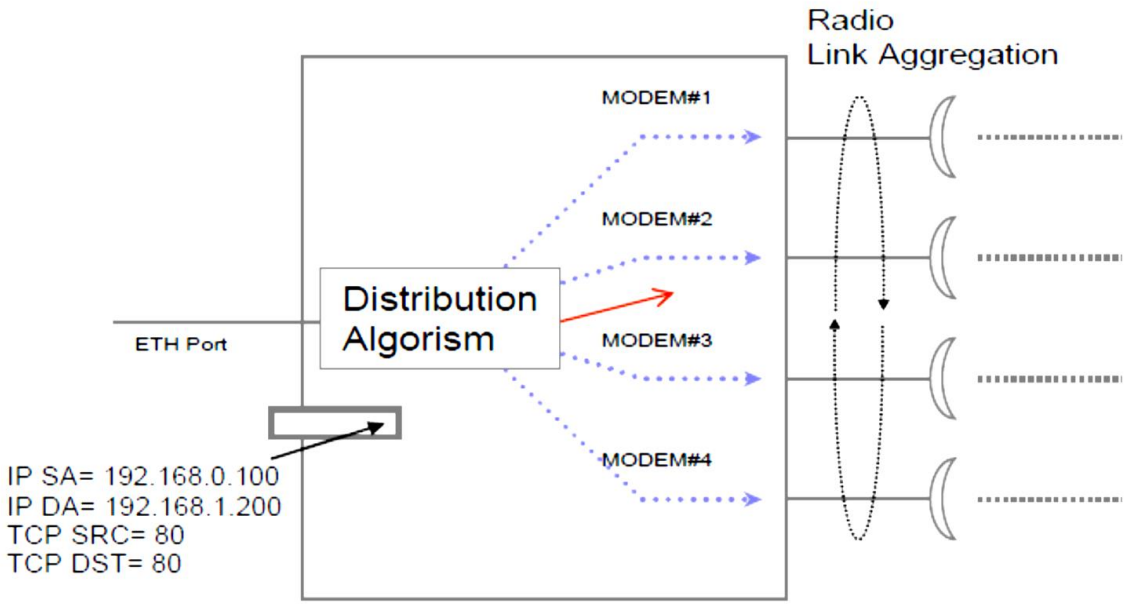


Fig: 11 Radio Link Aggregation

RADIO LINK AGGREGATION (L1 BASED)

Radio link aggregation achieves high capacity with bundling 2 modem ports without relation to L2/L3/L4 types.

HIGH ACCURACY CLK SUPPLY FOR CLOCK SYNCHRONIZATION

Supports external clock, both native PDH/SDH TDM and SyncE for clock references.

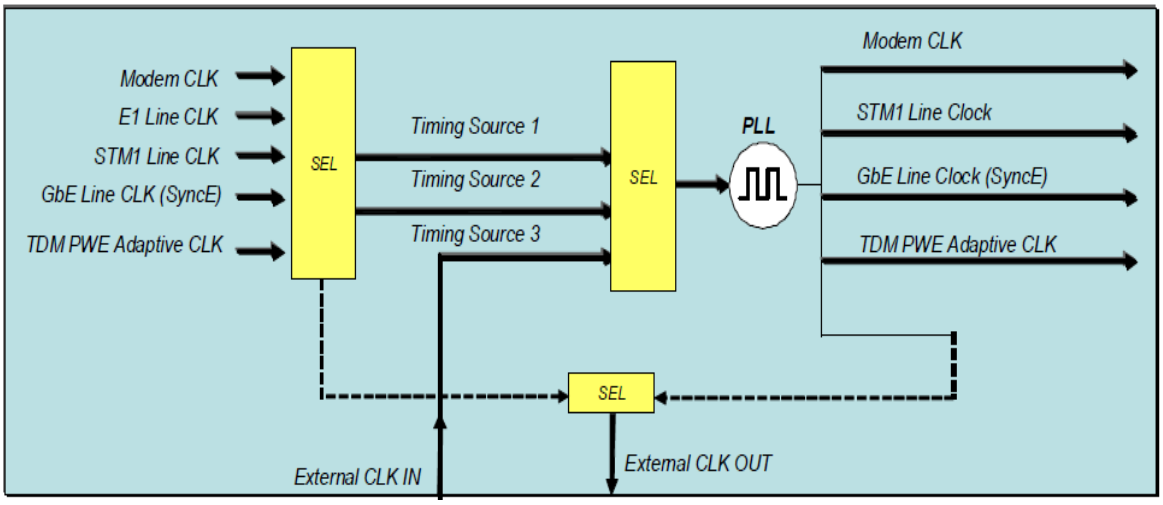


Fig:12 Synchronization methods

AUTOMATIC PROTECTION SWITCH (APS) FUNCTION

APS realizes optical line protection for STM-1. APS is a conventional Multiplex Section Protection (MSP) function simplification to fit RST mode equipment (ITU-T G.841, Non-revertive mode).

STM-1 TRANSMISSION

Two kind of transport mode are available to adopt a multiple variety of baseband traffic demand.

- **Transparent mode:** This mode can transparently transmits the STM-1 signal as it is in the STM-1 interface port.
- **Channelized mode:** This mode can achieve the cross-connection of each E1 channels in the payload of VC-12 in STM-1 stream.

*Specific signals/bytes in SOH (Section Overhead) is added or removed at the STM-1 interface port.

7.8 PERFORMANCE OF RADIO SECTION

EFFICIENT USAGE OF FREQUENCY RESOURCES

High modulation scheme (up to 2048QAM) for native Ethernet and native TDM transmission achieves high spectrum efficiency.

- Dual polarization transmission technologies with XPIC in single IDU chassis.
- AMR functions with hitless modulation switchover.

HIGH SYSTEM GAIN

High system gain achieved by Low Density Parity Check (LDPC) Forward Error

Correction (FEC) technology and distortion cancelling technique (linearizer) allowing smaller antennas and reducing platform cost.

FREQUENCY AGILITY AND EASY TUNING

Field-tunable based on your radio frequency channel* license through Local Craft Terminal (LCT).

ADAPTIVE MODULATION RADIO (AMR)

AMR is a technology to improve robustness mainly in the packet transmission environment by utilizing thermal threshold difference between modulation hierarchies, such as QPSK to 2048 QAM etc. For instance, intensive rain causing receiving level attenuation at high frequency bands, AMR keeps the link availability by automatically and error-free selection of the lower thermal threshold modulation. In a IP packet transmission, i.e., no hierarchy transmission case, link connectivity in other word, robustness might be more important factor even though transmission capacity is significantly reduced. Prioritization between TDM and Ethernet packets or prioritization between Ethernet ports or VPN-base is the quite important matter to maintain the quality of the highest priority service.

Since severe rain attenuation is rapidly fluctuated, it is required to sufficiently correspond to such high descent and ascent speeds of receiving signal level. Adoption of small stepping method such as utilizing both forward error correction code ratio difference and modulation may not always catch up to these speeds and may not effectively work in real world.

Table 1 shows the AMR range for channel spacing and modulation scheme.

Table 1

CS* / Modulation	7 MHz* mode	14 MHz* mode	28 MHz* mode	40 MHz* mode	56 MHz* mode	
QPSK	13	27	56	78	113	Mbps
16 QAM	26	55	113	156	227	Mbps
32 QAM	33	69	141	196	284	Mbps
64 QAM	40	83	170	235	341	Mbps
128 QAM	47	96	198	274	398	Mbps
256 QAM	53	111	227	314	456	Mbps
512 QAM	60	124	254	351	510	Mbps
1024 QAM	67	137	279	386	559	Mbps
2048 QAM	-	152	309	428	620	Mbps

*: Channel Separation -: Not mapped

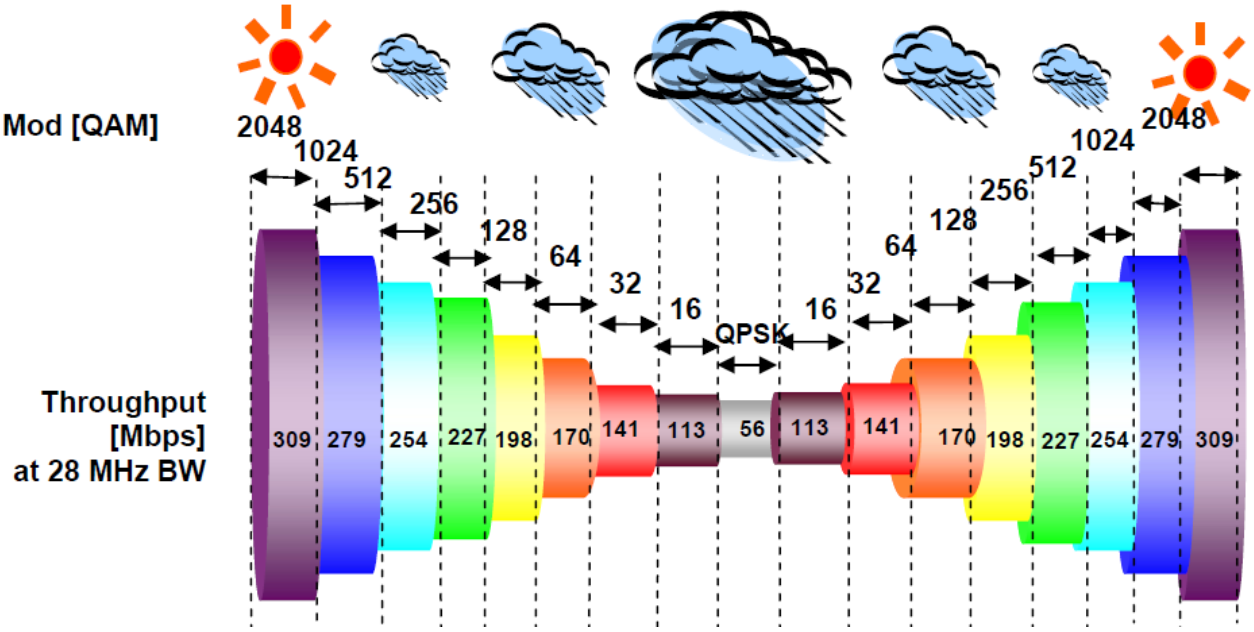


Fig:13 AMR capacity changing image

CROSS POLARIZATION INTERFERENCE CANCELLER (XPIC)

iPASOLINK 400 can double its transmission capacity up to 1240 Mbps in 56 MHz (55 MHz for 18 GHz band) bandwidth by adopting NEC's state-of-the-art XPIC technology. The additional required components from single pole transmission are; dual-polarized antenna, one more ODU in IDU. Through these additions, you can achieve double capacity without additional footprint or indoor mounting space.

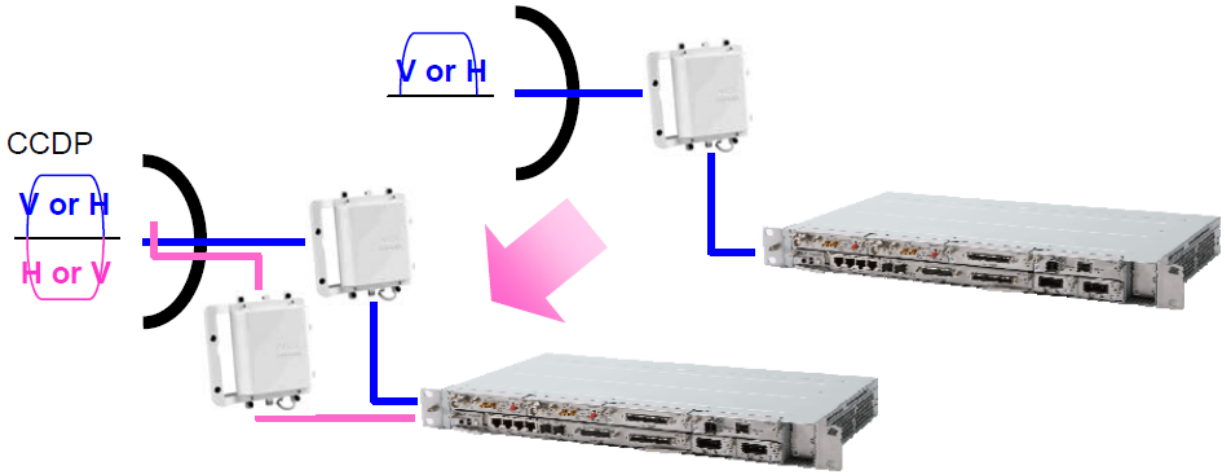


Fig:14 Double the capacity upgrade

Table 2 iPASOLINK 400 throughput with XPIC

Dual Transmission Capacity (Throughput (Mbps)*2*3)						
CS*1 / Modulation	7 MHz Mode	14 MHz Mode	28 (27.5) MHz Mode	40 MHz Mode	56 (55) MHz Mode	
QPSK	26	52	112	156	226	Mbps
16 QAM	52	110	226	312	454	Mbps
32 QAM	66	138	282	392	568	Mbps
64 QAM	80	166	340	470	682	Mbps
128 QAM	94	192	396	548	796	Mbps
256 QAM	106	222	454	628	912	Mbps
512 QAM	120	248	508	702	1020	Mbps
1024 QAM	134	274	558	772	1118	Mbps
2048 QAM	-	304	618	856	1240	Mbps

7.9 BASEBAND INTERFACE

The iPASOLINK 400 has various interfaces specified by the ITU-T standard and IEEE standard as listed below:

E1 INTERFACE [MAIN BOARD]

- Signal rate : 16 x E1 (2.048 Mbps)
- Interface : HDB-3 (ITU-T G.703)
- Impedance : 75 ohms or 120 ohms (selectable)

E1 INTERFACE [UNIVERSAL SLOT]

- Signal rate : 16 x E1 (2.048 Mbps)
- Interface : HDB-3 (ITU-T G.703)
- Impedance : 75 ohms or 120 ohms (selectable)

LAN INTERFACE 2XGBE (SFP) [MAIN BOARD]

- Type : 1000Base-SX/LX, LC (SFP)
- Port Number and Interface : 2

LAN INTERFACE 2XFE OR GBE (RJ-45) [MAIN BOARD]

- Type : 10/100Base-T(X) or 10/100/1000Base-T (auto or fixed)
- Port Number and Interface : 2

LAN INTERFACE 4XGBE (2XSFP+2XRJ-45) [UNIVERSAL SLOT]

- Type : 10/100/1000Base-T(X) (auto or fixed) / RJ-45, 1000Base-SX/LX/ LC (SFP)
- Port Number and Interface : 4

STM-1 OPTICAL INTERFACE [UNIVERSAL SLOT]

STM-1 interface card has E1 and STM-1 converter function, and optical or electrical interface is selectable with SFP. This card can be added into up to 3 universal slots.

- Signal rate : 1 or 2 x 155.52 Mbps (APS only)
- Interface : S-1.1/L-1.1 (ITU-T G.957)
- Connector : LC (SFP)

STM-1 ELECTRICAL INTERFACE [UNIVERSAL SLOT]

This interface is provided with the same interface card as STM-1 optical interface, and optical or electrical interface is selectable with SFP. This card can be added into up to 3 universal slots.

- Signal rate : 1 or 2 x 155.52 Mbps (APS only)
- Interface: CMI (ITU-T G.703)

ODU INTERFACE

This interface is a port used to connect ODU with IDU with the coaxial cable. This interface card can be added into up to 4 universal slots.

- Connector: TNC female

HYBRID COMBINER/DIVIDER

` Hybrid Combiner/Divider comprises directional coupler, antenna interface, radio mounting interfaces and polarizer. The RF signal power received by the single polarized antenna is equally distributed and sent to two outdoor units through the Hybrid Combiner/Divider for 1+1 protected systems.

Fig:15 7/8 GHz Hybrid (N connector type)

7.10 CONCLUSION

The iPasolink 400 may contain up to four (4) modems. Each modem can provide Ethernet L2 capacity 10 to 400 Mbit/s or PDH/SDH capacity up to 152 x E1 or 2 x STM-1 or various combinations. The actual capacity depends on the available channel width and available signal to noise/interference ratio and the fade margin required to fulfil the availability targets.

In the most basic configuration only one of the four slots contains a modem. The main card has always FE/GbE and E1 interfaces. The other slots may contain additional GbE, SDH or E1 interfaces or modems. In addition, TDM over packet (PWE), Synchronous Ethernet etc. options are available.

8 IP ADDRESSING AND IPV6

8.1 LEARNING OBJECTIVE

After reading this unit, you should be able to understand:

- An IP Address and its usage
- IPv4 Addressing Scheme
    - Classful and Classless Addressing Scheme
    - No of Networks / Host per class
    - IPv4 Address Pattern
    - Characteristics of Classes
    - Network and Broadcast Addresses
- Subnetting
    - Identifying Network Address
- VLSM – Variable Length Subnet Mask
- CIDR – Classless Inter Domain Routing
- To differentiate between Public and Private IP address

8.2 INTRODUCTION

Internet Protocol version 4 (IPv4) is the fourth revision in the development of the Internet Protocol (IP) and the first version of the protocol to be widely deployed. Together with IPv6, it is at the core of standards-based internetworking methods of the Internet. As of 2012 IPv4 is still the most widely deployed Internet Layer protocol. IPv4 is described in IETF publication RFC 791 (September 1981).

IPv4 is a connectionless protocol for use on packet-switched Link Layer networks (e.g., Ethernet). It operates on a best effort delivery model; in that it does not guarantee delivery, nor does it assure proper sequencing or avoidance of duplicate delivery. These aspects, including data integrity, are addressed by an upper layer transport protocol, such as the Transmission Control Protocol (TCP).

IPv4 uses 32-bit (four-byte) addresses, which limits the address space to 4.3 billion (232) addresses. Addresses were assigned to users, and the number of unassigned addresses decreased. IPv4 address exhaustion occurred on February 3, 2011. It had been significantly delayed by address changes such as classful network design, Classless Inter-Domain Routing, and network address translation (NAT).

8.3 IPv4 ADDRESS

Each host on a TCP/IP network is uniquely identified at the IP layer with an address. This is called an IP address. An Internet Protocol (IP) address specifies the location of a host or client on the Internet. The IP address is also known as Protocol address. It's a logical address.

The IPv4 address is 32 bits long. From the machine's perspective, an address may look like 11001010000011100100000000000001. But for human understanding the 32 bits of IP

address are divided into 4 bytes of 8 binary digits and each binary byte is converted into decimal and is separated by a dot hence also known as Dotted Decimal Notation. As human beings, we see an IP address like 202.14.64.1

In decimal the address range is 0.0.0.0 to 255.255.255.255. An IP address is having two parts: Network ID or Network Part and Host ID or Host Part. It is of the form <networkID, hostID>

8.4 IPv4 ADDRESSING SCHEME

- Classful
- Classless

8.4.1 CLASSFUL ADDRESSING SCHEME:

This was the original addressing scheme in which IPv4 address space was structured into five classes (A, B, C, D and E). The value of first octet of an IP address determines the class of network to which it belongs in classful addressing scheme.

- A, B & C classes are used to represent host and network address.
- Class D is a special type of address used for multicasting.
- Class E is reserved for experimental use.

Class Identifier: These are the few initial bits which determine the class of an IP address. This is turn indicates how many bits are defining network and host.

Subnet Mask: This is the mask which helps in determining the number of bits for network. In other words, it helps in determining network ID of an address.

Network Address: Network Address is an address of the network. In network address, all host bits are set to 0. It is similar to STD code in BSNL landline numbers.

Host Address: Host address is an address assigned to an interface of a node. Network address along with host bits determines the host address. Host part is equivalent to telephone number assigned to landline phone.

8.4.1.1 Number of Networks / Hosts in Class A, B, and C

CLASS	NO OF NETWORKS	NO OF HOSTS / NETWORK
A	126	16,777,214
B	16,384	65,534
C	2,097,152	254

8.4.1.2 Class D Address

- These are special addresses known as multicast addresses
- This address is assigned to a group of networks and not to represent a unique address

- This address is used to send IP datagrams to a group but not to all the hosts on the network
- This address is also used to address router update messages

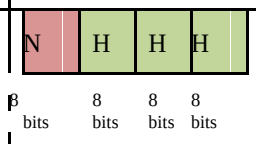
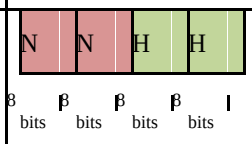
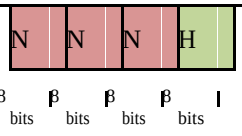
8.4.1.3 Class E Address

- These are reserved for future purposes.

8.4.1.4 IPv4 Address Bit Pattern

Class	8 Bit. 8 Bit. 8 Bit. 8 Bit
Class A	0-127
Class B	128-191
Class C	192-223
Class D	224-239
Class E	240-255

8.4.1.5 Characteristics of classes

ATTRIBUTE	CLASS A	CLASS B	CLASS C	CLASS D	CLASS E
Class Identifier	0	10	110	1110	1111
Addresses begins with	1 to 126	128 to 191	192 to 223	224 to 239	240 to 254
Natural or Default Mask	/8 or 255.0.0.0	/16 or 255.255.0.0	/24 or 255.255.255.0	-	-
Network Part / Host Part				-	-

In Class A, Network ID 0 is not used, and 127 is reserved for loopback.

8.4.1.6 Network and Broadcast Address

Network Address: The network address is the first address in a range of IP addresses and is used to communicate with all network devices on a particular network. The network address contains zeroes in the host portion of the IP address.

Example Network Address

The network address in a range of IP addresses always contains all zeroes in the host portion of the address as shown below:

192	.	168	.	1	.	0
11000000		10001010		00000001		00000000

The network address is important to network equipment, to routers and to routing. Network addresses are used to represent destination networks in routing tables.

Broadcast Address: A broadcast address is the last address in a range of IP addresses and allows information to be sent to all machines on a given subnet rather than a specific machine. The broadcast address contains ones in the host portion of the IP address.

Example Broadcast Address

The broadcast address in a range of IP addresses always contains all ones in the host portion of the address as shown below:

192	.	168	.	1	.	255
11000000		10001010		00000001		11111111

203.251.7.25	Network ID – 203.251.7.00000000 => 203.251.7.0
203.251.7.0	Broadcast ID – 203.251.7.11111111 =>203.251.7.255

8.4.2 CLASSLESS ADDRESSING SCHEME

In classless addressing scheme, classful networks are subnetted or super netted and their default subnet mask are changed, thereby just by analyzing the class of address by analyzing initial few bits will not help in determining the network ID and for this subnet mask is must.

8.5 SUBNETTING

Chopping up of a network into a number of smaller networks is called subnetting. Subnetting an IP Network can be done for a variety of reasons, including organization, use of different physical media (such as Ethernet, FDDI, WAN, etc.), preservation of address space, and security.

It allows to assign some of the bits, normally used by the host portion of the address, to the network portion of the address. The format of subnetted IP address would be <network number, subnet number, host number>. It allows efficient use of full network address.

Subnet is a real network under a network. Any of the classes can be subnetted. The most common reason is to control network traffic.

8.5.1 SUBNETTING USING 1 BIT

Depending upon number of subnets to be carved out of given network, no of bits from host part can be used for creating these subnets. Example, 1 bit can create 2 subnets, 2 bits for 4 subnet and so on.

Example: Subnetting using 1 bit can be performed in order to divide a network into 2 equal sub-networks.

Network N.N.N.H/24
Subnet -1: N.N.N.0|00000001
Subnet -2: N.N.N.1|00000000

Subnet -2: Subnet -1:
N.N.N.128/25 N.N.N.64/25
Hosts 2^7-2 = 126 Hosts 2^7-2 = 126

8.5.2 IDENTIFYING NETWORK ADDRESS

Performing a bitwise logical AND operation between the IP address and the subnet mask results in the *Network Address* or Number.

For example, using 140.179.240.200 (Class B) IP address and the default Class B subnet mask, we get:

10001100.10110011.11110000.11001000	140.179.240.200	Class B IP Address
11111111.11111111.00000000.00000000	255.255. 0. 0	Default Class B S/N Mask
----------		
10001100.10110011.00000000.00000000	140.179.0.0	Network Address

8.6 VLSM: Variable Length Subnet Mask

Subnetting creates subnets with equal number of hosts, in a network. The number of bits subnetted i.e. the length of subnet mask will be same for all the subnets. To co-op with the variable number of hosts in subnets, in a network, number subnetted bits i.e. the

length of subnet mask for the subnets will also vary. The method of achieving subnetting, with variable length of subnet mask, is known as Variable Length Subnet Mask.

8.7 CIDR: Classless Inter Domain Routing

This is pronounced as – cider. It is also known by the name supernetting. It is defined in RFC 1519. It helps in reducing number of route table entries.

Example: Following networks can be represented as single network.

i.	192.168.0.0/24	
ii.	192.168.1.0/24	192.168.0.0/22
iii.	192.168.2.0/24	
iv.	192.168.3.0/24	

8.8 Public and Private IP Addresses

On the basis of usage of IP address in networks it can be classified as

- Public IP Addresses
  These are the address spaces that are used in Public Networks like Internet.
- Private IP Addresses
  These are used in Private Networks like LAN.

8.9 PRIVATE SUBNETS

There are three IP network addresses reserved for private networks. These can be used by anyone for setting up their internal IP networks. These are equivalent to intercom facility which is setup in a colony or in apartment. These address blocks are:

- 10.0.0.0/8
    - 24-bit block
    - Complete class-A network number
- 172.16.0.0/12
    - 172.0001/0000.0.0-172.0001/1111.255.255
    - 20-bit block
    - Set of 16 contiguous class-B network numbers
- 192.168.0.0/16
    - 16-bit block
    - Set of 256 contiguous class-C network numbers

8.10 SUMMARY

IPv4 address is a 32 bit number which is used to identify network devices on the network. Since, the complete IPv4 address space is finite number i.e. 4.38 billion addresses out of which few hundred million addresses are usable for Internet; therefore, it is vital to efficiently manage this resource for proper functioning of network and Internet. Understanding the addressing concepts helps in building the network and provisioning of addresses to various network components. This has been done with Subnetting, VLSM and to aggregate the routes CIDR is used.

8.11 SELF ASSESSMENT QUESTIONS

- What is an IP address and what is its importance for the network?
- What are various classes in classful addressing scheme? How to differentiate between classes using the initial four bits? How many class B networks are possible?
- How many bits are required for subletting a network to cater 8 sub networks?
- Under what circumstances VLSM is used? How it helps in efficiently usage of IP address pool?

8.12 LEARNING OBJECTIVE

After reading this unit, you should be able to understand:

Limitations of IPv4

Features of IPv6

8.13 INTRODUCTION IPv6

Internet Protocol version 6 (IPv6) is the sixth revision in the development of the Internet Protocol (IP) and the second version of the protocol to be widely deployed. Together with IPv4, it is at the core of standards-based internetworking methods of the Internet.

The current version of IP - IPv4 has not changed substantially since RFC 791, which was published in 1981. IPv4 has proven to be robust, easily implemented, and interoperable. It has stood up to the test of scaling an internetwork to a global utility the size of today's Internet. This is a tribute to its initial design.

However, the initial design of IPv4 did not anticipate the areas like growth of internet, need for simpler configuration, security consideration, support for prioritized and real-time delivery of data etc.

8.14 LIMITATIONS OF IPv4

8.14.1 ADDRESSING PROBLEM

Although the 32-bit address space of IPv4 allows for 4.38 billion addresses, previous and current allocation practices limit the number of public IPv4 addresses to a few hundred million. As a result, public IPv4 addresses have become relatively scarce, forcing many users and some organizations to use a NAT (Network Address Translation) to map a single public IPv4 address to multiple private IPv4 addresses.

Additionally, the rising prominence of Internet-connected devices and appliances ensures that the public IPv4 address space will eventually be depleted.

8.14.2 ROUTING CRISES

Initially, IPv4 addressing scheme was following classful addressing. However, with the expansion of Internet and re-allocation of IPv4 address space, this classful addressing form lost its original shape and transformed into classless addressing by opting for options like subnetting and VLSM. This resulted in loss of aggregation of routes and routing entries have increased tremendously resulting in routing crises for the router for routing the traffic.

8.14.3 END TO END PROBLEM

As current IPv4 address space provides only few hundred million public addresses, which are insufficient for fulfilling the need of hosts in the Internet world. In order to overcome this limitation, with the help of NAT single global address is being mapped with private address space. Although NATs promote reuse of the private address space, they violate the fundamental design

principle of the original Internet that all nodes have a unique, globally reachable address, preventing true end-to-end connectivity for all types of networking applications.

8.14.4 SECURITY

Private communication over a public medium such as the Internet requires cryptographic services that protect the data being sent from being viewed or modified in transit. Although a standard now exists for providing security for IPv4 packets (known as Internet Protocol security, or IPsec), this standard is optional for IPv4 and additional security solutions, some of which are proprietary, are prevalent.

8.14.5 MOBILITY

The problem of mobility for IPv4 was first addressed in a standards track specification, RFC 2002, "IP Mobility Support," in 1996. But this mobility is limited in true sense.

8.14.6 PERFORMANCE AND COST

The performance of IPv4 network will deteriorate if the infrastructure is not upgraded with time to match the traffic requirement which is increasing with application as well as user base along with routing entries because of increasing network complexity. This also involves cost in terms of trained man-power to maintain it. Also it requires efforts for configuring services like NAT which is mainly because of scarcity of IPv4 resource.

8.15 FEATURES OF IPv6

8.15.1 LARGE ADDRESS SPACE

IPv6 has 128-bit (16-byte) addresses. Although 128 bits can express over 3.4×10^{38} possible combinations, the large address space of IPv6 has been designed to allow for multiple levels of subnetting and address allocation, from the Internet backbone to the individual subnets within an organization.

Even with all of the addresses currently assigned for use by hosts, plenty of addresses are available for future use. With a much larger number of available addresses, address-conservation techniques, such as the deployment of NATs, are no longer necessary.

8.15.2 GLOBAL REACHABILITY

With IPv4 NATs, there is a technical barrier for applications that rely on listening or peer based connectivity because of the need for the communicating peers to discover and advertise their public IPv4 addresses and ports.

With IPv6, NATs are no longer necessary to conserve public address space, and the problems associated with mapping addresses and ports disappear for developers of applications and gateways. More importantly, end-to-end communication is restored between hosts on the Internet by using addresses in packets that do not change in transit. This functional restoration has immense value when one considers the emergence of peer-to-peer telephony, video, and other real-time collaboration technologies for personal communications etc.

By restoring global addressing and end-to-end connectivity, IPv6 has no barrier to new applications that are based on ad hoc connectivity and peer-based communication.

8.15.3 SCOPED ADDRESSES AND ADDRESS SELECTION

Unlike IPv4 addresses, IPv6 addresses have a *scope*, or a defined area of the network over which they are unique and relevant. For example, IPv6 has a global address that is equivalent to the IPv4 public address and a unique local address that is roughly equivalent to the IPv4 private address. Typical IPv4 routers do not distinguish a public address from a private address and will forward a privately addressed packet on the Internet. An IPv6 router, on the other hand, is aware of the scope of IPv6 addresses and will never forward a packet over an interface that does not have the correct scope.

There are different types of IPv6 addresses with different scopes. When multiple IPv6 addresses are returned in a DNS name query, the sending node must be able to distinguish their types and, when initiating communication, use a pair (source address and destination address) that is matched in scope and that is the most appropriate pair to use. For example, for a source and a destination that have been assigned both global (public) and link-local addresses, a sending IPv6 host would never use a global destination with a link-local source. IPv6 sending hosts include the address selection logic that is needed to decide which pair of addresses to use in communication. Moreover, the address selection rules are configurable.

This allows you to configure multiple addressing infrastructures within an organization. Regardless of how many types of addressing infrastructures are in place, the sending host always chooses the "best" set of addresses. In comparison, IPv4 nodes have no awareness of address types and can send traffic to a public address from a private address.

The benefit of scoped addresses is that by using the set of addresses of the smallest scope, your traffic does not travel beyond the scope for the address, exposing your network traffic to fewer possible malicious hosts.

8.15.4 NEW HEADER FORMAT

The IPv6 header has a new format that is designed to minimize header processing. This is achieved by moving both nonessential and optional fields to extension headers that are placed after the IPv6 header. The streamlined IPv6 header is more efficiently processed at intermediate routers.

IPv4 headers and IPv6 headers are not interoperable. IPv6 is not a superset of functionality that is backward compatible with IPv4. A host or router must use an implementation of both IPv4 and IPv6 to recognize and process both header formats. The new default IPv6 header is only twice the size of the default IPv4 header, even though the number of bits in IPv6 addresses is four times larger than IPv4 addresses.

8.15.5 STATELESS AND STATEFUL ADDRESS CONFIGURATION

To simplify host configuration, IPv6 supports both stateful address configuration (such as address configuration in the presence of a DHCP for IPv6) and stateless address configuration (such as address configuration in the absence of a DHCPv6 server).

With stateless address configuration, hosts on a link automatically configure themselves with IPv6 addresses for the link (called link-local addresses), with IPv6 transition addresses, and with addresses derived from prefixes advertised by local routers.

- **IPSEC HEADER SUPPORT REQUIRED**

Support for the IPsec headers is an IPv6 protocol suite requirement. This requirement provides a standards-based solution for network protection needs and promotes interoperability between different IPv6 implementations. IPsec consists of two types of extension headers and a protocol to negotiate security settings. The Authentication header (AH) provides data integrity, data

authentication, and replay protection for the entire IPv6 packet (excluding fields in the IPv6 header that must change in transit). The Encapsulating Security Payload (ESP) header and trailer provide data integrity, data authentication, data confidentiality, and replay protection for the ESP-encapsulated payload.

- **BETTER SUPPORT FOR PRIORITIZED DELIVERY**

New fields in the IPv6 header define how traffic is handled and identified. Traffic is prioritized using a Traffic Class field, which specifies a DSCP value just like IPv4. A Flow Label field in the IPv6 header allows routers to identify and provide special handling for packets that belong to a flow (a series of packets between a source and destination). Because the traffic is identified in the IPv6 header, support for prioritized delivery can be achieved even when the packet payload is encrypted with IPsec and ESP.

- **NEW PROTOCOL FOR NEIGHBORING NODE INTERACTION**

The Neighbor Discovery protocol for IPv6 is a series of Internet Control Message Protocol for IPv6 (ICMPv6) messages that manages the interaction of neighboring nodes (nodes on the same link). Neighbor Discovery replaces and extends the Address Resolution Protocol (ARP) (broadcast-based), ICMPv4 Router Discovery, and ICMPv4 Redirect messages with efficient multicast and unicast Neighbor Discovery messages.

8.15.6 EXTENSIBILITY

IPv6 can easily be extended for new features by adding extension headers after the IPv6 header. Unlike options in the IPv4 header, which can support only 40 bytes of options, the size of IPv6 extension headers is constrained only by the size of the IPv6 packet.

8.15.7 IPV6 HAS MORE EFFICIENT FORWARDING

IPv6 is a streamlined version of IPv4. Excluding prioritized delivery traffic, IPv6 has fewer fields to process and fewer decisions to make in forwarding an IPv6 packet. Unlike IPv4, the IPv6 header is a fixed size (40 bytes), which allows routers to process IPv6 packets faster.

Additionally, the hierarchical and summarizable addressing structure of IPv6 global addresses means that there are fewer routes to analyze in the routing tables of organization and Internet backbone routers. The consequence is traffic that can be forwarded at higher data rates, resulting in higher performance for tomorrow’s high-bandwidth applications that use multiple data types.

8.15.8 IPV6 HAS SUPPORT FOR SECURITY AND MOBILITY

IPv6 has been designed to support security (IPsec) (AH and ESP header support required) and mobility (Mobile IPv6) (optional). Although one could argue that these features are available for IPv4, they are available on IPv4 as extensions, and therefore they have architectural or connectivity limitations that might not have been present if they had been part of the original IPv4 design. It is always better to design features in rather than bolt them on. The result of designing IPv6 with security and mobility in mind is an implementation that is a defined standard, has fewer limitations, and is more robust and scalable to handle the current and future communication needs of the users of the Internet.

The business benefit of requiring support for IPsec and using a single, global address space

is that IPv6 can protect packets from end to end across the entire IPv6 Internet. Unlike IPsec on the IPv4 Internet, which must be modified and has limited functionality when the endpoints are behind NATs, IPsec on the IPv6 Internet is fully functional between any two endpoints.

8.16 CONCLUSION

There are many reasons for IPv6 supports and there is also need to migrate from current version of Internet IPv4 to IPv6 for availing additional benefits of Internet. However, for quite some time, things will move in parallel and smooth transition will be in benefit for the Internet world. Therefore, we will see IPv4 and IPv6 simultaneously being used by the Interenet users, and the service provider. Also the application that will be developed during this phase will also keep in mind the requirement of IPv4 and IPv6.

9 MULTIPLAY BROADBAND NETWORK

9.1 LEARNING OBJECTIVE

In this chapter rural broad band and multiplay broad band is covered. After reading this chapter, the participants will be able to understand the concepts of rural broad band, multiplay broad band, VPN, SLA, value added services, messaging services, internet data center services and other broad band services like IP multicasting services, on demand services etc.

9.2 NIB II PROJECT DETAILS

The turnkey implementation of "National Internet Backbone- Phase II" involved the following projects

Name of project	Description
Project 1	MPLS based IP Infrastructure
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.

NIB-II envisages four projects:-

- MPLS based IP Infrastructure in 100 cities (29 city STM-16 core).
- Access Gateway platform Narrow band (Augmentation of existing Dial up Internet capacity.
- Access Gateway Platform Broadband in 235 cities (Based on ADSL Technology)
- Services Platform consisting of messaging, Provisioning, billing, customer care, enterprise management system and Data centres.
- 71 location Managed IP & MPLS Network using MPLS enabled Routers
- Centralized NOC and DR site for NMS & PMS
    - NOC site at Bangalore, DR site at Pune
- Integration with Narrowband and Broadband RAS Projects
- Test bed Setup - Proof of Concept Centre

9.3 Objective of NIB-II

- NIB-II is a mission to build world-class infrastructure that will help accelerate the Internet revolution in India.
- 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 and any to any connectivity.
- 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 etc.
- Value Added Services like
  - Encryption Services
  - Firewall Services
  - Multicast Services
  - Network Address Translation (NAT) Service that will enable private users to access public networks
- Messaging Services
- Internet Data Centre Services at Bangalore, Delhi and Mumbai.
- Broad Band Services like
  - Broadcast TV using IP Multicasting service
  - Multicast video streaming services
  - Interactive Distant learning using IP multicasting Services
  - Video on demand
  - Interactive gaming service

9.4 NETWORK ARCHITECTURE

- A1 – 5 Core cities:-
  - Bangalore, Chennai, Mumbai, Delhi, Kolkatta.
- A2/A3 – 9 next level core cities:-
  - Pune, Hyderabad, Ahmedabad, Ernakulam, Lucknow, Jaipur, Indore, Jullundur, Patna.
- A4 – 10 Major cities.
- B1, B2 – 47 other cities.
- A1 city core routers (Cisco 12416) are fully meshed between locations on STM-16.
- A2 core routers (Cisco 12410) dual home to Core A1 routers on STM-16.
- A3 core routers (Cisco 12410) are dual home to the nearest A1 or A2 routers on STM-16.
- A4 core routers (Juniper M40) are dual home to the nearest A1 or A2 or A3 routers on STM1 links.
- IGW – International Gateway Router – Connectivity to Internet is through this router.
- IXP – Internet Exchange Point – ISP's connect each other through this router.
- IDC – Internet Data Center – for connecting to BSNL Data Centers.
- IP-TAX – BSNL IP-TAX traffic enters to NIB2 through this router.
- RR – Router Reflector – For reflecting of BGP routes to the edge routers.
- B1 and B2 cities have only EDGE routers, which are dual homed to nearest A1/A2/A3/A4 core routers.
- All Core locations also have edge routers.
- 10 A4 locations have Juniper core routers with Cisco 7613 Edge routers.
- Some core locations have Cisco core router and Juniper edge router.

NIB2 Expansion and Year 2 Order Overview

- 29 locations added which makes the total to 100
- Core backbone is getting aligned to BSNL Transmission (DWDM) network

- 24 City core network increased to 29
- All 29 city core network links are STM-16 (ie STM1 connectivity of A4 cities will be upgraded to STM16)
- New 5 Cities are Belgaum, Dehradun, Rajkot, Jodhpur, Jabalpur

METRO ETHERNET PROJECT

- Providing Metro Ethernet Broadband connectivity at A1 and A2 locations of NIB2
- Total 12 routers ordered for Metro Ethernet Project
- 2 routers each at 6 locations for Metro Ethernet project
- Bangalore (A1) – 1*12416 and 1*12410
- Chennai (A1) – 1*12416 and 1*12410
- Kolkata (A1) – 1*12416 and 1*12410
- Ahmedabad (A2) – 2*12410
- Hyderabad (A2) – 2*12410
- Pune (A2) – 2*12410

9.5 COMPONENTS OF BROAD BAND ACCESS NETWORK

- Broad band Remote Access Server (BBRAS)
- Gigabit and Fast Ethernet Aggregation Switches (LAN Switches).
- Digital Subscriber Line Access Multiplexers (DSLAMs)
- SSSS/SSSC (Subscriber Service Selection System/ Centre)
- Servers for AAA, LDAP at NOC.
- Provisioning and configuration management at NOC.
- DSLCPEs
- The DSLAMs will in general be 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 will be aggregated through a FE interface except 480 port DSLAM, which will be aggregated through Gigabit Ethernet Interface.
- The 240 ports DSLAM will have two number of FE interface.
- The FX or GBIC module in DSLAM and LAN switch should be capable of driving upto 10km on a single mode fibre.
- The SX or GBIC module in LAN Switch used for connecting Tier2 to Tier1 will support 40km.In bigger cities like A1, A2, A3 and A4, one BBRAS per city will be deployed initially.
- There will be no BBRAS at B1 and B2 cities.
- The DSLAMs in B1.B2 and other lower hierarchical cities will be aggregated through Layer 2 switches, and will be connected to the nearest BBRAS of A cities on Ethernet over SDH.
- The BRAS shall terminate the PPP sessions initiated by the customer and extend the connection further to MPLS VPN/ Internet as desired by the customer.

9.6 BROADBAND MULTIPLAY

Project 1 – IP / MPLS Core Backbone

- 100 location Managed IP & MPLS Network

- Awarded to HCL Infosystems Ltd.
- Network using Cisco (12410, 12416, 7613) and Juniper (M40e, M20) Router
- Common Backbone for all other projects of BSNL and integration with other projects of NIB-2 and other Data Projects of BSNL
- International Gateways connected for Internet access
- Provides MPLS-VPN Services and Internet Services, in certain cases

Project 2.1 – Narrowband Access Network

- Consists of Narrowband RAS (NRAS)
- Awarded to UTStarcom
- Network built using UTStarcom Total Control 1000
- Provides access to Dial-up Customers for Internet Access & Dial-VPN

Project 2.2 – Broadband Access Network

- Network for Providing Broadband Access
- Awarded to Huawei and UTStarcom (70 : 30 Split)
- Network built on Huawei Broadband RAS (BRAS), Huawei Tier-1 Switch, Huawei / 3Com Tier-2 Switch and Huawei / UTStarcom DSLAMs
- Provides Broadband Internet Access (DataOne) and VPN Services
- Broadband RAS (BRAS) working as PE Router for MPLS Core Network
- BRAS present at all 'A' Type Locations – 23 in No.
- Tier-1 Switch co-located with and connected to BRAS
- Layer 2 Network below is aggregated by Tier-1 Switch
- Tier-2 Switches connecting to Tier-1 Switches in Star Fashion
- DSLAMs connect to Tier-2 Switch

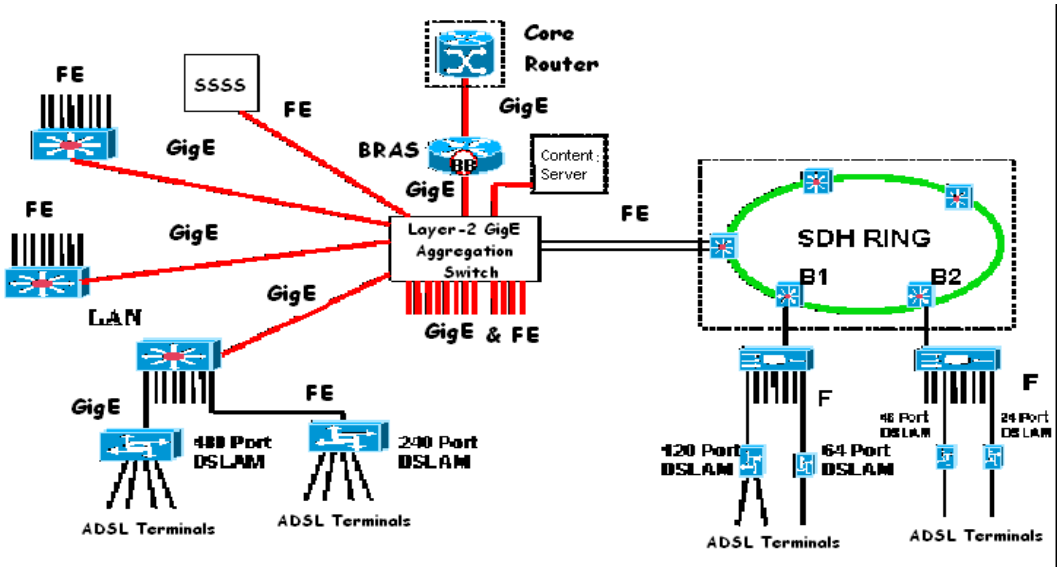


Figure 1: Broadband Project 2.2 Layout

Project 3 – Server / Application Infrastructure

- Consists of Data Centers in 4 locations – Bangalore, Pune, Mumbai & Noida
- Awarded to TCIL consortium with TCS and IBM
- IBM Servers, Nortel Network & Security equipment
- Provides Mail, DNS, Co-Hosting, Co-location, Billing etc.

Network Architecture

- A1 – 5 Core cities :Bangalore, Chennai, Mumbai, Delhi, Kolkatta
- A2 – 3 Tier-2 cities: Pune, Hyderabad, Ahmedabad,
- A3 – 6 next level core cities : Ernakulam, Lucknow, Jaipur, Indore, Jullundur, Patna
- A4 – 10 Major cities; Chandigarh, Ranchi, Mangalore, Nagpur, Bhubaneshwar, Guwahati, Vijaywada, Allahabad, Raipur, Coimbatore
- B1,B2 – 76 other cities

BROADBAND MULTIPLAY PROJECT COMPONENTS

- L3PE (MCR / PE Router of NIB-2 Project 1 – Supplied by HCL)
- BNG – Broadband Network Gateway
- Connects Multiplay Network to NIB2 Backbone (Project 1)
- RPR Tier-1 Switch
- Provides connectivity from BNG to Connects
- RPR Tier-2 Switch
- OC LAN Tier-2 Switch
- DSLAM
- DSL Tester
- Installation Related Material

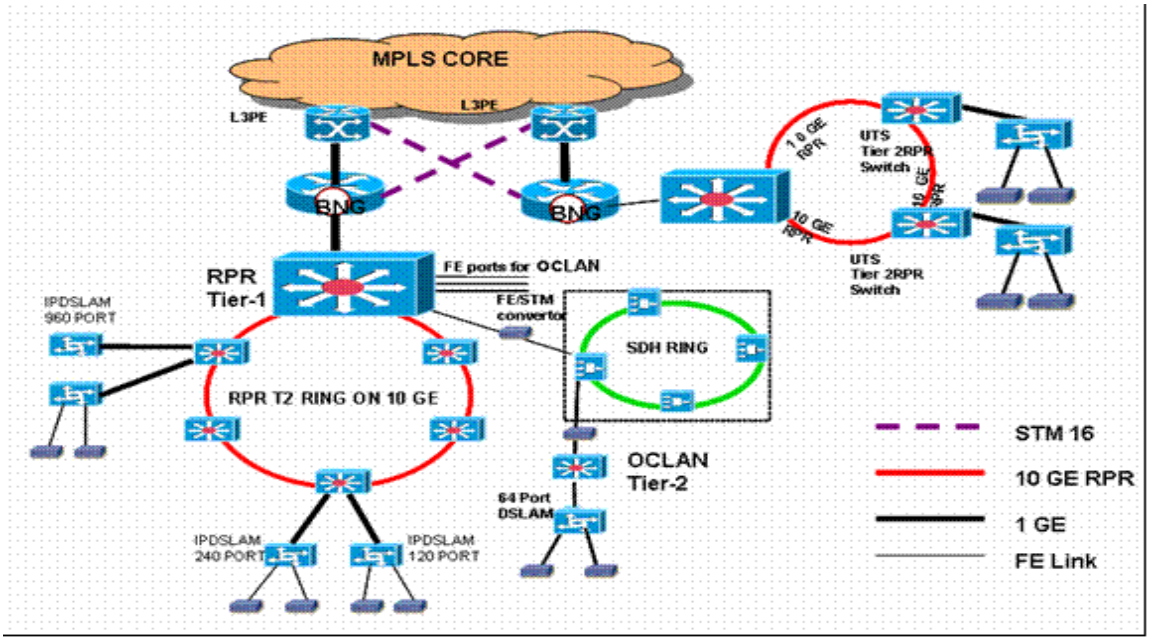


Figure 2: Broadband Multiplay Layout

Metro Core Routers

- Providing Access to the Broadband Multiplay NW at A1, A2 locations of NIB2
- Total 12 routers implemented as Metro Ethernet Project
- 2 routers each at 6 locations
- Bangalore (A1) – 1*12416 and 1*12410
- Chennai (A1) – 1*12416 and 1*12410
- Kolkata (A1) – 1*12416 and 1*12410
- Pune (A2) – 2*12410
- Hyderabad (A2) – 2*12410
- Ahmedabad (A2) – 2*12410

9.6 SERVICES ON BB-MULTIPLAY

- **TVOIP** (also called as IPTV) delivers television programming to households via broadband connection using Internet protocols.
- Internet Protocol Television (IPTV) is expected to change the way people watch TV. As the name suggests, IPTV is television programs delivered to subscribers through the Internet
- It requires a subscription and IPTV set-top box **(STB)**.
- 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.
- **IPTV (Internet Protocol Television**) is a system where a digital television service is delivered by using Internet Protocol over a network.
- If you've ever watched a video clip on your computer, you've used an IPTV system in its broadest sense.
- For residential users, IPTV is provided with Video On Demand and may be bundled with Internet services such as Web access and VoIP.
- Microsoft is one of the many companies developing solutions to support the Internet Protocol TV (IPTV) market.
- IPTV is an emerging technology and will evolve into a completely interactive experience in the future!
- First things first: the Set-Top Box (STB), on its way out in the cable world, will make resurgence in IPTV systems.
- The box will connect to the home DSL line and is responsible for reassembling the packets into a video stream and then decoding the contents.

- 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.)

VOIP

- 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)

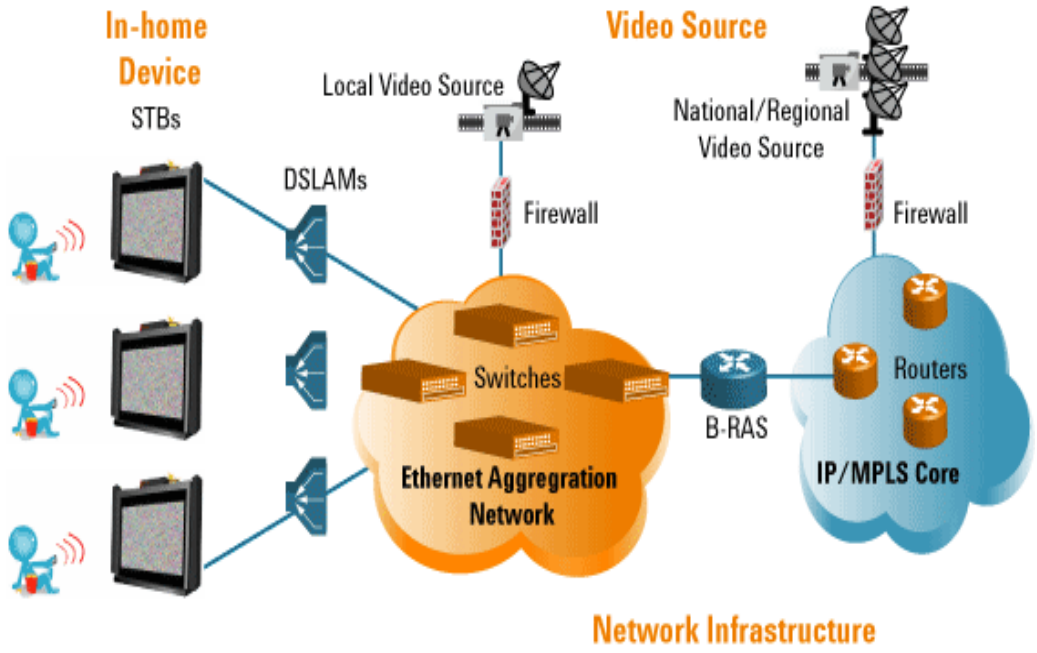


Figure 3: Network Infrastructure

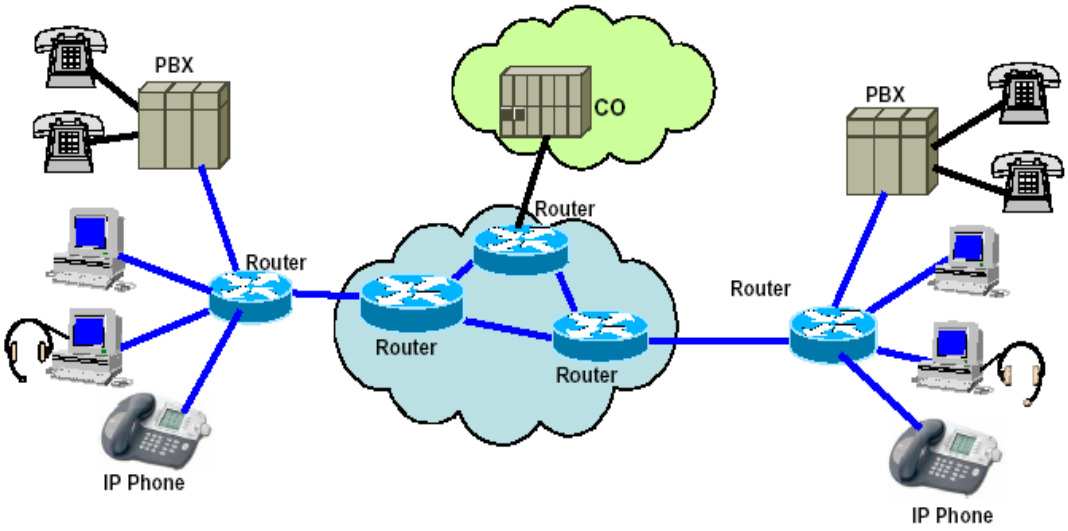
Benefits of VoIP

- Cost reduction
  - Toll by-pass
  - WAN Cost Reduction

a. Operational Improvement

  - Common network infrastructure
  - Simplification of Routing Administration Business Tool Integration
  - Voice mail, email and fax mail integration
  - Web + Call

Mobility using IP



- Converged network
- Separated or integrated applications

Figure 4: VOIP NETWORK

VoIP Protocols

- **H.323:**
  - ITU-T standard, latest version v4
  - Peer-to-peer protocol that supports terminals communicating over packet based networks
- **SIP:**
  - IETF standard, RFC 3261
  - Peer-to-peer protocol for initiation, modification termination of communication sessions between users
- **MGCP:**
  - ITU-T and IETF collaboration, RFC 3435
  - Master/slave protocol for media gateway controller to control media gateway.

9.7 CONCLUSION

BSNL has planned to roll out this service in 898 cities progressively. The service is being provided at Pune, Chennai, Bangalore, Kolkata, Hydrabad and Ahmedabad. This service is being provided through franchisees. Many cities already have franchisees for broadband content and they can offer this service. A pool of private IP addresses will be allotted by BSNL to the said franchisee, which will be used for allotting IP address to the IPTV customer.

10 CONCEPT OF ONE NETWORK

LEARNING OBJECTIVE:

- Learn the concept and requirement of One Network
- Learn the activities involved in one network concept
- Implementation of one network program
- Learn about the network and partner team management

10.1 INTRODUCTION TO ONE NETWORK

The activities related to network management and customer management are being done currently at the exchange / equipment location level. Custer service management is generally done through indoor staff station 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)

10.2 ACTIVITIES IN ONE NETWORK

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

(A) 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

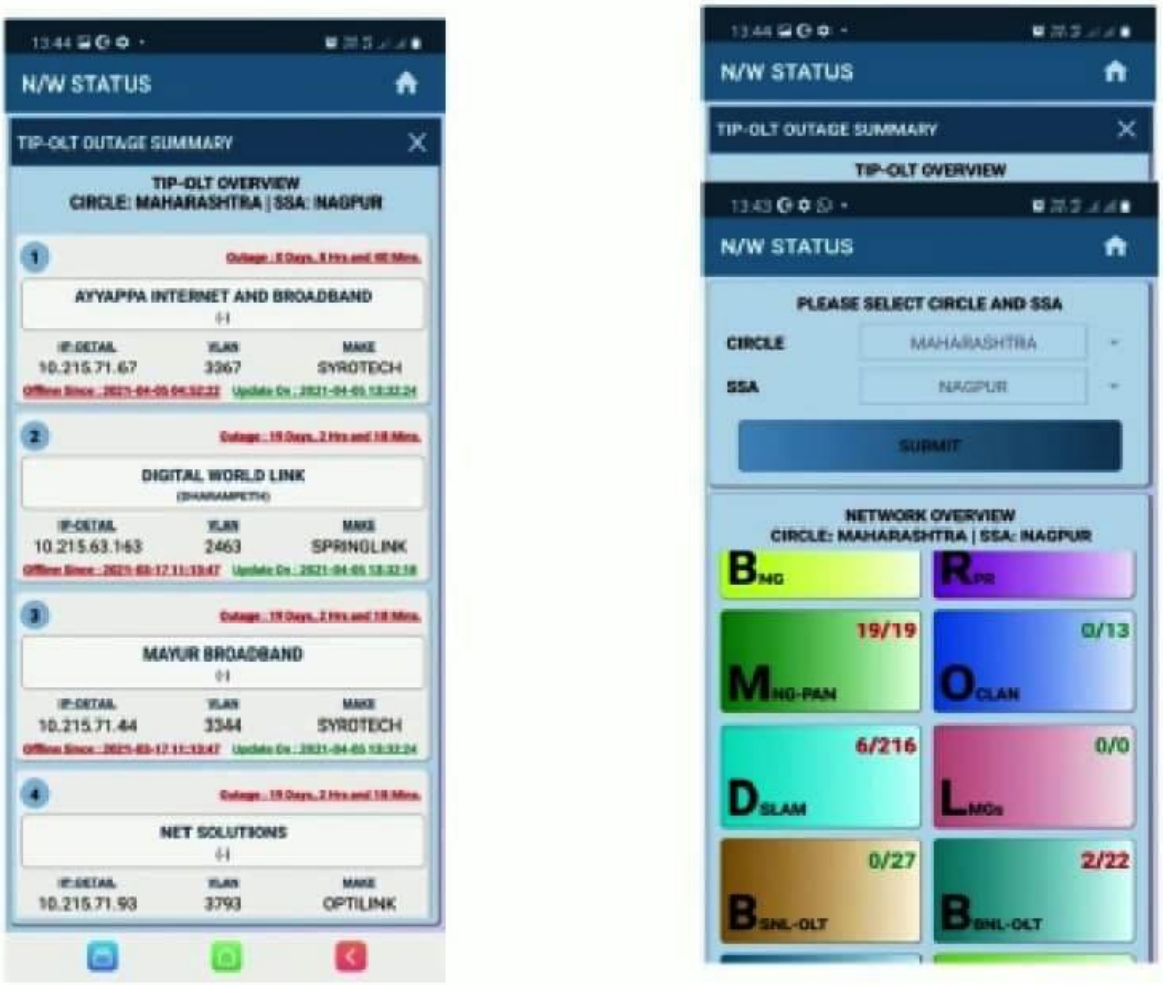


Figure 1: TIP OLT Management

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(B) 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.

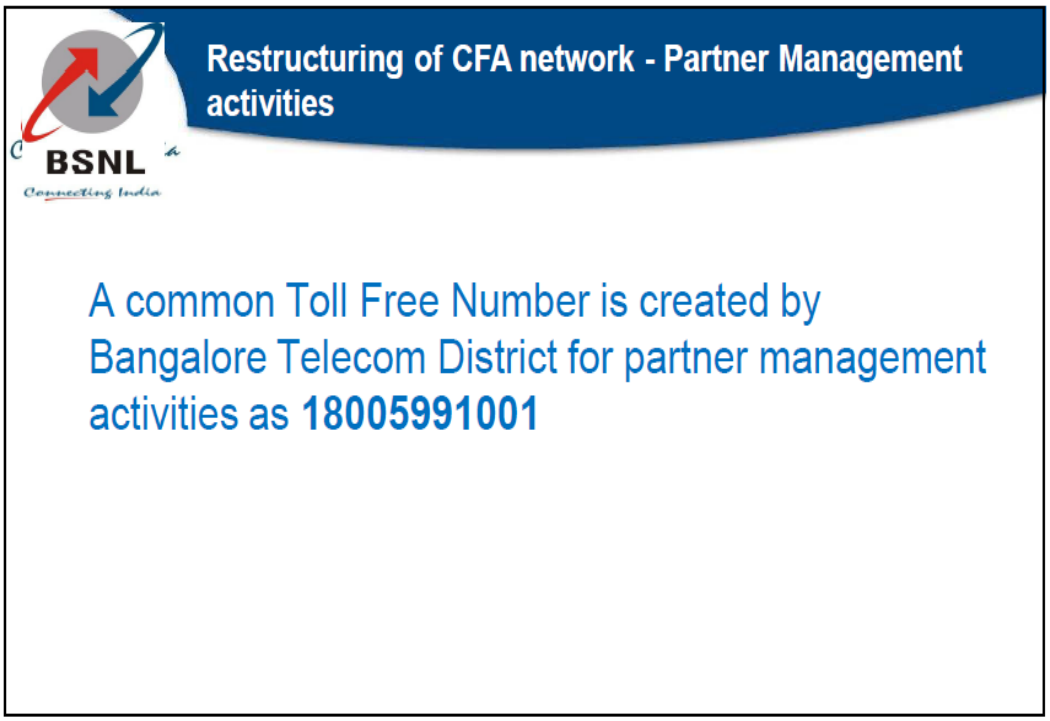


Fig 2 Common Toll Free Number for partner management

- 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.

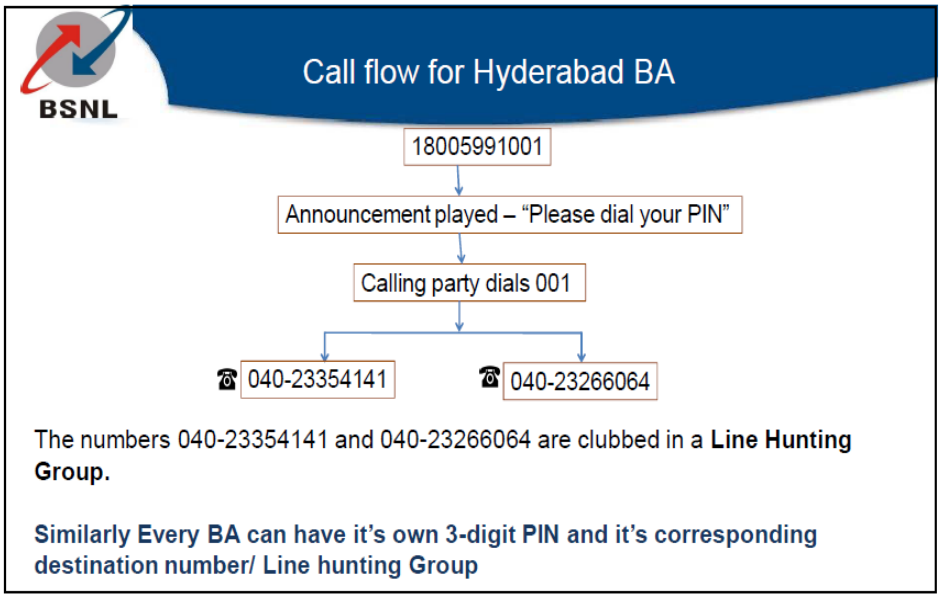


Fig 3 Call flow for BA

10.2.1 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.

10.2.2 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

10.2.3 OFC ROUTE PATROLLER MONITORING

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

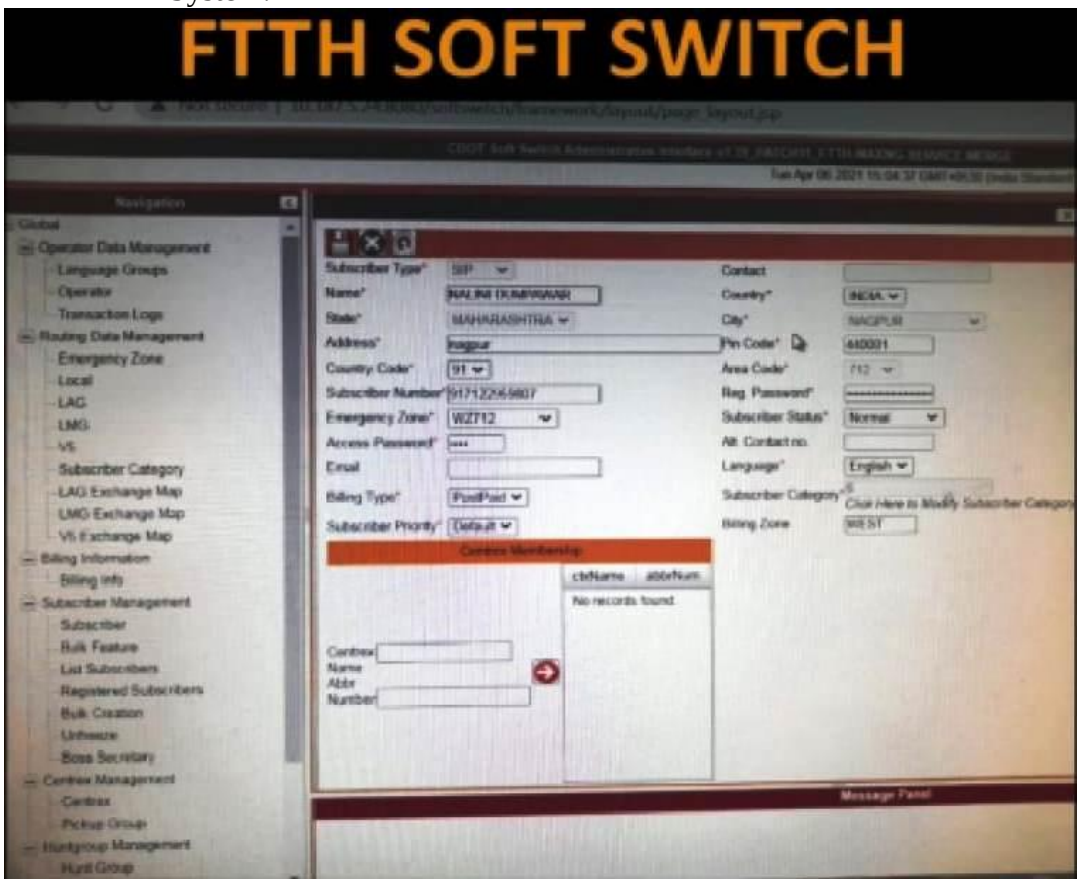


Figure 4 **:** FTTH Soft Switch

10.3 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)

10.4 NETWORK MANAGEMENT BA TEAM

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

(A) Network Management Team Details

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

(B) Partner Management Team Details

Name	Designation	CLUSTER FTTH	Mobile No.	E-mail ID

10.5 ONE NETWORK BA TEAM CASE STUDY OF MAHARASHTRA CIRCLE

Sl. No.	Name of circle	Name of BA	BA Type	Members in the centralized NOC team for network management	Members in the CGPS for the cluster/FTTH partner
	MH	Ahmednagar	Category-B	12	6
	MH	Amaravati	Category-C	8	4
	MH	Aurangabad	Category-C	8	4
	MH	Chandrapur	Category-C	8	4
	MH	Goa	Category-C	8	4
	MH	Jalgaon	Category-C	8	4
	MH	Kalyan	Category-B	12	6
	MH	Kolhapur	Category-B	12	6
	MH	Nagpur	Category-C	8	4
	MH	Nanded	Category-C	8	4
	MH	Nashik	Category-C	8	4
	MH	Pune	Category-A	16	8
	MH	Satara	Category-C	8	4
	MH	Solapur	Category-C	8	4

10.6 CONCLUSION:

As the name suggest 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 CDR

11.1 LEARNING OBJECTIVE

This chapter covers the concept of CDR used in BSNL. After reading this chapter the participants will understand the concept of implementation of CDR based convergent billing and customer care system. This project in the process of replacing all the existing 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.

11.2 INTRODUCTION AND SCOPE

BSNL is going to implement a CDR based convergent billing and customer care system. This project is going to replace all the existing systems of Commercial, TRA (Telecom Revenue Accounting), FRS (Fault Repair Service) and DQ (Directory Enquiry). The project will cover the customer care and billing for the following services:

- Landline
- Broadband
- Leased line

The project is not simply a replacement of the existing systems, but it is much more than that. For the first time in the history of BSNL, we are going to have 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 will also provide a Web Self Care (WSC) module which will enable customers to access the system through Internet for placing any request, for making payments, or for general enquiry.

This project envisages installation of provisioning and mediation systems which will interface with around 3000 PSTN switches and MSC based WLL systems. The subscriber management shall be done through the Provisioning system. The CDRs generated for all the calls will be pulled by the Mediation system.

We are going to have world renowned rating and billing systems which will process the mediated CDRs. The combination of CRM and the billing system will enable BSNL to introduce flexible user-friendly tariff Plans. It will also enable us to introduce schemes which we are not able to do now with the present billing systems.

The project also involves implementation of Payment Management system. It is specially designed and developed by TCS for BSNL. This system will be 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.

There is going to be separate software for bill formatting. The software will allow us to prepare the bills as per the design (uniform for all circles) that includes all types of graphics, logos, advertisements, etc. in multi color and bilingual formats. The system will prepare a Print file, which can then be given to the printer for printing. The printing sub system is not part of this project. The Print file will be used by the SSAs/Circles for printing the bills by using the existing methods whether outsourced, or in-house. BSNL is proposing to have Zonal Printing systems with probably five Printing Centres across the country. The Print file will then be sent to the Central Printing systems and distributed to the customers from there.

11.3 IMPLEMENTATION

The entire project is going to be implemented with four Data Centres at Hyderabad, Pune, Chandigarh and Kolkata. These four Data Centres will take 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 Zone-wise distribution of Circles is given below:

ZONE	CIRCLE
SOUTH	Andhra Pradesh,Chennai District, Tamilnadu, Karnataka, Kerala
EAST	Kolkata Telecom District, West Bengal Circle, Orissa, Jharkhand, Bihar, Assam, North East-I, North East-II, Andaman & Nichobar
WEST	Maharashtra, Gujarat, Madhya Pradesh, Chattisgarh.
NORTH	Punjab Circle, UP-East, UP-West, Haryana, Rajasthan, Himachal Pradesh, Uttarakhand, Jammu & Kashmir

The Billing system for South East is going to be 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 will be used in this project for the South East Zone. In the North West, the system for billing will be from M/s.Converges.

11.4 CONVERGENT BILLING

This project shall implement a convergent billing system, which enables us to issue a single bill for a customer taking any type of service from BSNL. The electronic stapling software shall be implemented in all the four zones. A customer having presence only in a particular zone, spanning across SSAs and Circles, can have a single bill for all the services he takes from BSNL whether the bill for the particular service is prepared or not from this system. The electronic stapling software installed at Hyderabad, shall take care of Corporate customers having All India presence. This system will have interfaces with other zonal billing systems, GSM billing systems and the NIB billing system. With these interfaces, it is possible to issue a single bill to a Corporate customer having All India presence. The system is also capable of taking the payments against this single bill and then distributing the payments back to the original billing systems of the different services taken by the customer for proper accounting. This is one of the biggest advantages of this project.

The system will also help us introduce Combo Plans, offering flexible tariff plans to customers availing Landline, Broadband and GSM services.

11.5 HARDWARE

As far as hardware is concerned, we are buying Data Centre (DC) Class servers which are high-end servers having 64 cores/CPUs in each machine. These high end machines shall be used for hosting the main applications such as Billing and CRM. We are buying low-end servers which are two-CPU servers for small applications like Anti-virus, HTTP, Web servers, Authentication etc. They are mostly Windows or Linux based servers.

In the Hyderabad Data Centre alone, we are going to have 18 DC class servers and around 200 low-end servers.

11.6 NETWORK

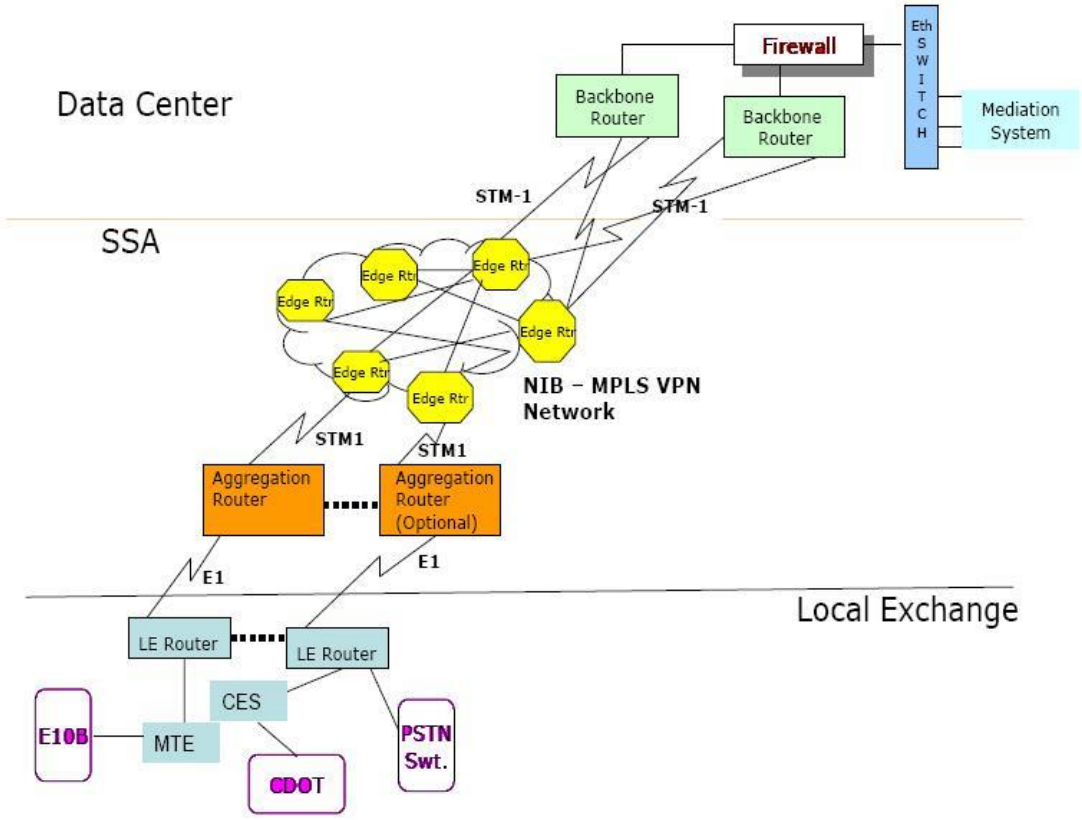
This project shall implement a country-wide Intranet. This network will connect all SSAs, Circles and the Corporate Office, providing connectivity to all its main exchanges, all officers dealing with customers, such as JTOs, SDEs, AOs, and the entire management. So far, each SSA or Circle has established networks for implementing DOTSOFT and other local systems. This project is going to integrate all the networks and provide a country-wide IP network with MPLS as the backbone. This network will be used not only for implementation of the CDR project, but also for implementing all other IT projects in future, such as ERP.

The following figure shows in general the exchange network and the collection methodology of CDRs. Each exchange is connected to a router, which is called LE router (Local Exchange router). All new technology switches such as OCB, EWSD, 5ESS, AXE, shall be connected using X.25 cards and Ethernet interface (wherever available). All CDOT exchanges will be connected to the LE router using CES equipment supplied by CDOT through HCL. All E10B exchanges will be connected to the LE router through MTE (Magnetic Tape Emulator). Each LE router is connected to the Aggregation Router through E1 links. All the E1s coming from the different exchanges will be aggregated to the Aggregation Router. Each Aggregation Router in each SSA shall be connected over STM-1 link to the nearest MPLS node. For redundancy purposes, the connectivity shall be establishe d to two MPLS nodes. The Data Centre is also connected to the MPLS network presently through STM-1 links, to start with. This end link will be enhanced to 1 GBPS link or more, later. Thus, each exchange shall be connected to the Data Centre over E1 end links and through the MPLS network.

The existing CSR network will also get connected to the Aggregation Router. Thus, all the terminals of Commercial, TRA, FRS and Directory Enquiry which are now connected to the local systems, will be connected to the Data Centres through the Aggregation Router. The project envisages –

- Establishment of new network for collection of CDRs from the exchanges,
- Usage of existing CSR network, with addition of a few CSRs, if necessary,

  and re-utilization of existing PCs in the network.


Data Center
Firewall
Eth Switch
Backbone Router
Backbone Router
Mediation System
STM-1
STM-1
SSA
Edge Rtr
Edge Rtr
Edge Rtr
Edge Rtr
Edge Rtr
Edge Rtr
NIB – MPLS VPN Network
STM1
STM1
Aggregation Router
Aggregation Router (Optional)
E1
E1
Local Exchange
LE Router
LE Router
CES
E10B
MTE
PSTN Swt.
CDOT

11.7 PCs

A few numbers of PCs are allotted to each SSA either for new locations, or for replacement of old PCs. In case SSAs require more PCs than are provided in the CDR project, then SSAs have to take necessary action to procure those PCs. In general, as per Corporate Office orders, all PCs which are more than 5 years old, are eligible for scrapping and replacement. If existing PCs can be upgraded, then it has to be done by upgrading the RAM to 256 MB (Minimum) if possible. If new PCs are being bought, then they have to be purchased with 512 MB RAM, minimum if WINDOWS XP is the Operating System, or 1GB RAM, if WINDOWS VISTA is the Operating System. The project will not have in general any client software to be loaded. Applications shall be Web based. Therefore, the end user's PC needs to have a browser with atleast WINDOWS XP as the Operating System. WINDOWS 98 PCs have to be either upgraded to XP or replaced.

11.8 IVRS and Integration with Call Centres

This project is going to have centralized IVRS (in each zone), CTI (Computer Telephony Interface), IP EPABX, etc. The core equipment required for Call Centre operations will therefore be installed at the Data Centres. The existing Call Centres, mostly one per each Circle, will then be connected to the Data Centres. In future, the 1500 calls and the 198 calls will be routed to this IVRS. Depending upon the Number or the CLI, the call will be routed through the IP network to the respective Call Centres. IP phones are provided to each Circle as part of this project. The Call Centre Agent will therefore have one IP phone and a PC connected over an IP network to the Data Centre. The customer data is displayed on the screen of the computer and the IP phone provides the voice communications with the customer. This is how the existing Call Centres will be integrated with the Data Centres.

11.9 SOFTWARE

The main components of the software that are being procured in this project are:

- CRM (including FRS)
- Billing
- Accounting
- Mediation
- Provisioning
- Web Self Care (WSC)
- Bill formatter
- Revenue Assurance (RA)
- Inventory management, which takes care of customer inventory such as MDF particulars, Pillar, DP particulars, etc.
- Directory enquiry
- Inter Operator Billing and Accounting system (IOBAS)
- Fraud Management System (FMS)
- Enterprise Management System (EMS)
- Enterprise Application Interface (EAI)
- RDBMS (mostly Oracle)

11.10 DISASTER RECOVERY

The customer care and billing and other related operations of 334 SSAs are going to be migrated to the four Data Centres. It is very important therefore to have a business continuity Plan in case of a disaster. A disaster is defined as an event that makes

continuation of normal functions of a Data Centre impossible. An event could be any one of the incidents like Flood, Fire, prolonged power shut down, strike, earthquake, etc.

In this project, Hyderabad is configured as the DR site for Kolkata and vice versa. Similarly, Pune is configured as the DR site for Chandigarh and vice versa. The degradation of performance for the applications failing over to the DR site is permitted upto 50%. This means for example, a billing operation taking 8 hours in the normal course, can take upto 16 hours in case of a disaster.

11.11 After CDR Project

The introduction of this new project will eliminate the need of individual SSAs maintaining and operating IT systems for all the four functionalities, i.e. Commercial, TRA, FRS and DQ. The SSAs shall be the end-users of the systems and will 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, it is proposed to change certain business processes within BSNL, a few of them are explained below:

- **Revenue Accounting:**

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

- **Surcharge/Late Fee**

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

- **PCO Billing**

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

- **Deposits**

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

- **Billing Cycles**

  The number of billing cycles in an SSA may increase. The new system is going to have a centralized billing process common for all the SSAs in a zone. Therefore, the customers in the entire zone shall be divided into different billing cycles to evenly distribute the process load on the servers. The number of billing cycles may even go upto 15 once the project is rolled out in all the SSAs.

- **CDR Based Billing**

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

month.

Though the system offers lot of flexibility in configuring different Plans, BSNL in turn may have to follow certain discipline in offering various Plans to the customers. It is proposed to authorize the Circle Office team to configure the plans as per business requirements and in future SSAs may not be able to configure new Plans on their own. Each Plan shall be identified by a Plan Code in the system. This discipline will help the organization in monitoring the launch of tariff Plans across the country and it will help BSNL to take correct business decisions.

- **What The Ssas Should Do In Preparing For The Project:**

1. Providing connectivity of exchange routers to MPLS VPN. Each exchange must be connected through one E1 link to the Aggregation Router. A redundant (second) E1 link will be connected to the second Aggregation Router.
2. Connectivity of Aggregation Router of SSA to two of the nearest MPLS nodes through STM-1 links
3. Connecting the existing CSR network to the Aggregation Router of the SSA.
4. Providing Transmission media to all these connectivities. Coordination with the Telecom Region to get channel allocation and connectivity to the MPLS node.
5. Coordination with NIB (Data network Circle) for allotment of STM-1 ports at all the MPLS nodes.
6. Cleaning and preparation of the data in the existing systems for data migration - to follow the guidelines given already by DDG(TRF).
7. Reconciliation of data between switches and the billing systems. All the numbers found working in the telecom switch should be reconciled with those working in the billing system also. The number of disconnected/closed connections must also be reconciled between the switch and the billing system.
8. All connections which are closed must be settled and accounts finalized and are not to be transferred to the new system.
9. Thorough review of outstanding must be done and fictitious outstanding and other outstanding must be written off as per the Corporate Office guidelines.
10. Deposits data must be verified and corrected in the existing system before we take up data migration.
11. All the facilities like CLIP, STD, ISD, Call forwarding, etc., must be gathered for all the customers and kept ready before data migration.
12. All the accessories being charged to the customers in the existing billing system must be thoroughly verified.
13. FRS data for all the customers regarding MDF, Pillar, and DP must be gathered and kept ready. To start with, it is important to collect the information regarding Localities and Sub-localities, Pillars and DPs. Mapping of the External plant inventory to the Locality and the JTO Outdoor is very important. Instructions issued in this regard by CGM IT may please be followed.
14. All the new technology switches, CDOT and E10 B exchanges must be kept ready for CDR generation for 100% of calls. The requirement of X.25 interface cards and cables must be projected to the Corporate Office, keeping IT Circle informed.

15. The upgradation and procurement of PCs as mentioned earlier in this Article must be done on top priority.
16. SSAs may ensure availability of Bar Code Scanners at all Online counters and availability of A4 page scanners for scanning the application forms.
17. All the Circles must review the existing network and project requirement of network elements for the Roll-out phase of this project to the IT circle.
18. All the SSAs are requested to watch the CDR Project link provided in the BSNL Intranet Portal for regular updates and information on the progress of this project.

11.11 CONCLUSION :

This project can be successful only with the coordination and cooperation of all the Wings of BSNL and in the SSAs, especially those of IT, Planning, Accounts, and Engineering officers. This is one of the biggest IT Projects taken up by any Telecom Operator in India and it is our duty to see that it is a success.

12 ENTERPRISE SERVICE

12.1 LEARNING OBJECTIVE

There is a growing need of connecting various branches of an Enterprise, which might be located across the globe. Lease line & Internet bandwidth has become a must for networking multi site business. Today's business owner wants to focus more on its core competencies rather than trying to implement such things of their own. Such a networking solution often requires not just bandwidth, but hardware components, security solution and maintenance also.

12.2 KEY FEATURES

a) Complete Reliable Services from One Interface Organization.
b) Supply of not only Bandwidth but also Leased line Modems / Routers etc. i.e. Complete Telecom Solutions.
c) Secured Network.
d) Proactive Monitoring of the customers Network.
e) Guaranteed SLA.

BSNL offering verities of Enterprise solutions as discussed below:

12.3 ENTERPRISE VOICE/MOBILITY SERVICE

12.3.1 EPABX

BSNL permits telephone subscribers to use their own PABX/EPABX connected to the BSNL network under certain commercial/technical conditions:

a) The type of Subscriber owned EPABX should be approved by BSNL

b) External extensions outside subscriber's premises will be permitted only on the specific approval of the concerned authority and charged as per departmental tariff. In cases where external extensions from subscriber owned EPABX are provided within the premises of the subscribers using their own cables and wires without crossing any public road, no charge will be levied.

c) Subscriber is free to use the existing internal wiring of the internal extensions left at the premises after the closure of the EPABX.

d) External extensions from subscriber owned PABX may be provided by the department and charged. Underground cables and lines may continue to be maintained by the department since the same may be required for provision of various telecom services the subscriber may require.

e) In cases where BSNL feels that the existing cables/overhead wires are not be used/likely to be used by the company the same can be made over to the user after recovering the depreciated value of assets.

f) Where subscribers themselves provide and maintain external extensions from the EPABX, applicable license fee would be charged if the extensions are crossing a public road.

g) Cases where PBX/PABX facilities are surrendered before the expiry of the guarantee period will be regulated as per Company rules.

12.3.2 CENTREX

It is central office based communication service, which integrates all your multi located telephone lines (Existing and New) into a single highly functional communication group with more distinctive features without any additional equipment (like EPABX) at your premises. Highly cost effective, Free Intra Centrex calls, No worry to select innovative (PBXs) equipment, No risk of

obsolescence of technology, No requirement of power supply, No need to waste valuable floor space, No annual maintenance charges, totally flexible are some of the salient features of Centrex facility.

The following conditions are prescribed for the provision of Centrex facility:

a) The registration amount, initial deposit, monthly rental, installation charges, etc for DELs under Centrex shall be same as normal DEL.

b) All intra Centrex calls shall be free.

c) The free monthly call shall be allowed on the DELs covered under the Centrex.

d) There is no upper limit on the number of members in the Centrex group.

e) The option of consolidated billing, payment and discount, under the **" Corporate Account Holders scheme"** where applicable, may be provided to the groups or organizations covered under the Centrex.However, the condition of combined billing for all the DELs covered therein shall be mandatory. In other words, wherever technically feasible to generate single/consolidated billing/payment the Centrex feature shall be offered, otherwise it will not be provided. However, existing Centrex groups may continue even without consolidated billing/payment.

f) The DELs belonging to public services like, call centers, enquiry numbers, ISP Dial in numbers, paging service numbers, etc., besides franchises, PCO holders shall not be part of the Centrex group.

12.3.3 TOLL FREE SERVICE

This service is an ideal business promotion tool for business communities who want their customer to call them free of cost. Totally customer oriented organizations can provide information about their products, allow customers to place orders or even register their complaints/suggestions and offer assistance to customers without the user getting charges. Other features are:

a) This service can be taken on any existing telephone line without requiring any additional line.

b) Any user of BSNL telephone network can call FPH/TLF number free of charge.

c) All charges are to pay by the FPH/TLF holder (who has taken this service & receive the call).

d) The service subscriber is allotted a FPH service number (Eleven digits). For same FPH service number, the subscriber can have many destination numbers.

e) Any subscriber who is willing to become a free phone subscriber outside the cities where the IN switches are installed, the call charges will be as per the national STD tariff.

f) The charges indicated here are FPH service charges and they do not include the normal charges levied for basic telephony service.

g) Billing for the same is separately issued to subscriber on monthly basis, which does not include landline rent & charges on which the TLF/FPH services is taken.

h) Access Code is 1800233 (For new IN platform).

i) Total digit for service is 1800-233-ABCD (For new IN platform)

j) Vanity numbers are available for selection of ABCD on charge basis.

12.3.4 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 implementing ISDN.

- **Connectivity**

The ISDN subscriber will have full connectivity, nationally, to other analog telephone subscribers. At present ISDN services are available to and from India for the following countries:-

Australia, Austria Belgium, Canada, Denmark, France, Germany, Ireland, Italy, Israel, Japan, Malaysia, Netherland, Norway, Phillipines, Singapore, Switzerland, Thailand, U.A.E, U.S.A

- **Services Offered By ISDN**

a) Normal Telephone & Fax (G3)
b) Digital Telephone -with a facility to identify the calling subscriber number and other facilities.
c) G4 Fax
d) Data Transmission at 64 Kbps with ISDN controller card
e) Video Conferencing at 128 Kbps
f) Video Conferencing at 384 Kbps (Possible with 3 ISDN lines)
g) ATM (Asynchronous Transfer Mode) or PVC (Permanent Virtual Circuit)

- **Variety of supplementary Services supported by ISDN**

a) Calling Line Identification Presentation (CLIP)
b) Calling Line Identification Restriction (CLIR)
c) Multiple Subscriber Number (MSN)
d) Terminal Portability (TP)
e) Call Hold (CH)
f) Call Waiting (CW)
g) User to User Signaling (UUSI)

- **Types of Accesses**

There are two types of "accesses" (connections) for ISDN.

– **Basic Rate Access (BRA): 2B+D**
a) 2 Channels of 64 Kbps for Speech And Data.
b) 1 Channel of 16 Kbps for Signalling

– **Primary Rate Access (PRA): 30 B+D**
a) 30 Channels of 64 Kbps for speech and data.
b) 1 Channel of 64 Kbps for signalling.

3G MOBILE SERVICE

BSNL 3G voice service also come under the category of Enterprise Voice service

12.4 ENTERPRISE DATA SERVICES

12.4.1 MPLS Based VPN Services

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!

MPLS based VPNs reduce customer networking complexity, costs and totally do away with the requirement of in-house technical work force. Rather than setting up and managing individual point-to-point circuits between each office using pair of Leased Lines, MPLS VPN customers need to provide only one connection from their office router to a service provider edge router.

BSNL has tied up with various Networking solution providers to provide end-to-end solution to its valued customers, including Customer End (CE) routers and other networking components.

12.4.1.1 What advantages does MPLS VPN have over other Technologies:

BSNL's primary objectives in setting up the BGP/MPLS VPN network are:

a) 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.
b) Make the service very simple for customers to use even if they lack experience in IP routing.
c) Make the service very scalable and flexible to facilitate large-scale deployment.
d) Provide a reliable and amenable service, offering SLA to customers
e) Capable of meeting a wide range of customer requirements, including security, quality of Service (QOS) and any-to-any connectivity.
f) Capable of offering fully managed services to customers.
g) Allow BSNL to introduce additional services such as bandwidth on demand etc over the same network.

12.4.2 INTERNET LEASED LINE

a) ILL is an always on Internet connection based on leased line access (i.e. dedicated access). Leased lines provide the last mile access from the user premises to BSNL equipment.
b) Required by heavy users like educational institutes, big cyber café, small and medium corporate house who need to constantly remain online with Internet.
c) Permanent Internet connection as compared to the temporary connectivity through dialup access.
d) Far superior quality as compared to dialup, thanks to digital signaling, less noise, fewer exchanges etc.

e) A scalable access method - Bandwidths starting from 64 Kbps to 2 Mbps to 8 Mbps, 10/100Mbps Ethernet connectivity, 34/45/155 Mbps and beyond can be deployed.

f) Since the access is "always on", it is possible to associate a pool of permanent IP addresses with a particular leased line. Using IP addresses provided by BSNL, it becomes possible to deploy a variety of services such as mail, FTP, WWW, DNS, and proxy, to name the most common requirements of organizations. In other words, leased lines enable hosting of services of all types, and provide a platform for enterprise intranets and extranets, apart from what we may term as "entry level" services such as messaging, which still account for over 70 percent of all Internet access.

g) Leased Internet bandwidths up to 2Mbps are provided using modems on copper pair, however, large bandwidths are provided using OFC in the last mile.

12.4.3 VPN OVER BROADBAND

Presently , BSNL is providing VPNoBB for General EB customers as well as e-Governance projects for bandwidth 256 kbps to 24 Mbps

12.4.3.1 V-SAT Network

The network consists of a Hub located at Bangalore and VSATs located throughout the country. The VSAT communicates to the HUB through Express AM1 Satellite. All VSATs are connected in STAR topology and VSAT to VSAT communication is through the HUB at Bangalore. For more information on the service kindly read the FAQ . Ku band VSAT network of BSNL is capable of providing high speed data transfer up to 2Mbps (presently 512 Kbps) and voice communication service covering the entire country.

Tariff

a) BSNL offers competitive and affordable Tariff.

b) The Tariff is offered based on customer applications.

Customer Care

a)Reliability of Network 99% and above.

b) 24x7 Help Desk and Technical support.

c) Zone wise customer support centers for quick Fault clearance.

d) Billing information can be accessed through Web Self care.

e) Complaints can be booked either through internet, Toll free Phone Number.

12.4.4 LEASED LINE

To transmit data between computer and electronic information devices, BSNL provides data communication services to its subscribers. It offers a choice of high, medium and low speed leased data circuits as well as dial-up lines. Bandwidth is available on demand in most of the cities. Managed leased Line Network (MLLN) offers flexibility of providing circuits with speeds of n x 64 Kbps up to 2 Mbps. Useful for internet leased lines and international principle Leased Lines (IPLCs).

For dedicated point to point speech, private wire, tele-printer and data circuits are given on lease basis. Leased circuits are provided to subscribers for internal communication between their offices/factories at various sites within a city/town or different cities/town on point to point basis, or on a network basis interconnecting the various sites.

12.4.4.1 Managed Leased Line Service (MLLN)

The MLLN is a Managed Leased Line Network system which is proposed to provide Leased line connectivity. The State-of-the-art technology equipment MLLN is designed mainly for having effective control, monitor on the leased line so that the down time is very much minimized.

Speech Circuits (Hot Line or Private Wire)

Local or Long distance circuits within two locations in a city or between two different cities provided for the same applicant. The Terminating equipment at both ends is telephone without dialing facility. Both way signaling and speech is possible.

Data Circuits

Local or Long distance data circuits at different speeds viz. nx64 kbps and 2 mbps. Data Circuits are of different types:

a) Point to Point Data Circuits - Local and Long Distance

b) Private Data Network - More than one Local or Long Distance leased circuits converging on a location such that data from one leased circuit can be transferred automatically to another leased circuit for the same subscriber.

c) Closed User Group - Leased circuits can be used by more than one legal entity if they form closed user group. The following categories of user groups constitute closed user groups for the purpose of licensing Private Telecom Networks.

12.4.5 IDC SERVICE

BSNL IDC is a service brand name for the data center services provided by Bharat Sanchar Nigam Limited, A leading telecom service provider in India. BSNL IDC is a state-of-the-art data center located at six major locations across India who maintains most fault tolerant networks. Internet Data Center services comprises IT operations which is provided with the expertise well recognized worldwide.

12.4.5.1 Managed Co-location Services

Co-location refers to co-locating your server or hardware at a Service Provider's Data Center and willing to pay only the rental charges for Bandwidth, racks space and climate control.

- **Features**

a) Customers have flexibility to even choose the SLAs most suited to their business environment
   - Tier III uptime certified Datacentres, 99.982% uptime guaranteed SLA
   - Custom-designed racks and space
   - Scalability on Demand anytime

b) High levels of security (ISO 27001 & SAS 70 Certified Datacentres)

c) 24x7 physical security – Security guards, CCTV surveillance and biometric access control

d) Flexible pricing customized to customer's convenience.

12.4.5.2 Managed Hosting Services

It is a type of hosting in which the Customer leases an entire/ or part of server dedicated/ or shared with anyone. This is more efficient, client oriented and flexible. Here Customers are having full control over the servers and has choice of operating system, system configuration etc. Customers have to pay according to their requirement about system configurations. It can provide less overhead and a larger Return on Investment (ROI).

- **Features**

a) Convenience: Stop worrying about the fundamental problems of buying and maintaining hardware, giving you the convenience of focusing on your business instead diverting your mind towards management of infrastructure management.
b) Control: Have control over the configuration, administration of your servers, choice of hardware etc.
c) Scalability: Customer can increase resources such as memory or storage etc.
d) Security: To protect your data security parameters can be tailored to Customer requirements. Customer can adopt multiple levels of security measures to safe and smooth operations.
e) Faster deployment of services
f) Vanishes threat of obsolescence
g) Rapid response (e.g. in matters of configuration etc.)

12.4.5.3 Managed IT Services

It is a way of shifting day to day responsibilities of managing IT infrastructure in an efficient and more effective manner.

- **Features**

a) Clients can use our expertise in managing servers, storage, security, database, backup and DR, capacity planning, facilities management, service desk operations and remote infrastructure management.
b) Any type of enrolment can be in an open and transparent way with a dedicated account manager providing a single point of contact and a personal commitment to successful outcomes.
c) Our skill set covers network engineering, business information systems combined with broad IT project management capabilities to ensure that your technology and business goals are achieved.

12.4.6 ENTERPRISE BROADBAND

12.4.6.1Wi-Fi

Wi-Fi Services have been introduced for providing high speed internet access at convenient public locations hereunder called as Hot Spots. Installation of Hot Spots is already under process at various cities/ locations.

Hot Spot Type-A is applicable for public utility services like Airports, Railway Stations, Universities and their campus etc initially for a period of 90 days from the date of its launch.

Hot Spot Type-B is applicable for personal type of services like Hotels, private owned institutes/ Colleges/ libraries/ Universities and their campuses etc. Prepaid schemes for Hot Spot B owners on commission basis, is also available.

12.4.6.2DSL BROADBAND

DSL is a wireline transmission technology that transmits data faster over traditional copper telephone lines already installed to homes and businesses. **DSL**-based **broadband** provides transmission speeds ranging from several hundred Kbps to millions of bits per second

12.4.6.3FTTH BROADBAND

Fiber to the home (**FTTH**) is the delivery of a communications signal over optical fiber from the operator's switching equipment all the way to a home or business, thereby replacing existing copper infrastructure such as telephone wires and coaxial cable.

12.4.6.4VPN OVER FTTH

The VPNoFTTH service for e-governance projects will be offered as on 'Add On' service on BSNL FTTH only to those customers who opt a BB plan of minimum Rs.700/- per month values. The customers will be able to access either VPN or Internet at a time.

12.5 MANAGED ENTERPRISE SERVICES

12.5.1 Manage Network Service

BSNL Managed Network Services is a fully managed Secured Data services, providing a truly one-stop and a complete experience that significantly reduces risks and complexities involved in implementing and maintaining a robust IP network. It brings together all of a business communications needs in an integrated offering.

With the promise of an integrated platform with one-stop convenience and fully managed experience, BSNL Managed Network Services is an All-in-One comprehensive bundle of hardware, connectivity packages and managed services.

It is a solution that simply, affordably and reliably supports your business.

Comprehensive Service Package:

The "One-Stop" promise delivered by BSNL Managed Network Services is beyond technical integration of the best-in-breed network and hardware setup. It offers truly executable technical and business propositions for your business today:

a) No CAPEX

b) No risk of technical obsolescence

c) Scalable according to changing business needs

d) One helpdesk number to call for troubleshooting and fault resolution.

e) Integrated customer report (Web Based) giving you a complete view of your network

12.5.2 Managed Global Audio Conferencing Service

BSNL has launched Global Audio conferencing Service in association with British Telecom (BT). It is an easy to use, reservation-less conferencing service aimed at Enterprise customers. The Enterprise customer has to subscribe the service by filling a form as application. There are no charges for service subscription. Charges are only for the usage of the service.

12.5.3 Managed SaaS

BSNL Managed SaaS (Software as a Service) Business Mail Service has been launched with M/s Microsoft India Ltd.

12.6 OTHER ENTERPRISE SERVICES

12.6.1 Web Colocation

Web Co-location is an easy and cost effective solution to house a company's powerful infrastructure without losing the administrative control on the equipments.

- **Typical Applications**
  E-commerce, financial, B2B, email and other data storage and retrieval.
- **Facilities**
  a) Air-Conditioned, dust free, fire-safe and secure space with racks (42 U) at the nodes for co-location.
  b) Necessary CAT5 cabling for connecting the server to the LAN.
  c) AC and DC power supply.
  d) One Sancharnet account of 100 hours to customer to enable administration of the server.
  e) BSNL provides one IP Address per site on request

12.6.2 Fleet Tracking

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 e Track 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.

- **Features**
  a) No driver intervention
  b) Automatic Real time system.
  c) Vehicle information available 24 X 7
  d) Secured internet access anywhere in the world.
  e) Information through fax and emails
  f) Mobile Query SMS
  g) Widest Coverage on National highways through 20000+ BSNL towers spanning across 5000+ cities/town
  h) Transparency and Trust at your doorstep with MIS reports for better fleet management

12.6.3 Video Conferencing

'v-Sangoshti' BSNL Managed Public Room video Collaboration Service, is a unique service , making video conferencing facility accessible and simple to everybody across nation. Its ready to use infrastructure, along with rapid connectivity , ease of use and lower total cost of ownership.
v-Sangoshti studios are 24x7 available video collaboration rooms that are connected to multiple such public rooms nationally and can be used by any Retail ,SMB , Enterprise or any PSU/Government customers through reservation on demand basis on "pay as you go" model.

These studios have the capability to connect to any private video enabled device across Public IP,MPLS , ISDN access having SLA with ease of use,higher uptime , proactive operator assistance and high definition video resolution to the users.
It provides additional facilities of recording , live streaming , web casting and can connect to audio devices i.e landline/mobile on user demand.

12.6.4 Web Hosting

Web hosting is a service that allows users to post Web pages to the Internet. It allows users to publish their own information resources to any Internet user interested in accessing them. It is a business that provides the technologies and services needed for web sites to be viewed on the web.

- **Features**
  a) Domain name hosting
  b) Web Publishing : HTML pages with Browser supported MIME pages
  c) Server side scripting: Perl. Java Servlets , JSP
  d) Web Server: Apache, Tomcat.
  e) Data base : MYSQL
  f) SMTP (Exim) and POP3 (apop3d) service for each domain
  g) Multiple e-mail ids per domain with flexible mail quota possible
  h) FTP access for uploading /downloading files
  i) Centralized authentication for SMTP, POP3,FTP and for administration
  j) Multiple Web Hosting Plans to choose
  k) Multi user Admin- Administration Console for the management of services & usage reports.
  l) Multi User – User Administration Console for limited management of services and usage reports Data Transfer quota Exceeded Message Display.
  m) No hard limit on quota
  n) Round the clock Technical report support through Help Desk (1957)

12.6.5 Bulk Push SMS

BSNL Bulk SMS service provides a simple and user-friendly way for sending bulk as well as individual messages at affordable rates. This Service includes the facility to send both transactional and promotional SMSs. Transactional and Promotional SMS can be send by customers through our webportal/API. Promotional SMS can be availed by the Customers having telemarketing registration .

12.6.6 GSPS(Global Satellite Phone Service)

BSNL's GSPS also called satellite phone service, provides voice communication and messaging from any part of the globe. However, presently, the services will be available within India only. It is a ubiquitous service, hence can be used from all part of the country including territorial water. It is being provided through world's most advanced satellite communications network working on Inmarsat I-4 F2 satellite located at 63.90 degree East

It is suitable for persons working in remote areas or disaster affected areas – defence, border security organizations, disaster management bodies, trekkers, fishermen, maritime applications.

12.7 CONCLUSION

In this session we learn about the different Enterprise Services (Voice, Data, Broadband etc) with their key features.

13 EB LIFE CYCLE

13.1 LEARNING OBJECTIVE:

This lesson provides the insight into the BSNL's Enterprise Business Strategy, Certification of International standards, Business alliances and SWOT analysis to its competitors.

13.2 ENTERPRISE BUSINESS STRATEGY:

This sales initiative can happen from either party. Purchasers usually float request for proposal (RFP) or Expression of Interest (EoI) or Call for Tenders. Other possibility is the seller based on his own research and understanding suggesting a solution to a company for their unfulfilled need or a better solution than the existing in use.

Goal is to help a client find value in offered solutions on a long-term basis ensuring win-win for the company & client.

While marketing is for masses, BD specifically targets select clients where high revenue is expected either through sale of its own services or introduction of joint products/services.

The emphasis is to make more money by selling solutions rather than just plain vanilla services.

13.2.1 Certification to International Standards:

Most enterprises requesting Telecom Services want to be assured that the vendor providing these services is capable and competent to provide these services and be able to sustain the QOS standards that have been promised. Towards this end conditions are placed in the call for offers about previous experience of similar work, physical evidence of necessary infrastructure, financial clout and necessary licenses and permissions to provide the services. Further they also mandate that the organization is compliant to certify to relevant International/ National Quality standards. Some of this certification requirements are as listed below for the information.

ISO 9001:2008 Quality Management System,

ISO/IEC 20000-1:2005 Information Technology Service Management System

ISO 27001:2005 Information Security Management System.

13.3 SWOT ANALYSIS OF MAJOR TELECOM SERVICE PROVIDERS

The Strength, Weakness, Opportunity and Threat (SWOT) Analysis is very important for crafting Enterprise level strategy by keeping the competition in mind.

An indicative SWOT analysis of BSNL's competitors at national level is given for the mobile communication related services in mind. Similar can be done at state and district level to identify the competition and its strategies depending on their strengths and weakness to craft BSNL EB cell strategies.

13.4 ENTERPRISE CUSTOMER CLASSIFICATION

13.4.1 OBJECTIVE:

This lesson provides the insight into the Needs of EB customers, Classification and Grading of EB customers and a tentative organization structure required for catering of the needs of EB customers.

13.4.2 ENTERPRISE CUSTOMER GENERAL REQUIREMENTS:

- Consultancy for the designing of customized solution to their Enterprise needs
- One stop solution
- Telecom Expense management
- Unified communication solution
- Faster roll out
- Scalability
- 24x7 monitoring & servicing
- Simplicity of deal
- Long term commitment
- Business continuity (Disaster Management)
- Trustworthiness of the solution provider

13.4.3 ENTERPRISE CUSTOMER CLASSIFICATION:

GRADING OF ENTERPRISE CUSTOMER

Platinum

Enterprise Customers with an annual turnover of over Rs.500 Crore & Enterprise Customers operating in the Telecom and IT sector with an annual turnover of Rs 100 Crore are categorized as Platinum Customers.

Each Platinum Customer will be serviced by one designated National Account Manger (NAM). Penetration in the new Platinum Account is one of the important targets of Platinum Enterprise Business Unit. The targets for the penetration of new platinum customers are time to time communicated by EB section of HQ to each circle. The Platinum Account is said to be penetrated if a minimum business of Rs.40 lakhs per annum per account is generated from the customers.

Gold

Enterprise Customers with an Annual turnover of Rs.100 crore to Rs. 500 crore & Enterprise Customers operating in the Telecom and IT sector with an annual turnover of Rs 50 Crore are categorized as Gold Customers.

Each Gold Customer will be serviced by one designated Key Account Manager (KAM). Penetration in the new Gold Account is one of the important targets of Gold Enterprise Business Unit. The targets for the penetration of new Gold customers are time to time communicated by EB

section of HQ to each circle. The Gold Account is said to be penetrated if a minimum business of Rs.10 lakhs per annum per account is generated from the customers

Silver

All Enterprise Customers not falling into Platinum and Gold classes are categorized as Silver Customers

Customer classified as 'Silver' can also be serviced by Channel Partners. Channel Partners are outside agencies appointed by BSNL to deal with the service needs of the customers.

Generally Platinum and Gold customers will be identified by centrally by the Enterprise Business Unit of BSNL Corporate Office. Silver Customers will be identified by each Telecom Circle in consultation with the SSAs. The coding of Enterprise Customers will be done by the units identifying them by applying the standard attribute set.

13.5 SALES PROCESS, SALES FUNNEL AND SALES REVIEW.

13.5.1 OBJECTIVE:

This lesson provides the insight into the Sales Process, Buying and Selling cycles, Closing of Order, post-closing activities and reporting of the entire Sales process data into the EB portal.

13.5.2 THE SALES PROCESS

Pre –Sales Preparation:

a . Success comes from preparation.

b. Success in marketing comes from comprehensive preparation as it helps in understanding your prospect's needs, resolve their doubts and objections and combat competition.

c. Pre sales preparation helps in being: Organized, Confident, And Effective.

Components of pre-sales preparation:

a. Knowledge of C-P-C

b. stands for company, Product and competition

Elements of Planning and Preparation:

a. Enhance your Knowledge on CPC

b. FAB – Feature, Advantage, Benefit

c. Self-presentation

13.5.2 FAB (FEATURE, ADVANTAGE BENEFIT)

- **Understanding Features:**

a. Feature describe the characteristics of a product / Company / Plan

- **Understanding Advantages:**

a. Advantage refers to the general usage of a feature of any plan or product

b. The best method of identifying the advantages is to identify all the features of a plan/

product and how does it help the prospect?

- **Understanding Benefits:**

a. The second step in proposing a solution is to link the advantages of the product/plan to the stated needs of the prospect.
b. The more benefits sales personnel states the greater the chances of success.

13.5.3 THE THREE STEPS OF PROPOSING A SOLUTION:

a. Summarizing the buying criteria of the prospect

b. Associate or link the advantages of the product to the stated needs of the prospect. In other words, state benefits for a solution
c. Summarize the benefits and ask for commitment.

13.5.4 THE BUYING CYCLE (REED-CYCLE):

Recognize the Need: First an individual feels the need to buy a product / Service

Evaluate the options: Then, he evaluates various offers in the market and short-lists the one that meet his needs most closely

Eliminate Doubts: Having identified the brand that he would like to buy, he gets clarification on concerns regarding the product / service

Decide to Buy: Finally, he decides to purchase the product/ service

13.5.5 THE SELLING CYCLE (ODPEC-CYCLE):

Opening: The stage the company representative is attending to the customer for the first time.

Developing the Sale: This is the stage at which the company representative is supposed to determine whether or not the customer has recognized the need.

Proposing a solution: A customer has various options to satisfy a need. At this stage the company representative should demonstrate to the customer that the offered product is the best solution to the customer's need as compared to the other options available.

Eliminating Doubts: At this stage the company representative should clarify all the doubts of the customer so that the doubts should turn into strong beliefs to purchase the product. It is essential to uncover all the doubts as the client may not always express his doubts and then address these doubts.

Closing: This is the stage where the customers make the payment and receive the delivery of the product according to the terms and conditions agreed upon.

13.5.7 CLOSE TECHNIQUES:

2-3 close technique: Summarize in sets of three items- we will give you This, That and The Other, Use the classic business measurement trilogy-Cost, Quality and Time

Best time Close technique: Invoke seasonal effects, such as its an introductory offer for limited period

No-hassle close technique: Make completing the deal easy for them. Fill in all forms for them. Do all the paper work.

13.5.8 POST SALES FOLLOW UP:

The customer keeps evaluating the product even after taking the delivery and might develop negative feelings if he is unable to operate the product for any reason. He might come across unfavorable reports. It is important to manage the customers' post sales feelings by remaining in touch with the customer.

EB Portal

BSNL has introduced Online EB portal for the recording, processing, updation, reporting and monitoring of all the EB related activities.
The NAMs/KAMs are added in the portal and a separate user name and passwords are generated for them in the EB portal.
EB portal can be accessed through a separate link in the BSNL Intranet.

13.5.9 CONCLUSION:

From this lesson trainee is able to understand Sales Process, Buying and Selling cycles, Closing of Order, post-closing activities and reporting of the entire Sales process data into the EB portal.

13.6 DIFFERENT SERVICES / PRODUCTS AND CUSTOMER NEEDS

13.6.1 LEARNING OBJECTIVE:

This lesson provides the insight into the Enterprise Customer needs, Business Vendor selection criteria's of EB customers and various BSNL services for their customized needs.

13.6.2 ENTERPRISE CUSTOMER NEEDS:

Desire Of Enterprise Customer:

a. Complete Reliable Services from One Interface Organization.
b. Supply of not only Bandwidth but also Modems / Routers etc. i.e. Complete Telecom Solutions.
c. Secured Network.
d. OPEX Model instead of CAPEX
e. Proactive Monitoring of the customers Network.
f. Guaranteed SLA.

13.6.2.1 Why do they Buy and What is important to Enterprise Customers:

Why Use a Managed Service Provider	Managed Service Provider Selection Criteria
1. Cost Reduction	1. Customer Service
2. Better availability	2. Technical Support
3. Core / Context	3. Guaranteed SLA
4. Reduce Admin Time	4. Price
5. Single Point of Contact	5. Overall Reputation and Experience
6. Faster Technology refresh	6. Coverage / Foot Print
7. Performance	7. Reputation in a Particular Service
8.Knowledge Transfer	8. Breadth of Service Offerings
9. Reduce No. Of Suppliers	9. Existing Relationships
10.Meet Business Objectives	10.Ability to get all Services from One Provider

It is not just about Price, it's about 'Quality of Support and Service'

13.7 BUSINESS ETIQUETTE

Etiquette Attributes:

The essential attributes of good social and business etiquette are:

- Thoughtfulness
- Respect
- Graciousness
- Equal treatment

The three components of Business etiquette:

1. Appearance
2. Actions
3. Words

Typically, an effective presentation has four parts:

1. **Recap**

- Recap the last discussion and the outcome
- Update on other meetings that have a bearing or impact on the presentation

Customer should feel that they have been heard

2. **Value articulation**

- Value articulation in qualitative and quantitative terms
- Value generated encompassing multiple scenarios/ options

Customer should be convinced that solution delivers significant value

3. Solution details

- Solution details including capabilities of the solutions, components of the solution, network architecture etc

Details of solutions to be modified based on the audience

4. Credentials

- Credentials of BSNL in the same/similar products or solutions
- BSNL credentials in components of products or solutions

Customer should feel that BSNL is the best partner for delivering the solution

13.8 BSNL MANAGED ENTERPRISE SOLUTION:

Managed Services:

Traditionally Bandwidth used to be taken from Service Providers and Enterprises used to keep SI (System Integrators) for taking care for Customer Premises Equipments. Today Enterprises want One Interface – TSP (Telecom Service Provider) that will take care of all requirements. This trend is growing worldwide as well as in India. Managed Services concept is getting popular because of these changing requirements.

Private Players are having everything except Reach of Network and End Link Options. BSNL has nothing except Reach of Network and End Link Options**.** BSNL Advantage – Building up allied things are much easier than extending reach and scaling up end link options, provided we have proper focus for the same.

Advantages of BSNL Managed Enterprise Solution:

- 24x7x365 proactive monitoring for ―Complete peace of mind
- Guaranteed SLA
- Lower Total Cost of Ownership (TCO)
- Known cost for management & fixed price
- Single point of contact
- Single supplier instead of multiple vendors
- No cost of building own management & reporting system

13.9 CONCLUSION:

From this lesson trainee is able to understand importance of the Channel partners, System Integrators and other Business partners for delivering managed solutions to the EB customers.

13.10 BSNL MANAGED SAAS (SOFTWARE AS A SERVICE)

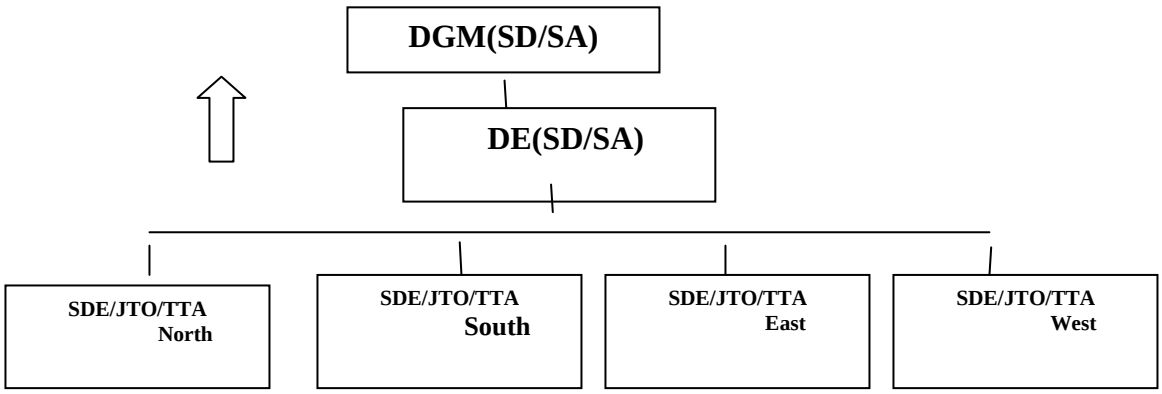
BSNL Software as a Service (SaaS) is a model of software deployment wherein an application is licensed to the customer for use as a service on demand. On-demand licensing and use would alleviate the customer's burden of equipping a device with every conceivable application. On-demand licensing enables software to become a variable expense, rather than a fixed cost at the time of purchase. Managed Business Mail is the first product from BSNL in the series.

13.11 SERVICE DELIVERY AND SERVICE ASSURANCE:

As part of restructuring separate SD / SA wings are created headed by DGM / AGM level officers to look after the issues of provisioning and further continuing the services. Two structures are given for SD / SA activity as follows:

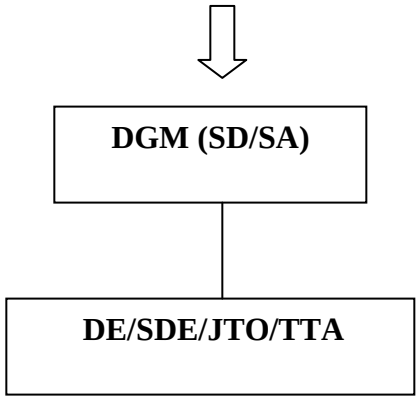
Model SD/SA structure for Enterprise (Gold and Silver):

A. For Outgoing Request:



Separate teams are required for Platinum and Gold. Personnel for following up on request for customers that are billed within the circle (in case of Gold Office) or city (in case of Platinum office)

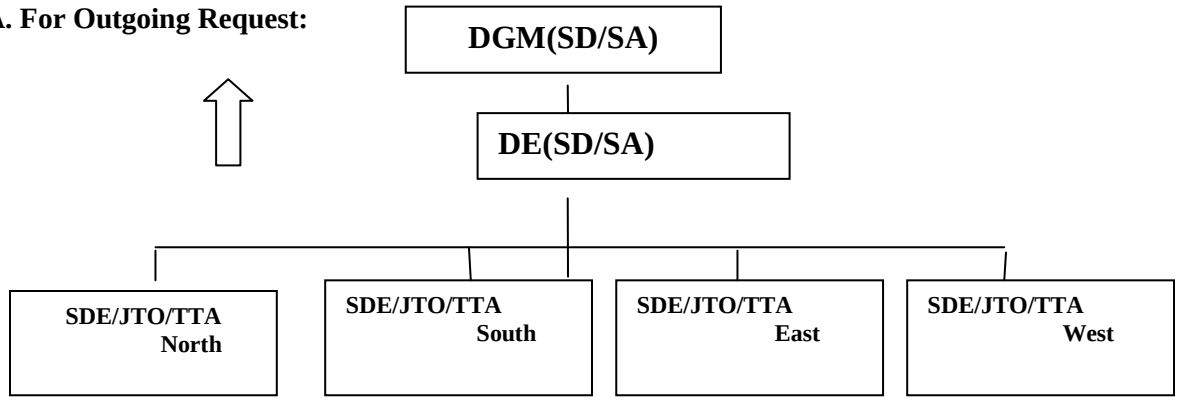
B. For Incoming Request:



Only one time required within the Circle. Follow up on all circuits to be delivered or assured within the Circle.

SD/SA structure for Enterprise (Platinum):

A. For Outgoing Request:



13.12 CONCLUSION:

From this lesson trainee is able to understand various IT systems, discounting policies for various EB customers, Separate teams for Service Delivery and Service Assurance for EB customer business. The trainee will get the concept of EB life cycle.

14 WI-FI HOTSPOT FOR ENTERPRISE SOLUTION

14.1 LEARNING OBJECTIVES :

- How a Wi-Fi Network works, adding Wi-Fi to computer.
- Benefits & Disadvantages of Wi-Fi Hot spot connections
- Wi-Fi security features and protected setup. Setting up Wi-Fi Hotspot at home.
- BSNL Wi-Fi hot spot plans.

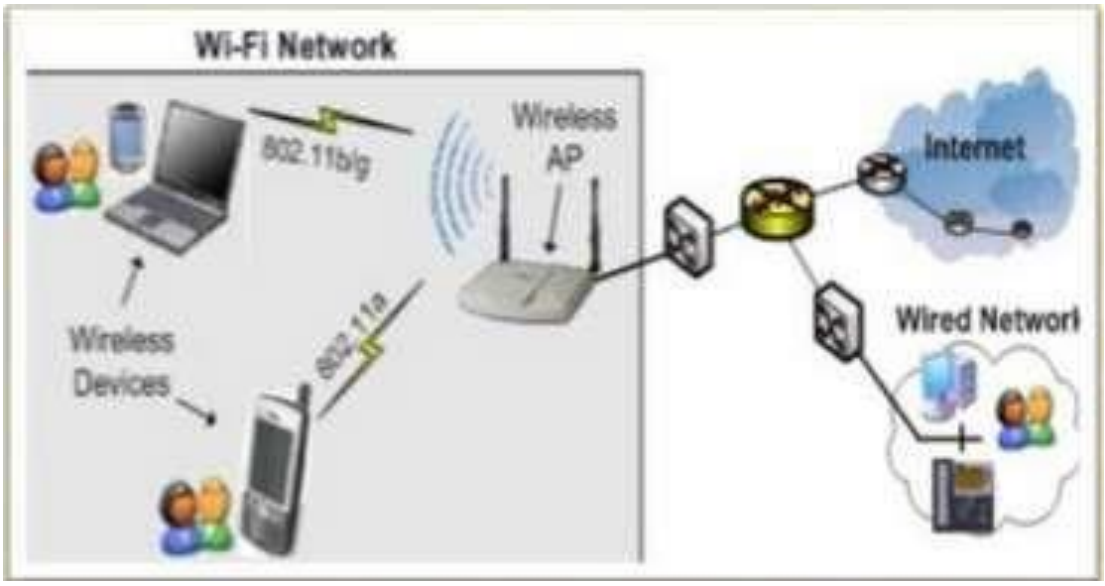
14.2 INTRODUCTION

- **WiFi** is the wireless way to handle networking.
- It is also known as **802.11 networking**.
- The big advantage of WiFi is its simplicity.

You can connect computers anywhere in your home or office without the need for wires. The computers connect to the network using radio signals, and computers can be up to 100 feet orso apart.

How a Wi-Fi Network Works?

Figure 1: WI-FI NETWORK



14.3 WiFi Range

Regardless of which setup you use, once you turn yourWireless Access Point on, you will have a WiFi hotspotin your house. In a typical home, this hotspot will provide coveragefor about 100 feet (30.5 meters) in all directions, although walls and floors do cut down on the range. Even so, you should get good coverage throughout a typical home. For a large home, you can buy inexpensive signal boosters to increase the range of theHotspot.

14.4 Adding Wi-Fi to your Computer

- Many new laptops already come with a WiFi card built
- It is also easy to add a WiFi card to a laptop or a desktop PC.
- Buy a suitable standard network card.
    - For a laptop, this card is a PCMCIA
    - For a desktop machine, buy a PCI card or USB type
- Install the driver

Figure 2: NETWORK CARDS

14.5 Benefits of Wi-Fi

- Mobility
- Compatibility with IP networks
- High speed data
- Unlicenced frequencies
- Security
- Easy and fast installation
- Scalability
- Low cost

14.6 Disadvantages of Wi-Fi

- Generates radiations which can harm the human health
- We must disconnect the Wi-Fi connection whenever not using
- Not very long distance communication
- Compared to wired connection, still costly

• 14.7 WI-FI STANDARDS

- Standards are mutually agreed upon rules adopted bythe industry on how the wireless networks operate.
- The core protocols are listed in the 802.11 standards, which was originally available in 1997
- There are a couple of standards that describe Wi-Fi. All of them are part of the 802.11 suite.

Figure 3: IEEE 802.11 Suite

Network standard	Maximum Speed (Mbps)	Range (feet)	Frequency (GHz)	Power drain	Cost
802.11b	11	100-150	2.4	Moderate	Low
802.11a	54	60-100	5	High	High
802.11g	54	150-250	2.4	Moderate	Moderate
802.11n	200	Up to 300 feet	2.4 & 5	Moderate	Moderate

WiFi radios that work with the 802.11b and 802.11g standards transmit at 2.4 GHz, while those that complywith the 802.11a standard transmit at 5 GHz.

- Normal walkie-talkies normally operate at 49 MHz. Thehigher frequency allows higher data rates

WiFi radios use much more efficient coding techniques (process of converting 0's and 1's into efficient radio signals) that also contribute to the much higher data rates.

- The radios used for WiFi have the ability to changefrequencies

For example, 802.11b cards can transmit directly onany of three bands, or they can split the available radio bandwidth into dozens of channels and **frequency hop** rapidly between them.

- The advantage of frequency hopping is that it is much more immune to interference and can allow dozens of WiFi cards to talk simultaneously withoutinterfering with each other.

802.11b: First to reach the marketplace. It is the slowest and least expensive of the three. 802.11b transmits at 2.4 GHz and go up to 11Mbps.

802.11a: Was next. It operates at 5 GHz and can handle up to 54 Mbps.

802.11g: Mix of both worlds b & g. It operates at 2.4Ghz (giving it thecost advantage of 802.11b) but it has the 54 megabits per second speed of 802.11a. It is also backward

compatible to 802.11b.

802.11ac : Backward compatible with 802.11n & its predecessors, maximum of 450 megabits per second on a single stream, sometimes called **5G WiFi** because of its frequency band, sometimes **Gigabit WiFi** because of its potential to exceed a gigabit per second on multiple streams

➢ 14.8 WI-FI BACKGROUND

1990 : 802.11 development started by IEEE

The aim was to develop a standards for medium access control (MAC)

and physical layer (PHY)

1997 : First version of 802.11 standard was ratified

First version delivered 1Mb/s and 2Mb/s data rates

1999 : 802.11a and 802.11b amendments were released Data ratesimproved to 5.5Mb/s and 11Mb/s at 2.4GHz (802.11) Wired EquivalentPrivace (WEP) introduced

5GHz operation with OFDM modulation at 54Mb/s (802.11a)

2001 : FCC approved the use of OFDM at 2.4GHz

2003 : OFDM modulation at 54Mb/s at 2.4GHz (802.11g)

2009 : 801.11n amendment were ratified

PHY relies heavily on multiple-input multiple-output (MIMO) technology
Can use both 2.4Ghz and 5Ghz at the same time
Throughput increased even up to 600Mbps

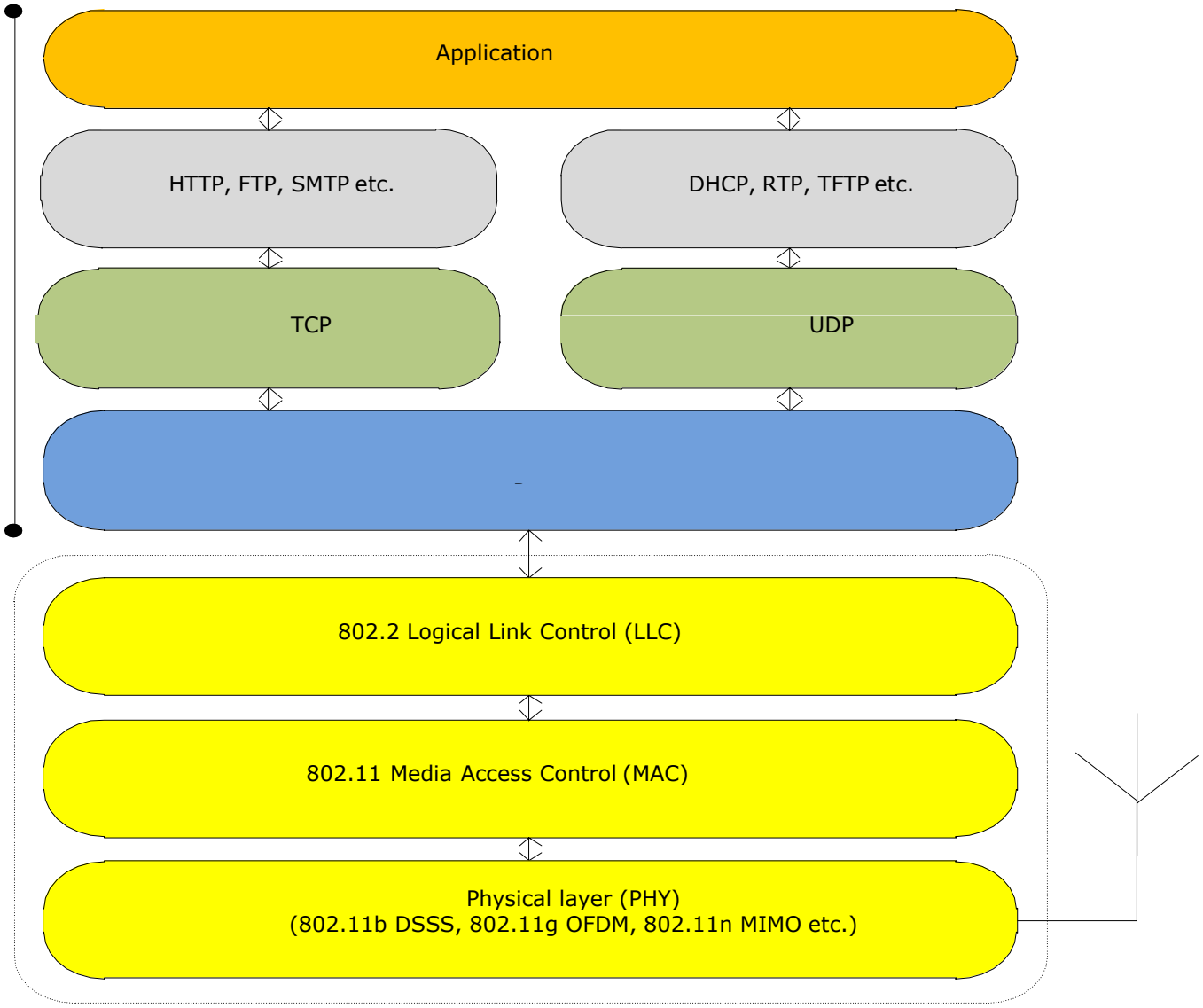
2009 : Bluetooth 3.0 + HS
802.11 selected as the Bluetooth high speed channel

2009 : Wi-Fi direct specification introduced

2011 : 802.11ac development started
More throughput with wider bandwith, more MIMO streams and wider
256-QAM modulation. Provides 500-1000Mbps throughput

14.9 802.11 ARCHITECTURE

Figure 4: 802.11 ARCHITECTURE



14.9.1 Physical Layer

➢ 2.4 GHz and/or 5GHz transceiver Industrial Scientific Medical (ISM) bandLicense free

Spread spectrum technology

FHSS, DSSS and OFDM modulations

FHSS (Frequency Hopping Spread Spectrum)

Bandwidth divided into 75 1MHz channels

Data throughput limited to 2Mbps because of hopping overhead and FCCregulations (1 MHz channel bandwidth)

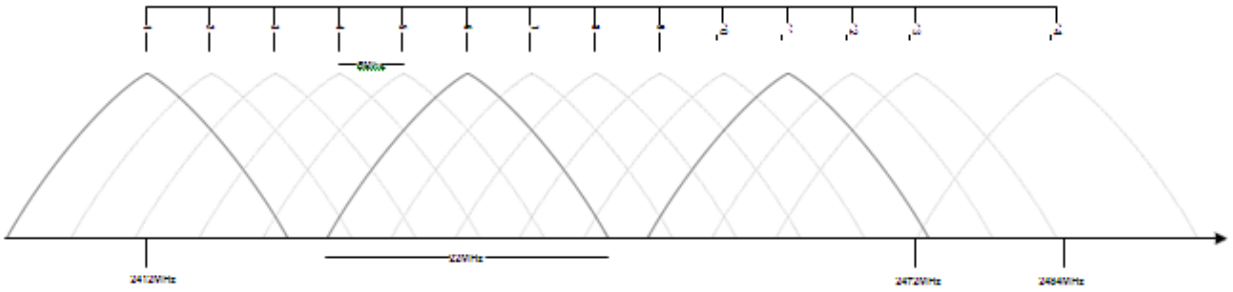
DSSS (Direct Sequence Spread Spectrum) Bandwidth divided into 14 22MHz channels overlap partially

OFDM (Orthogonal Frequency-Division Multiplexing)

20 or 40MHz bandwidth

Uses several non-overlapping channels overlap partially

Figure 5: Wi-Fi Physical Layer Channels



Europe : channels 1-13
USA : channels 1-11
Japan : channels 1-14

TABLE -1 802.11 STANDARDS

Standard	Frequency	Bandwidth (MHz)	Symbol rate (Mb/s)	MIMO streams	Modulation
802.11	2.4GHz	20	1, 2	1	DSSS, FHSS
802.11a	5Ghz	20	6, 9, 12, 18, 24, 36, 48, 54	1	OFDM
802.11b	2.4GHz	20	5.5,11	1	DSSS
802.11g	2.4GHz	20	6, 9, 12, 18, 24, 36, 48, 54	1	OFDM, DSSS
802.11n	2.4/5GHz	20	7.2, 14.4, 21.7, 28.9, 43.3, 57.8, 65, 72.2	4	OFDM
		40	15, 30, 34, 60, 90, 120, 135, 150		

14.10 802.11 Media Access Control (MAC)

- Manages and maintains communications between 802.11 stations and clients

- Coordinates access to shared radio channels Uses CSMA/CA (Carrier Sense Multiple Access / Collision Avoidance) algorithm to access the media
- Similar to *Bluetooth* Link Layer
- Because of the shared media operation, all Wi-Fi networksare half duplex.
- All Wi-Fi networks are contention-based TDD systems, where the access point and the mobile stations all vie foruse of the same channel.
- There are equipment vendors who market Wi-Fi meshconfigurations, but those implementations incorporatetechnologies that are not defined in the standards.

TABLE-2 802.11 MAC FUNCTIONS

Function	Explanation
Scanning	Scanning of access points. Both active (probe) and passive (beacon) scanning are provided by the standard.
Authentication	Authentication is the process of proving identity between the client and the access point.
Association	Once authenticated, the client must associate with the access point before sending data frames.
Encryption	Encryption of payload
RTS/CTS	The optional request-to send and clear-to-send (RTS/CTS) function allows the access point to control use of the medium for stations activating RTS/CTS.
Power Save Mode	The power save mode enables the user to turn on or off enables the radio.
Fragmentation	The fragmentation function enables an 802.11 station to divide data packets into smaller frames.

14.11 Logical Link Control (LLC)

The LLC provides end-to-end link control over 802.11-based wireless LAN

LLC services:

Unacknowledged connectionless service

- Higher layers must take care of error and flow control mechanisms
- Peer-to-peer, multicast and broadcast communication

Connection-oriented service

- Error and flow control
- Peer-to-peer communication

Acknowledged connectionless service

- Flow and error control with stop-and wait ARQ

- Peer-to-peer, multicast and broadcast communication

14.12 WI-FI CONNECTIONS

- Connection (Logical) is the mutual agreement between two ports to have a communication.
- Wi-Fi networks can be of BSS and ESS types
- Two Wi-Fi devices can have mainly two types of connections.
- Ad-hoc connection (Peer-to-Peer connection)
- Infrastructure connection (AP Connection)

14.13 AD-HOC MODE

- Essentially a peer-to-peer(also called work group) model.
- Ad Hoc connections can be used to share information directly between devices. This mode is also useful for establishing a network where wireless infrastructure does not exist.

Some uses,

- Synchronize data between devices.
- Retrieve multimedia files from one device and "play" them onanother device.
- Print from a computer to a printer without wires.

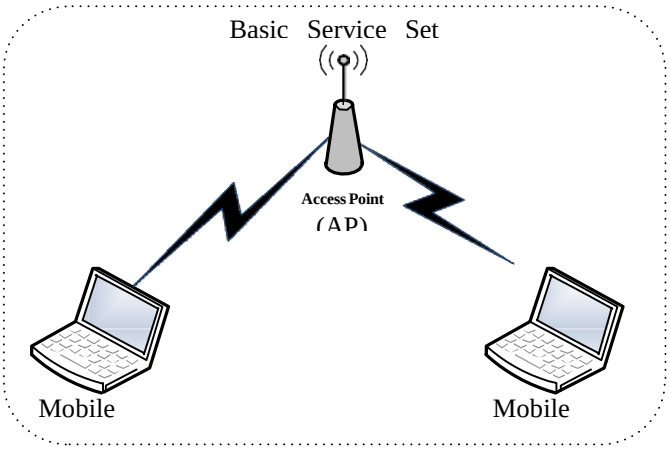
There are many applications of ad hoc networking in the military and inspecialized networks

14.14 INFRASTRUCTURE MODE

- Essentially a Client/Server model
- Infrastructure mode connection can be used to share information from one Wi-Fi client to AP.
- Many Wi-Fi clients can access an AP at a time
- Normally used to access internet.

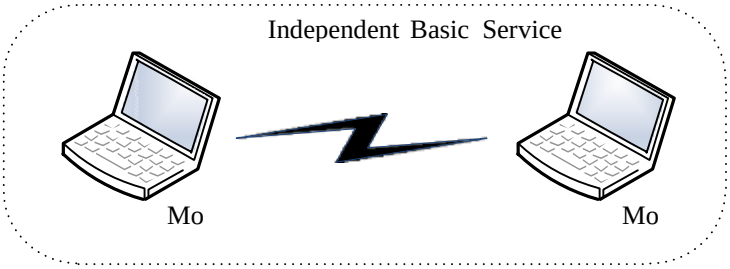
Basic Service Set (BSS)

- A set of stations controlled by a single "Coordination Function"
- Typically uses an Access Point (AP)
- All mobile stations must be accessible by the access point of the infrastructure BSS
- In the infrastructure network, stations must associate with the access point in order to get access to network services



Independent Basic Service Set (IBSS)

- A BSS without an Access-Point Is basically ad-hoc networking

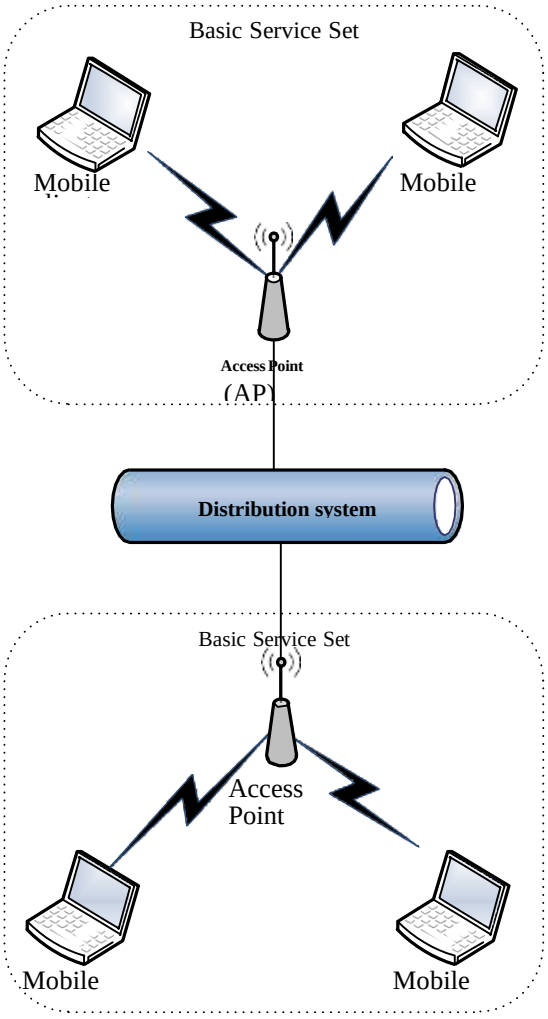


Extended Service Set (ESS)

- A set of one or more Basic Service Setsinterconnected by a Distribution System (DS)
- Traffic always flows via Access-Point

Distribution System (DS):

- A system to interconnect two or more BSS
- Typically wired Ethernet
- Could be also wireless like 802.11, WiMax, 3G/4G etc.



AP – client services:

- Authentication/ De-authentication: open, shared key or WPS

  Privacy : WEP, WPA or WPA2

Distribution System services:

- Association: maps the client into the distribution system via access point
- Disassociation: release of association
- Distribution: used to deliver MAC frames across the distribution system
- Integration: enables delivery of MAC frames between DS and non 802.11
- Re-association: transition of association from one access point to an other

14.15 CONNECTING TO A HOTSPOT

There are actually two steps to making aconnection.

- The first is to have your notebook "talk" to thehotspot, which means that the hardware and hotspot must recognize each other. This shouldhappen automatically as long as

your wireless hardware is turned on and new.

- On the newest machines, an 802.11 card will automatically connect with an 802.11 hotspot and a network connection will be established. As soon as you turn on your machine, it will connect and you will be able to browse the Web, send email, etc. using Wi-Fi.
- On older machines you often have to go through a simple 3-step process to connect to ahotspot.
- Access the software for the 802.11 card -- normally there is an icon for the card down in the system tray at the bottom right of the screen.
- Click the "Search button" in the software. Thecard will search for all of the available hotspotsin the area and show you a list.
- Double-click on one of the hotspots to connectto it
- On ancient 802.11 equipment (more than 2-3 years old),there is no automatic search feature.
- You have to find what is known as the **SSID** of the hotspot (usually a short word of 10 characters or less) as well as the channel number (an integer between 1 and 11)and type these two pieces of information in manually.
- All the search feature (in newer equipment) is doing is grabbing these two pieces of information from the radio signals generated by the hotspot and displaying them for you.
- On most notebook models, you will see some sort of signal icon on the bottom right hand corner of your screen or a lit indicator on the notebook itself, which will give you feedback for "On" and signal strength (a red screen means your radio is Off; a green screen indicates it is On).

You can also see the quality of the signal by clicking on the radio icon (may vary by system):

Figure 6: SIGNAL QUALITY

14.16. WI-FI SECURITY

- Wi-Fi hotspots can be open or secure.
- If a hotspot is open, then anyone with aWi-Fi card can access the hotspot.
- If it is secure, then the user needs to know a Security key

14.16.1 Wi-Fi Security Features

The 802.11 provides the following security features

- **Association -** Client needs to associate with the Access Point
- **Authentication-** Authentication is either open, shared key or WPS
- **Access control (MAC Filter)-** Access Point can decide which clients are allowed to associate based on MAC addressTrivial to spoof MAC address

14.16.2 Wi-Fi Security Types

- **Encryption**

Wired Equivalent Privacy (WEP)	***- (insecure)***
Wireless Protected Access (WPA)	***- (insecure)***
Wireless Protected Access 2 (WPA2)	**– (Secure)**
API	***- (for China)***
WPS	***- (For novice)***

- **Data integrity**
  Data can not be modified on-the-fly. Quarantined by Encryption

- **Data confidentiality**

  No eavesdropping with decryption of data.Quarantined by encryption.

14.16.3 WEP (Wired Equivalent Privacy)

- This encryption standard was the original encryption standard for wireless.
- Security issues known since 2001, can be cracked in <1minute
- WEP has two variations: 64-bit encryption and 128-bit encryption
- 64-bit encryption was the original standard but was found to be easily broken.
- 128-bit encryption is more secure and is what most people use if they enable WEP.
- For a casual user, any hotspot that is using WEP is inaccessible unless you know this WEP key.

14.16.4 WPA (Wi-Fi Protected Access)

- WPA is the successor to WEP
- WPA uses TKIP for encryption, some routers also supportAES.
- Security issues known since 2008 in TKIP, consideredunsecure
- Latest version of WPA is WPA2 (Uses TKIP or AES)

14.16.5 Wireless Protected Access 2 (WPA2)

- WPA2 is a Wi-Fi Alliance branded version of the final 802.11i standard.
- The primary enhancement over WPA is the inclusion of the AES- algorithm as a mandatory feature.
- The CCMP/AES algorithm is considered secure, given a good enough password
- WPA2 Personal (WPA2-PSK): Uses a password, common.
- WPA2 Enterprise (WPA2-RADIUS): Certificates on server

Note: Wi-Fi Alliance will mandate Wi-Fi CERTIFIED products only to support WPA2 AES

14.16.6 Wi-Fi Protected Setup

The protocol is meant to allow home users who know little of wirelesssecurity.

PIN entry (mandatory)
Commonly a numeric code printed on the AP needs to be fed to STA

Push button configuration (optional for STA)
Configured by pressing physical button on both device and AP

A security problem with WPS devices was identified in 2011allowingbrute force attacks on the PIN

It is expected that future AP will prevent brute force attacks
In the meanwhile, security researchers recommend turning disablingWPS

Note: A major security flaw was revealed in December2011
Security: WAPI

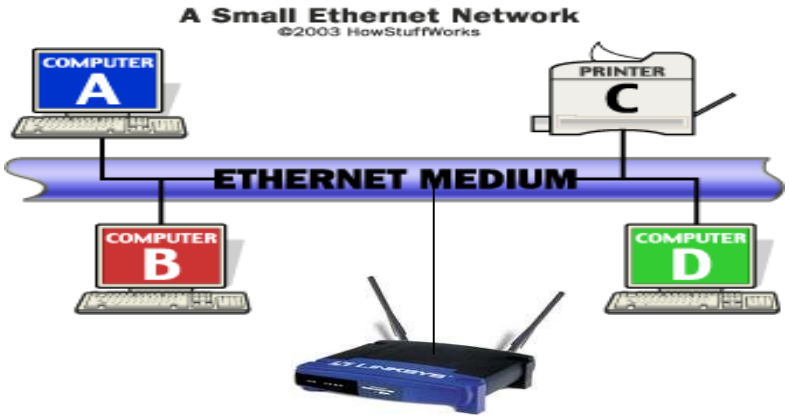
14.16.7 WLAN Authentication and Privacy Infrastructure (WAPI)

A wireless security standard defined by the Chinese government that must be supported by cell phones sold in China.

14.17 SETTING UP WI-FI HOTSPOT AT HOME

If you already have several computers hooked together on an Ethernet network and want to add a wireless hotspot to the mix,you can purchase a **Wireless Access Point** and plug it into the Ethernet network.

Figure 7: Wireless Access Point



Different types of IProuting

Figure 8: Setup #1

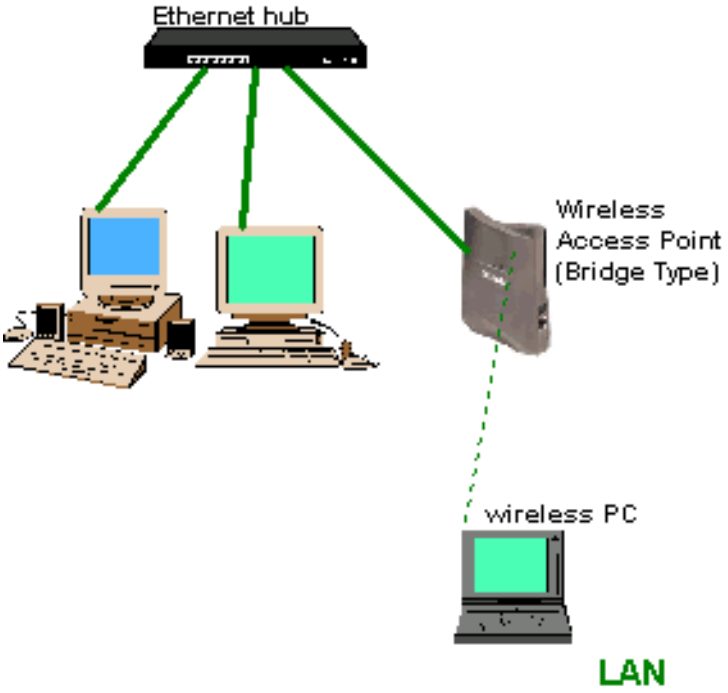
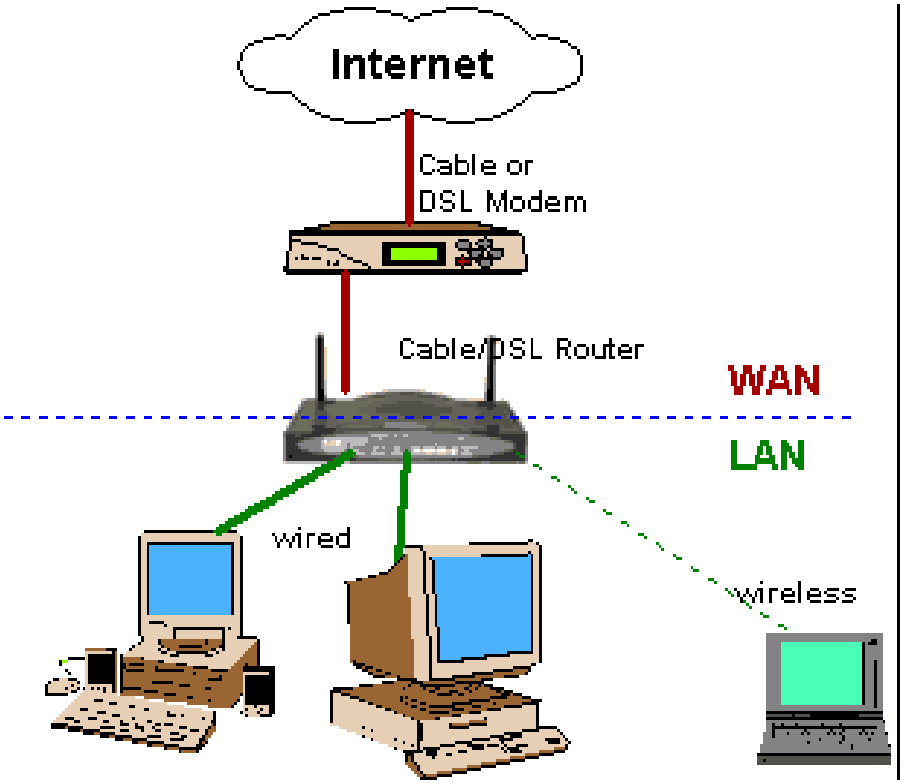


Figure 9: Alternate Setup using a Wireless Router



If you are setting up a network in your home for the first time, or if you are upgrading, you can buy a Wireless Access Point Router
This is a single box that contains:

1) a port to connect to your cable modem or DSL modem,
2) a router,
3) an Ethernet hub,
4) a firewall and
5) a wireless access point.

You can connect the computers in your home to this boxeither with traditional Ethernet cables or with wireless cards.

14.18 CONFIGURING A HOTSPOT

Most wireless access points come with defaultvalues built-in. Once you plug them in, they start working withthese default values. However, you may want to change things. You normally get to set three things on youraccess point.

14.18.1 Things to Configure in a Hotspot

1) **The SSID** -- Service Set IDentifier is a sequence of characters that uniquely names a WLAN.
2) **The channel** – the radio link used by access point/router to communicate to wireless devices. Normally it will default to channel 6.
   However, if a nearby neighbor is also using an access pointand it is set to channel 6,

there can be interference. Choose any other channel between 1 and 11.

3) **The WEP or WPA key** – Normally select WPA
Access points come with simple instructions for changing these three values. Normally you do it with a Web browser. Once it is configured properly, you can use your new hotspot to accessthe Internet from anywhere in your home.

Additionally you can configure ACL (MACFilter)

14.19 SOME OTHER WI-FI FEATURES

14.19.1 Wi-Fi Direct

- Allows Wi-Fi devices to talk to each other without the need for wireless access points
- Wi-Fi Direct essentially embeds a software access point, or "softAP", into any device that wishes to support Direct.
- Requires support for Wi-Fi Protected Setup with its push-button or PIN-based setup.
- When a device enters the range of the Wi-Fi Direct host, it canconnect to it

Primary use cases:

- Point-to-point file sharing (phones, picture frames, HDDs)
- Synchronization
- Wi-Fi tethering

14.19.2 Wi-Fi Multimedia - WMM

- Quality of Service (QoS) targeting multimedia applications
- Implemented on MAC layer as amendment (IEEE 802.11e)
- For queues or categories: **voice, video, best effort** and **background**. No guaranteed throughput.

WMM power save:

- Requires AP to buffer each queue
- Allows STA to request data from the queue or schedule delivery
- Power saving comes from sleeping while AP is buffering

IEEE 802.11ac

- **The next generation after IEEE 802.11n -** 433Mbit/s - 1Gbit/s data rates (not throughput)
- **Throughput through wider channels -** 80MHz and 160MHz
- **More dense modulation -** 256-QAM

14.20 WI-FI ALLIANCE

- An open, non-profit organization responsible of : Wi-Fistandards development, marketing, Wi-Fi certificationetc.
- Wi-Fi Alliance developed standards: WPA, WPA2, WMM, Wi-Fi Direct etc.

- Formed originally to resolve the interoperability issues between different manufacturers' 802.11 devices.Similar organization to Bluetooth SIG

The latest prepaid tariff of **BSNL WiFi hotspot plans** will provide 4G level high speed internet access to any mobile customer, available at convenient public locations in the name of WiFi Hotspots with reliable BSNL WiFi Plans.

The hotspots offer show stopper data services in Digital India Project, with high speed internet downloads and BSNL is pinning its flag in a big way in Digital India Project by joining with QuadGen Wireless, Larsen Toubro to manage each BSNL WiFi Hotspot.

It's a mega internet push at true cost for wireless mobile internet connectivity at above 4G level and these prepaid BSNL WiFi Plan (Wireless Broadband) charges for these public hotspots will be very much in line.

BSNL 4G level WiFi hotspots allows ultra speed broadband internet connectivity with unlimited downloads and has to be launched in various locations as categorized already with 2/ 4 / 10 Mbps bandwidth connectivity according to an area.

- **Small WiFi Hotspot:** Cafe, Lounge, Food court etc, = 2 Mbps(dedicated).
- **Mid-Size WiFi Hotspot**: Malls, IT Parks, Resorts, Hospitals etc = 4 Mbps(dedicated).
- **Large Size WiFi Hotspot**: Campus, Very Large Mall, Uncovered Broadband Semi Urban/Rural Areas at 10 Mbps(dedicated)

14.20.1 Who will use BSNL WiFi hotspot plans

- The subscriber of BSNL mobile services or any another network will use these high speed BSNL wireless broadband plans and services.
- These hotspots can use on any WiFi device with subscription plans.

The telecom giant has launched 14 types of BSNL WiFi hotspot plans under the prepaid category and all these plans are chargeable as per lowest prescribed rates for volume based data mentioned against with validity as follows.

TABLE-3 BSNL WiFi Hotspot Plans in India

WiFi Plan Name	Price with GST	Free Data Volume	Validity in Days
BSNL WiFi 19	Rs. 19	2 GB	2
BSNL WiFi 39	Rs. 39	7 GB	7
BSNL WiFi 59	Rs. 59	15 GB	15
BSNL WiFi 69	Rs. 69	30 GB	28

TABLE-4 BSNL Special Hotspot Plan for ITBP Sites in Chhattisgarh Circle

Name of WiFi Plan	STV Price (Inclusive GST)	Free Data	Validity in Days
BSNL WiFi 240	Rs. 240	20 GB	28
BSNL WiFi 349	Rs. 349	30 GB	28

BSNL WiFi 599	Rs. 599	50 GB	28
BSNL WiFi 999	Rs. 999	100 GB	28

TABLE-5 Khelari, Bhaunathpur and Garu Special Hotspot Plans of BSNL in Jharkhand circle for the Wi-Fi Hot Spot services provided by M/s GOIP

Name of WiFi Plan	STV Price (Inclusive GST)	Free Data	Validity in Days
BSNL WiFi 100GB	Rs. 240	100 GB	30
BSNL WiFi 200 GB	Rs.460	200 GB	30
BSNL WiFi 250GB	Rs. 525	250 GB	30

As on date and in coming future, wireless data consumption is being the major part of the telecom revenue generation, where the telecom operator offers BSNL WiFi hotspot plans with reliable data services at customer end, Because it is the top most priority to offer the best quality wireless data speed.

These BSNL WiFi monthly plans provides the data than expected 4G speeds with simple activation process, and on introduction of this new BSNL WiFi prepaid plans, customer will obtain retail WiFi services as high-speed wireless internet connectivity, and the below are the only internet spots available across India as a regular BSNL WiFi hotspot plans with lowest prepaid tariff for 4G speed internet.

14.20.2 What is BSNL International WiFi

As per the technical issues, BSNL suspended International WiFi services with effect from 7th October 2019, and this may resumed after sometime…

It is a high-quality mobile internet service available across the world in more than 100 countries, allowing the customer to access International WiFi without SIM card, where Bharat Sanchar Nigam Limited launches this International WiFi service in association with Tata Communications.

With this new BSNL Mobile service, the user need not require carrying any BSNL SIM card or abroad SIM to access Internet services in anywhere outside India, and at present majority of the users making the voice/video calls through the Internet using Whatsapp, Viber, Skype, and other social application, where the telecom brand starts this BSNL International WiFi hotspot services with the best quality roam free data services across the world.

BSNL has deployed Tata Communications WiFi+ and WiFi® cloud communication solution to provide seamless internet access at above 44 million Wi-Fi hotspots around the globe which include international flights and rail systems.

In India, BSNL is one and only one operator starts International WiFi service, and it removes the friction from accessing WiFi and makes simple to use Wi-Fi® data, Now the consumers of BSNL prepaid and postpaid plans under GSM mobile services which travel abroad need not worry about the internet facility in any country.

Also, there is no need for International SIM card to avail internet and required to search for BSNL International roaming countries list and with this International WiFi hotspot BSNL, a subscriber can access the unlimited high-speed internet from anywhere in the world without any worry about the bill for international access.

WiFi+ and WiFi® are the services offered for BSNL mobile customers to access global WiFi network when travels outside India, and any customer is cumbersome to log in every time to access WiFi hotspots due to frequent asking for passwords to join in WiFi network when travels.

With this WiFi+, BSNL mobile customer has just register once by creating a password, and then the subscriber will connect automatically to WiFi® when travels to different city or country, so, if you are a BSNL mobile user and you are going abroad to any country across the globe, and this BSNL International WiFi hotspots could help you to plan the best with seamless internet connectivity.

- **Where these BSNL International WiFi Hotspots available?**

  Across the globe approximately there are 44 million International WiFi hotspots of BSNL are available.

  All these cover USA, UK, France, UAE, Brazil, Netherlands, China, Portugal, Korea, Thailand, Japan, Indonesia, Malta, Taiwan, Germany, Mexico, Italy, Russia, Turkey, HongKong, Switzerland, Malaysia, Belgium, etc.

- **How to identify the availability of WiFi hotspot in other countries?**

  Introduced WiFi lookup services so every user can easily check their destination for BSNL International WiFi roaming service at WiFi lookup and this search service will access from anywhere in the world to check whether the address covers with BSNL WiFi International hotspot or not.

- **Can any smartphone user avail this BSNL International WiFi Hotspot service?**

  Yes, any user who uses the smartphone with Android or iOS platforms can access this International WiFi hotspot facility of BSNL.

- **After starting the travel, can I activate BSNL International WiFi hotspot service?**

  No, the BSNL WiFi hotspot service needs to activate before departure from India, and the validity of the purchased pack will start from that activation date before 30 days of purchase.

- **What is the difference between the purchase of International WiFi voucher and Activation?**

  When a customer buys the Voice, SMS or Data packs of BSNL, the recharge date is the trigger date only, because it starts automatically from the day.

  But in the case of BSNL International WiFi plans, customer facilitates to purchase the pack in advance and activate them within 30 days, and from the activation date, only the validity of purchased WiFi package will start.

- **Can I repay the packs from anywhere in the world or only from India?**

  For the first time, it should be done from India only, and after activation of service, a customer can purchase the BSNL International WiFi plans online from anywhere across the globe.

- **How many modes available to activate BSNL International WiFi service?**

  My BSNL App is the only one way possible to enable the service.

- **Whether a subscriber recharges from one mobile will allow BSNL International WiFi from another device?**

  Users will enable any Android or iOS devices, but they have to register and activate on a mobile device which carries abroad by using My BSNL App.

14.20.3 BSNL International WiFi Hotspot Speed

Many customers were having a shadow of doubt commonly, about what is the unlimited internet speed they will get at the hotspots in abroad?

- Across the world, many service providers are offering the hotspots. So, the rate of speed varies from one to one depends at the time of the users in that particular hotspot and the speed provided by that service provider partnered with BSNL and Tata.
- The designed algorithm will always connect to best high-speed WiFi network only, and this BSNL International WiFi hotspots will surely enhance the user experience beyond 4G speeds while roaming internationally.

Are there any particular steps to follow for activation of service in abroad?

- Make sure the WiFi is in ON condition.
- Check the BSNL International WiFi signal strength at that location, if the signal bars show tiny, try to change your movement.

What I have to do, if having trouble to connect WiFi, even the location covers with BSNL International WiFi hotspot?

- The user will activate the service from India. When he/she enters into a WiFi hotspot location in abroad will connect automatically with high-speed data, If not done, please follow the simple two steps.

  Try to Stop/OFF your WiFi service once in your wireless device (Smartphone/ iPhone/ Tab/ iPad).

  Restart the device and On your WiFi. Immediately it will connect BSNL International WiFi hotspot services.

BSNL International WiFi Data Packs

Introduced the only type of plan to access unlimited WiFi internet services across the globe, and the latest price of the pack is Plan 501 i.e. **INTL WIFI 501**

- **INTL WiFi 501:** BSNL International WiFi hotspot required customer has to recharge with a Rs.501 voucher, and the validity of the package is 30 days from the date of recharge/activation.

- The above BSNL International WiFi plan price is inclusive of present GST to use unlimited internet across the globe at managed hotspots.

Can I subscribe these from my existing balance?
No, you have to recharge separately with the following models, because of the service not links with GSM or CDMA mobile services.

- **BSNL Online Recharge Portal**
- **Through My BSNL App**

These above two ways allow all debit cards, credit cards, international cards, cash cards, etc..

BSNL or Tata Communications own all the hotspots?

- No, BSNL and Tata Communications joins the hands with Hotspot providers to provide seamless access to 44 million WiFi hotspot services Internationally across the globe.

14.20.4 BSNL International WiFi Customer Care

If you have any problems in connecting BSNL International WiFi hotspot even after restarting the phone in abroad, please complain by e-mail to any of the following addresses

- roaming2_0@tatacommunications.com
- mybsnlapp@bsnl.co.in
- wifiroaming@bsnl.co.in.

Immediately the executives will assist you through reply mail. You can also contact at the numbers +91 9409401234, +91 9427020003 and 1800 180 1503.
Is there any refund for a customer who suddenly cancels the program in abroad, but already activated the service?

- BSNL International WiFi Plans once purchased will not be repaid in any case.

Can we have access to flights, if available is there any restriction?

- At present, BSNL International WiFi in-flight facility is not available, and in f
- uture it may be possible, soon after the launch, BSNL will intimate to all customers.

Can I use this service in India if I cancel the program?

- This service is only for abroad data usage, and also it is named as BSNL International WiFi Roaming service, In India, the customer will access WiFi hotspots through BSNL 4G plus, where both the services designed separately, there is no interlinking between them.
- If a customer recharges the voucher but not activated before 30
- days due to a cancellation in the program at abroad, It will treats as a loss only.

Do you have anything more tips or queries related to this BSNL WiFi hotspots and the plans along with International WiFi hotspots, please share with us in the comments below to reach all.

14.20.5 Categories Mobile, WiFi

- 4 Best USB WiFi Adapters to enable WiFi without Router
- 5 Best WiFi Routers 2021 in India for Home or Office
- BSNL VPNo3G Tariff for Providing VPN Services in India
- BSNL Broad Fi 4G Hotspot Connects Your Home Internet Wirelessly
- Connect BSNL 4G Plus Hotspot using your Mobile Data
- Create Mobile Hotspot to Share your BSNL 4G Unlimited Data
- Wireless Configuration for BSNL Secure WiFi and Malware Protection
- Tenda WiFi Router Login Configuration and Password Change
- BSNL WiFi Broadband Plans Unlimited for Wireless Internet
- BSNL Foreigner Prepaid Plans at Discounted Price* with Unlimited Usage Who Visit India

3 thoughts on “BSNL WiFi Hotspot Plans / Services in India and Internationally”

1. **Anand Shreedhar**

March 31, 2019 at 11:09
I am using Xiaomi Mi3 handset & it does not support 4G.It supports only 3G, Can I still use bsnl International wifi service on my mobile?
Reply

2. **Elangovan A**

July 28, 2018 at 22:48
BSNL Wifi international is functioning well and I want to renew the subscription for another month, Is it possible when I am in abroad.
Reply

3. **sainath**

   February 5, 2019 at 16:38
   Just renew your international WiFi subscription online by just login into My BSNL App

14.21 CONCLUSION:

From this lesson trainee will be able to understand about Wi-Fi Hotspot network ,its connectivity & set up . Different plans of Wi-Fi Hotspot & the different modes available to activate BSNL International Wi-Fi Hotspot service.

15 LEAD MANAGEMENT IN EB AND PRABAL PLUS LEASED CIRCUIT FAULT MANAGEMENT

15.1 LEARNING OBJECTIVE:

Lead management is the process of capturing leads, tracking all touch points with business like email, chat, or website behavior, and qualifying and Engaging them until they purchase your product.

A successful lead management process includes five steps:

a) Lead Capturing

b) Lead enrichment & Tracking

c) Lead Qualification

d) Lead distribution

e) Lead nurturing

The Enterprise Business Portal provides the Enterprise Business Team of BSNL with end to end web based software solution that delivers a secure, scalable and reliable tool to enter, update, manage various Enterprise Business activities within BSNL and facilities to track and report the various activities of EB Team.

The Enterprise Portal is a replacement of the current Excel based Reporting where the current software is used enter the lead, Opportunity Data, generate Quotation, Service Orders and also keep track of the stages an opportunities are. The Enterprise Portal will utilize the user and unit id information stored in the database to limit the access to the information available for that user retaining the security and accessibility at various levels.

The Enterprise Portal consists of the following:

- Information Storage
- Reporting

15.2 Information Storage

- Stores information about users, units, leads, opportunities, companies in a database.
- Track changes to lead/opportunity and company information, who made the changes and

when it was made.

- Updates opportunity data generated on weekly basis for generation of various reports, for example sales funnel report.
- Stores documents like contracts, MOU's and other information in database..
- Stores information on Companies and Users.

15.3 Reporting

- Visually display out reports of information in spreadsheet (.xls) format and saved to a file or to be printed.

15.4 System Configuration

A Mozilla firefox web browser is required to view the activity and the menus. A graphical user interface (GUI) along with an application programming interface (API), which will allow other methods of interacting with the data, and third party application integration to be created as needed. A keyboard and a mouse are required for inputting data.

List of User Interfaces

❖ **Dashboard**

Dashboard provides an easy access and interactive view of various pending tasks, reports, statistics and graphs related to the opportunity management and reports.

❖ **User Menu**

Contains Submenus to access various pages of EB Portal

1. User Management
2. Lead Management
3. Customer Information
4. Manage Accounts
5. Reports-Sales
6. Invoice
7. O M Options
8. Escalation
9. Search
10. FRS
11. Email/SMS

❖ **Tasks**

Can View various tasks and their status. Allows to create a new Project, Task and edit them.

❖ **Activities**

❖ **Header Bar Menus**

User can interact with various dropdown menus to access Mail, Tasks and other features.

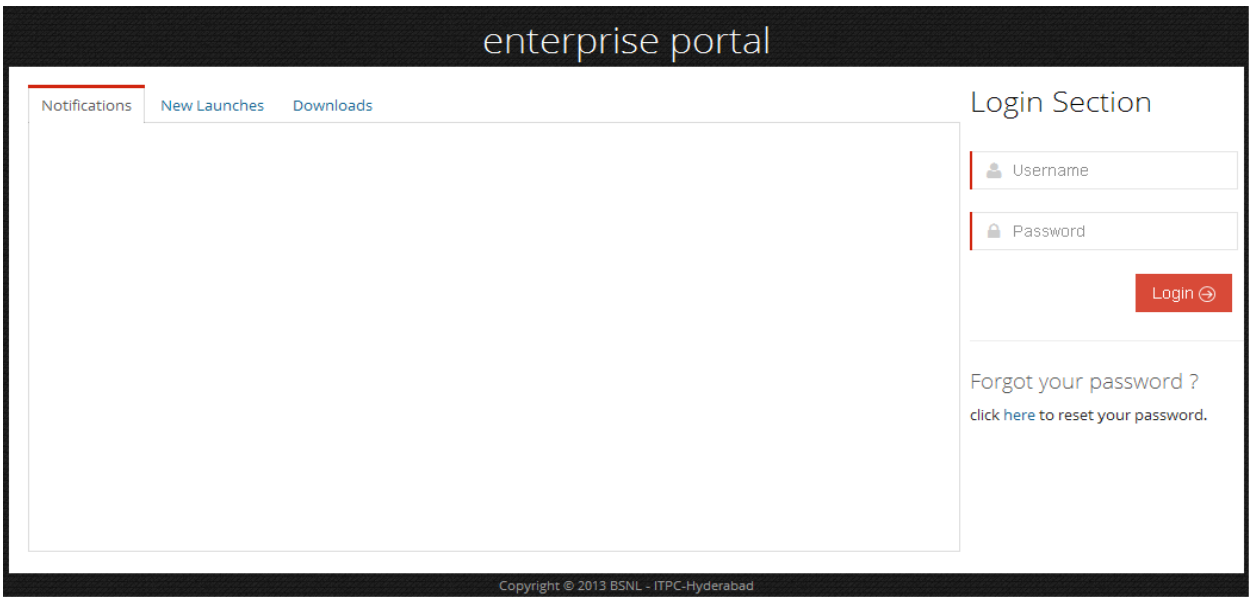
15.4.1 Dependencies and Constraints

The project is dependent on the current hardware/software policies and procedures in place for EB Portal.

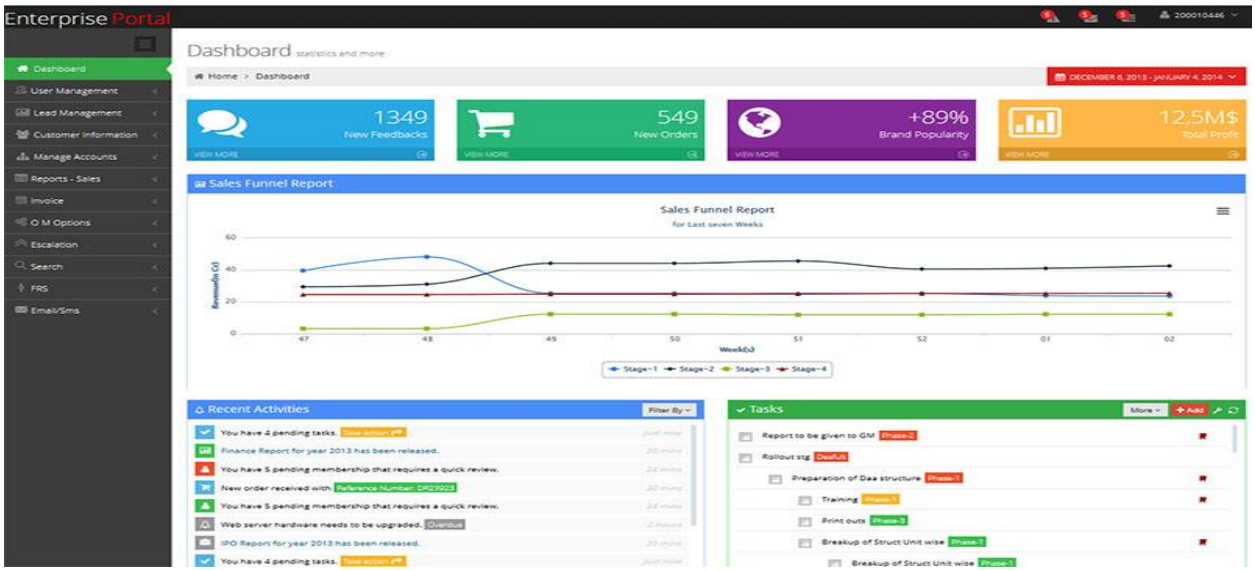
The user interface must be viewable on a monitor with a 1024x768 resolution or larger

1. 15.4.2 GETTING STARTED

Logging On



When a user wants to use the Enterprise Portal, the user will key in theUsername (Hrms),password and click "Login." The system will transition to a screen with various menu options and Dashboard page being open. After the user logs on to the system, the user can select the specific activity.



To prevent unauthorized access to sensitive portions of the system, a specific username and password is needed that is generated by the Administrator. A user will be prompted to enter their login and password to access the Enterprise Portal

System Menu

❖ **Dashboard**:

Dashboard provides an easy access and interactive view of various pending tasks, reports, statistics and graphs related to the opportunity management and reports.

❖ **User Management**:

User Management allows the Administrator to create and manage EB users, where each user is created by mapping his HRMS, unit working , reporting officer and SSA/Circle Information. Each user is identified by a userId and unitId. The Administrator grants the authorizations, Access type, Type of User (NAM,KAM,Admin e.t.c) while creating the user.

❖ **Lead Management**:

Lead Management Module allows creation and management of leads, Opportunities, Quotations and Service Orders for the logged User. The user can

- Create a new lead.
- Convert the leads to opportunities.
- Change the stages of the individual opportunities.
- Create Quotation and process them online for approval, send them by mail or print.

- Convert the opportunity to sales order and route to the related third party Packages like CRM, TVRIT for further processing.

❖ **Customer Management** :

Customer Management allows a user to create a Company which may or may not have a lead/opportunity, Manage the point of contact and other contact information and also arrange the companies in a hierarchical structure for easy access. If a company exists in the Enterprise Portal, the user will be provided with a auto suggest while searching for a company throughout the Enterprise Portal.

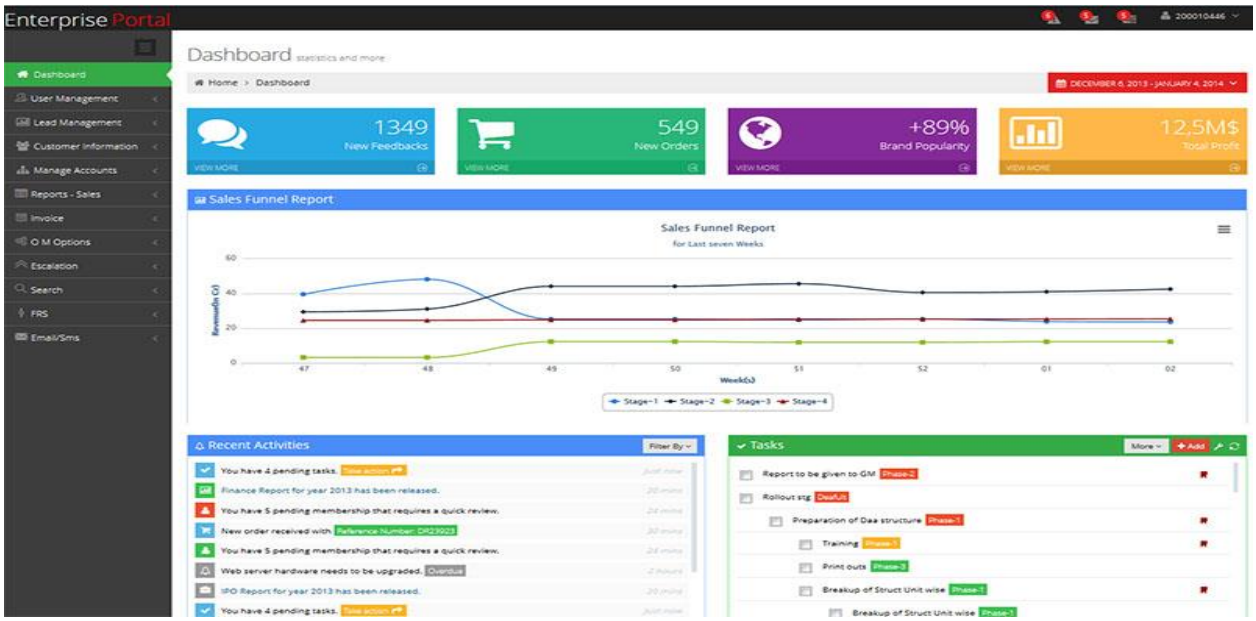
❖ **Account Management** :

Account Management allows a user to manage the Account related information of the Company/ Customer in the Enterprise Portal.

❖ **Reports** :

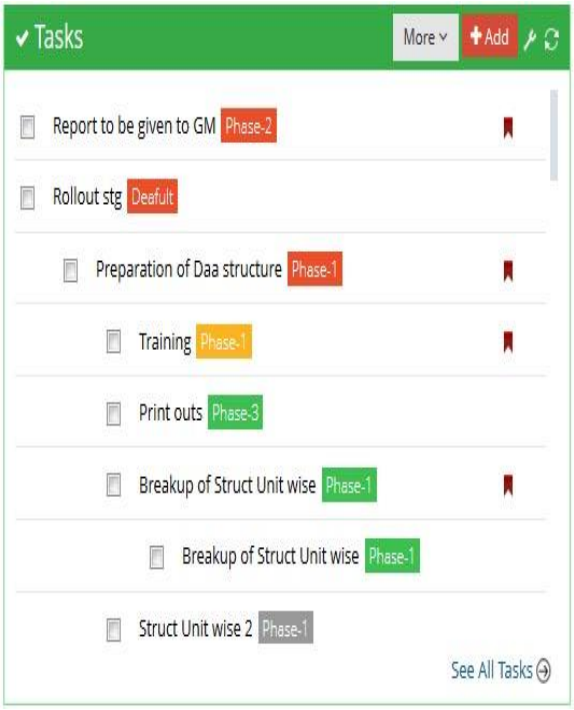
The user can access and view various reports useful for the Enterprise Business User to access the various stages and performance metrics.

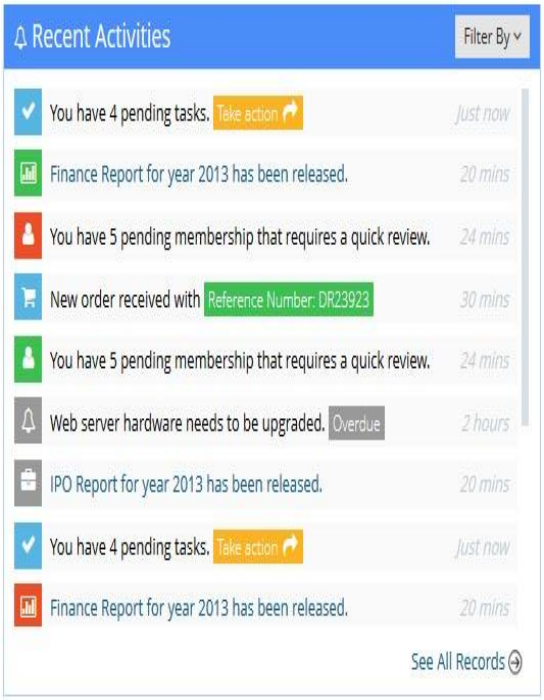
Dashboard



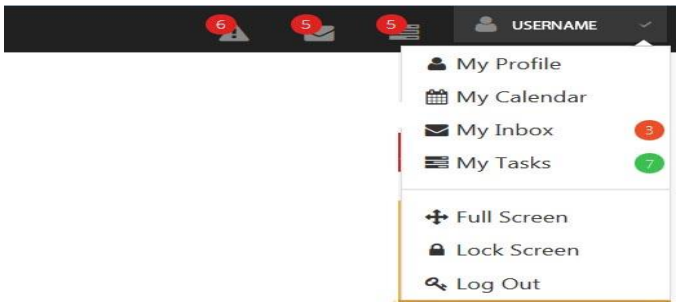
- The Dashboard is the first window that appears after the user logs in to the system, which shows various reports, activities and Tasks along with the user menu, which the user can directly interact with.
- The user can now select any options and Menus available on the page


Sales Funnel Report
Sales Funnel Report
for Last seven Weeks
Revenue(In Cr)
60
40
20
0
47
48
49
50
51
52
01
02
Week(s)
Stage-1
Stage-2
Stage-3
Stage-4


Tasks
More
Add
Report to be given to GM
Phase-2
Rollout stg
Deafult
Preparation of Daa structure
Phase-1
Training
Phase-1
Print outs
Phase-3
Breakup of Struct Unit wise
Phase-1
Breakup of Struct Unit wise
Phase-1
Struct Unit wise 2
Phase-1
See All Tasks

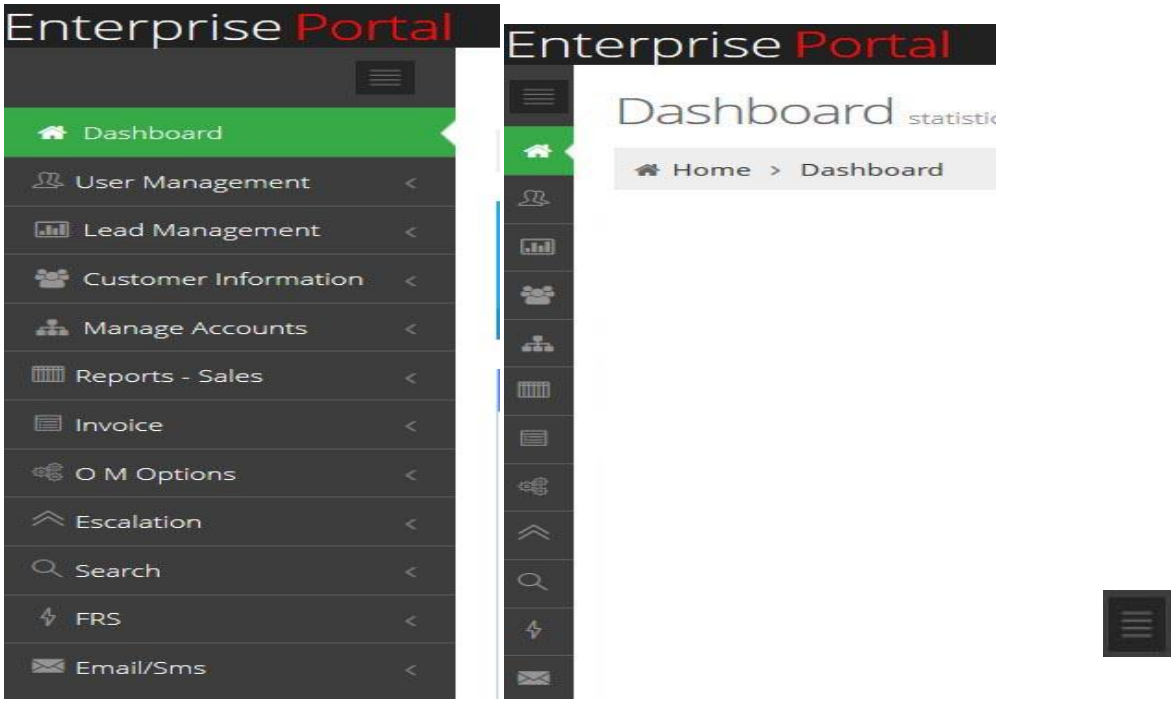

Recent Activities
Filter By
You have 4 pending tasks.
Take action
Just now
Finance Report for year 2013 has been released.
20 mins
You have 5 pending membership that requires a quick review.
24 mins
New order received with
Reference Number: DR23923
30 mins
You have 5 pending membership that requires a quick review.
24 mins
Web server hardware needs to be upgraded.
Overdue
2 hours
IPO Report for year 2013 has been released.
20 mins
You have 4 pending tasks.
Take action
Just now
Finance Report for year 2013 has been released.
20 mins
See All Records

Menu Header


6
5
5
USERNAME
My Profile
My Calendar
My Inbox
3
My Tasks
7
Full Screen
Lock Screen
Log Out

Menu Header Bar gives information and access to the user to his profile, Inbox, Tasks Calendar widgets which are personal to the user.

Menu Side Bar



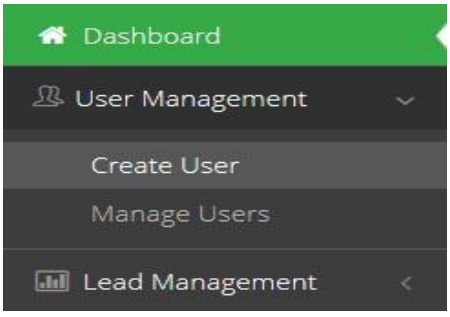
The Menu can be minimized to allow for maximum utilization of user space by clicking the button.

Exit System

When a user wishes to leave the EB Portal, the user clicks "Log Out." The “Log out” button will always be displayed at the bottom of the drop-down menu of User Header Menu in web page. As soon as you click the “Log out” button you will be logged out of the system and taken back to the login screen page.

2. USING the SYSTEM

This section describes the various Menus and usage



❖ User Management

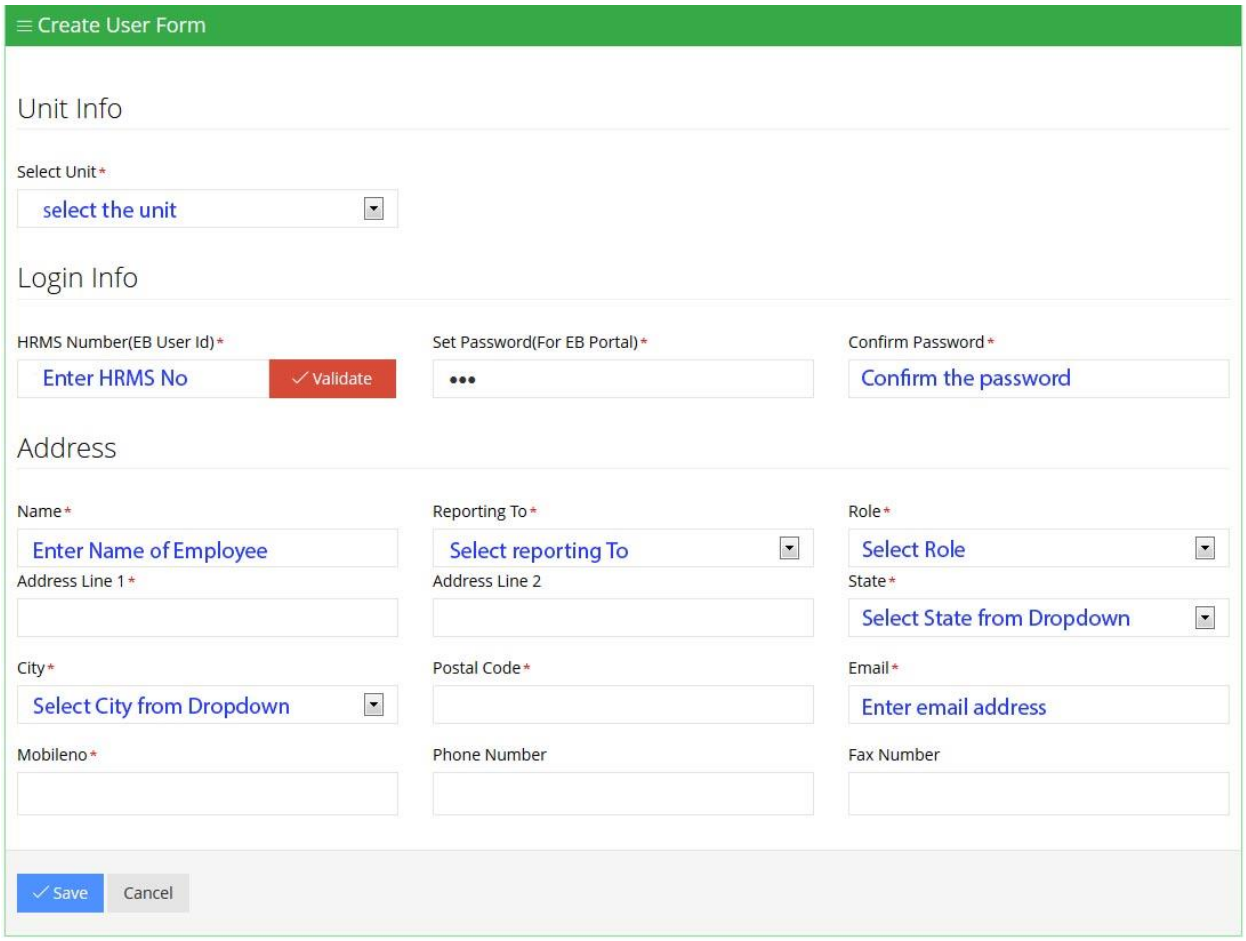
Allows to

- **Create User:**Create a New Users for the EB Portal by verifying the credentials and entering all the

required personal and unit information at one go**.**

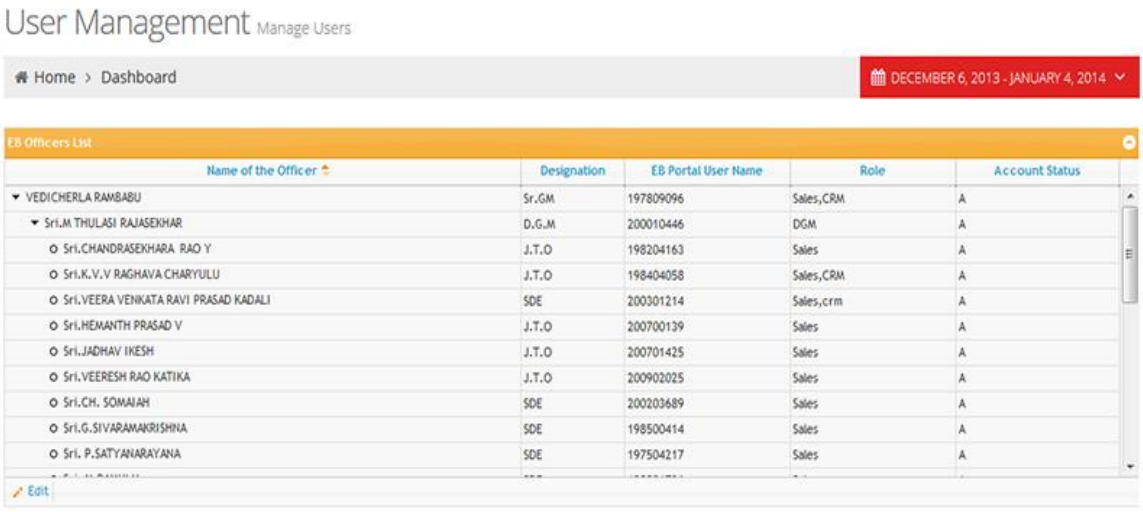
- **Manage Users:** Edit existing Users involving data, roles, reporting to and status.

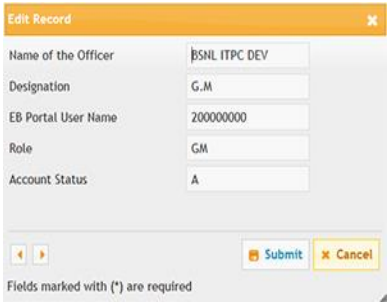
Create User



1. Select the unit working.
2. Enter the HRMS Number and click ✓ Validate to verify the HRMS Number. The relevant fields are updated.
3. Enter the password and confirm the password.
4. Select “Reporting To” from the list.
5. Select the “Role” from the list ,where the available options are “Accounts”, ”CRM”, ”Sales” and “Mgmt”.
6. Complete the form with required mandatory fields and click ✓ Save button.

Manage User

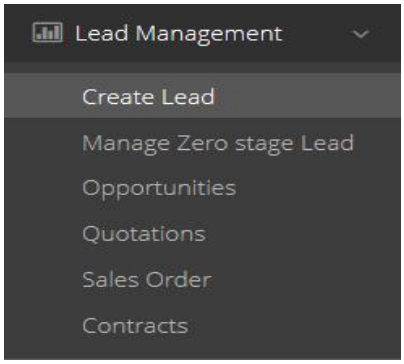




Manage User displays a tree structure hierarchy of users present in the EB portal , which can be expanded by clicking on arrow. This allows editing of basic information of User by clicking the Edit Button.

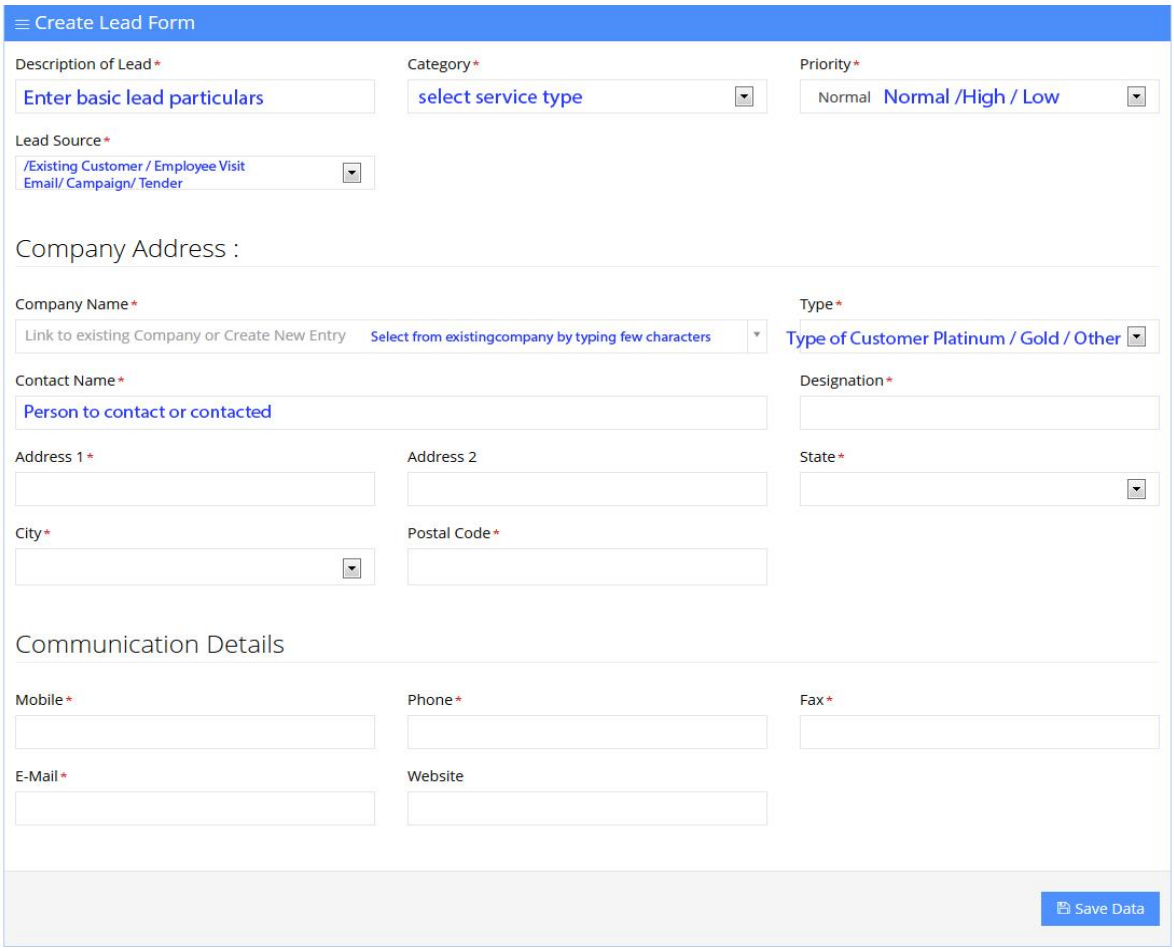
This opens a Edit Dialog where the user can edit the basic user information and save it into the database.

❖ **Lead Management**



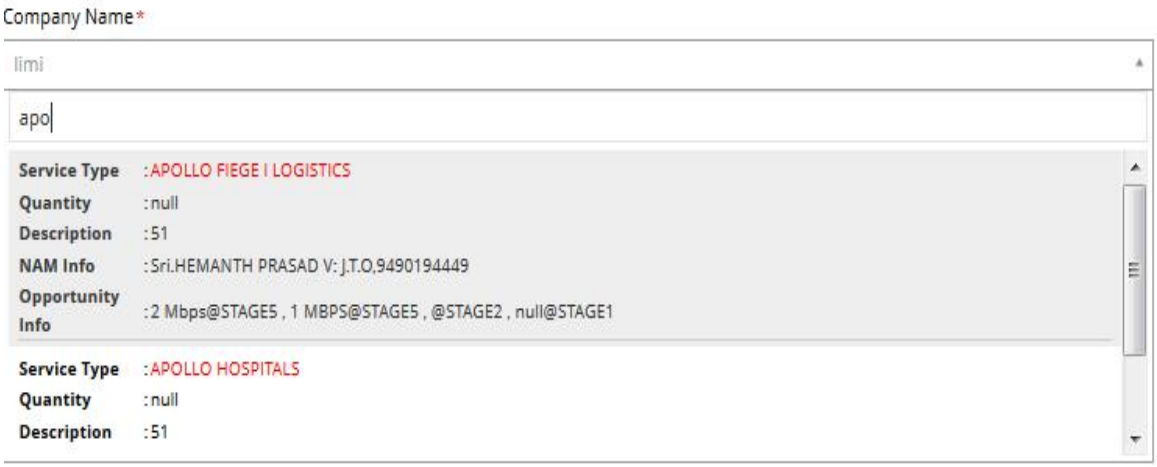
1. **Create Lead**: Create a Zero Stage Lead.
2. **Manage Zero Stage Lead**:Edit Zero Stage Lead and Move from lead to opportunity.
3. **Opportunities:** Edit available Opportunities.
4. **Quotations**: Generate Quotations and send Quotations.
5. **Sales Orders**: Generate Sales Orders and send Sales Orders.
6. **Contracts**: Save Contract documents and maintain Contract durations of Services to companies.

Create Lead



A lead is created using this module, where the lead is generated as a Zero Stage lead by entering the required information in the fields.

1. Description of Lead : Enter description which allows a lead to be uniquely identified from the available leads.
2. Category : Select the service type that the Customer is interested in availing (Landline/ GSM e.t.c)
3. Priority: Select priority as High/Low or Normal (default).
4. Lead Source: Select the source of the lead available from the list.
5. Company Name: If existing customer, on entering 3 characters, the company name is populated along with NAM and current leads. Else saves the company name.



6. Fill in the complete input fields that are marked as mandatory by *symbol and click on 

.

7. When invalid data is entered or mandatory fields are left incomplete, the lead will not be saved and error message is displayed.

8. On Successful entry a message “Lead has been Created Successfully” is displayed.

15.5 Caveats and Exceptions

If there are special actions the user must take to insure that data is properly saved or that some other function executes properly, describe those actions here. Include screen captures and descriptive narratives if applicable.

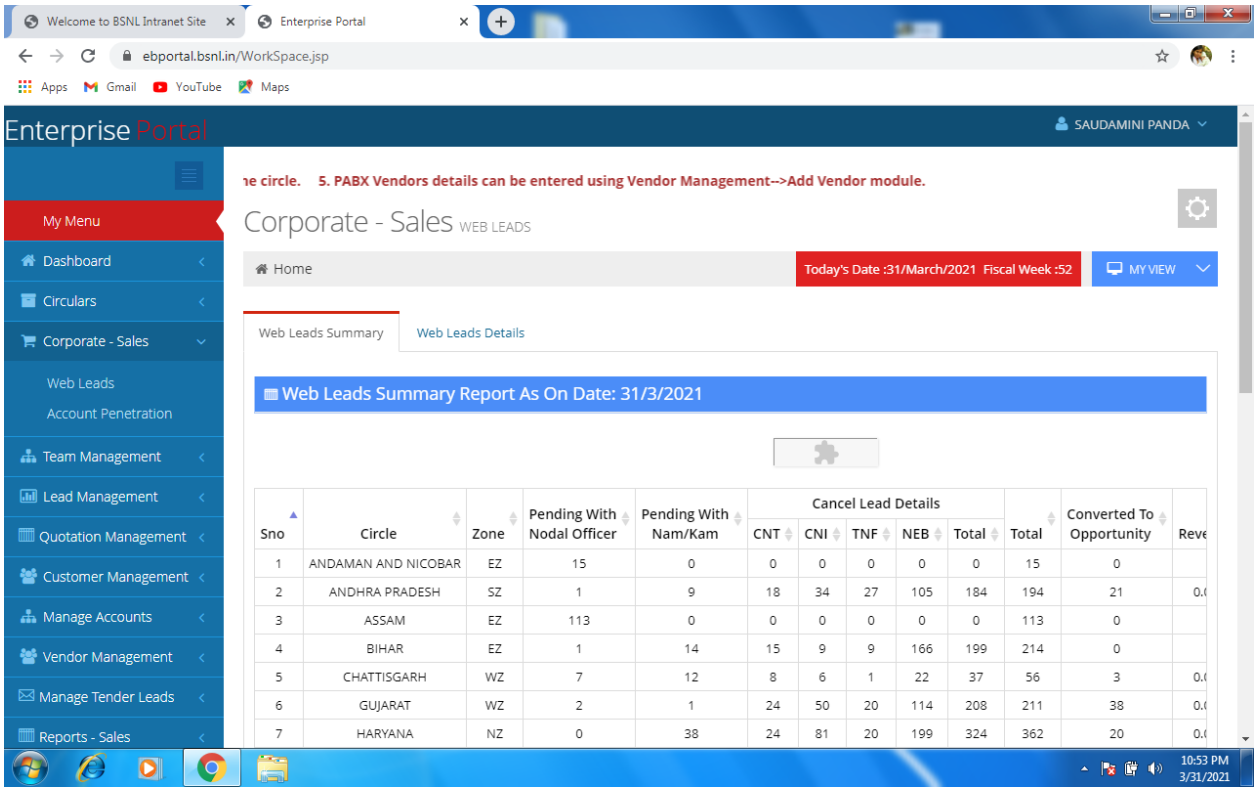
15.6 LEAD MANAGEMENT IN EB PORTAL

CORPORATE SALES :

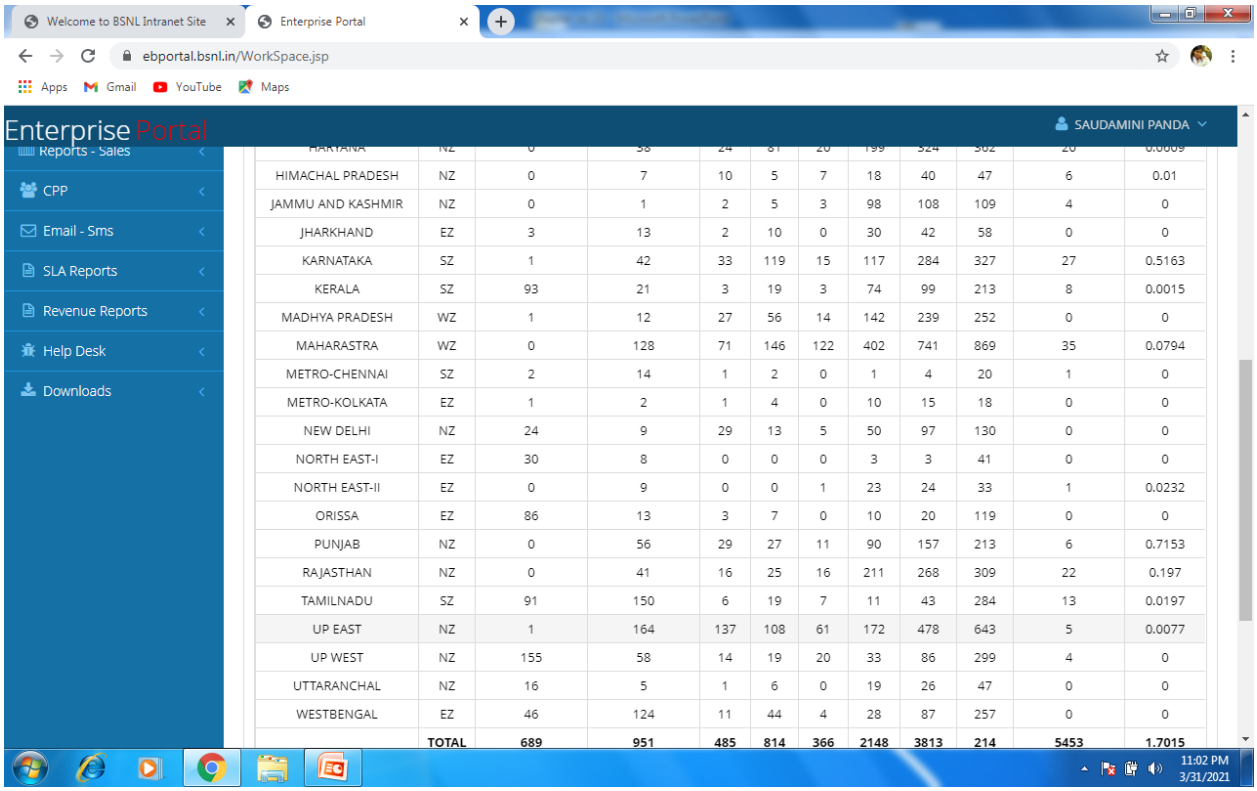
Corporate sales include the responsibilities of meeting with customers nd accessing their requirement, capture key. develop maintain and retain excellent relationship with clients .develop a mapping of the client and achieve revenue targets. Corporate sales include :

1) Web leads

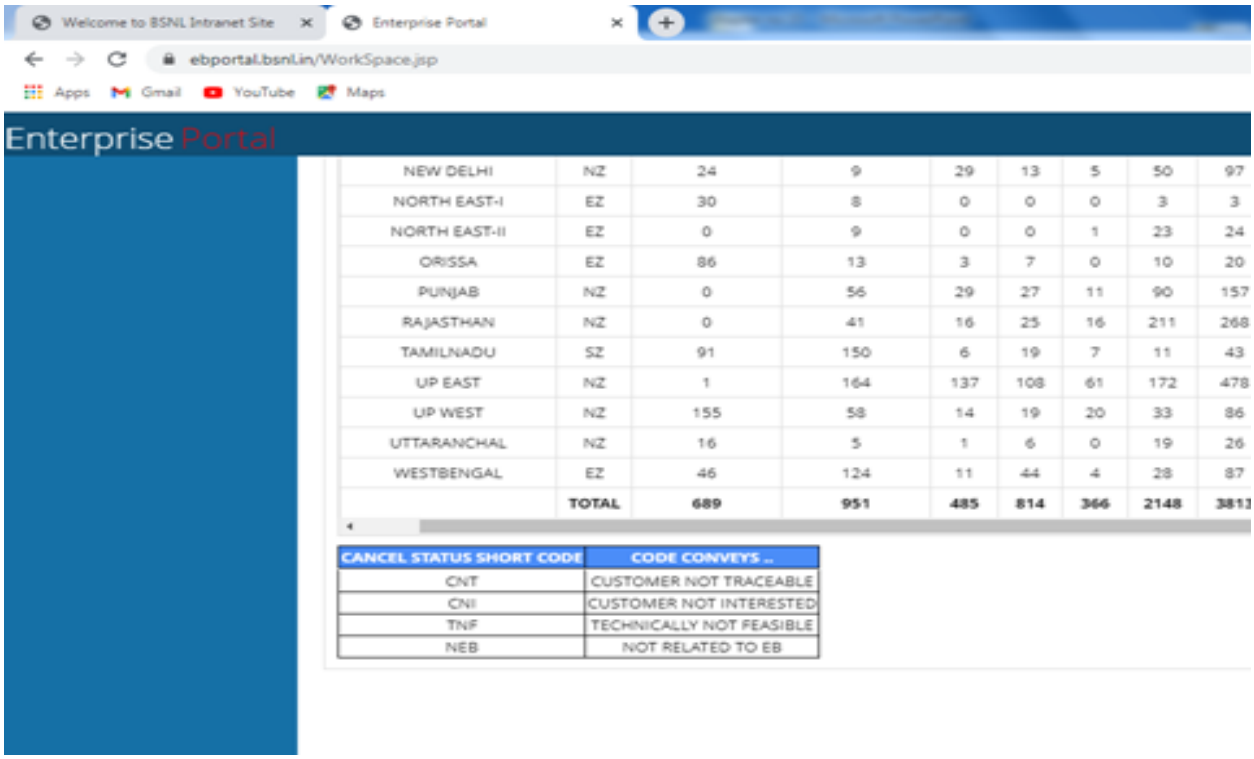
2) Account penetration



Sno	Circle	Zone	Pending With Nodal Officer	Pending With Nam/Kam	Cancel Lead Details					Total	Converted To Opportunity	Reve
					CNT	CNI	TNF	NEB	Total			
1	ANDAMAN AND NICOBAR	EZ	15	0	0	0	0	0	0	15	0	
2	ANDHRA PRADESH	SZ	1	9	18	34	27	105	184	194	21	0.(
3	ASSAM	EZ	113	0	0	0	0	0	0	113	0	
4	BIHAR	EZ	1	14	15	9	9	166	199	214	0	
5	CHATTISGARH	WZ	7	12	8	6	1	22	37	56	3	0.(
6	GUJARAT	WZ	2	1	24	50	20	114	208	211	38	0.(
7	HARYANA	NZ	0	38	24	81	20	199	324	362	20	0.(



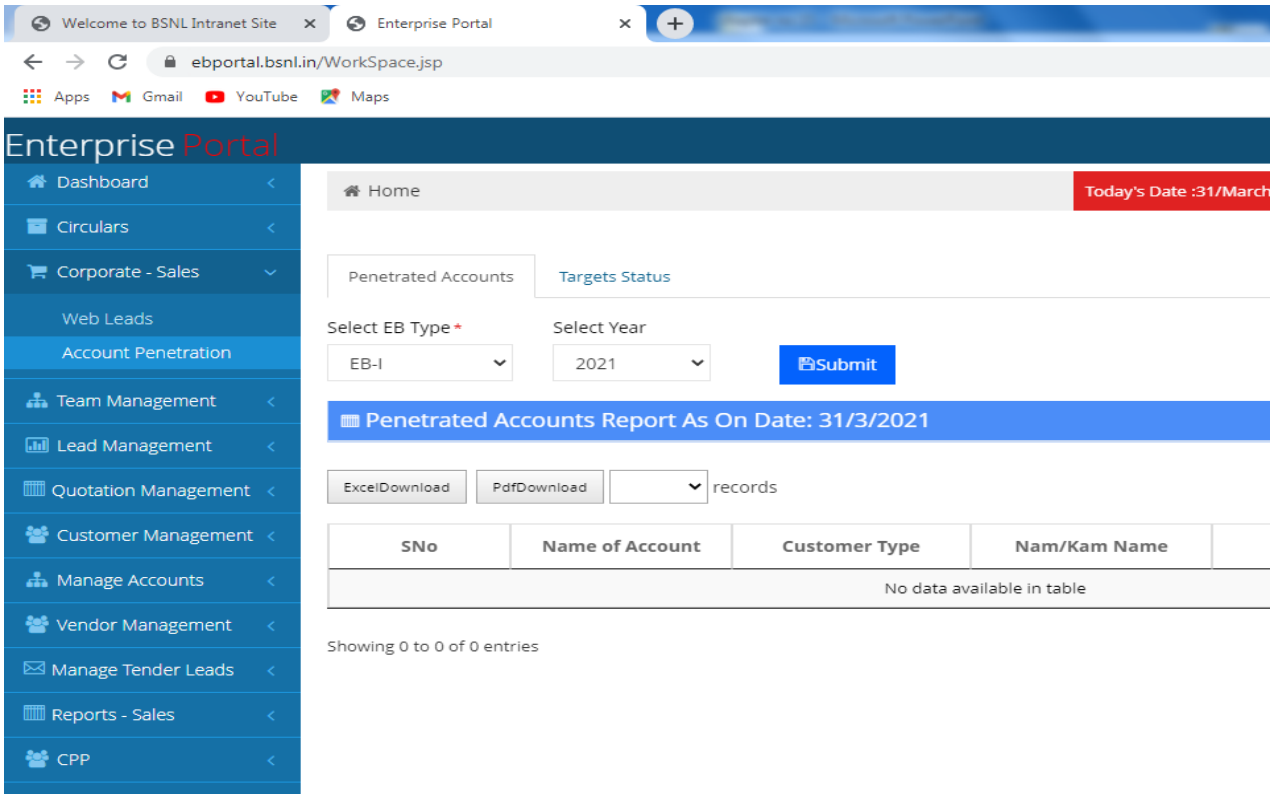
HIMACHAL PRADESH	NZ	0	7	10	5	7	18	40	47	6	0.01
JAMMU AND KASHMIR	NZ	0	1	2	5	3	98	108	109	4	0
JHARKHAND	EZ	3	13	2	10	0	30	42	58	0	0
KARNATAKA	SZ	1	42	33	119	15	117	284	327	27	0.5163
KERALA	SZ	93	21	3	19	3	74	99	213	8	0.0015
MADHYA PRADESH	WZ	1	12	27	56	14	142	239	252	0	0
MAHARASTRA	WZ	0	128	71	146	122	402	741	869	35	0.0794
METRO-CHENNAI	SZ	2	14	1	2	0	1	4	20	1	0
METRO-KOLKATA	EZ	1	2	1	4	0	10	15	18	0	0
NEW DELHI	NZ	24	9	29	13	5	50	97	130	0	0
NORTH EAST-I	EZ	30	8	0	0	0	3	3	41	0	0
NORTH EAST-II	EZ	0	9	0	0	1	23	24	33	1	0.0232
ORISSA	EZ	86	13	3	7	0	10	20	119	0	0
PUNJAB	NZ	0	56	29	27	11	90	157	213	6	0.7153
RAJASTHAN	NZ	0	41	16	25	16	211	268	309	22	0.197
TAMILNADU	SZ	91	150	6	19	7	11	43	284	13	0.0197
UP EAST	NZ	1	164	137	108	61	172	478	643	5	0.0077
UP WEST	NZ	155	58	14	19	20	33	86	299	4	0
UTTARANCHAL	NZ	16	5	1	6	0	19	26	47	0	0
WESTBENGAL	EZ	46	124	11	44	4	28	87	257	0	0
	TOTAL	689	951	485	814	366	2148	3813	214	5453	1.7015



NEW DELHI	NZ	24	9	29	13	5	50	97
NORTH EAST-I	EZ	30	8	0	0	0	3	3
NORTH EAST-II	EZ	0	9	0	0	1	23	24
ORISSA	EZ	86	13	3	7	0	10	20
PUNJAB	NZ	0	56	29	27	11	90	157
RAJASTHAN	NZ	0	41	16	25	16	211	268
TAMILNADU	SZ	91	150	6	19	7	11	43
UP EAST	NZ	1	164	137	108	61	172	478
UP WEST	NZ	155	58	14	19	20	33	86
UTTARANCHAL	NZ	16	5	1	6	0	19	26
WESTBENGAL	EZ	46	124	11	44	4	28	87
	TOTAL	**689**	**951**	**485**	**814**	**366**	**2148**	**3811**

CANCEL STATUS SHORT CODE	CODE CONVEYS ..
CNT	CUSTOMER NOT TRACEABLE
CNI	CUSTOMER NOT INTERESTED
TNF	TECHNICALLY NOT FEASIBLE
NEB	NOT RELATED TO EB

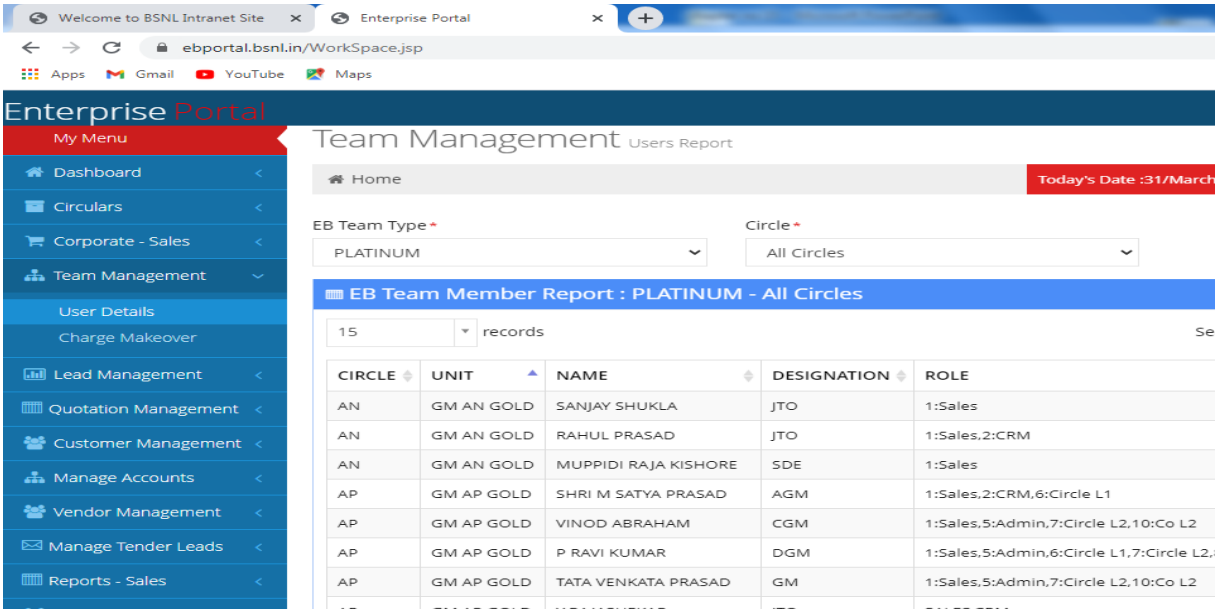
2) ACCOUNT PENETRATION :

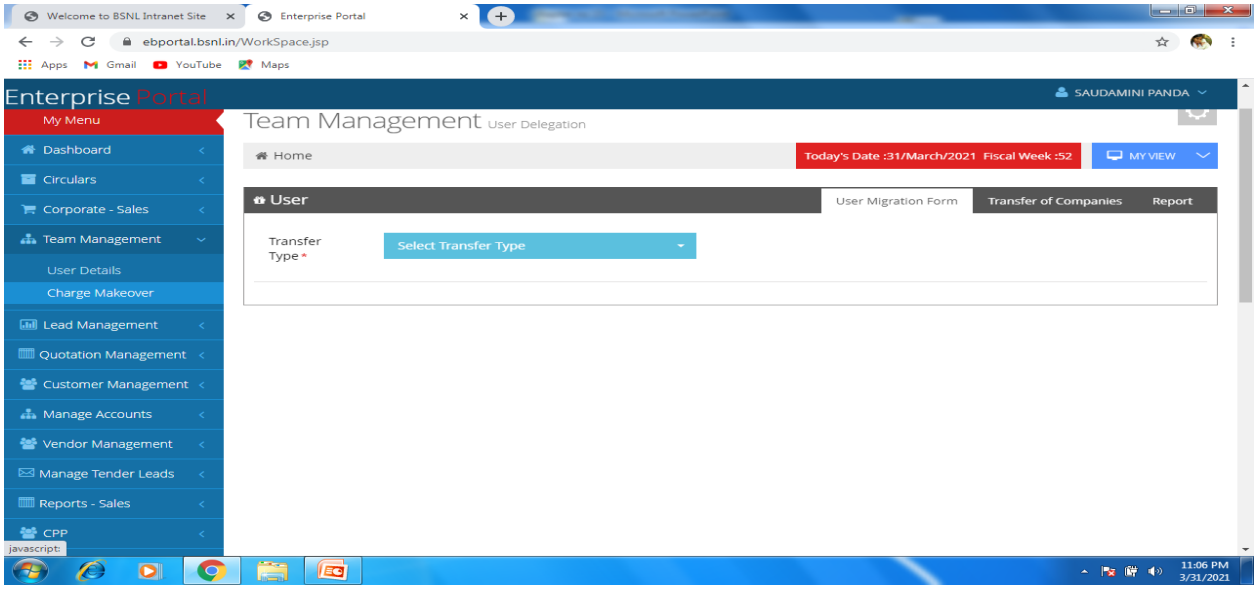


TEAM MANAGEMENT : The Managing Team is responsible for managing the companys core business operations as a whole,which requires planning of various development process. Team management includes two main factors:

1) User details

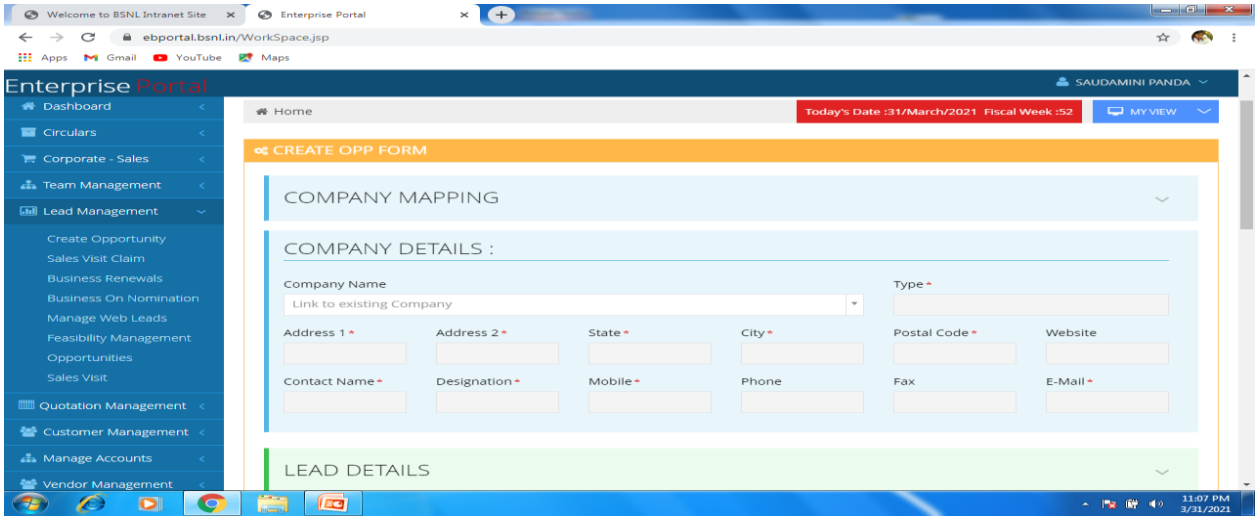
2) Charge makeover

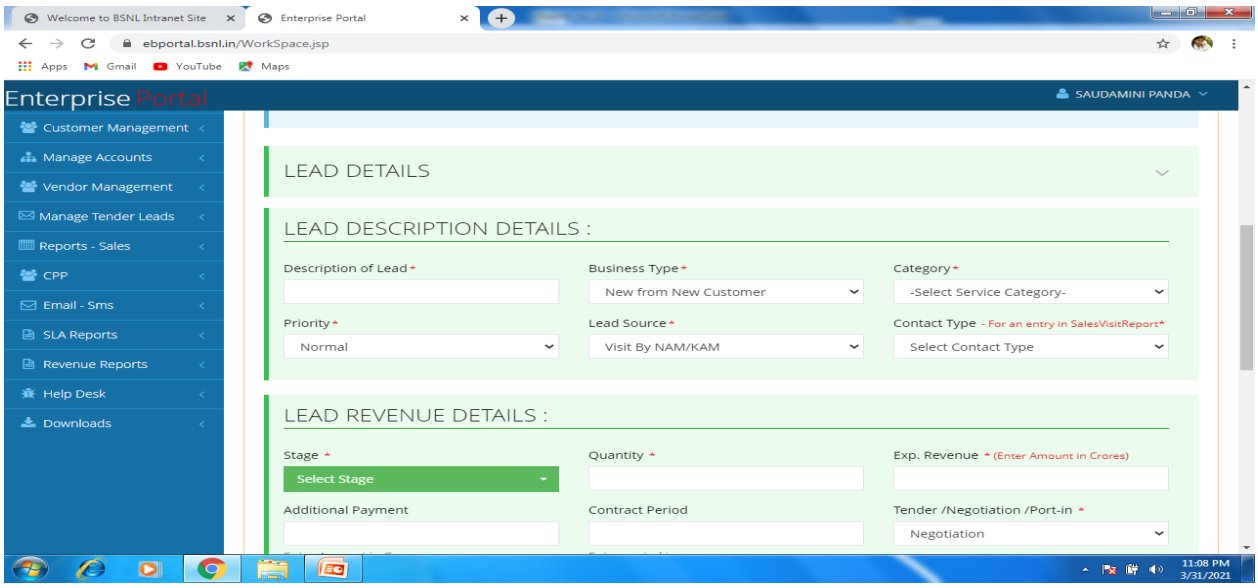




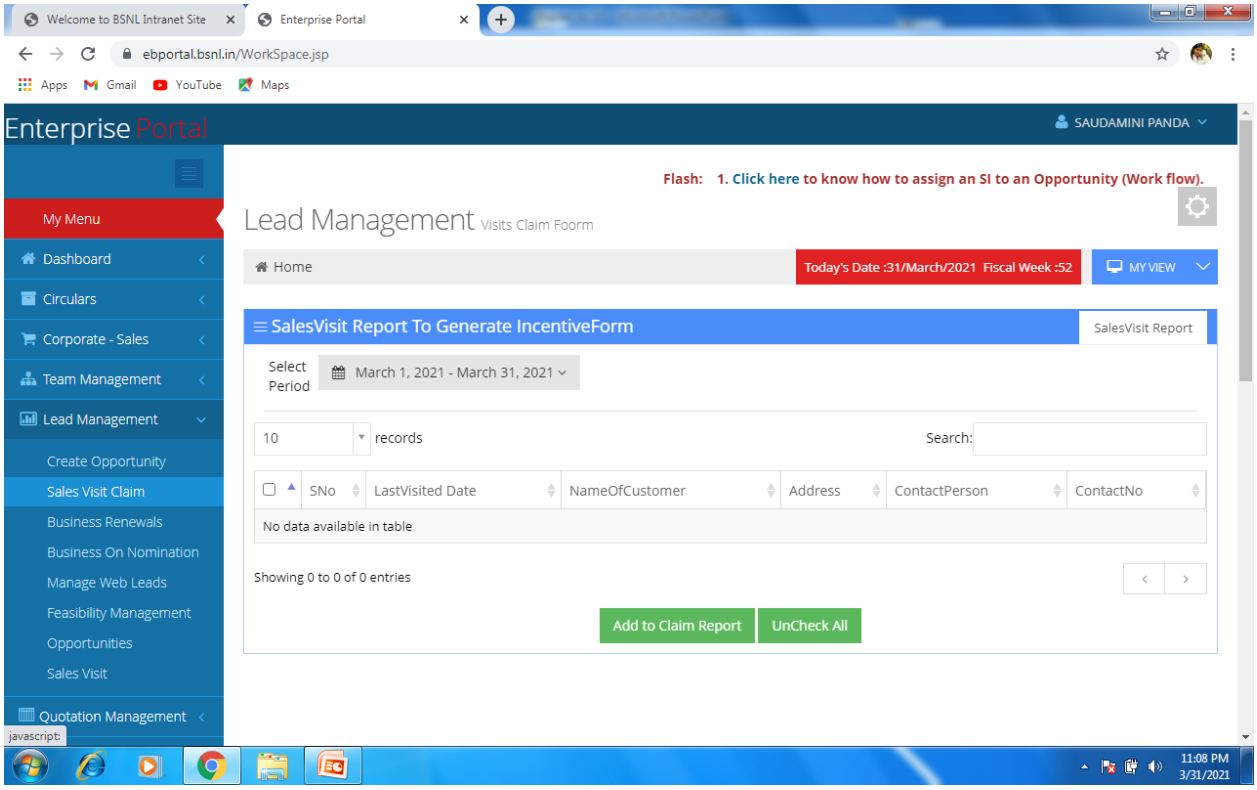
LEAD MANAGEMENT : Lead management is the process of acquiring and managing leads until the point where they make a purchase.lead management includes:

1) Create opportunity
2) Sales visit claim
3) Business renewals
4) Manage web leads
5) Opportunities
6) Sales visit

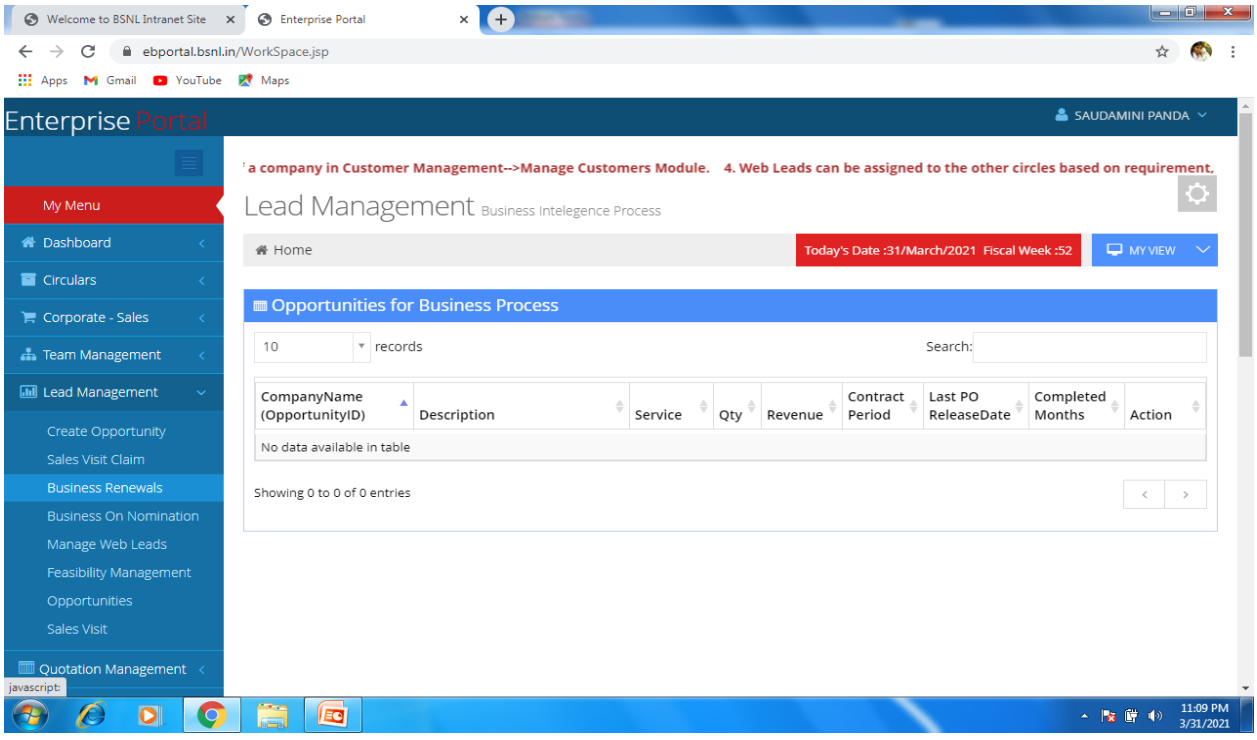




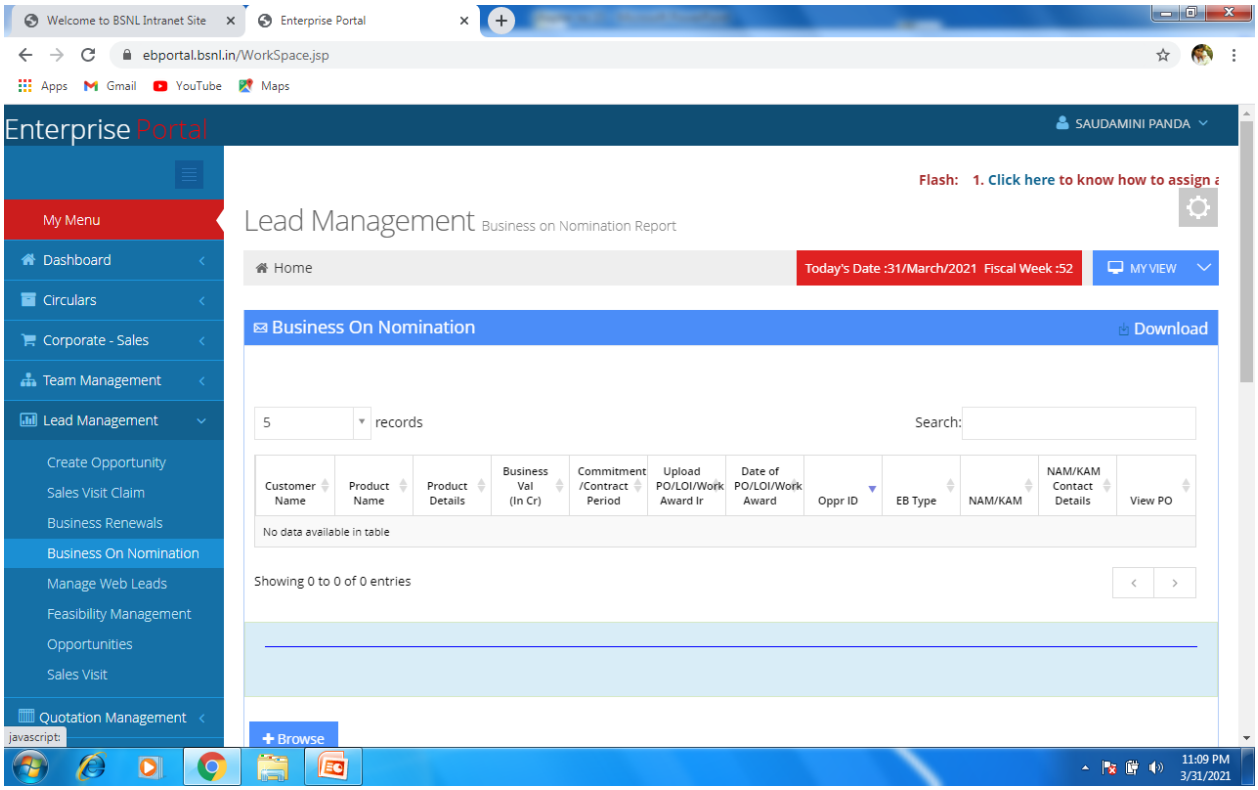
SALES VISIT CLAIM:



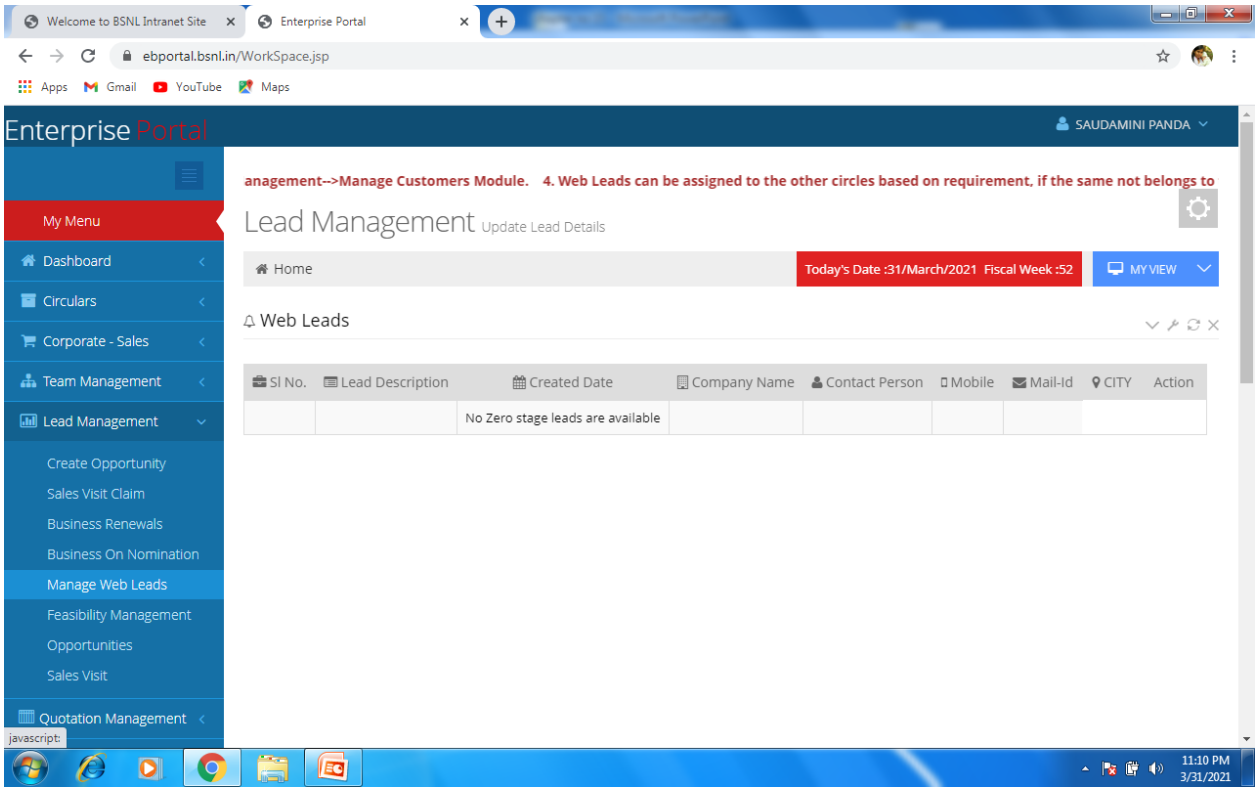
BUSINESS RENEWALS:



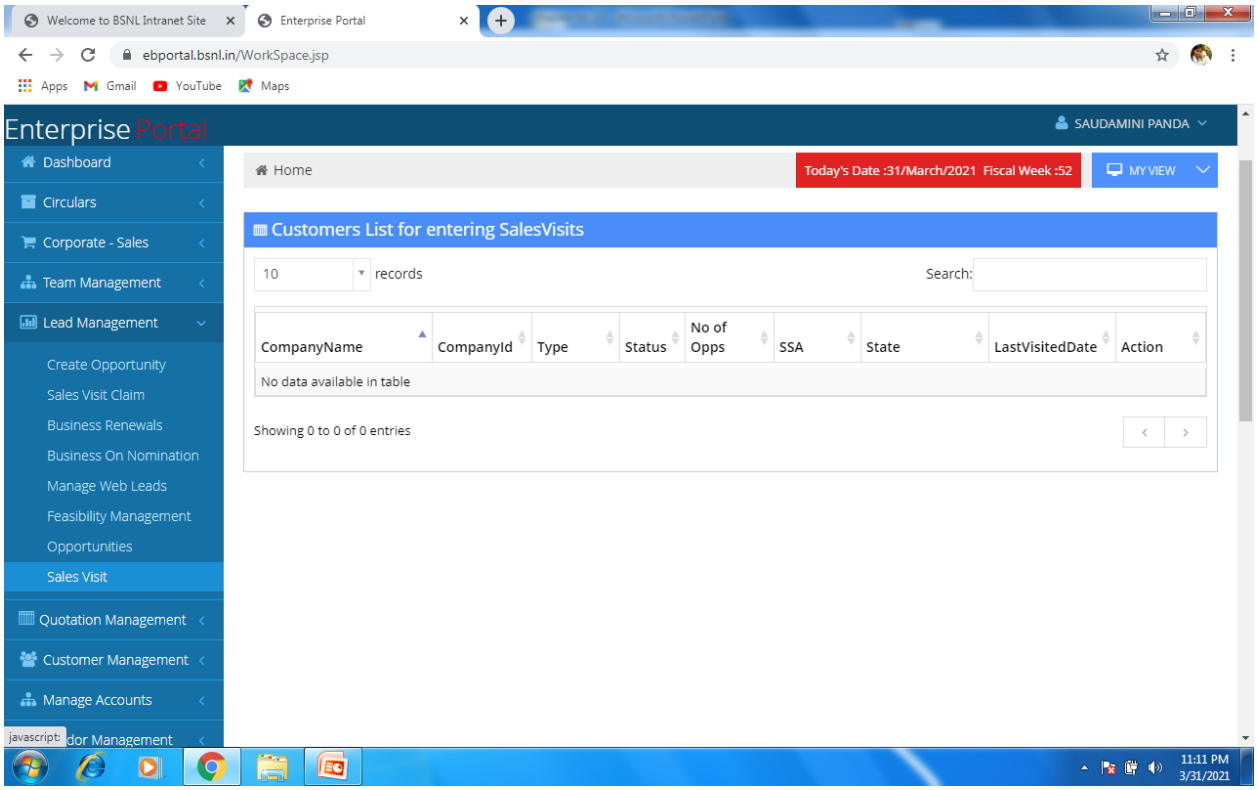
Business on Nomination :



Manage web leads:



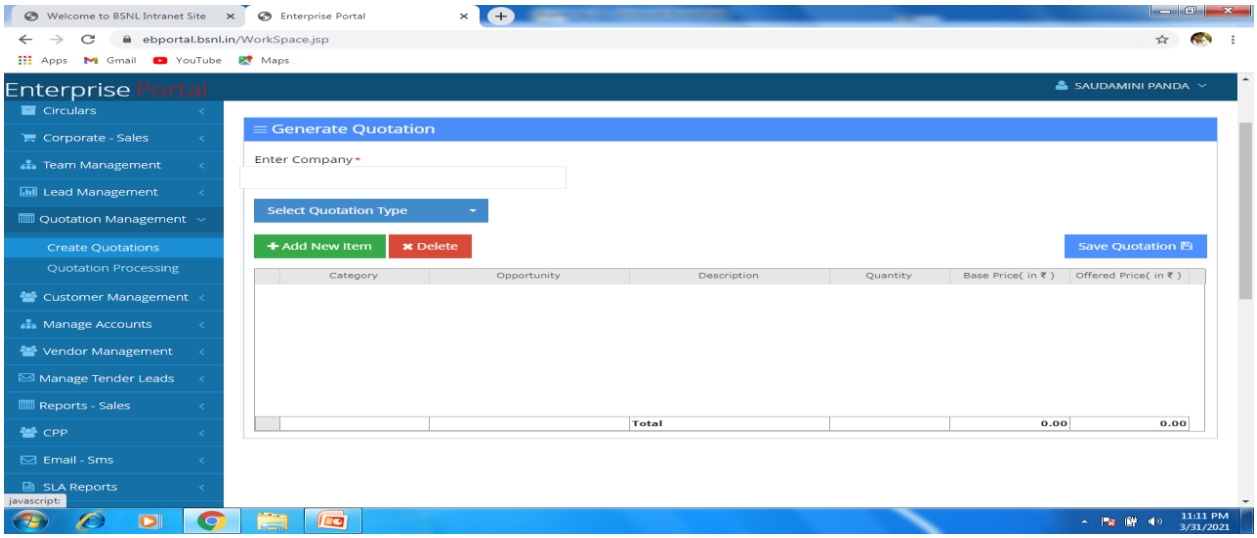
Sales visit :

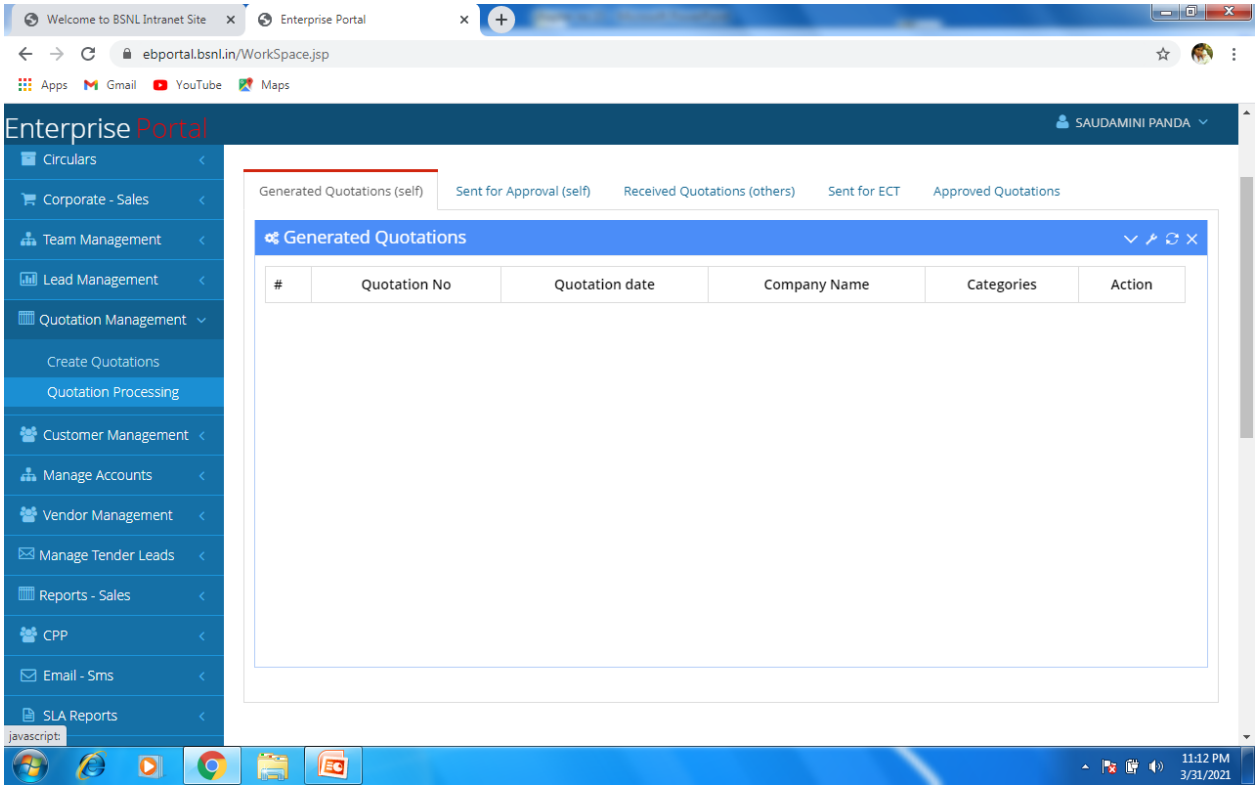


QUOTATION MANAGEMENT : It is the tool that kicks off the sales process by allowing multiple facets of the company to identify potential leads and prepare for the forecasting of those sales in production.i

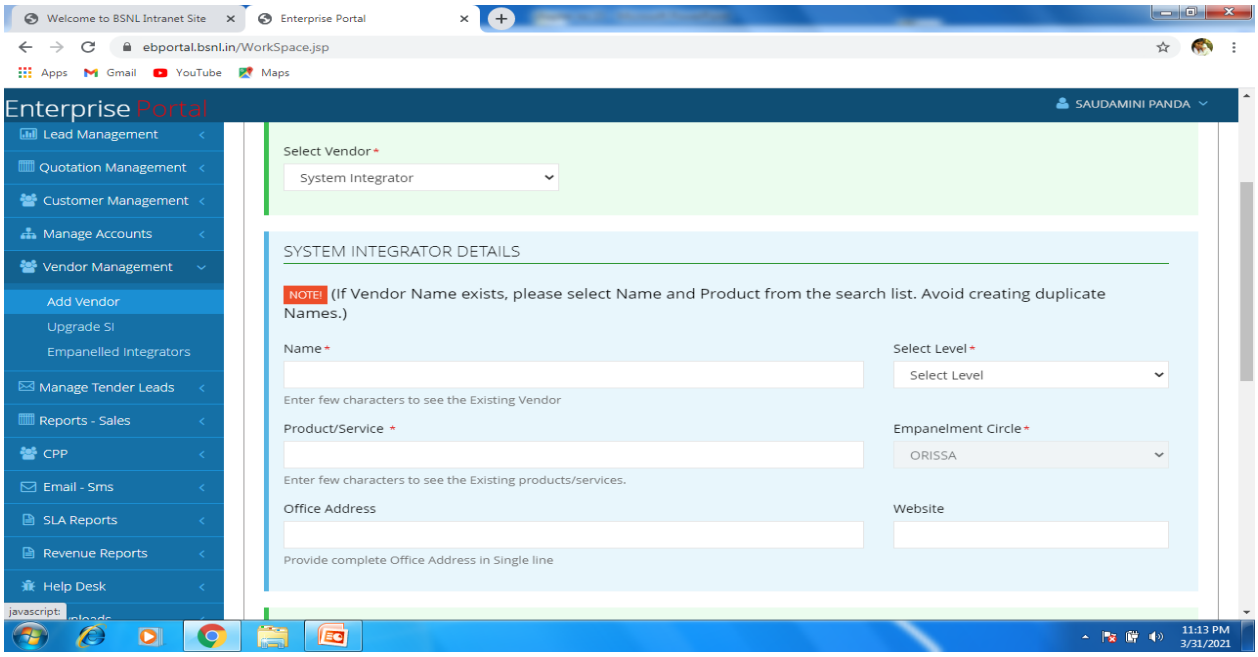
It includes :

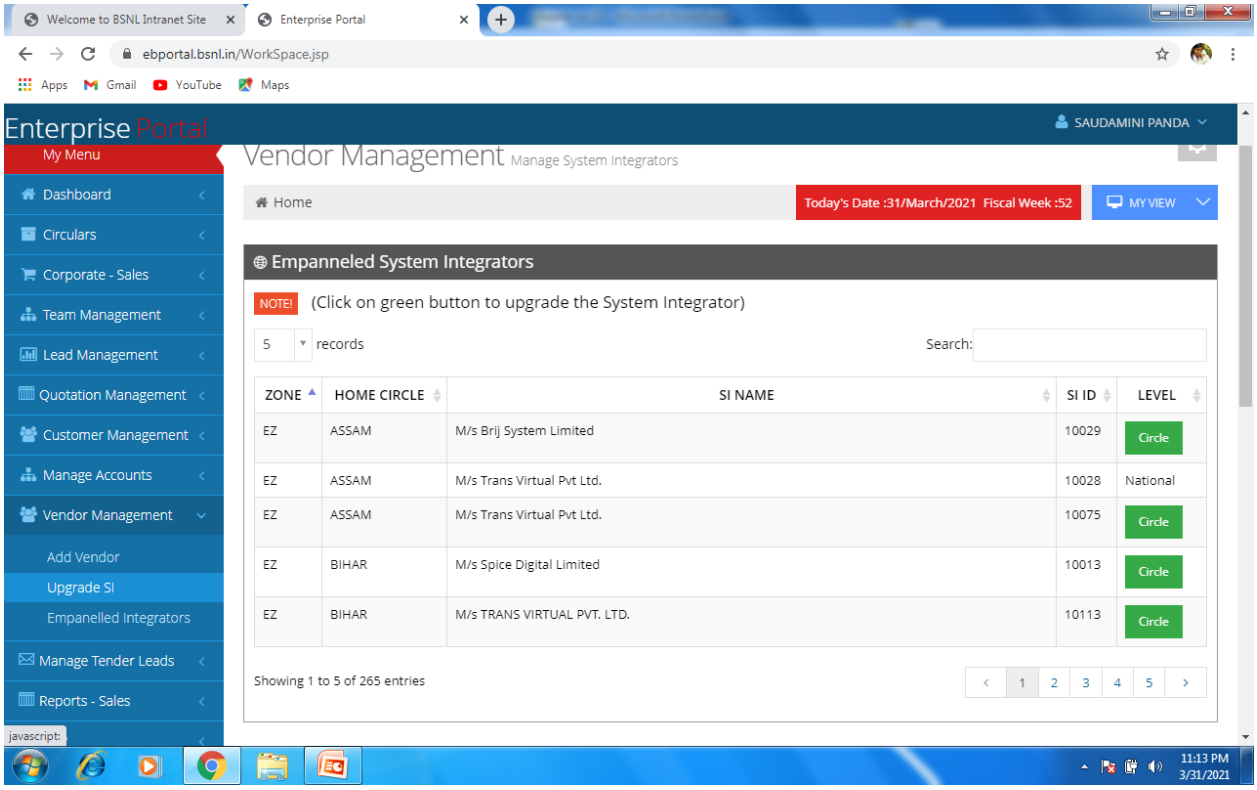
1) Create Quotations
2) Quotation processing

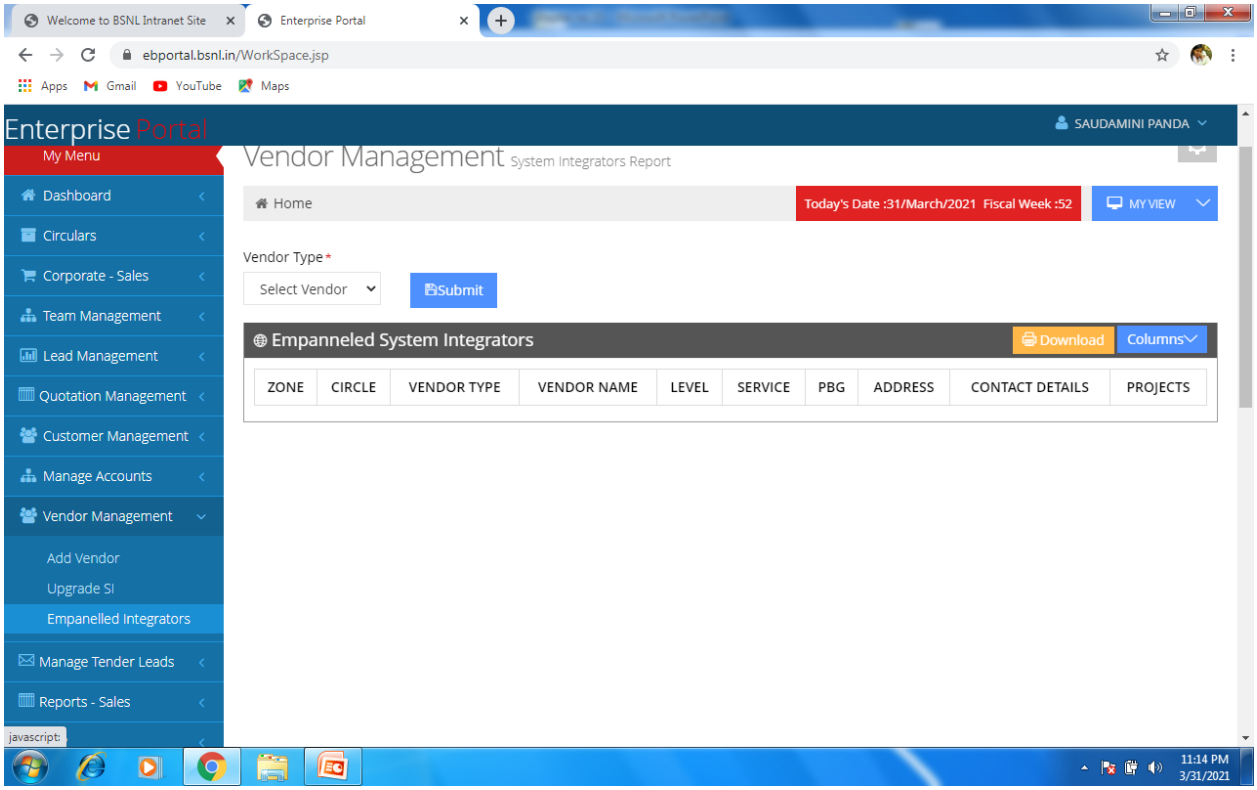




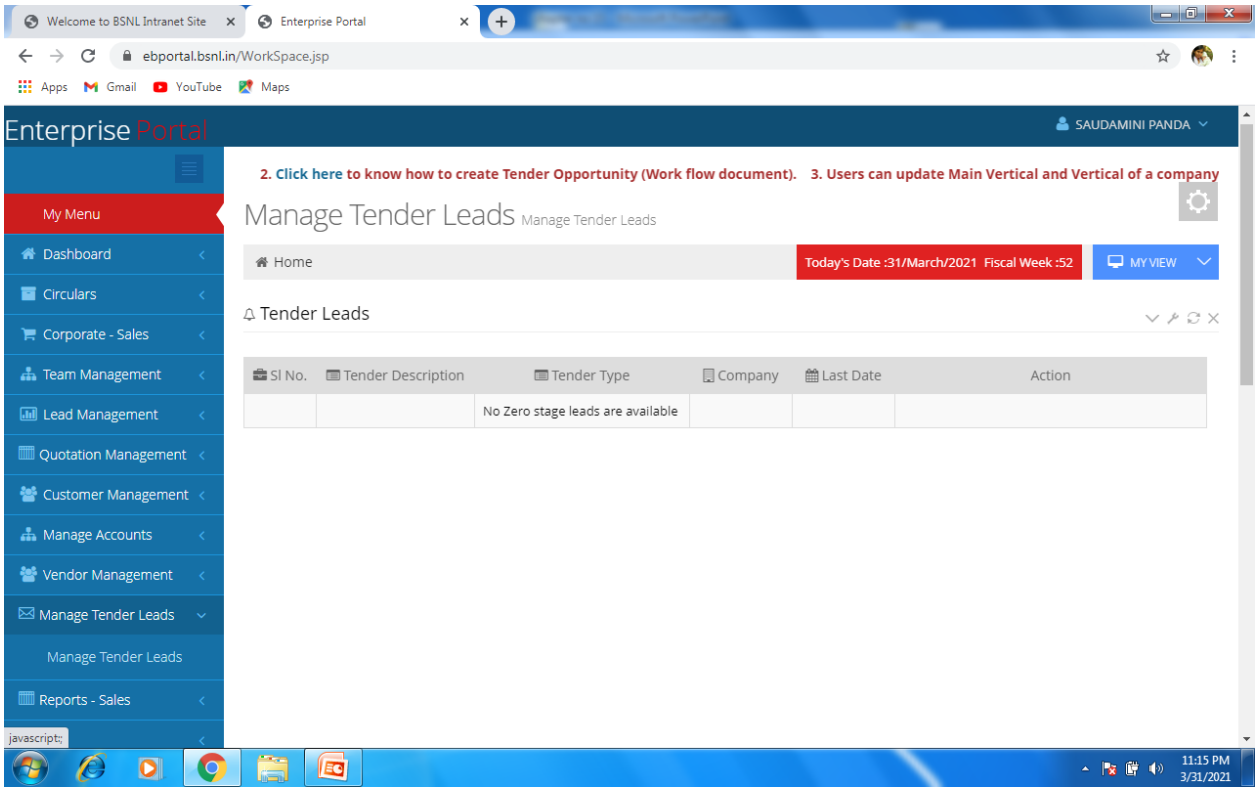
VENDOR MANAGEMENT: Vendor management is the process of fully identifying all the significant companies that aid the delivery of a product or service of our organization.vendor management includes : add vendor , upgrade SI



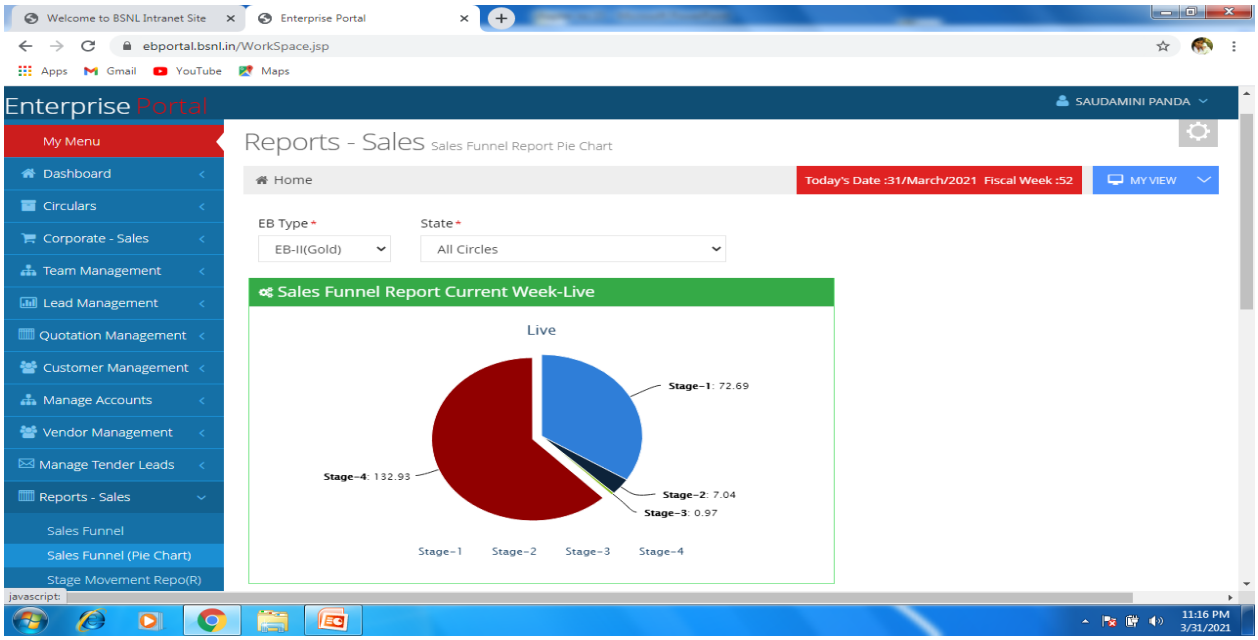

Welcome to BSNL Intranet Site
Enterprise Portal
ebportal.bsnl.in/WorkSpace.jsp
Apps Gmail YouTube Maps
Enterprise Portal
SAUDAMINI PANDA
My Menu
Vendor Management Manage System Integrators
Dashboard
Circulars
Corporate - Sales
Team Management
Lead Management
Quotation Management
Customer Management
Manage Accounts
Vendor Management
Add Vendor
Upgrade SI
Empanelled Integrators
Manage Tender Leads
Reports - Sales
Home
Today's Date :31/March/2021 Fiscal Week :52
MY VIEW
Empanneled System Integrators
NOTE! (Click on green button to upgrade the System Integrator)
5 records
Search:
ZONE HOME CIRCLE SI NAME SI ID LEVEL
EZ ASSAM M/s Brij System Limited 10029 Circle
EZ ASSAM M/s Trans Virtual Pvt Ltd. 10028 National
EZ ASSAM M/s Trans Virtual Pvt Ltd. 10075 Circle
EZ BIHAR M/s Spice Digital Limited 10013 Circle
EZ BIHAR M/s TRANS VIRTUAL PVT. LTD. 10113 Circle
Showing 1 to 5 of 265 entries
1 2 3 4 5
11:13 PM
3/31/2021

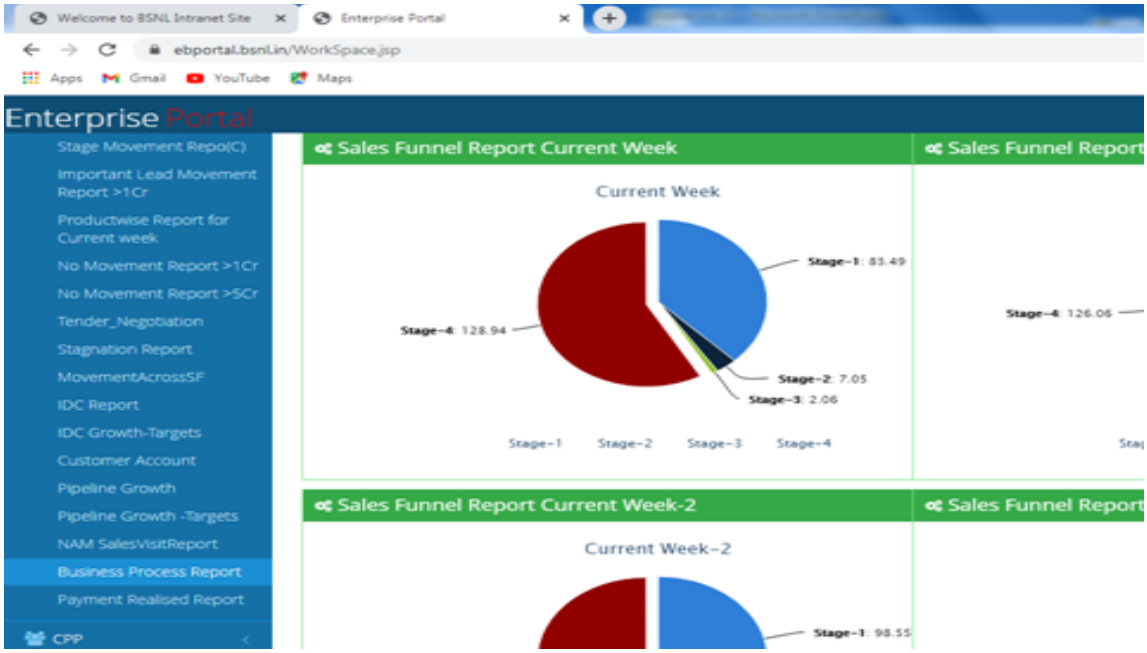

Welcome to BSNL Intranet Site
Enterprise Portal
ebportal.bsnl.in/WorkSpace.jsp
Apps Gmail YouTube Maps
Enterprise Portal
SAUDAMINI PANDA
My Menu
Vendor Management System Integrators Report
Dashboard
Circulars
Corporate - Sales
Team Management
Lead Management
Quotation Management
Customer Management
Manage Accounts
Vendor Management
Add Vendor
Upgrade SI
Empanelled Integrators
Manage Tender Leads
Reports - Sales
Home
Today's Date :31/March/2021 Fiscal Week :52
MY VIEW
Vendor Type*
Select Vendor
Submit
Empanneled System Integrators
Download
Columns
ZONE CIRCLE VENDOR TYPE VENDOR NAME LEVEL SERVICE PBG ADDRESS CONTACT DETAILS PROJECTS
11:14 PM
3/31/2021

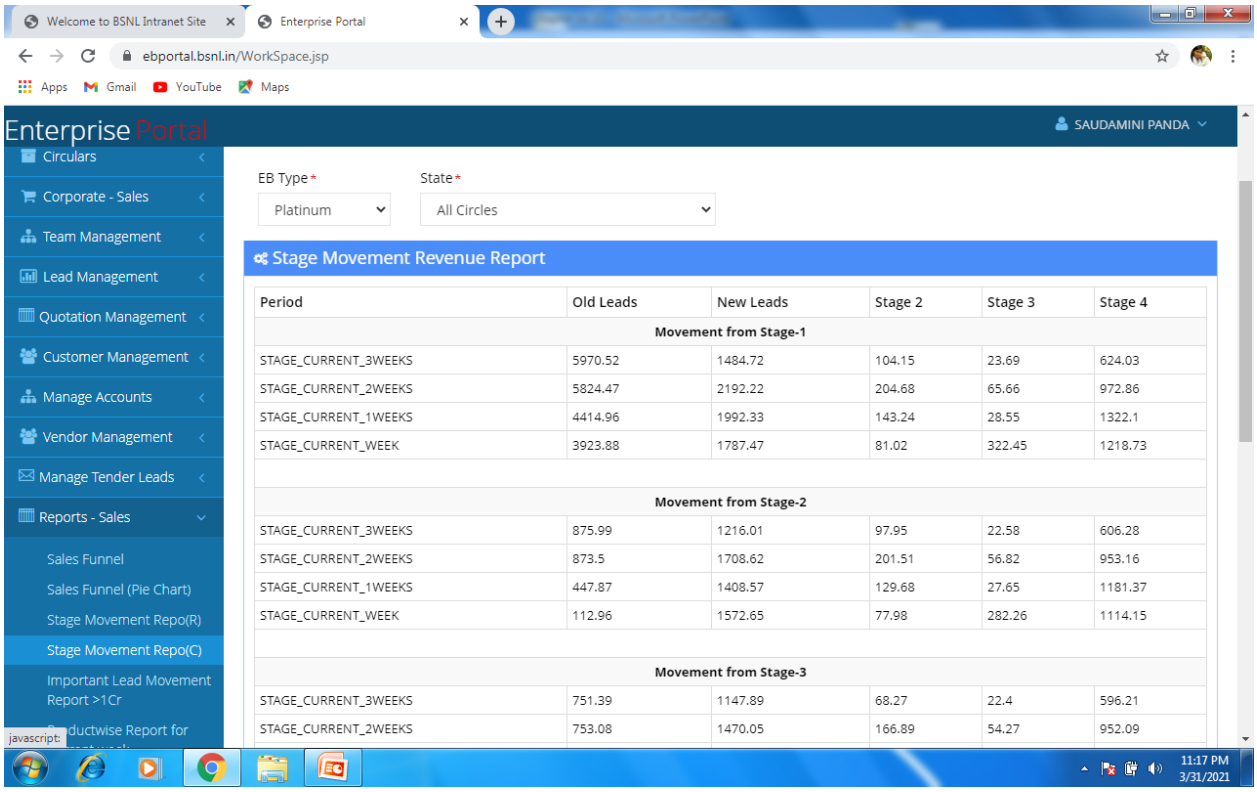
TENDER MANAGEMENT :Tender management is the process of planning, selecting,and publishing bids efficiently,keeping a clear audit trail that can be used to determine best practice for future contracts.

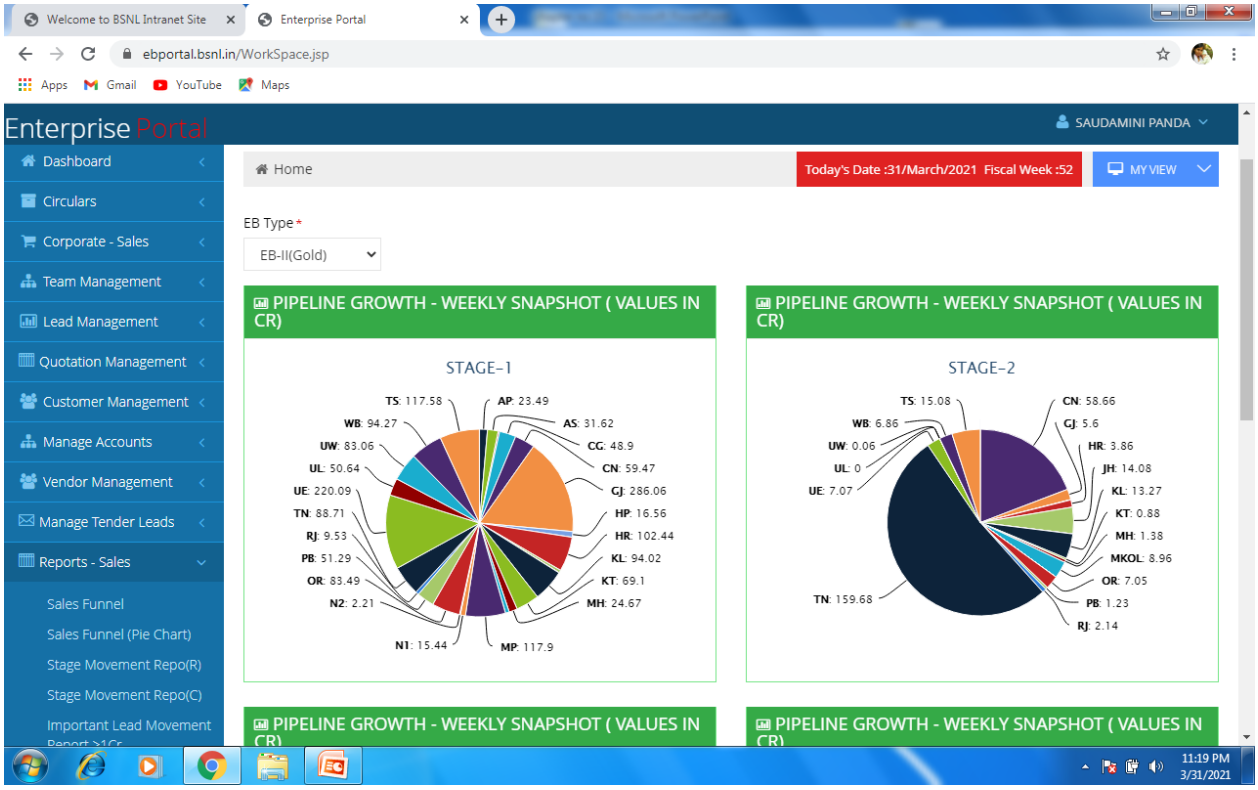


REPORT SALES :




Welcome to BSNL Intranet Site
Enterprise Portal
ebportal.bsnl.in/WorkSpace.jsp
Apps
Gmail
YouTube
Maps
Enterprise Portal
Stage Movement Repo(C)
Important Lead Movement Report >1Cr
Productwise Report for Current week
No Movement Report >1Cr
No Movement Report >5Cr
Tender_Negotiation
Stagnation Report
MovementAcrossSF
IDC Report
IDC Growth-Targets
Customer Account
Pipeline Growth
Pipeline Growth -Targets
NAM SalesVisitReport
Business Process Report
Payment Realised Report
CPP
Sales Funnel Report Current Week
Current Week
Stage-1: 83.49
Stage-2: 7.05
Stage-3: 2.06
Stage-4: 128.94
Stage-1
Stage-2
Stage-3
Stage-4
Sales Funnel Report
Stage-4: 126.06
Sales Funnel Report Current Week-2
Current Week-2
Stage-1: 98.55
Sales Funnel Report


Welcome to BSNL Intranet Site
Enterprise Portal
ebportal.bsnl.in/WorkSpace.jsp
Apps
Gmail
YouTube
Maps
Enterprise Portal
SAUDAMINI PANDA
Circulars
Corporate - Sales
Team Management
Lead Management
Quotation Management
Customer Management
Manage Accounts
Vendor Management
Manage Tender Leads
Reports - Sales
Sales Funnel
Sales Funnel (Pie Chart)
Stage Movement Repo(R)
Stage Movement Repo(C)
Important Lead Movement Report >1Cr
EB Type *
Platinum
State *
All Circles
Stage Movement Revenue Report
Period
Old Leads
New Leads
Stage 2
Stage 3
Stage 4
Movement from Stage-1
STAGE_CURRENT_3WEEKS 5970.52 1484.72 104.15 23.69 624.03
STAGE_CURRENT_2WEEKS 5824.47 2192.22 204.68 65.66 972.86
STAGE_CURRENT_1WEEKS 4414.96 1992.33 143.24 28.55 1322.1
STAGE_CURRENT_WEEK 3923.88 1787.47 81.02 322.45 1218.73
Movement from Stage-2
STAGE_CURRENT_3WEEKS 875.99 1216.01 97.95 22.58 606.28
STAGE_CURRENT_2WEEKS 873.5 1708.62 201.51 56.82 953.16
STAGE_CURRENT_1WEEKS 447.87 1408.57 129.68 27.65 1181.37
STAGE_CURRENT_WEEK 112.96 1572.65 77.98 282.26 1114.15
Movement from Stage-3
STAGE_CURRENT_3WEEKS 751.39 1147.89 68.27 22.4 596.21
STAGE_CURRENT_2WEEKS 753.08 1470.05 166.89 54.27 952.09
11:17 PM
3/31/2021


Welcome to BSNL Intranet Site
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Gmail
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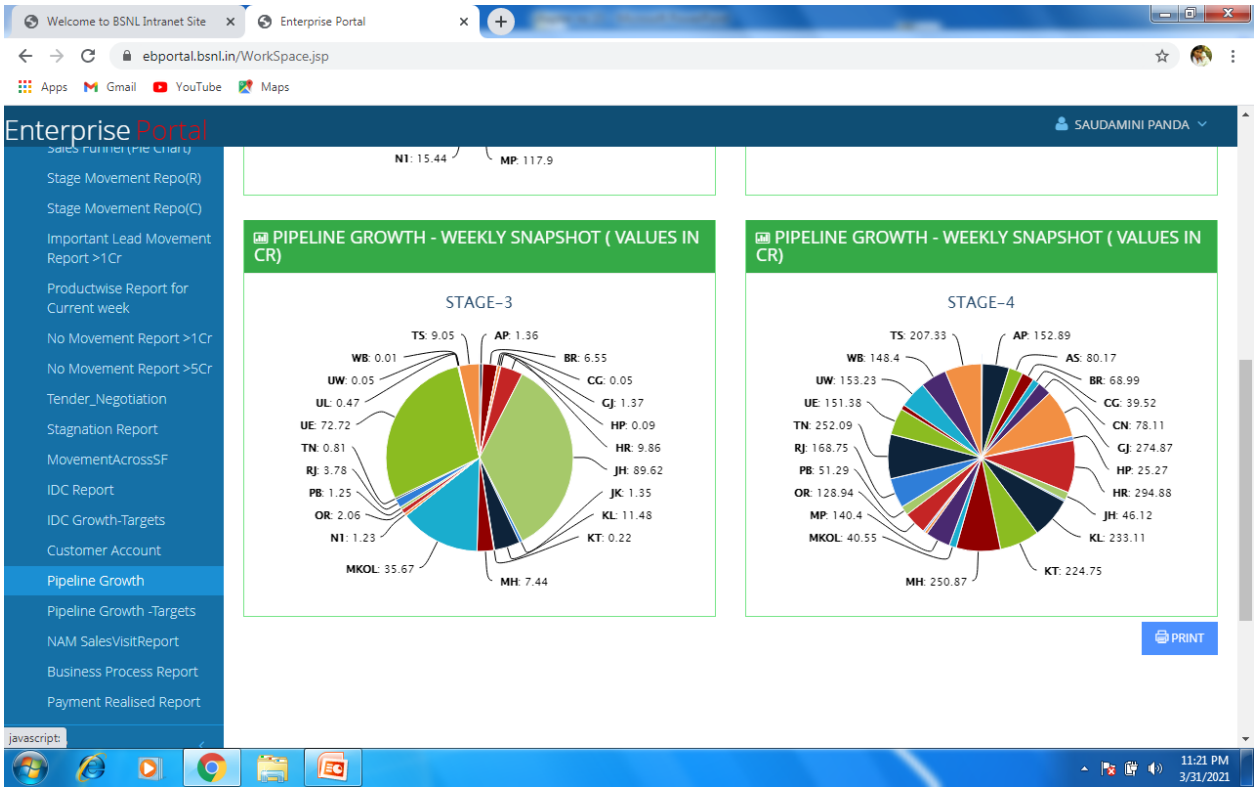
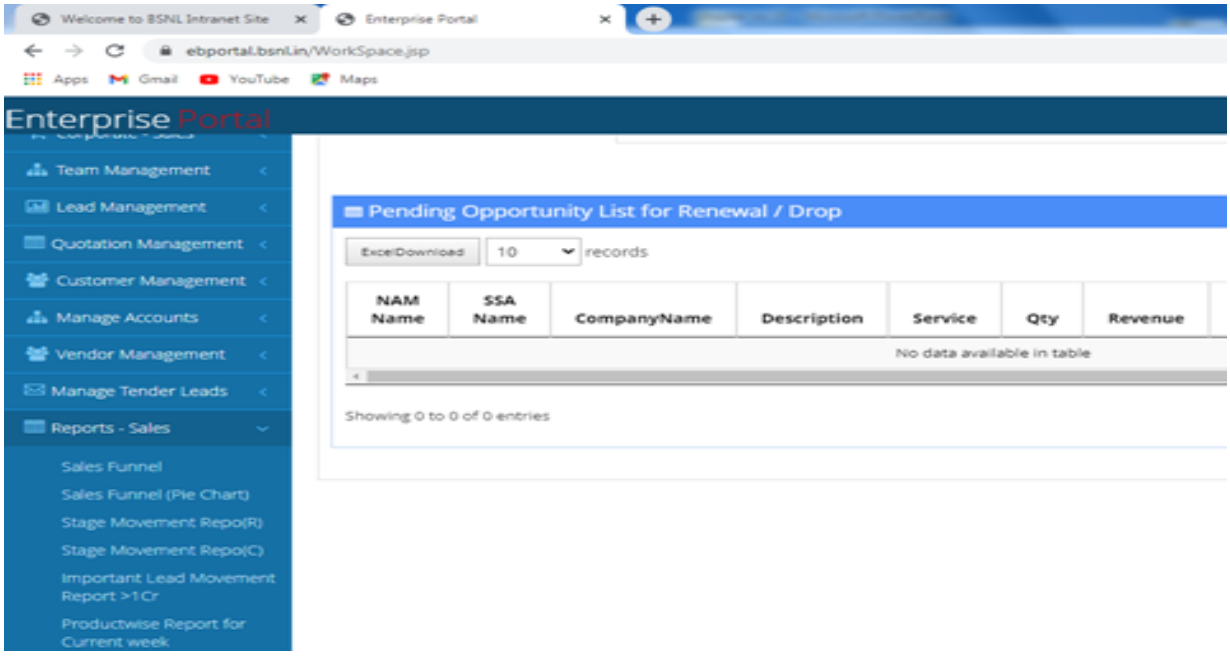
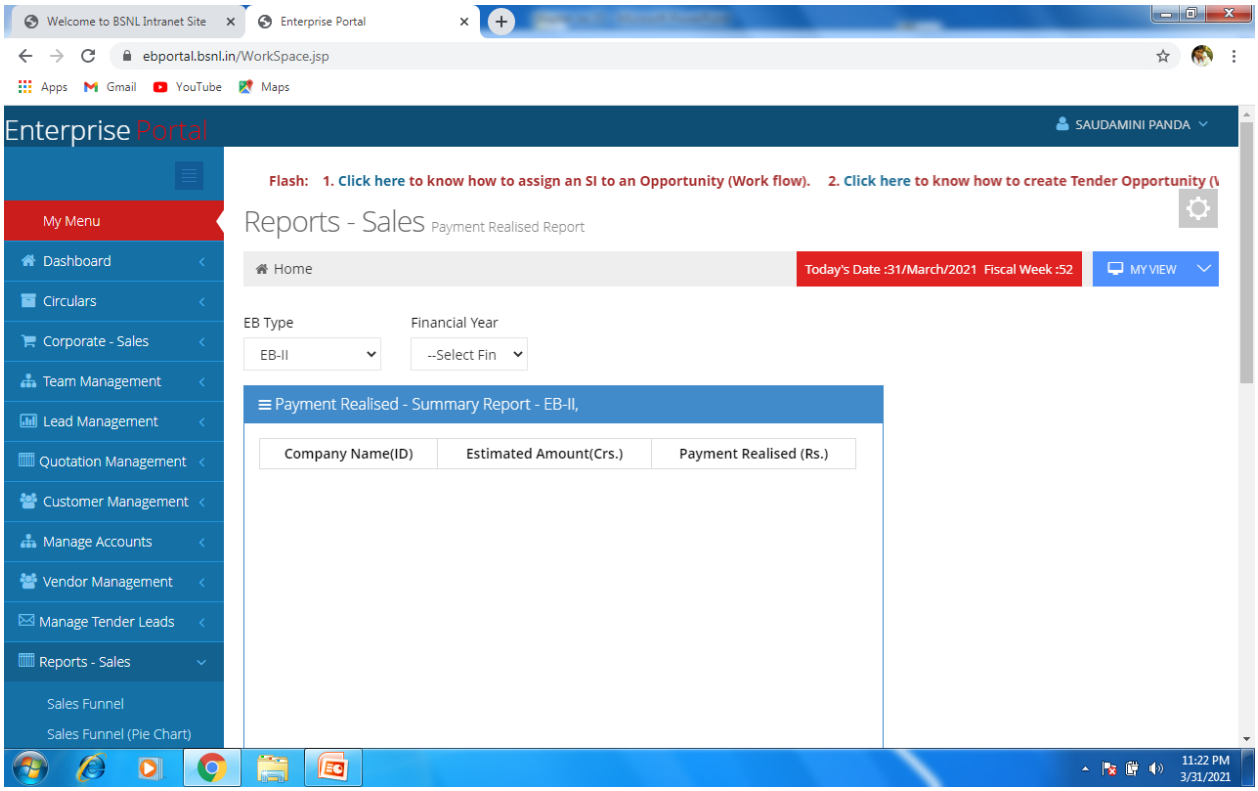
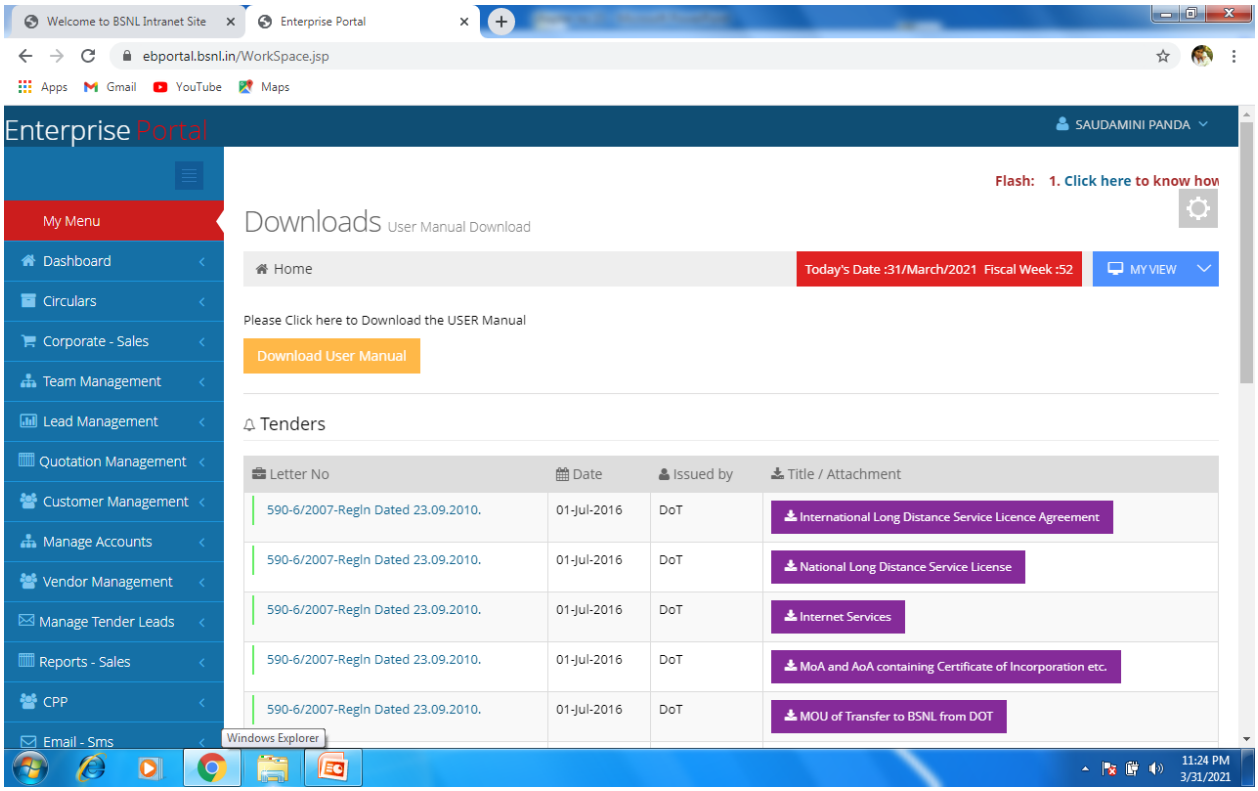
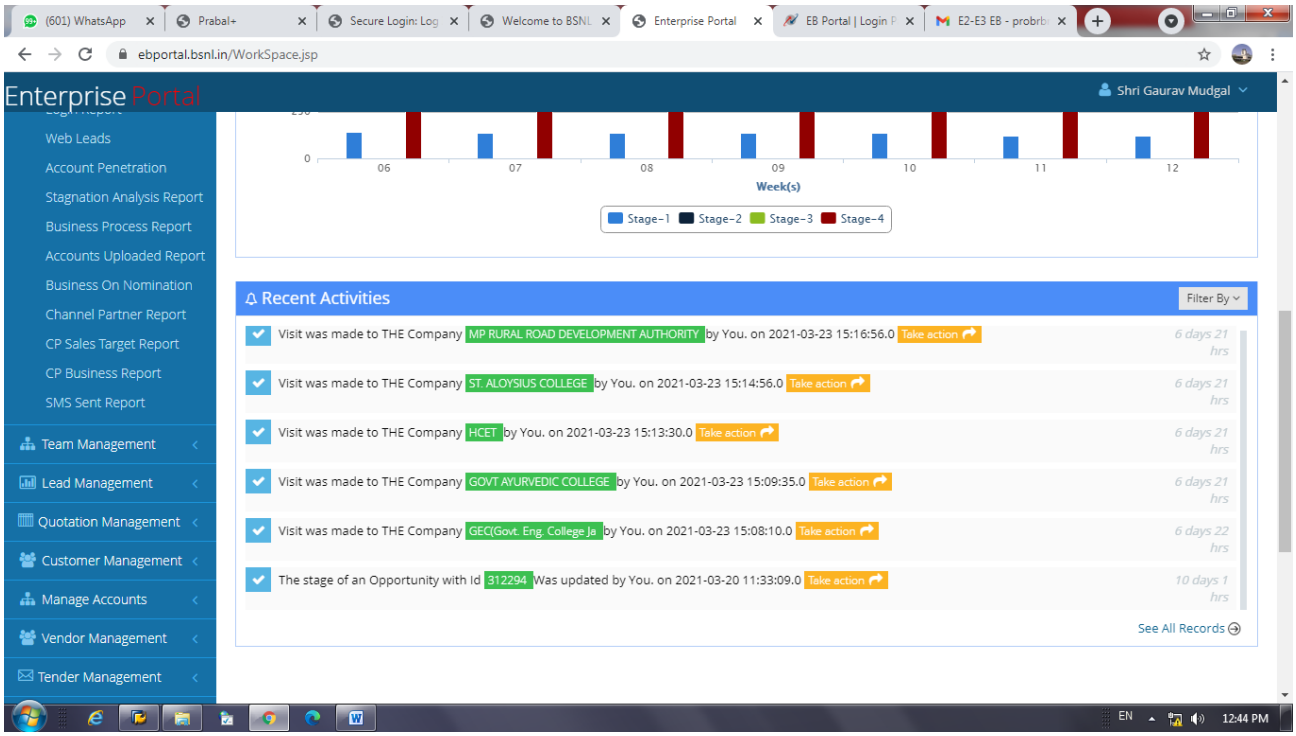
Maps
Enterprise Portal
SAUDAMINI PANDA
Dashboard
Circulars
Corporate - Sales
Team Management
Lead Management
Quotation Management
Customer Management
Manage Accounts
Vendor Management
Manage Tender Leads
Reports - Sales
Sales Funnel
Sales Funnel (Pie Chart)
Stage Movement Repo(R)
Stage Movement Repo(C)
Important Lead Movement
Home
Today's Date :31/March/2021 Fiscal Week :52
MY VIEW
EB Type *
EB-II(Gold)
PIPELINE GROWTH - WEEKLY SNAPSHOT (VALUES IN CR)
STAGE-1
TS: 117.58
AP: 23.49
WB: 94.27
AS: 31.62
UW: 83.06
CG: 48.9
UL: 50.64
CN: 59.47
UE: 220.09
GJ: 286.06
TN: 88.71
HP: 16.56
RJ: 9.53
HR: 102.44
PB: 51.29
KL: 94.02
OR: 83.49
KT: 69.1
N2: 2.21
MH: 24.67
N1: 15.44
MP: 117.9
PIPELINE GROWTH - WEEKLY SNAPSHOT (VALUES IN CR)
STAGE-2
TS: 15.08
CN: 58.66
WB: 6.86
GJ: 5.6
UW: 0.06
HR: 3.86
UL: 0
JH: 14.08
UE: 7.07
KL: 13.27
KT: 0.88
MH: 1.38
MKOL: 8.96
OR: 7.05
TN: 159.68
PB: 1.23
RJ: 2.14
PIPELINE GROWTH - WEEKLY SNAPSHOT (VALUES IN CR)
PIPELINE GROWTH - WEEKLY SNAPSHOT (VALUES IN CR)
11:19 PM
3/31/2021


Welcome to BSNL Intranet Site
Enterprise Portal
ebportal.bsnl.in/WorkSpace.jsp
Apps
Gmail
YouTube
Maps
Enterprise Portal
SAUDAMINI PANDA
Stage Movement Repo(R)
Stage Movement Repo(C)
Important Lead Movement Report >1Cr
Productwise Report for Current week
No Movement Report >1Cr
No Movement Report >5Cr
Tender_Negotiation
Stagnation Report
MovementAcrossSF
IDC Report
IDC Growth-Targets
Customer Account
Pipeline Growth
Pipeline Growth -Targets
NAM SalesVisitReport
Business Process Report
Payment Realised Report
N1: 15.44
MP: 117.9
PIPELINE GROWTH - WEEKLY SNAPSHOT (VALUES IN CR)
STAGE-3
TS: 9.05
AP: 1.36
WB: 0.01
BR: 6.55
UW: 0.05
CG: 0.05
UL: 0.47
GJ: 1.37
UE: 72.72
HP: 0.09
TN: 0.81
HR: 9.86
RJ: 3.78
JH: 89.62
PB: 1.25
JK: 1.35
OR: 2.06
KL: 11.48
N1: 1.23
KT: 0.22
MKOL: 35.67
MH: 7.44
PIPELINE GROWTH - WEEKLY SNAPSHOT (VALUES IN CR)
STAGE-4
TS: 207.33
AP: 152.89
WB: 148.4
AS: 80.17
UW: 153.23
BR: 68.99
UE: 151.38
CG: 39.52
TN: 252.09
CN: 78.11
RJ: 168.75
GJ: 274.87
PB: 51.29
HP: 25.27
OR: 128.94
HR: 294.88
MP: 140.4
JH: 46.12
MKOL: 40.55
KL: 233.11
MH: 250.87
KT: 224.75
PRINT
javascript:
11:21 PM
3/31/2021


Welcome to BSNL Intranet Site
Enterprise Portal
ebportal.bsnl.in/WorkSpace.jsp
Apps
Gmail
YouTube
Maps
Enterprise Portal
Team Management
Lead Management
Quotation Management
Customer Management
Manage Accounts
Vendor Management
Manage Tender Leads
Reports - Sales
Sales Funnel
Sales Funnel (Pie Chart)
Stage Movement Repo(R)
Stage Movement Repo(C)
Important Lead Movement Report >1Cr
Productwise Report for Current week
Pending Opportunity List for Renewal / Drop
ExcelDownload
10
records
NAM Name
SSA Name
CompanyName
Description
Service
Qty
Revenue
No data available in table
Showing 0 to 0 of 0 entries


Welcome to BSNL Intranet Site
Enterprise Portal
ebportal.bsnl.in/WorkSpace.jsp
Apps
Gmail
YouTube
Maps
Enterprise Portal
SAUDAMINI PANDA
Flash: 1. Click here to know how to assign an SI to an Opportunity (Work flow). 2. Click here to know how to create Tender Opportunity (
My Menu
Dashboard
Circulars
Corporate - Sales
Team Management
Lead Management
Quotation Management
Customer Management
Manage Accounts
Vendor Management
Manage Tender Leads
Reports - Sales
Sales Funnel
Sales Funnel (Pie Chart)
Reports - Sales
Payment Realised Report
Home
Today's Date :31/March/2021 Fiscal Week :52
MY VIEW
EB Type
EB-II
Financial Year
--Select Fin
Payment Realised - Summary Report - EB-II,
Company Name(ID)
Estimated Amount(Crs.)
Payment Realised (Rs.)
11:22 PM
3/31/2021

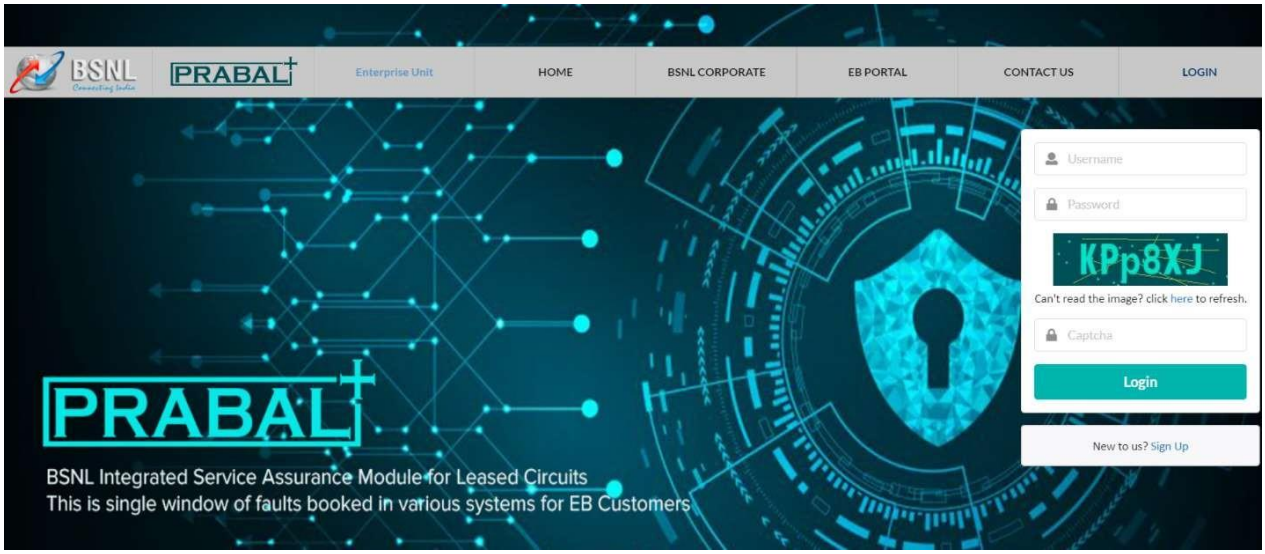

Welcome to BSNL Intranet Site
Enterprise Portal
ebportal.bsnl.in/WorkSpace.jsp
Apps
Gmail
YouTube
Maps
Enterprise Portal
SAUDAMINI PANDA
Flash: 1. Click here to know how
My Menu
Dashboard
Circulars
Corporate - Sales
Team Management
Lead Management
Quotation Management
Customer Management
Manage Accounts
Vendor Management
Manage Tender Leads
Reports - Sales
CPP
Email - Sms
Downloads
User Manual Download
Home
Today's Date :31/March/2021 Fiscal Week :52
MY VIEW
Please Click here to Download the USER Manual
Download User Manual
Tenders
Letter No
Date
Issued by
Title / Attachment
590-6/2007-Regln Dated 23.09.2010.
01-Jul-2016
DoT
International Long Distance Service Licence Agreement
590-6/2007-Regln Dated 23.09.2010.
01-Jul-2016
DoT
National Long Distance Service License
590-6/2007-Regln Dated 23.09.2010.
01-Jul-2016
DoT
Internet Services
590-6/2007-Regln Dated 23.09.2010.
01-Jul-2016
DoT
MoA and AoA containing Certificate of Incorporation etc.
590-6/2007-Regln Dated 23.09.2010.
01-Jul-2016
DoT
MOU of Transfer to BSNL from DOT
Windows Explorer
11:24 PM
3/31/2021


ebportal.bsnl.in/WorkSpace.jsp
Enterprise Portal
Shri Gaurav Mudgal
Web Leads
Account Penetration
Stagnation Analysis Report
Business Process Report
Accounts Uploaded Report
Business On Nomination
Channel Partner Report
CP Sales Target Report
CP Business Report
SMS Sent Report
Team Management
Lead Management
Quotation Management
Customer Management
Manage Accounts
Vendor Management
Tender Management
Week(s)
Stage-1 Stage-2 Stage-3 Stage-4
Recent Activities
Filter By
Visit was made to THE Company MP RURAL ROAD DEVELOPMENT AUTHORITY by You. on 2021-03-23 15:16:56.0 Take action
Visit was made to THE Company ST. ALOYSIUS COLLEGE by You. on 2021-03-23 15:14:56.0 Take action
Visit was made to THE Company HCET by You. on 2021-03-23 15:13:30.0 Take action
Visit was made to THE Company GOVT AYURVEDIC COLLEGE by You. on 2021-03-23 15:09:35.0 Take action
Visit was made to THE Company GEC(Govt. Eng. College Ja by You. on 2021-03-23 15:08:10.0 Take action
The stage of an Opportunity with Id 312294 Was updated by You. on 2021-03-20 11:33:09.0 Take action
See All Records
12:44 PM

PRABAL+ **BSNL Enterprise Unit**

15. 7 Introduction

Service Delivery and Service Assurance are the two main pillars of Enterprise Business in BSNL. Service Assurance plays key role in retaining EB customers in today's competitive market and improves revenue collections. Prabalplus is an in-house software, fully developed by BSNL team that provides integrated fault escalation mechanism for all faults, irrespective of the service availed by the enterprise customer. As part of new initiatives from Director(Enterprise) to overcome existing challenges and to provide single window approach for all the faults escalation, complete information to field units on leased circuits is incorporated in Prabalplus software. This software is a single window for service assurance to various Enterprise Services like MPLS, Point to Point, VSAT, Dark Fibre etc,. It consolidates faults booked in various platforms like Remedy, CDR, SBI, Ku Band etc and provides dash board based on user scope and gives quick view to management on the progress of rectification along with various useful information on the customer profile, type and pendency of faults at Exchange level, BA/SSA level and Circle Level. Faults are categorized as per priority, Project, Circle/SSA wise and service wise. Prabal plus is a web based application and can be easily accessible from any PC, mobile computing device or browser-based systems.



This Prabal plus software is secured, modular and expandable to cater to complete enterprise customers covering all circles in BSNL. Some of the key features are as below:-

1. Single window to monitor the fault tickets booked in various systems.
2. Direct and immediate escalation to field units for early restoration of faults.

3. Key information on links to field units for faster resolution of faults.
4. Tag key projects with Customer SLA's for special attention.
5. Prioritizing faults based on the Band Width, QoS and SLAs of customers.
6. SLA Reports to calculate Uptime of the link based on fault tickets.
7. Vendor Performance Monitoring by assigning tickets to the maintenance vendor.
8. Integrated with Mobile Handset based Telegram app to support field units.
9. Ease of tracking for the management to monitor the performance of field units.
10. Automatic SMS based escalation feature to field and Nodal units to act immediately.
11. Flexibility to assign/ Escalate faults by EB Teams and Nodal LC teams.
12. Integrated testing tool for MPLS Circuits without depending on NOC.
13. Captures ETR/RFO of faults booked from field units.
14. Decentralized updating facility pertaining to their area to Field and EB Units.
15. Escalation from last mile to MPLS NOC for L1, L2, L3 support.
16. Link Fault history will be helpful to restore and analyze the repeat faults.
17. Interactive Chatbot called Ask Prabal+ available to field officers.

It is expected that adoption of this software will enable the field units in real time monitoring of the fault status and to improve the response times. Any suggestions for the improvement of the software and features from the field units are most welcome.

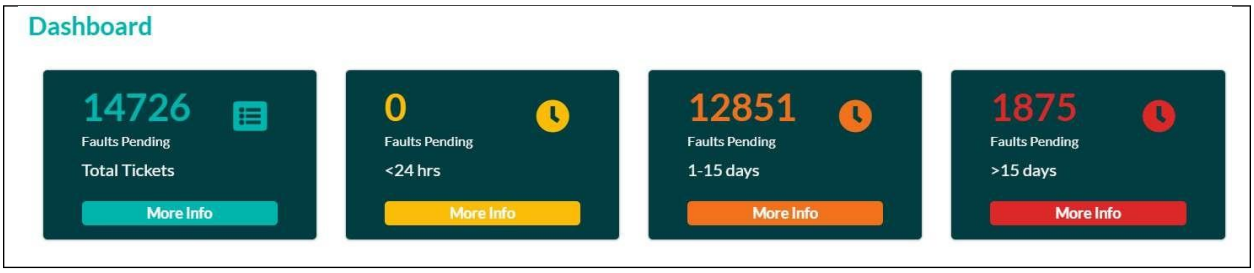
Getting Started -Signing In-

Prabalplus is hosted in public domain '**www.lcprabal.bsnl.co.in**'. The first page is login page, by default the username is set as mobile number and the same mobile number is used for authentication and escalation of Leased Circuits faults. Enhanced security feature is enabled with CAPTCHA to avoid bots and limit it to genuine users. The main menu provides, the user with the access allowed as per the role based access privilege provided. Horizontal navigation menu provides Dashboard, Profile and logout. Vertical Navigation menu provides:

Prabal+ ▸ Links ▸ Tickets ▸ Customer ▸ Reports ▸ Manage	**Links :** All Links, Search **Tickets :** All Tickets, My Tickets, Tickets History **Customer :** View Customers **Reports:** Fault Summary, Reason Pendency Report, Working Summary Report, Customer Wise Faults, Circle wise faults, SSA Wise Faults, Priority wise faults **Manage :** Users, Teams/Groups

15.7.1 Dashboard

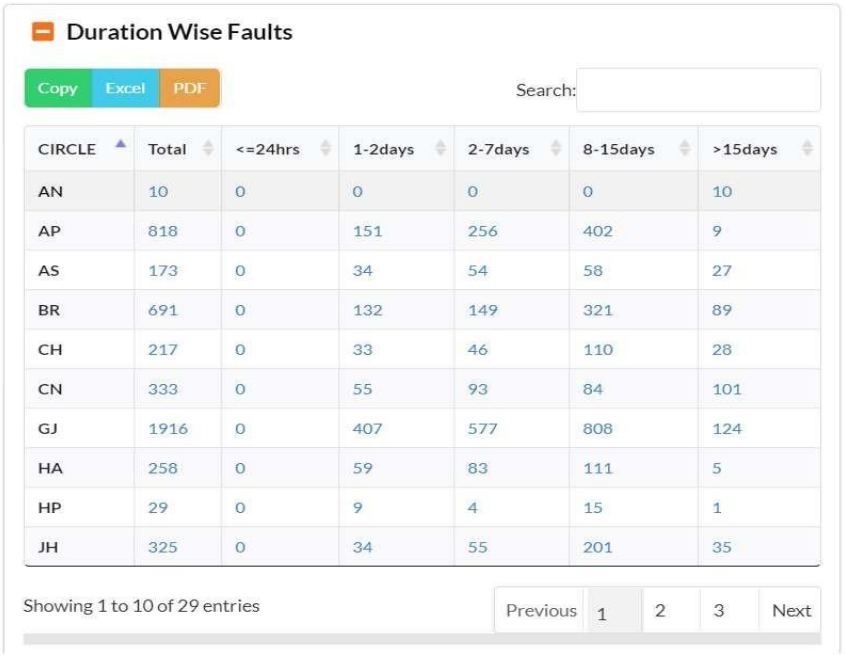
Prabalplus dashboard provides the summary view of the faults within the scope of the user. If a user with the scope of PAN India like NOC, BSNL CO logs in, the total faults will be shownwhereas for a circle user, the faults within the circle will be shown and so on.



The dashboard categorizes the faults as per duration of the faults and shows the total faults, faults with duration less than 24 hours, faults with duration between 1 day to 15 days and also faults with duration of more than 15 days. The duration is a global setting and the fault dashboard will give a quick indication of the faults in the scope of the user.

Dashboard page also provides summarized views of the faults as per project(Customer), Circle/SSA wise faults show duration wise(default) and display is also possible in other

criterion viz. as per Priority of the fault and service wise faults etc,.



Duration Wise Faults

Copy Excel PDF Search:

CIRCLE	Total	<=24hrs	1-2days	2-7days	8-15days	>15days
AN	10	0	0	0	0	10
AP	818	0	151	256	402	9
AS	173	0	34	54	58	27
BR	691	0	132	149	321	89
CH	217	0	33	46	110	28
CN	333	0	55	93	84	101
GJ	1916	0	407	577	808	124
HA	258	0	59	83	111	5
HP	29	0	9	4	15	1
JH	325	0	34	55	201	35

Showing 1 to 10 of 29 entries Previous 1 2 3 Next

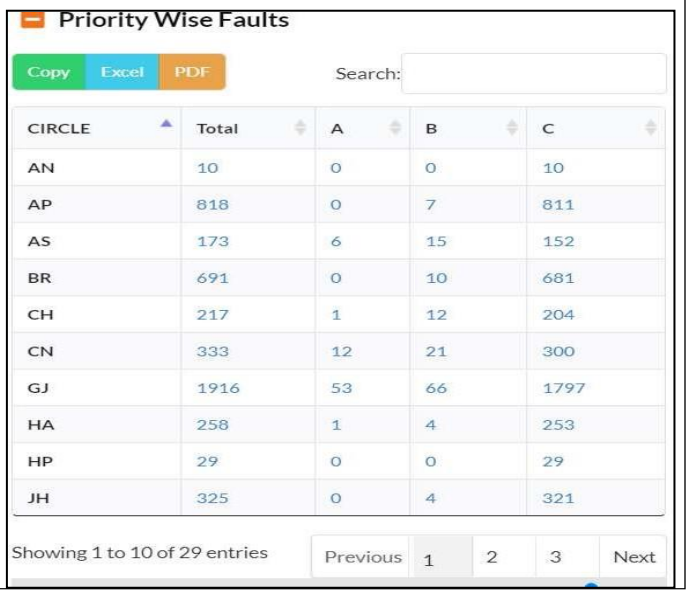
The circle wise/ SSA wise total faults are shown and they are split into the various granularity of duration viz.,
<24 hours,
1-2 days,
2-7 days,
8-15 days and more than 15days.

This will enable the users to give critical attention to the faults spilling over tohigher duration.

Circle/SSA Priority wise faults

The links are allotted priority based on rules or as per the priority assigned by LC coordinators depending upon the criticality of the issue.

Priority of the links are classified as Priority A, B and C. Priority A being the most critical faults. A link priorityis automatically assigned as per the bandwidth of the link, Importance of the project.

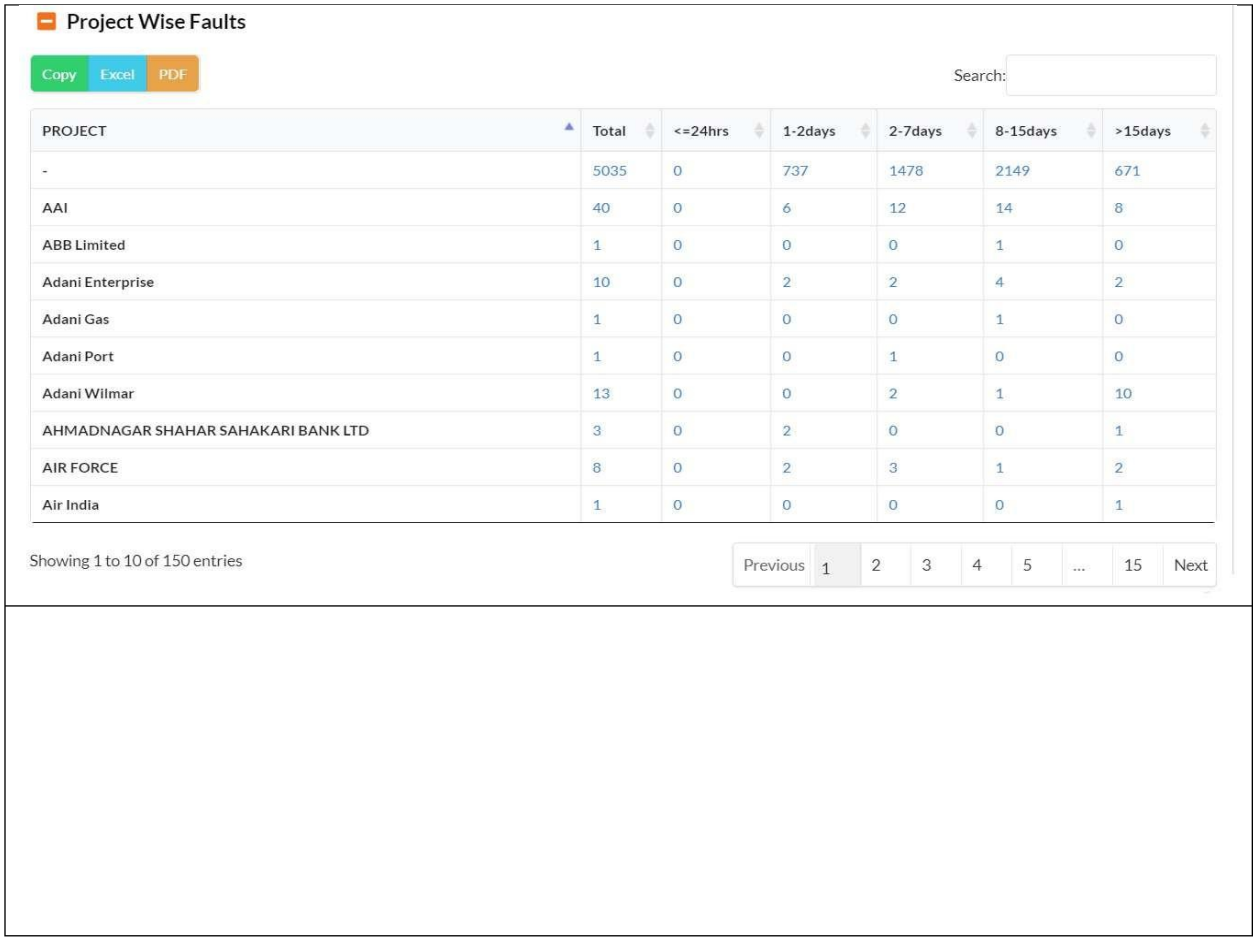


Priority Wise Faults

Copy Excel PDF Search:

CIRCLE	Total	A	B	C
AN	10	0	0	10
AP	818	0	7	811
AS	173	6	15	152
BR	691	0	10	681
CH	217	1	12	204
CN	333	12	21	300
GJ	1916	53	66	1797
HA	258	1	4	253
HP	29	0	0	29
JH	325	0	4	321

Showing 1 to 10 of 29 entries Previous 1 2 3 Next



Project Wise Faults

Copy Excel PDF

Search:

PROJECT	Total	<=24hrs	1-2days	2-7days	8-15days	>15days
-	5035	0	737	1478	2149	671
AAI	40	0	6	12	14	8
ABB Limited	1	0	0	0	1	0
Adani Enterprise	10	0	2	2	4	2
Adani Gas	1	0	0	0	1	0
Adani Port	1	0	0	1	0	0
Adani Wilmar	13	0	0	2	1	10
AHMADNAGAR SHAHAR SAHAKARI BANK LTD	3	0	2	0	0	1
AIR FORCE	8	0	2	3	1	2
Air India	1	0	0	0	0	1

Showing 1 to 10 of 150 entries

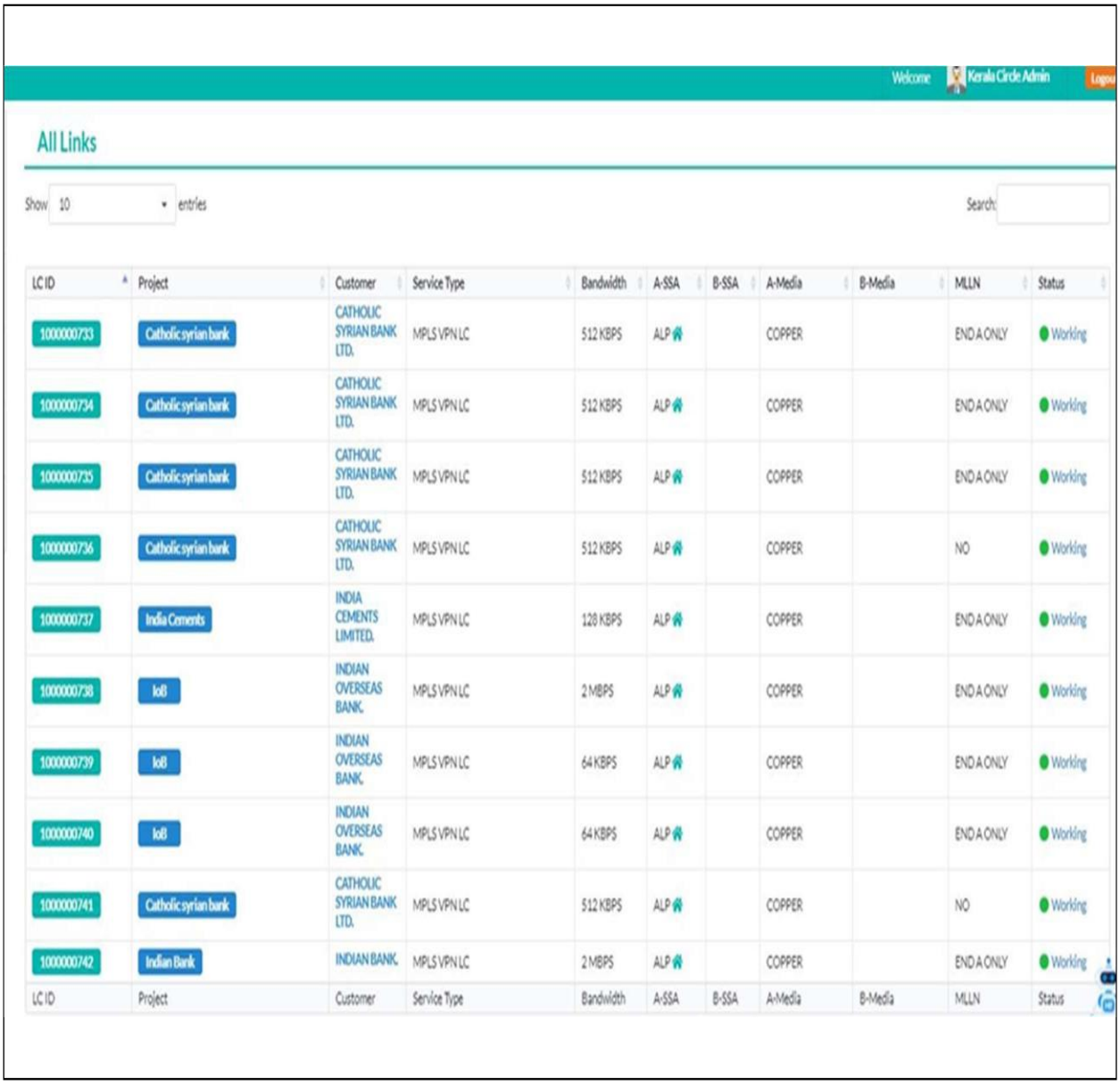
Previous 1 2 3 4 5 ... 15 Next

The user can see the faults here, classified as per the customer and the customer faults categorized as per the duration of the fault. The user can give his attention to any particular customer fault with this facility in the dashboard. As the faults are also classified as per the duration and the user can give critical care to long pending faults of the customer.

Note: *All the dash board views have the feature of downloading the dashboard view table as Excel or PDF or copy it to the clipboard. All fields in the dashboard can be sorted. The recordsin the table can be searched.*

15.8 Leased Circuits Management Module

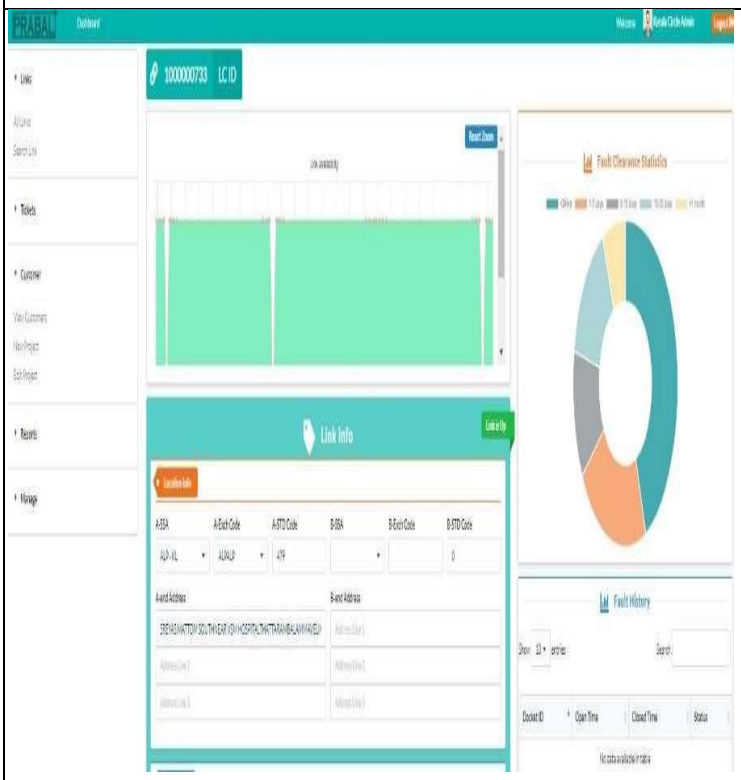
The Leased Circuits (LC) information and its details are extracted from external systems such as CDR-CRM, CDR-Clarity, BMAP, BI Reports, Remedy and VSAT that are presently working for different domains. The extracted data is processed and correlated automatically by Data Lake Mediation engine of Prabalplus. The processed data contains the LC commercial information such as Customer Name, LC Id, Customer Account No, MoU Id, Billing SSA, Billing Account No, Address, etc. and service information details like Service Type, Bandwidth, Media, WANIP, Modem Details, Class of Service, etc. Any new links addition, link upgradation/change and link closure will be updated in Prabalplus database automatically. The link will be grouped and will be made available to concern Circle/ SSA/ Exchange/NOCteams based on its Customer Account/End-A and End-B information/Service Type, etc. Theuser can see all the links belonging to his scope in All Links menu.



LC ID	Project	Customer	Service Type	Bandwidth	A-SSA	B-SSA	A-Media	B-Media	MLLN	Status
1000000733	Catholic syrian bank	CATHOLIC SYRIAN BANK LTD.	MPLS VPN LC	512 KBPS	ALP		COPPER		END A ONLY	Working
1000000734	Catholic syrian bank	CATHOLIC SYRIAN BANK LTD.	MPLS VPN LC	512 KBPS	ALP		COPPER		END A ONLY	Working
1000000735	Catholic syrian bank	CATHOLIC SYRIAN BANK LTD.	MPLS VPN LC	512 KBPS	ALP		COPPER		END A ONLY	Working
1000000736	Catholic syrian bank	CATHOLIC SYRIAN BANK LTD.	MPLS VPN LC	512 KBPS	ALP		COPPER		NO	Working
1000000737	India Cements	INDIA CEMENTS LIMITED.	MPLS VPN LC	128 KBPS	ALP		COPPER		END A ONLY	Working
1000000738	IoB	INDIAN OVERSEAS BANK.	MPLS VPN LC	2 MBPS	ALP		COPPER		END A ONLY	Working
1000000739	IoB	INDIAN OVERSEAS BANK.	MPLS VPN LC	64 KBPS	ALP		COPPER		END A ONLY	Working
1000000740	IoB	INDIAN OVERSEAS BANK.	MPLS VPN LC	64 KBPS	ALP		COPPER		END A ONLY	Working
1000000741	Catholic syrian bank	CATHOLIC SYRIAN BANK LTD.	MPLS VPN LC	512 KBPS	ALP		COPPER		NO	Working
1000000742	Indian Bank	INDIAN BANK.	MPLS VPN LC	2 MBPS	ALP		COPPER		END A ONLY	Working
LC ID	Project	Customer	Service Type	Bandwidth	A-SSA	B-SSA	A-Media	B-Media	MLLN	Status

Leased Circuits can be searched under 'Search Link Menu'. Various search options are available based on LC Id, Service Type, Media Type, MLLN Type and Circle, etc. It will be helpful for the user to identify the link quickly based on its requirement. The details of the link can be viewed by clicking the corresponding LC Id. In the link details, the users can get various information like:

(a) Graphical Link availability report
(b) Link fault clearance statistics
(c) Link fault history
(d) Link service information
(e) Link location information
(f) Link Customer information.

Leased Circuit master details	Leased Circuit Service Details
	
The Circle and SSA Coordinators can edit the basic information of the links such as End-A Exchange/SSA, End-B Exchange/SSA, Priority of the link, etc. SSA Local lead Maintenance teams can update service information related data such as Modem details, media type, MLLN, IP, VSAT Hub, Customer Contact Details, etc.	

15.9 LC Incident Management Module

The faults/tickets/dockets are extracted periodically from external source ticketing systems and loaded into data bases (Data lake) of Prabalplus software. These tickets are processed in the Prabalplus mediation server and a Prabalplus ticket is generated and assigned.

Information is polled & updated from

(a) CDR : Clarity Fault Management System (Pt 2 Pt)
(b) MPLS : Remedy (MPLS VPN L3/L2/ILL)
(c) VSAT : OS Ticket System (VSAT Links)
(d) SBI : Remedy (SBI MPLS Links)

Any new ticket/fault received from source systems will be assigned with unique 13-Charater Prabalplus incident number. The format of the Prabalplus Ticket details:

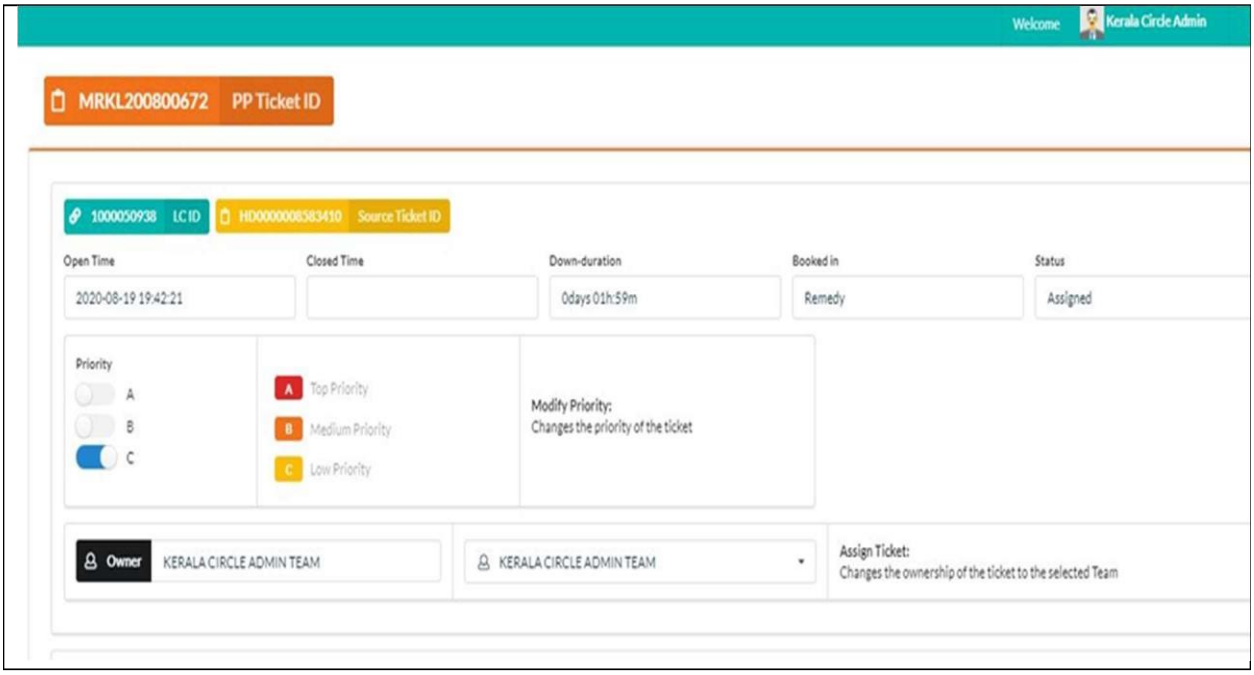
Position	Significance of Character	Remarks
1st	Service Type	I: Internet, P: P2P, M: MPLS, V: VSAT
2nd	Source Ticket System	R: BSNL Remedy, C: Clarity, S: SBI, V: VSAT
3rd and 4th	Circle Code	Ex. AP: Andhra Pradesh, GJ: Gujarat, TN: Tamilnadu
5th and 6th	2 Digit Year (Ticket Open Time)	Eg: 20
7th and 8th	2 Digit Month (Ticket Open Time)	Eg: 08 (For August)
9th to 13th	5 Digit Sequence number	Running Number

15.10 Ticket Flow:

Prabalplus system is synchronized with external source ticketing systems periodically to fetch all the pending faults. Prabalplus will generate a ticket and map it to source ticket for new faults booked in the external systems. Prabalplus software regularly compares with the existing ticketing systems and status is updated based on pending and resolved status in line with ticket's life cycle. The new tickets are assigned to the exchange team based on Circle, SSA, End-A exchange mapped to the link.

- If only one exchange team is available, it will be mapped to the concerned team.
- If more than one exchange teams are available, it will be mapped with exact exchange group.
- If exact match exchange group is unavailable, then the least number of exchanges in that group will be assigned for the ticket.

In case of absence of team, the tickets are by default assigned to SSA coordinator/Circle coordinators, who are responsible for creation of SSA users and in absence of SSA coordinator the system will assign the ticket to Circle coordinator. The Circle coordinator can create further groups/teams and the tickets can be reassigned to concern teams accordingly. This module is user friendly and self-explanatory and gives circuit ID, WAN IP, exchange code, open time, priority, Address, work logs etc,. Priority of the ticket can be changed for each docket/link as below:



Prabalplus system gives all tickets **assigned** to particular user under 'My Tickets'. The user handing this docket will change the status of ticket to '**In Progress'.** Once the issue is resolved, user can move the ticket status to '**Restored'** by providing Reason for Outage (RFO). This ticket is compared with source ticketing system '**Pending at Source**', after ticket is closed at source ticketing system, Prabalplus ticket status is changed as '**Closed Status'** Additional information for field units and for Enterprise Customers is captured in the system so that at any point of time information can be obtained as below for dockets:

- **Reason For Pending (RFP),** Field staff handling this fault will update by selecting options from the dropdown menu.
- **Expected Time to Restore (ETR),** Field staff will enter information in work log, this information is useful to communicate to customers.
- **Reason For Outage (RFO)**, Field staff handling this fault will update reason for outage, this will identify reasons for frequent faults and to share information to Customers.

This information is useful to the Enterprise Business teams and EBCC agents to communicate to customers on enquiry of the status of docket/fault. Senior management can also intervene and take appropriate action to minimize duration and repetition of faults.

Transferring ticket: In case the end user decides to transfer and reassign the tickets to other exchange teams/vendor under the same SSA, the same can be done. Facility is available to make over the fault to SSA Transmission teams. For P2P links, first the incident ticket willbe with End-A team and after analysis the same can be reassigned to End-B by clicking Transfer button. Prabalplus system is capable of taking inputs from the source ticketing

systems like Remedy/CDR and update the same in Prabalplus, RFO will be default updated as 'No RFO received' after two days, however there is provision to field staff to enter exact RFO in Prabalplus.

Resolved Tickets: All the resolved tickets for a period of 30 days are displayed for the users, however the closed tickets older than 30 days will be available through search and filter option to field units. The RFO Provided by field units will be reflected in Reason pendency reports as (a) Duration wise reason pendency, (b) Priority wise reason pendency, (c) Project Wise reason pendency.

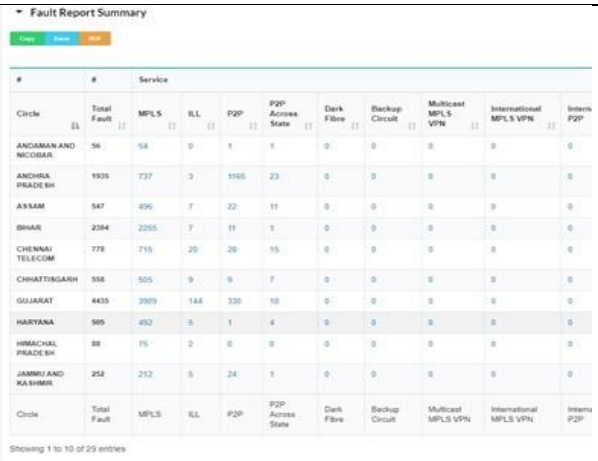
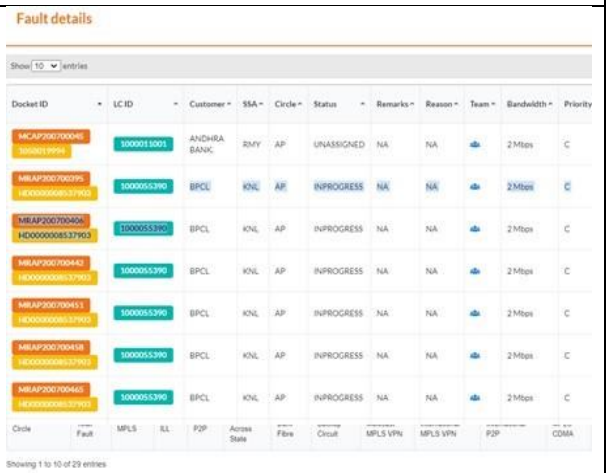
15.11 LC Reports Management

Comprehensive Leased Circuits Reports module of Prabalplus is designed keeping in view various levels of users in BSNL. This module provides near real time reports of the faults & status. All the reports are fetched from the distributed data bases of Prabalplus, which are cross joined and indexed for faster query outputs to give full information.

Types of Reports available in the Prabalplus		
Faults summary Report	Reason Pendency Report	Customer wise faults
Circle/SSA Wise faults	Priority wise faults	Working summary Report
These reports can be downloaded in Excel or PDF to local PC or can be copied to clipboard. Option is available to send to mobile phone on 'Telegram' app. Option to search and sort is available to provide matching results to the users.		

15.11.1 LC Fault Summary Report:

This Fault summary report provides all the faults under the user scope. Circle user can see all the faults with in Circle covering SSAs in circles, all India user can see faults of entire customers in BSNL of all the services provided, SSA user can see the faults in the domain of SSA. Further granularity of faults can be seen by the users.

Fault summary Report	Granularity of the faults
	

15.11.2 Reason for Pendency Report:

In some cases faults may be still not cleared and LC may not be restored due to various reasons. End user responsible for restoration of fault needs to select the reason for pendency of fault. Pendency of faults may be due to (a) Administrative reasons (b) CDR related(c) Customer side (e) Material requirement (f)TNF (g) Work in Progress from BSNL side (h) Vendor side pending.

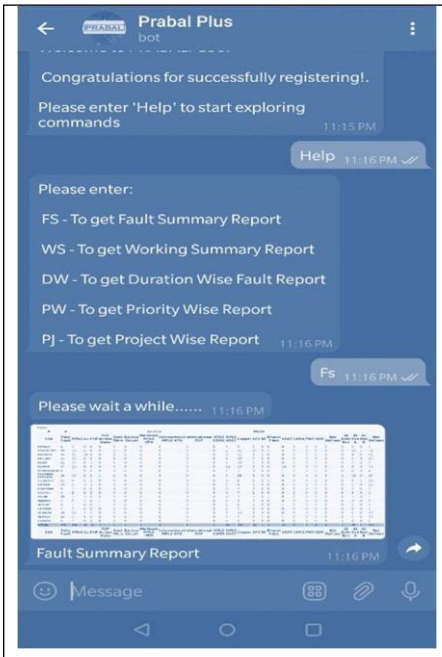
15.11.3 Working LC summary report:

Working circuit summary report is very much similar to the fault summary report. In this report the user can see the total working links in the circle/SSA. The working links will be further classified as per the type of service viz., MPLS, P2P, P2P across state, Dark fiber etc., and also the type of last mile media used for providing the service like copper, OF, RF, Bharat

Fiber, VSAT, CDMA, FWT and GSM. Links with not having last mile details are grouped as"**Not Defined**". The report also provides data of the links working through MLLN.

The working link details provides the basic details of the links of the service, media etc., and also provides bandwidth, A End, B End, whether link is working with MLLN and also the status of the link depending upon status of an open ticket.

15.11.4 Reports on Telegram (Mobile Handset):



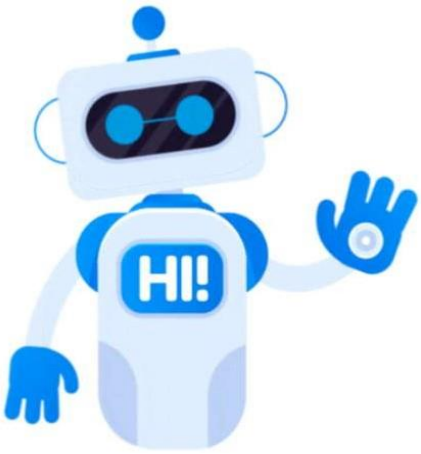
Telegram BOT is integrated with Prabalplus applications that run inside Telegram. Users can interact with Telegram bots named as Prabalplus bot by sending themmessages, commands and get required reports through Telegram. The user should be existing Telegram user and also a registered user in Prabalplus. After opening app from mobile, search for Prabalplus and interactive BOT will start in Telegram App.

The following commands can be used in Prabalplus BOT toget on line reports in mobile handset:

F S : Fault Summary
WS : Working link summary
DW : Duration wise fault
PW : Priority wise fault
PJ : Project wise fault

15.12 Ask Prabal (Intellegent Chatbot)

Ask Prabal is a scripted Chatbot application that operates on rule based intelligent analysis. This is having pre-trained knowledge and interactive machine to field officers to get most of the information instead of calling NOCs/Call Centers. Askprabal is capable of two way communication with the user and back end systems to provide required dynamic information like status of fault, QoS, BW etc.



Prabalplus Chatbot handles both Service Provisioning and Service Assurance related questions. It Extracts dynamic data from OSS&BSS systems, captures new questions asked and maintains separate DB for administrator to take action. Ask Prabal will greet the user by his name taken user details based on login, from the database. User inputs like wan-ip, circuit-id, remedy ticket number are validated for correct formats and if found invalid, user will be asked to enter valid inputs again. This tool is effective for field staff.

15.13 User Creation & Management

User management system has been implemented with role-based access control. The scope and privilege of the user depends upon the Group and Team the user belongs. A user with the scope of circle will be able to see only the links and faults pertaining to the circle. A BA/SSA scope user can view only links and faults pertaining to the BA/ SSA. The group to which the user belongs gives the scope of operation.

Groups: Group is used to define an administration area in the organization. Circle Group, SSA/BA group, NOC group, TX group, NAM, KAM etc. and the group will be managing operations in that area. Groups may contain sub-groups and are assigned levels to create theorganizational administrative hierarchy.

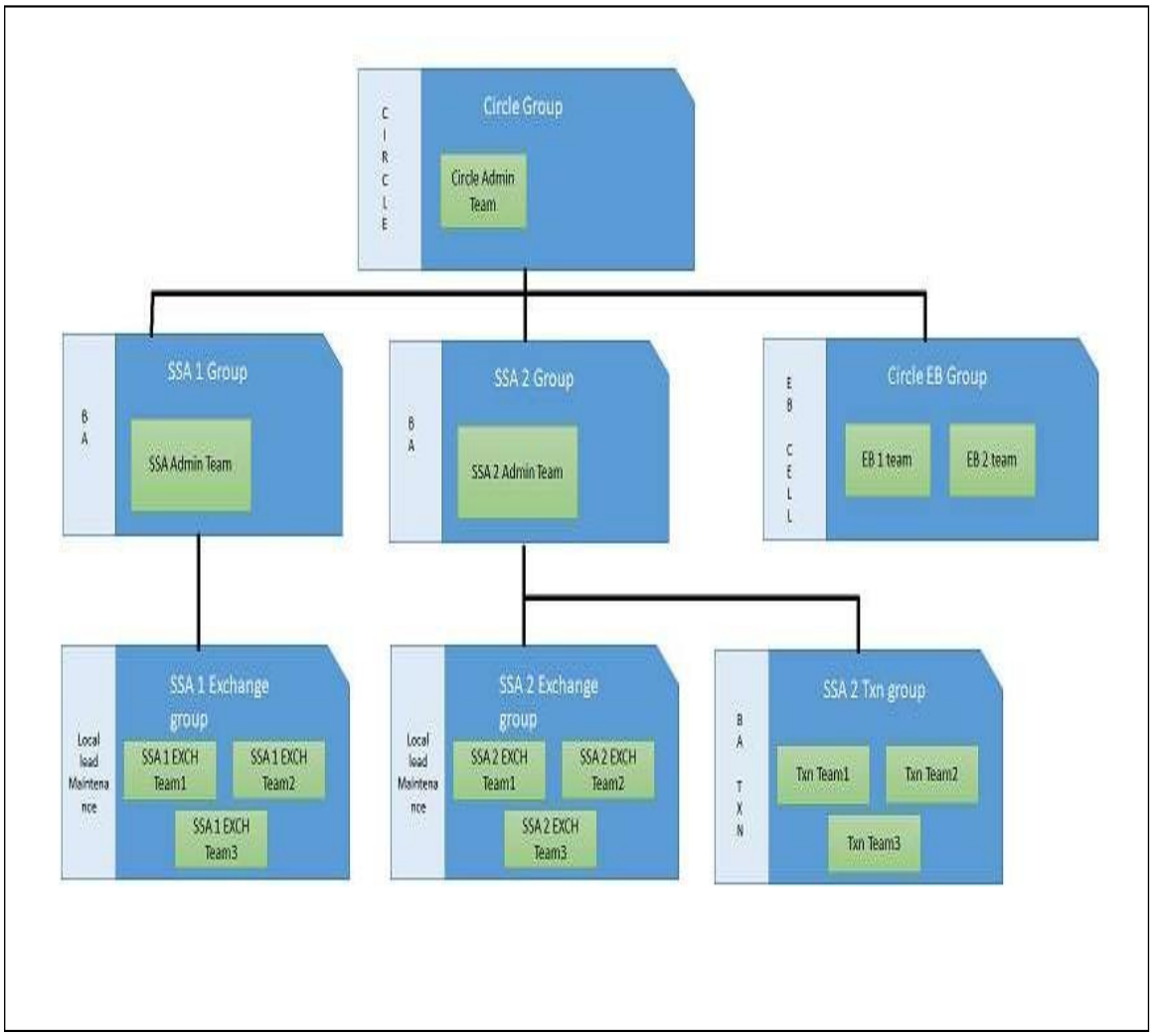
Teams: Team is defined as work area of the users attached to the team and the role of the users in restoring faults. Various teams are defined as ‘Coordinator’ who is taking care of un-

-assigned tickets in SSA and monitors progress with in SSA, BSNL Maintenance field teams responsible for restoration of faults eg., Exchange outdoor and indoor

staff, Vendor's third party team working for restoration of faults in the field.

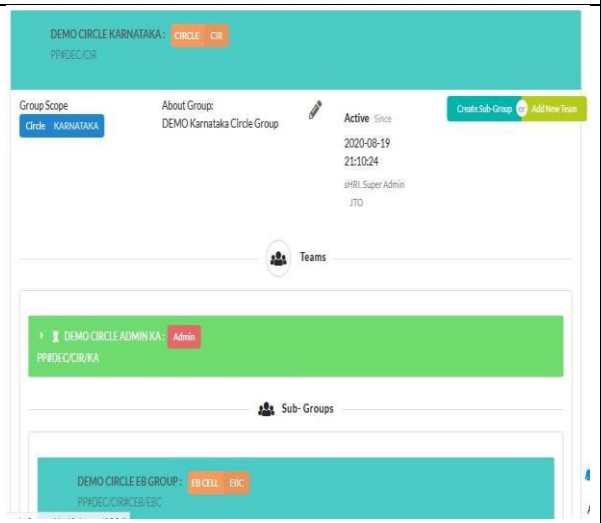
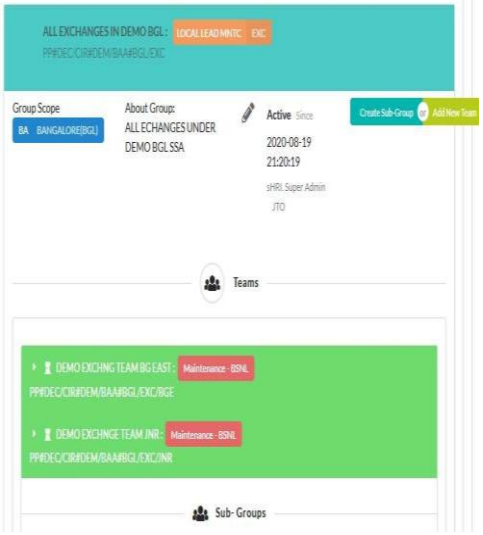
Users: Individual users are created with combination of Group and Team based on the roles defined to individual user. Mobile number is the username for the individual and circle administrator creates users based on their nature of work, Prabalplus role based access control system enables them to perform their roles and the user creation flow defined as:

Admin: First time when circle is boarded into Prabalplus platform, preconfigured groups are created in Circle level and SSA levels. Further groups need to be created by Circle admin to match their operational requirements, the recommended hierarchy at circle level is shown below:



(1) Create Groups Teams / Groups" option is available under Manage Menu. Existing Groups and teams are shown in nested boxes as per the hierarchy. Select the requiredlevel and provide a group name and code along with description of the

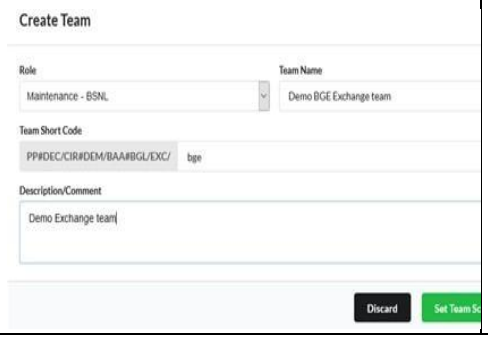
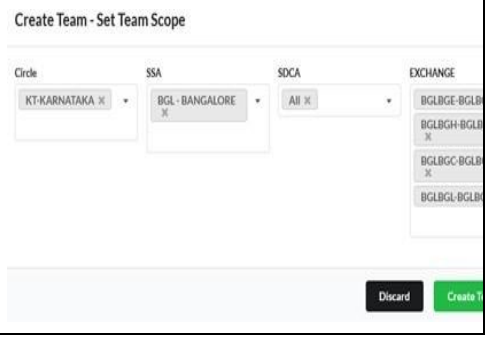
group.

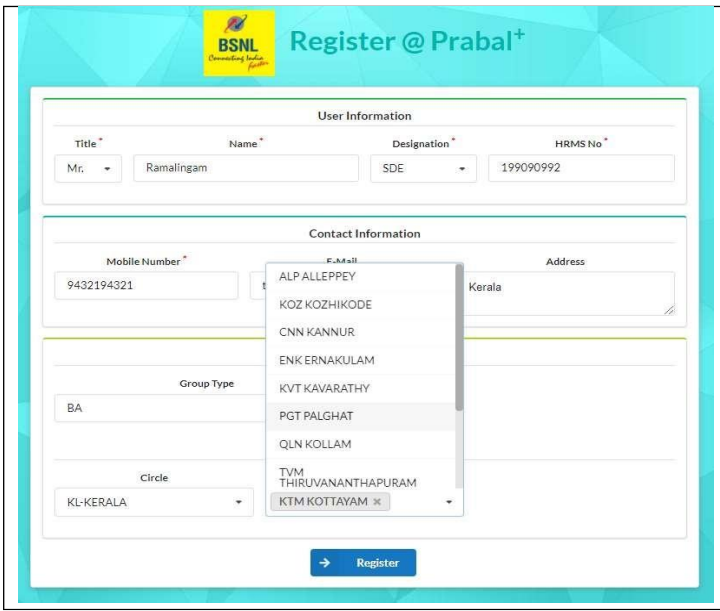
Nested groups as per hierarchy	Selection of group
	

On clicking ‘Set group scope’ options are available to set the scope for the group and as per the group type selected the options may vary. The options are available as drop down and at the last level, in this case the exchange, the user can select single exchange or multiple exchanges.

(2) Create Teams: A group can consist of one or more teams. New Team creation can be initiated by clicking ‘Add New Team’ button under the required Group. Administrator can select the required Role and provide a name to the team. This Name will be later used to assign to user. Team name should be unique and describe the team as there could be multiple teams that the Administrator selects while assigning the team to the user, if the teams are not distinct and descriptive it might cause confusion while assigning the user to the team.

Teams are to be created within the groups as per the requirements and scope of various users. Prabalplus supports user sign up request which will be forwarded to the Circle / SSA admins for approvals. This flow supports auto creation of teams as per the user requested scope, so this step may be skipped if required.

Create Team	Set Team Scope
	



New users in the field can sign up form which is available in log in page of www.lcprabal.bsnl.co.in.

Circle / SSA admin can validate credentials and approve this sign up form, alternately Admin can directly create Users by providing basic details like name and contact number and attach to the existing team.

(3) User Creation:

15.14 Prabalplus Support team

This document is prepared for internal use of BSNL employees to get started with Prabalplus software developed and deployed in BSNL. This software gives best in class support to field officers and to improve services to Enterprise Customers in BSNL.

Intended users:

(a) BSNL Corporate Office EB & LC units
(b) Circle Administrator/Coordinator
(c) SSA/BA Administrator/Coordinator

(d) Exchange officer in-charges
(e) Transmission in-charges
(f) Field officers and Field support Vendors

Requirements:

Standard Internet Browser like Google Chrome, Fire Fox, Internet Explorer. Mobile based Telegram: Mobile handset with Telegram app preinstalled.

"www.lcprabal.bsnl.co.in"	lcprabal.support@bsnl.co.in	Telegram:"**prabalplus bot**"

15.14.1 FAULT MANAGEMENT :

In Network Management, fault management is the set of functions that detect, isolate and correct malfunctions in a telecommunication network. Compensate for environmental changes and include maintaining and examining error logs, accepting and acting on error detection notifications,tracing and identifying faults.

Fault management involves a five step process:

1) Fault Detection

2) Fault Location

3) Restoration Service

4) Identification Of Root Cause Of Services

5) Problem Resolution

The fault should be detected as quickly as possible by the centralized management system about the same time as it is noticed.

Fault location involves identifying where the problem is located.

The restoration of services takes a higher priority over diagnosing the problem and fixing it.

15.15 CONCLUSION

The Enterprise Portal is a replacement of the current Excel based Reporting where the current software is used to enter the lead, Opportunity Data, generate Quotation, Service Orders and also keep track of the stages an opportunities are. The Enterprise Portal will utilize the user and unit id information stored in the database to limit the access to the information available for that user retaining the security and accessibility at various levels.

16 EB STRUCTURE IN BSNL AND ACCOUNT MANAGEMENT

16.1 LEARNING OBJECTIVE:

This lesson provides the insight into the Enterprise Business vertical of BSNL, Market size of Enterprise Business, Initiatives of BSNL for the special category of Enterprise Business customers, Roadmap and key growth areas of it.

16.2 ABOUT ENTERPRISE BUSINESS:

Aim of all business is to make more profit. To make profit two possibilities are selling high volume at less margin or low volume at high margin. Both approaches have its pros & cons. Companies usually adopt a mix of these approaches. To address both the retail market and the high volume Enterprise market BSNL has been structured into three business verticals namely, Consumer Mobility (CM), Consumer Fixed Access (CFA) both of which are focused on the retail market for wireless and wire-line telecom service products and Enterprise Business (EB) focused on generating high volume business by developing enterprise clients.

16.3 INTRODUCTION

India is currently the world's second-largest telecommunications market and has registered strong growth in the past decade and half. The Indian mobile economy is growing rapidly and is expected to contribute substantially to India's Gross Domestic Product (GDP).

The liberal and reformist policies of the Government of India have been instrumental along with strong consumer demand in the rapid growth in the Indian telecom sector. The government has enabled easy market access to telecom equipment and a fair and proactive regulatory framework that has ensured availability of telecom services to consumer at affordable prices. The deregulation of Foreign Direct Investment (FDI) norms has made the sector one of the fastest growing and a top five employment opportunity generator in the country.

16.3.1 MARKET SIZE

The Indian telecommunication services market will likely grow by 10.3 per cent year-on-year to reach US$ 103.9 billion by 2020

Driven by strong adoption of data consumption on handheld devices, the total mobile services market revenue in India is expected to touch US$ 37 billion in 2017.

Smartphone subscription in India is expected to increase four-fold to 810 million users by 2021, while the total smartphone traffic is expected to grow 15-fold to 4.5 exabytes (EB) per month by 2021.

India' has the second largest mobile subscriber base in the world. According to Telecom Regulatory Authority of India (TRAI), the total telecom subscriber base in December 2015 stood at 1.04 billion, out of which 1.01 billion were mobile subscribers and 25.52 million were wireline subscribers.

According to a study by GSMA, smartphones are expected to account for two out of every three mobile connections globally by 2020 making India the fourth largest smartphone market. Total number of Fourth-Generation (4G) enabled smartphone shipments in India stood at 13.9 million units in the quarter ending December 2015, which was more than 50 per cent of total shipments, thereby surpassing number of Third-Generation (3G) enabled smartphone shipments for the first time.

The broadband services user-base in India is expected to grow to 250 million connections by 2017, according to GSMA.

India added the highest number of net mobile phone subscriptions of 21 million during the fourth quarter of 2015.

International Data Corporation (IDC) predicts India to overtake US as the second-largest smartphone market globally by 2017 and to maintain high growth rate over the next few years as people switch to smartphones and gradually upgrade to 4G.

In spite of only 5 per cent increase in mobile connections in 2015, overall expenditure on mobile services in India is expected to increase to US$ 21.4 billion in 2015, led by 15 per cent growth in data services expenditure.

The Indian telecom sector is expected to generate four million direct and indirect jobs over the next five years according to estimates by Randstad India. The employment opportunities are expected to be created due to combination of government's efforts to increase penetration in rural areas and the rapid increase in smartphone sales and rising internet usage.

16.3.2 KEY GROWTH AREAS:

16.3.2.1 MANAGED NETWORK SERVICES

- Data Centers and Managed Network Services(MNS) key growth areas
- Experience Expertise and reliability valued by customers

DATA:

- MPLS VPN driving market growth
- Integrated "solutions" based selling is essential
- Trend towards customized product bundles for specific verticals(E.g. BFSI)
- Basic bandwidth to be commoditized
- Enterprise Mobility solutions (e.g. SFA)
- Reliability and competitive pricing is key

VOICE

- Mobile, Enterprise VoIP are growth drivers, fixed line voice is de-growing
- PRIs
- Mobile CUG
- Move towards Unified Communication Solutions, Managed voice and advanced voice services (e.g conferencing, Centrex etc.)

- Customers expect competitive pricing, & tailored plans tp help reduce their overall voice bill.

16.4 ASPIRATION OF BSNL FROM ENTERPRISE BUSINESS:

Growth in industrial and IT sectors in India during last few years has created new business opportunities in telecom sector.

- Enterprise customers are business customers with annual turnover of greater than Rs. 100 Crores
- The enterprise market is ~Rs 35,000 cr today, expected to grow to ~Rs. 60,000 cr in 5 years
- BSNL offers a wide range of products for this market
  Classified as voice, data and managed services
- Enterprise customers have moved from products to solutions
- BSNL will also have to move from products based selling to solutions based selling
- The enterprise market has three customer segments
- Each segment requires a distinct sales models
- Enterprise BU has been designed to house these models
- SD / SA structure for enterprise Gold / silver

BSNL's Transformation towards Enterprise Segment:

From		**To**
Product Focused	→	• *Solutions focused*
Soloed	→	*Converged*
Connectivity	→	*Services*
Legacy Products	→	*Next Generation Products*
"Customer Will Come"	→	*"Customer is King"*
XYZ Circle's Customer	→	*BSNL's Customer*
Reactive Order Booking	→	*Proactive BD*

16.5 CONCLUSION:

From this lesson trainee is able to understand the introduction of the Enterprise Business Vertical of BSNL, Market size of Enterprise Business, Initiatives of BSNL for the special category of Enterprise Business customers, Roadmap for the evaluation of Enterprise Business and key growth areas of this highly evolving business vertical of it.

16.6 ORGANIZATIONAL STRUCTURE OF BSNL FOR EB:

In order to leverage its widespread telecom network resources in India and to tap these business opportunities and to provide customized network solutions and services to its clients, BSNL decided in 2001 to set up BD cell in each circle and also at corporate office. GM & DGM posts were sanctioned to run these units.

In 2008, BD cell at corporate office was split thereby creating a new unit titled 'Enterprise Business' At circle level, earlier structure continued. In 2009, as part of massive restructuring under Project Shikhar, Director level post has been created for Enterprise & Whole Sale.

GM (Business Planning), GM (Enterprise Business), GM (ILD), GM (Lease circuit), GM (IT) and GM (Fin) report to Dir (E&WS) at BSNL HQ. A post of ED (core Network) have also been created and all project circles and maintenance regions have been brought under ED.

Also post of GM (EB-city) has been created in 4 big cities. All Circles now have GM (Enterprise) supported by DGM (Enterprise Sales) and DGM (Service Delivery/Service assurance.

Centralized National Account Managers (NAMs) organized by Industry Vertical. 5 to 10 Accounts are assigned to each NAM. They deal with Platinum Customer. High discounting flexibility with quick turnaround.

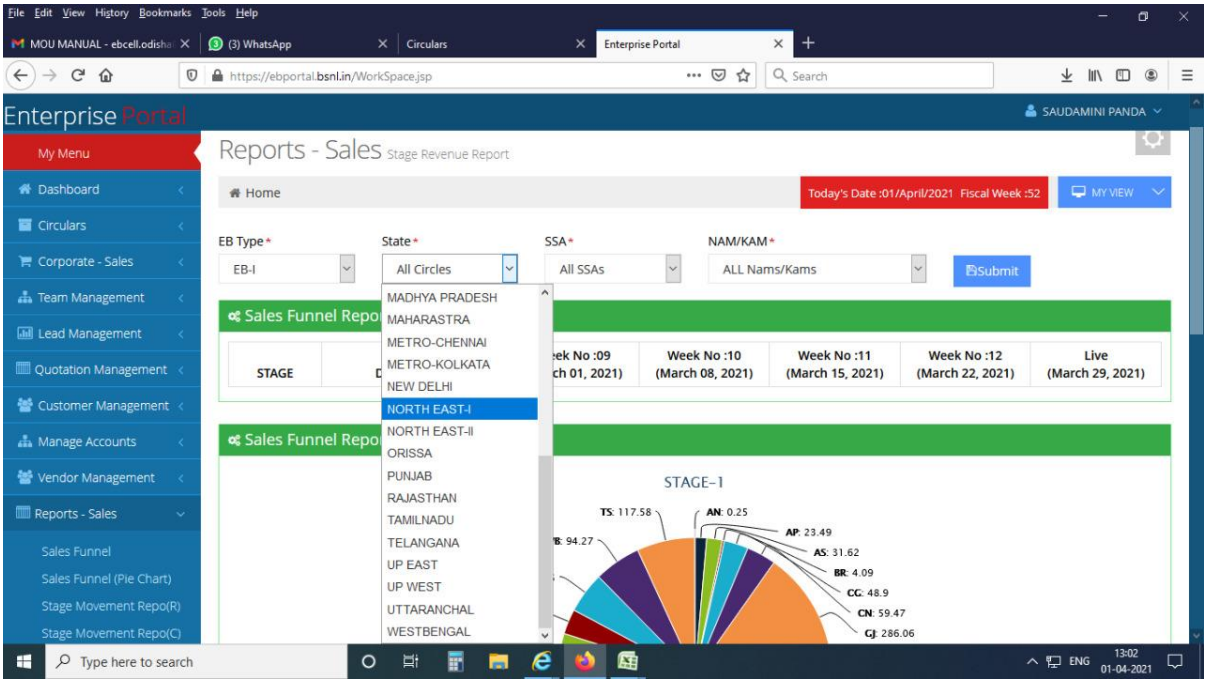
Circle based Key Account Mangers (KAMs). 25 to 75 accounts per KAM. They deal with Gold Customers.

Since the number of companies in Silver segment is very large, it is proposed that BSNL should use appropriate channel partners to ensure that sufficient attention is devoted to these accounts. Accounts are mapped to channel partners by geography and by their specializations.

16.7 WHAT IS EB-1 & EB-2

EB-1 & EB-2 Consists of following Telecom circles :

1) EB-1 ,are the EB platinum consists of following circle units :


Enterprise Portal
SAUDAMINI PANDA
My Menu
Reports - Sales Stage Revenue Report
Home
Today's Date :01/April/2021 Fiscal Week :52
MY VIEW
Dashboard
Circulars
Corporate - Sales
Team Management
Lead Management
Quotation Management
Customer Management
Manage Accounts
Vendor Management
Reports - Sales
Sales Funnel
Sales Funnel (Pie Chart)
Stage Movement Repo(R)
Stage Movement Repo(C)
EB Type*
EB-I
State*
All Circles
SSA*
All SSAs
NAM/KAM*
ALL Nams/Kams
Submit
MADHYA PRADESH
MAHARASTRA
METRO-CHENNAI
METRO-KOLKATA
NEW DELHI
NORTH EAST-I
NORTH EAST-II
ORISSA
PUNJAB
RAJASTHAN
TAMILNADU
TELANGANA
UP EAST
UP WEST
UTTARANCHAL
WESTBENGAL
STAGE
Week No :10 (March 08, 2021)
Week No :11 (March 15, 2021)
Week No :12 (March 22, 2021)
Live (March 29, 2021)
STAGE-1
TS: 117.58
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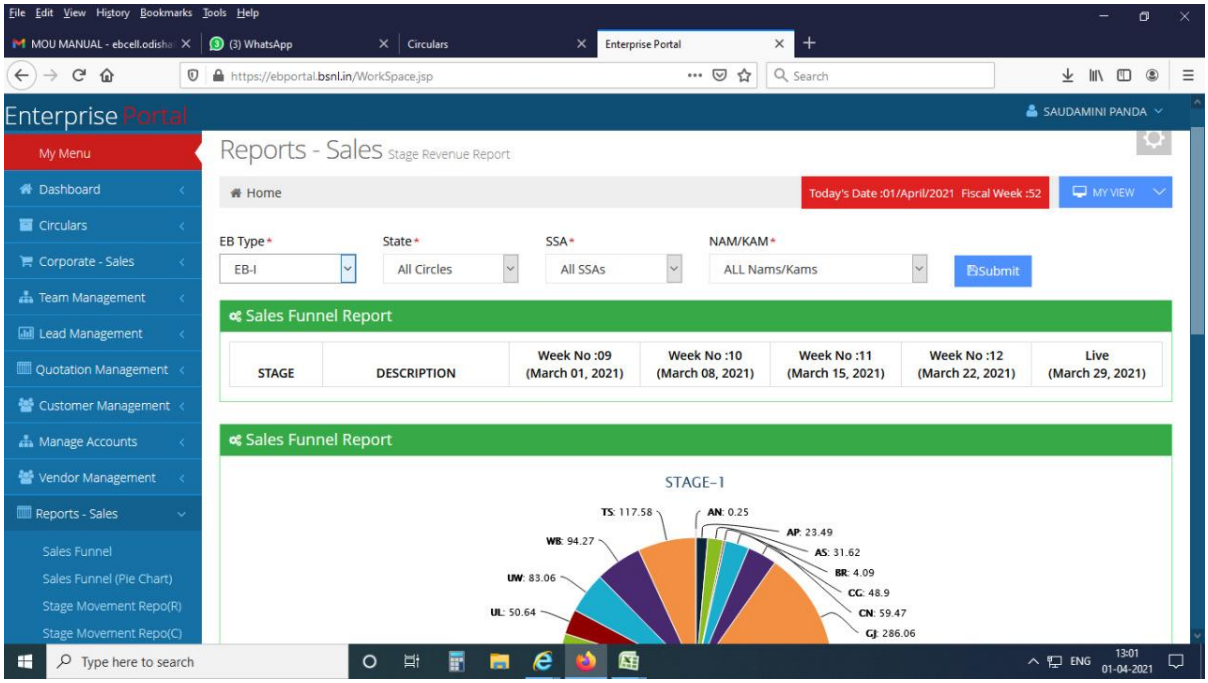
Enterprise Portal
SAUDAMINI PANDA
My Menu
Reports - Sales Stage Revenue Report
Home
Today's Date :01/April/2021 Fiscal Week :52
MY VIEW
Dashboard
Circulars
Corporate - Sales
Team Management
Lead Management
Quotation Management
Customer Management
Manage Accounts
Vendor Management
Reports - Sales
Sales Funnel
Sales Funnel (Pie Chart)
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Week No :09 (March 01, 2021)
Week No :10 (March 08, 2021)
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Week No :12 (March 22, 2021)
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Sales Funnel Report
STAGE-1
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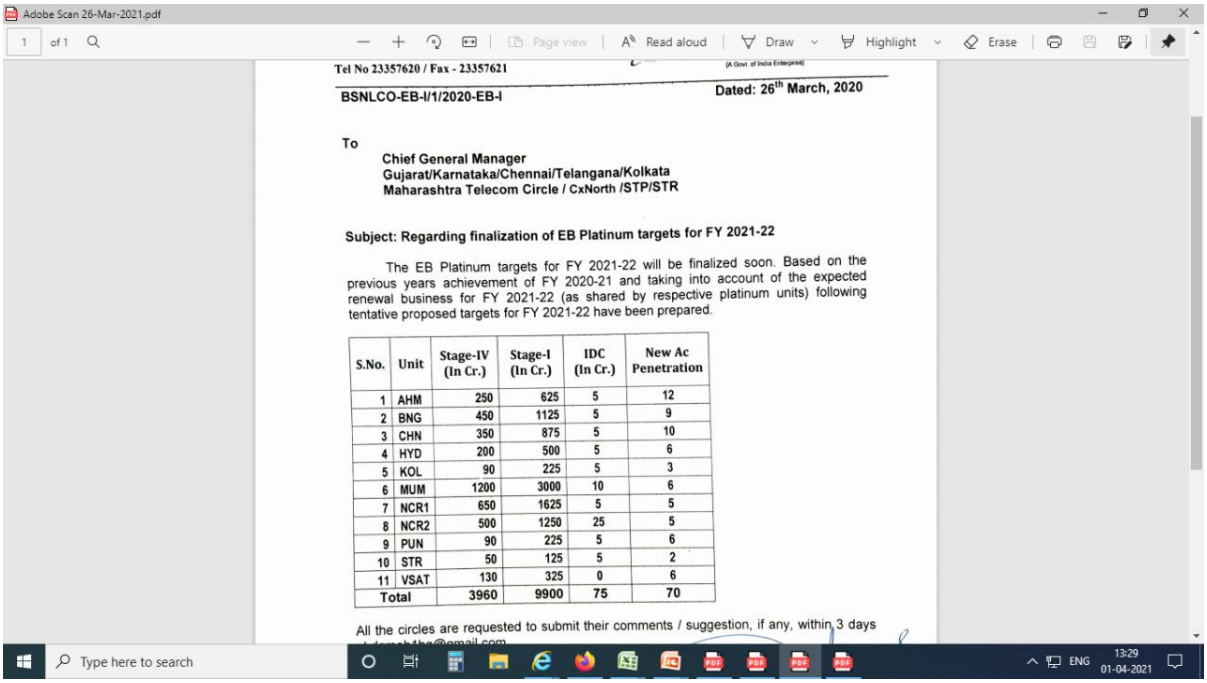


Tel No 23357620 / Fax - 23357621

BSNLCO-EB-I/1/2020-EB-I

Dated: 26th March, 2020

To

Chief General Manager
Gujarat/Karnataka/Chennai/Telangana/Kolkata
Maharashtra Telecom Circle / CxNorth /STP/STR

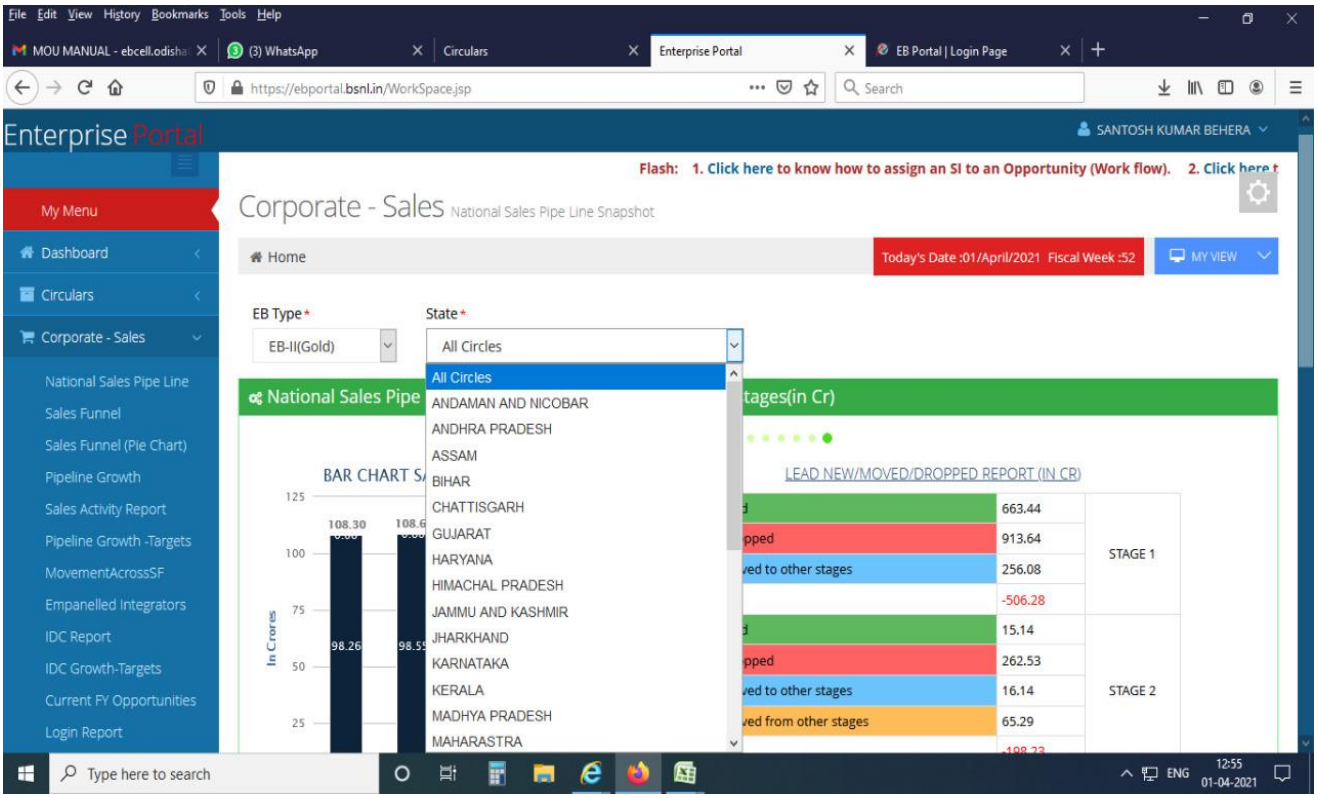
Subject: Regarding finalization of EB Platinum targets for FY 2021-22

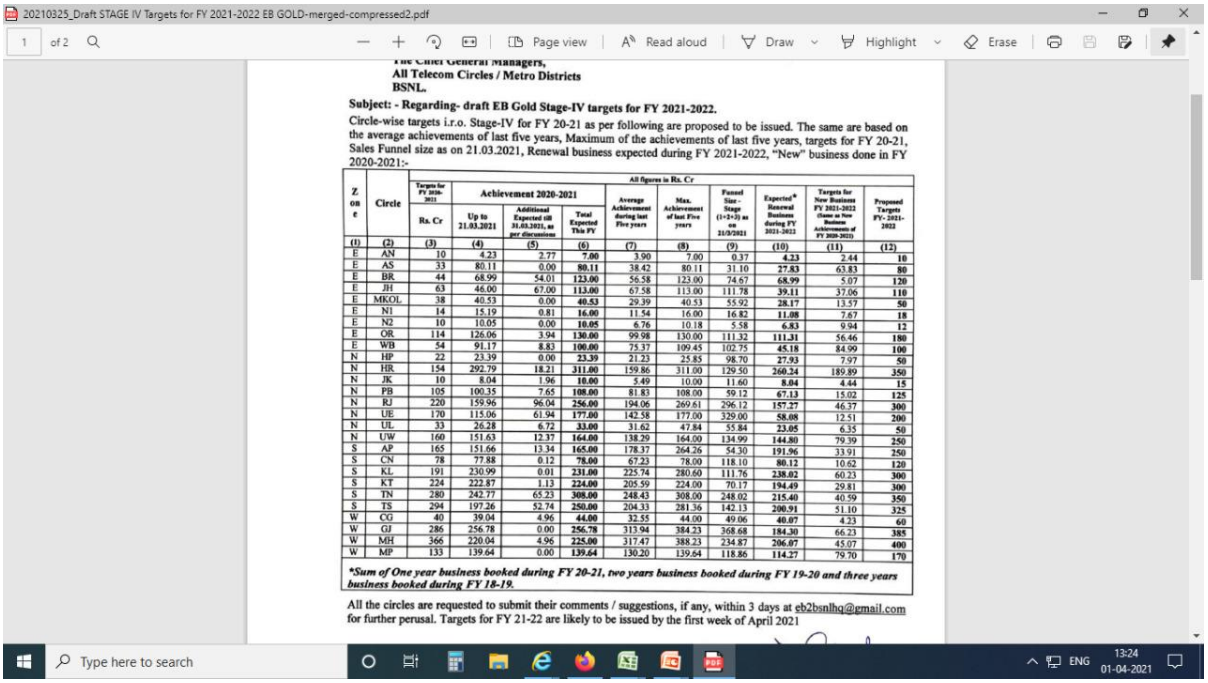
The EB Platinum targets for FY 2021-22 will be finalized soon. Based on the previous years achievement of FY 2020-21 and taking into account of the expected renewal business for FY 2021-22 (as shared by respective platinum units) following tentative proposed targets for FY 2021-22 have been prepared.

S.No.	Unit	Stage-IV (In Cr.)	Stage-I (In Cr.)	IDC (In Cr.)	New Ac Penetration
1	AHM	250	625	5	12
2	BNG	450	1125	5	9
3	CHN	350	875	5	10
4	HYD	200	500	5	6
5	KOL	90	225	5	3
6	MUM	1200	3000	10	6
7	NCR1	650	1625	5	5
8	NCR2	500	1250	25	5
9	PUN	90	225	5	6
10	STR	50	125	5	2
11	VSAT	130	325	0	6
Total		3960	9900	75	70

All the circles are requested to submit their comments / suggestion, if any, within 3 days

2) EB-2 , are the EB GOLD consists of the following circle units :





20210325_Draft STAGE IV Targets for FY 2021-2022 EB GOLD-merged-compressed2.pdf

1 of 2 — Page view | Read aloud | Draw | Highlight | Erase

All Telecom Circles / Metro Districts
BSNL.

Subject: - Regarding- draft EB Gold Stage-IV targets for FY 2021-2022.

Circle-wise targets i.r.o. Stage-IV for FY 20-21 as per following are proposed to be issued. The same are based on the average achievements of last five years, Maximum of the achievements of last five years, targets for FY 20-21, Sales Funnel size as on 21.03.2021, Renewal business expected during FY 2021-2022, "New" business done in FY 2020-2021:-

All figures in Rs. Cr

Zone	Circle	Targets for FY 2020-2021	Achievement 2020-2021			Average Achievement during last Five years	Max. Achievement of last Five years	Funnel Size - Stage (1+2+3) as on 21/3/2021	Expected* Renewal Business during FY 2021-2022	Targets for New Business FY 2021-2022 (Same as New Business Achievements of FY 2020-2021)	Proposed Targets FY- 2021-2022
		Rs. Cr	Up to 21.03.2021	Additional Expected till 31.03.2021, as per discussions	Total Expected This FY						
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
E	AN	10	4.23	2.77	7.00	3.90	7.00	0.37	4.23	2.44	10
E	AS	33	80.11	0.00	80.11	38.42	80.11	31.10	27.83	63.83	80
E	BR	44	68.99	54.01	123.00	56.58	123.00	74.67	68.99	5.07	120
E	JH	63	46.00	67.00	113.00	67.58	113.00	111.78	39.11	37.06	110
E	MKOL	38	40.53	0.00	40.53	29.39	40.53	55.92	28.17	13.57	50
E	NI	14	15.19	0.81	16.00	11.54	16.00	16.82	11.08	7.67	18
E	N2	10	10.05	0.00	10.05	6.76	10.18	5.58	6.83	9.94	12
E	OR	114	126.06	3.94	130.00	99.98	130.00	111.32	111.31	56.46	180
E	WB	54	91.17	8.83	100.00	75.37	109.45	102.75	45.18	84.99	100
N	HP	22	23.39	0.00	23.39	21.23	25.85	98.70	27.93	7.97	50
N	HR	154	292.79	18.21	311.00	159.86	311.00	129.50	260.24	189.89	350
N	JK	10	8.04	1.96	10.00	5.49	10.00	11.60	8.04	4.44	15
N	PB	105	100.35	7.65	108.00	81.83	108.00	59.12	67.13	15.02	125
N	RJ	220	159.96	96.04	256.00	194.06	269.61	296.12	157.27	46.37	300
N	UE	170	115.06	61.94	177.00	142.58	177.00	329.00	58.08	12.51	200
N	UL	33	26.28	6.72	33.00	31.62	47.84	55.84	23.05	6.35	50
N	UW	160	151.63	12.37	164.00	138.29	164.00	134.99	144.80	79.39	250
S	AP	165	151.66	13.34	165.00	178.37	264.26	54.30	191.96	33.91	250
S	CN	78	77.88	0.12	78.00	67.23	78.00	118.10	80.12	10.62	120
S	KL	191	230.99	0.01	231.00	225.74	280.60	111.76	238.02	60.23	300
S	KT	224	222.87	1.13	224.00	205.59	224.00	70.17	194.49	29.81	300
S	TN	280	242.77	65.23	308.00	248.43	308.00	248.02	215.40	40.59	350
S	TS	294	197.26	52.74	250.00	204.33	281.36	142.13	200.91	51.10	325
W	CG	40	39.04	4.96	44.00	32.55	44.00	49.06	40.07	4.23	60
W	GJ	286	256.78	0.00	256.78	313.94	384.23	368.68	184.30	66.23	385
W	MH	366	220.04	4.96	225.00	317.47	388.23	234.87	206.07	45.07	400
W	MP	133	139.64	0.00	139.64	130.20	139.64	118.86	114.27	79.70	170

Sum of One year business booked during FY 20-21, two years business booked during FY 19-20 and three years business booked during FY 18-19.

All the circles are requested to submit their comments / suggestions, if any, within 3 days at eb2bsnlhq@gmail.com for further perusal. Targets for FY 21-22 are likely to be issued by the first week of April 2021

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16.8 Summary of BSNL organizational Structure:

The role of EB wing, which has been created at corporate as well as circle levels is to identify the specific needs of enterprise customer which can be a mix of Voice, Data and Managed Services solutions. To give proper focus to such customers based on their potential, such customers are categorized as platinum, Gold and Silver.

Promotion of Enterprise business to platinum customers through marketing activities such as advertisements and promotions based on focused market research is also responsibility of EB wing. This wing is supported by other related units such as leased circuit, Network operations, Core Network planning and field units of CFA, CM for execution of enterprise projects. A key difference from previous approach to enterprise sales is the creation of DGM (Service Delivery/Service Assurance) post at Circle level. Earlier this work was handled by DGM Enterprise sales thereby overloading the post with dual responsibility of bringing new business as well as handling project management for such business.

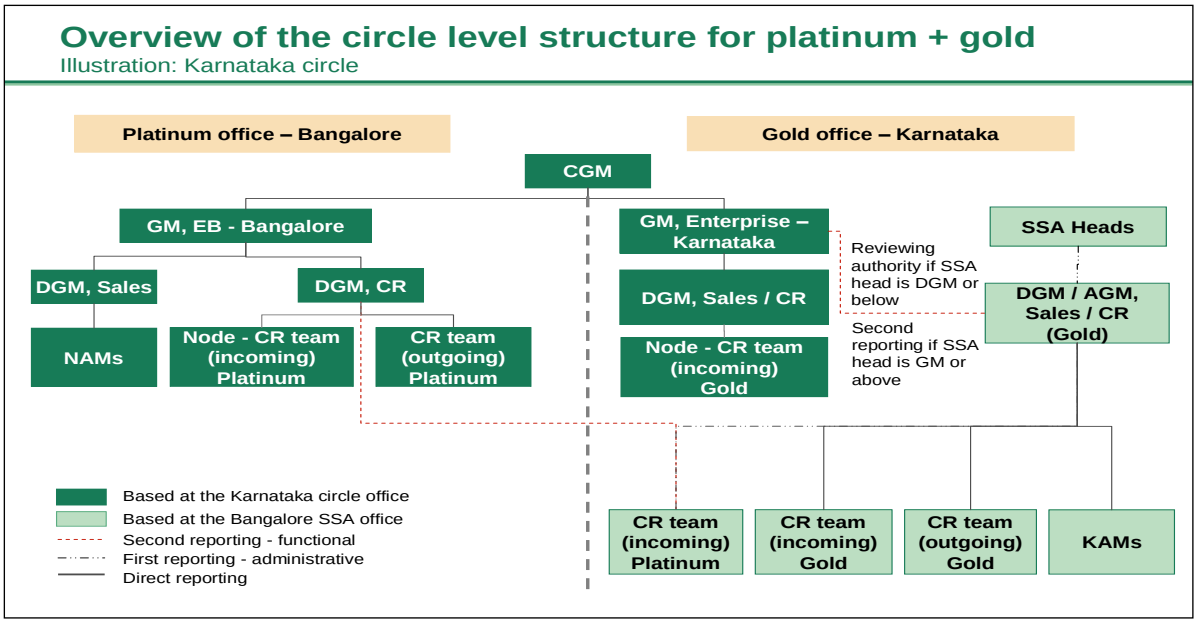
16.9 CONCLUSION:

From this lesson trainee is able to understand the Needs of EB customers, Classification and Grading of EB customers and a tentative organization structure required for catering of the needs of EB customers.

16.10 ORGANIZATION STRUCTURE

The Enterprise Business Unit at the circle level is structure as below:

Example taken from Karnataka Circle



(Figure 1)

The Customer Relations Team is established for both Platinum and Gold teams within the circle office. Both teams report to the GM, EB – City, if they assist the Platinum sales team or GM, Enterprise – Circle, if they assist the Gold sales team. The Platinum Customer Relations Team consists of DGM, Customer Relations located in the Circle office. The DGM is assisted by two teams – incoming and outgoing team.

16.11 Platinum Customer Relations Team

The Platinum Customer Relations *outgoing* team is responsible for receiving all SD/SA requests from the sales team that require coordination with other circles (outside the home circle). The outgoing team is further divided into North/South/East/West zones. Each outgoing zonal team deals with circles lying within that zone. For example, Outgoing team of North zone deals with circles like UP East, UP West, Haryana, Himachal Pradesh etc. The outgoing team interfaces with the National Account Managers (NAMs) located in the circle office and coordinates with the incoming Customer Relations team of other circles.

The Platinum Customer Relation *incoming* team is responsible for receiving all SD/SA requests from the sales team that require coordination with the home circle. As the Consumer Fixed Access Team which does the SD/SA activities is located at the field/SSA level, therefore the Platinum Customer Relation incoming team is also located at the SSA level. The SSAs in which this team is located are the SSAs in which Gold sales offices are working. In order to coordinate the incoming requests for SSAs in which this team is not placed, a nodal person is placed at the circle office under the DGM, Customer Relations. This nodal person acts as the nodal person for receiving all incoming SD/SA requests related to SSAs in which no incoming personnel is placed and pursues SD/SA requests in those SSAs.

16.12 Gold Customer Relations Team

The Gold Customer Relations *outgoing* team is responsible for receiving all SD/SA requests from the sales team that require coordination with other circles (outside the home circle). Since the Gold sales team (KAMs) is located in certain SSAs that are designated as Gold offices, therefore the outgoing team is also located in the same SSAs to complement and assist the sales team in those SSAs. The outgoing team is divided into North/South/East/West zones, similar to the structure used by the Platinum team.

The Gold Customer Relation *incoming* team is responsible for receiving all SD/SA requests from the sales team that require coordination with the home circle. As the Consumer Fixed Access Team which does the SD/SA activities is located at the field/SSA level, therefore the Gold Customer Relation incoming team is also located at the SSA level. The SSAs in which this team is located are the SSAs in which Gold sales offices are working. In order to coordinate the incoming requests for SSAs in which this team is not placed, a nodal person is placed at the circle office under the DGM, Enterprise. This nodal person acts as the nodal person for receiving all incoming SD/SA requests related to SSAs in which no incoming personnel is placed and pursues SD/SA requests in those SSAs.

In the circle office, there is only one DGM placed under the GM, Enterprise – Circle. This DGM has dual responsibility of coordinating for both Sales as well as Customer Relations. There is a standalone DGM/AGM placed in the SSA office who coordinates Sales and Customer Relations activity within that SSA. This DGM has a dual reporting. The DGM reports to the SSA Head as well as to the GM, Enterprise – Circle as the Circle office. The reporting to the GM, Enterprise is considered second reporting if the SSA Head in question is GM or above. The reporting is considered as previewing authority if the SSA Head is DGM or below.

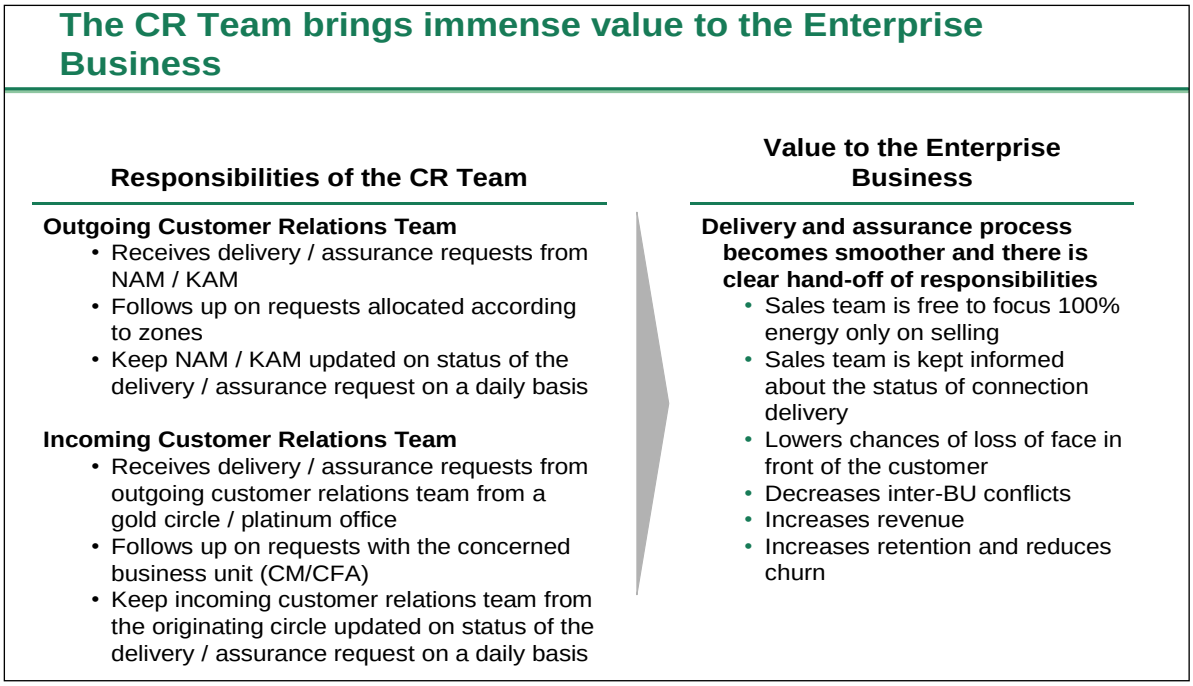
The DGM/AGM, Enterprise at the SSA will be responsible for both Sales and Customer Relations activity in his/her SSA. The following personnel will report to him/her in the SSA:

- Gold Customer Relations Team (Incoming)
- Gold Customer Relations Team (Outgoing)
- Platinum Customer Relations Team (Incoming)
- Key Account Managers

The Platinum Customer Relations Team (incoming) reports to the DGM/AGM within the SSA for administrative purpose but it's functional reporting lies with the DGM, Customer Relations at the circle office.

16.13 Roles and Responsibilities

The Customer Relations Team plays a critical role in expanding the Enterprise Business stream for BSNL.



(Figure 2)

The roles and responsibilities of the Customer Relations Team encompass a number of activities which include:

- Receiving delivery/assurance requests from **N**ational **A**ccount **M**anagers/**K**ey **A**ccount **M**anagers
- Following up on requests allocated according to zones (Outgoing)
- Following up on requests with the internal Consumer Mobility / Consumer Fixed Access business unit (Incoming)
- Keeping Key Account Manager or National Account Manager updated on the status of the delivery /assurance request on a daily basis

It is expected that the National Account Managers or the Key Account Managers will spend all of their time in the field in order to generate new business or to retain the existing business. If an account manager is able to generate any new sales, the commissioning requests related to the new sales is directly passed on by the Account Manager (through the DGM, Sales and the DGM, Customer Relations) to the outgoing team (if the request pertains to an external circle) or to the incoming team (if the requests pertains to the domestic circle). The incoming team also follows up on requests send by Enterprise teams located in other circles through their outgoing teams.

16.14 Review and Monitoring

In order to track the activities of the sales team and provide support to it, wherever necessary, a standard review format has been designed which tracks the sales activity, the size of the sales funnel and week by week status on all sales accounts allocated to an account manager for the Platinum/Gold Enterprise office within every circle/city. This

sales review format captures the movement of a lead from the point of prospecting to the stage where a final order is booked on the specific lead. In order to ensure that the tracking is continued till the stage that an order is commissioned and revenue is booked in the ABF account for BSNL, it is suggested to follow a similar review and monitoring mechanism for the Customer Relations Team on weekly basis.

It is suggested that the Customer Relations Team is reviewed along with the sales team on a weekly basis where its activities on two primary areas of focus is tracked:

- Service Delivery
- Service Assurance

In order to track progress on Service Delivery, all leads that appear in Stage 4 of the sales funnel (Stage in which order is booked and money has been received from the customer) are analyzed one by one and commissioning status on the same is sourced from the Customer Relations Team.

In order to track progress on Service Assurance, a status chart is prepared of all Service Assurance requests received by the Account Manager till date and that have been passed on to the Customer Relations Team and status on the same is updated on a weekly basis.

The picture below explains the templates in further detail.

Service Delivery Status Report - Data

Coordination status with multiple circles on a single deal booked

S. No.	Name of the Customer	Customer Code	Name of the account manager	Date on which payment was received	Zone	Circle	Requirements (no. of circuits and bandwidth)				Status Update (with comments)						
							LL	MPLS	ILL	MNS	Work order released	Send to Indoor / Outdoor / OFC	Stream allocated	Last mile provisioned	Modems installed	Link tested	Billing starts
1	Central Bank of India		V.K. Dubey	12 / 10 / 2009	North	UP East				20 links - 64 kbps	all 20 on 1.11.2009	Pending - expected on 1.1.2010	Pending - expected on 15.1.2010	Pending - expected on 15.1.2010	Pending - expected on 25.1.2010		
2	Central Bank of India		V.K. Dubey	12 / 10 / 2009	North	UP West				10 links - 64 kbps	all 10 on 2.11.2009	Pending – No update	Pending – No update	Pending – No update	Pending – No update		
3	Central Bank of India		V.K. Dubey	12 / 10 / 2009	South	AP				1 links - 64 kbps	Completed on 2.11.2009	Pending – No update	Pending – No update	Pending – No update	Pending – No update		
4	Kingfisher Airlines		R.R. Mahajan	1 / 11 / 2009	Home	MH		40 links – 2 Mb			all 40 on 2.11.2009	Pending – No update	Pending – No update	Pending – No update	Pending – No update		

Home circle signified as Home zone

(Figure 3)

Service Assurance Status Report - Data

S. No.	Name of the Customer	Customer Code	Name of the account manager	Date on which complaint was received	Zone	Circle	Requirements (no. of circuits and bandwidth)				Status Update (with comments)									
							LL	MPLS	ILL	MNS	Docket booked	Last mile checked	Last mile fault corrected	Stream checked	Stream fault corrected	CPE Fault checked	CPE Fault corrected	Cable breakdown corrected	Testing	Close the docket and confirm closure
1	Dewan Housing Finance Limited		V.K. Dubey	1.11.09	North	UP East				1 link - 64 kbps	Yes on 12.11.09	No	No	No	No	No	No	No	No	No

(Figure 4)

The templates above capture the review and monitoring on data circuits (both service delivery and assurance) on a weekly basis. Similar templates should be developed by the circle teams on Voice products (landline, PRI, Broadband and mobility) to monitor delivery and assurance status on the same.

16.15 ACCOUNT MANAGEMENT AND NATIONAL ACCOUNT MANAGERS:

16.15.1 OBJECTIVE:

This lesson provides the insight into the roles and responsibilities of Key Account managers and National Account Managers in details and EB customer expectations from the Key Account managers and National Account Managers to develop their own business.

16.15.2 ROLES AND RESPONSIBILITIES OF KEY ACCOUNT MANAGERS AND NATIONAL ACCOUNT MANAGERS:

Concept of National Account Manager (NAM) and Key Account Manager (KAM) has also been introduced to provide focused attention to corporate customers. Reimbursement of travel/meal/sundry expenses is allowed to NAM/KAM depending on their role and quantum of work.

- Account managers are pivotal to a BSNLs long term success. The perception of Enterprise Customers towards BSNL is solely depends on the account manager allotted to them.
- Account managers personify BSNL for its key customers. They have an almost monopolistic relation with their customers and are responsible for interactions on all things pertaining to a product or service. E.g. sale, delivery, assurance, billing etc
- A successful account manager has deep personal relations with his client outside of office as well.

- Account managers have to balance requirements of customers with needs of their own company to ensure long term relations.
- Eventually, the customer buys products and services on the consulting basis of their account managers. Account managers have a dual focus w.r.t. their customers

a. Building new relationships

- Scouting and acquiring new customers for BSNL enterprise business

b. Maintaining existing relationships

- Expanding scope of business with current customers in enterprise

Role of an account manager goes through five phases:

1) Understanding personal/ professional aspirations

- An account manager would define his/ her expectations from their position in BSNL.
- They would set long term/ short term goals

2) Pre work preparation

- The account manager would familiarise himself/ herself with the business of BSNL as well as the customer

3) Introductory meetings

- The account manager would set up scoping meetings with the customer to understand nature of opportunity

4) Solution Refinement

- The account manager would create solutions for their client's needs and understand the profitability of the same in the long run

5) Reporting

- The account manager would keep BSNL updated on their progress

Account Manager (AM) should have clearly time commitments to effectively manage different roles

a. New Sales

- Create sales opportunities by following leads for new customers
- Regularly follow up with existing customers to provide more products/ solutions whenever possible
- Map organizations of customers met with to understand current and future needs and other vendors supplying products

b. Relationships

- Call current clients and visit them at least once a month
- Ensure all clients are given updated product brochures from BSNL as and when issued

- Ensure all clients are aware of all BSNL enterprise related events

c. Reporting

- File timely reports on customers interacted with in order to allow proper review of business by BSNL
- Follow up with appropriate SD/ SA node to ensure speedy delivery of service to client
- Contact clients regularly to understand if product working satisfactorily

Preparatory work is required for all account managers before approaching customers:

1) BSNL Centric

- Account managers should be well versed with BSNL products
- Account manager should have at least high level knowledge on BSNL network, reach, connectivity etc
- Account manager should know BSNL enterprise business, marquee customers, best selling products etc

2) Account Centric

- Account manager should have clear idea of full name, location, nature of business of company before approaching them for meeting
- Account manager should try to assess which telecom provider is currently fulfilling customer's telecom needs (if its a new customer)

3) **Some perceptions the account managers must create with their customers:**

- Accessibility
- Keeps promises
- Respects my business
- Responsiveness
- Easy to do business with
- Easy to communicate with
- Understands criticality of situations
- Sincere and open

Key account fundamentals before approaching the firm

- Group/ Single Company
- Basic name and location
- Nature of business
- Shareholding
- Size of business
- Market share

16.16 CUSTOMERS' EXPECTATIONS FROM THEIR INITIAL MEETINGS WITH NAM/KAM:

What is on the customer's mind?	How can you be prepared?
What is the business of BSNL?	Show them the introduction letter
Do they know about my business?	Be prepared with introductory templates for the client
What can they offer me?	Be ready with the corporate pitch
How much time do I need to spend with them?	Set up time and agenda for meeting before hand

How much time do I need to spend with them?

Each NAM would have ~5- 7 accounts with a mix of old and new

ACCOUNT MANAGEMENT IN EB: Account management is a centralized approach to managing bank accounts and the authorized signatory information within a corporate.

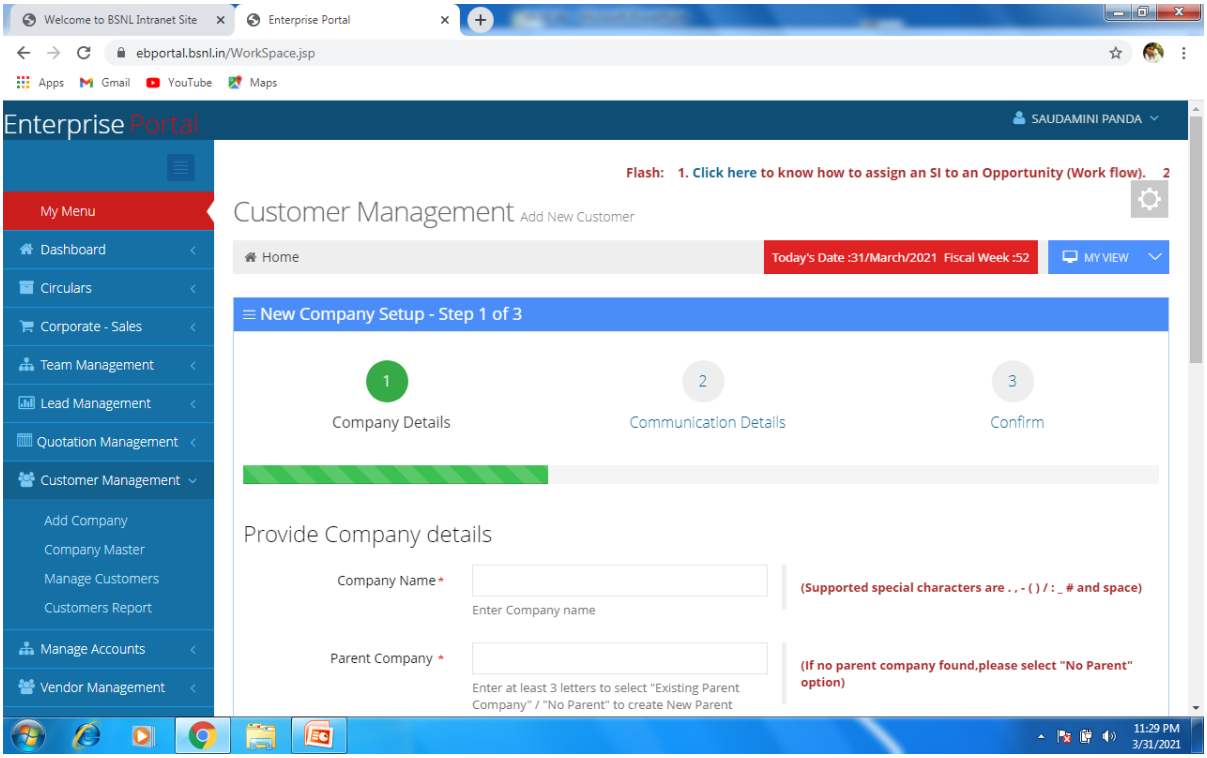
CUSTOMER MANAGEMENT: It is defined as the process of managing the relationship between an organization and its customers over time. It is important for companies to align their customer strategy with the company's aim and objective. It includes:

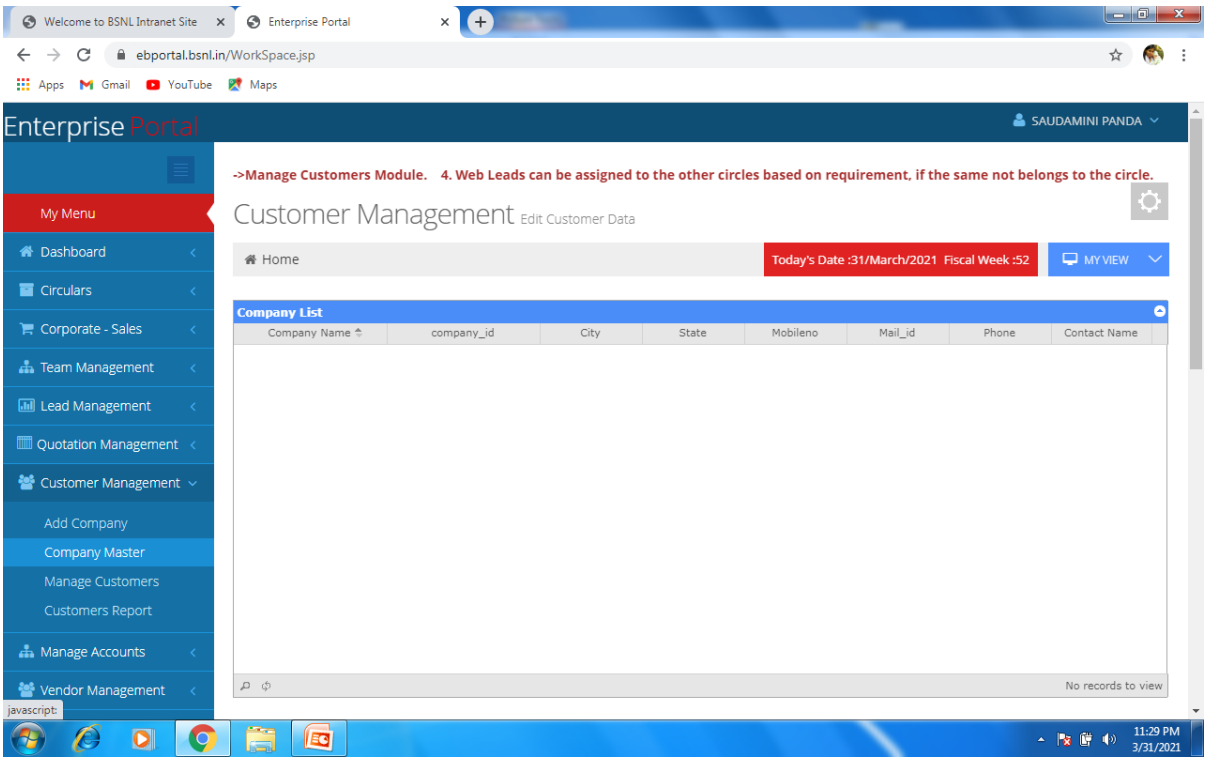
1) Add company

2) Manage customers

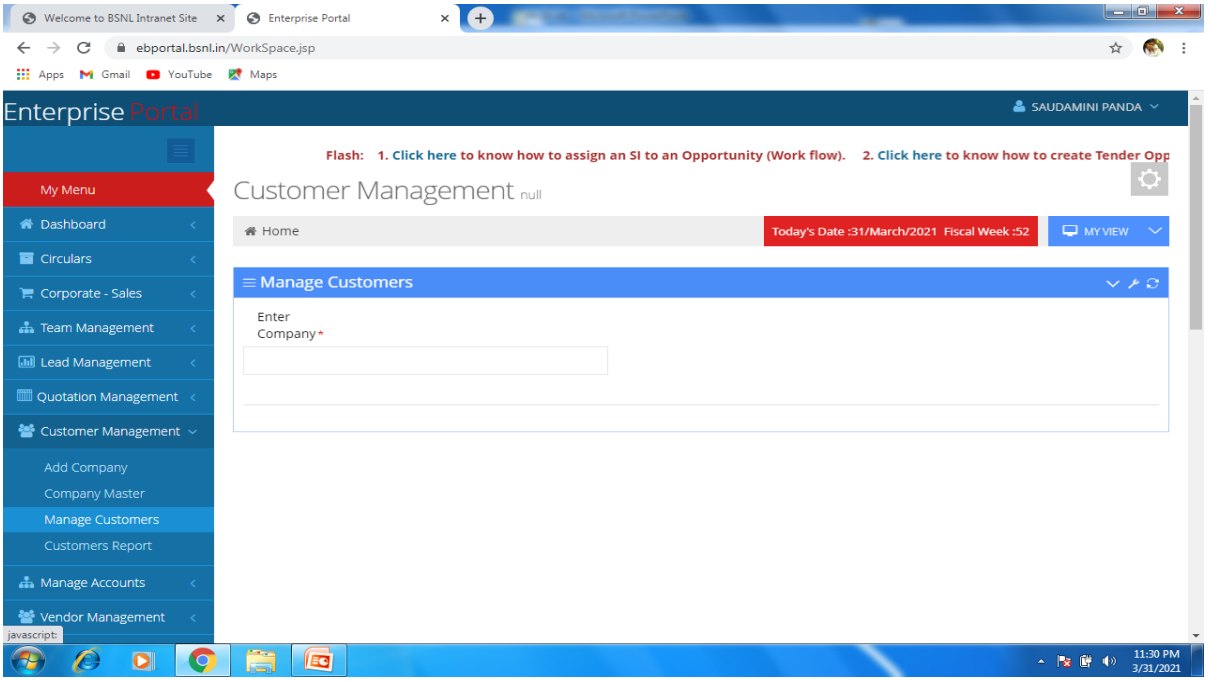
3) Customers report

1. **Add company :**

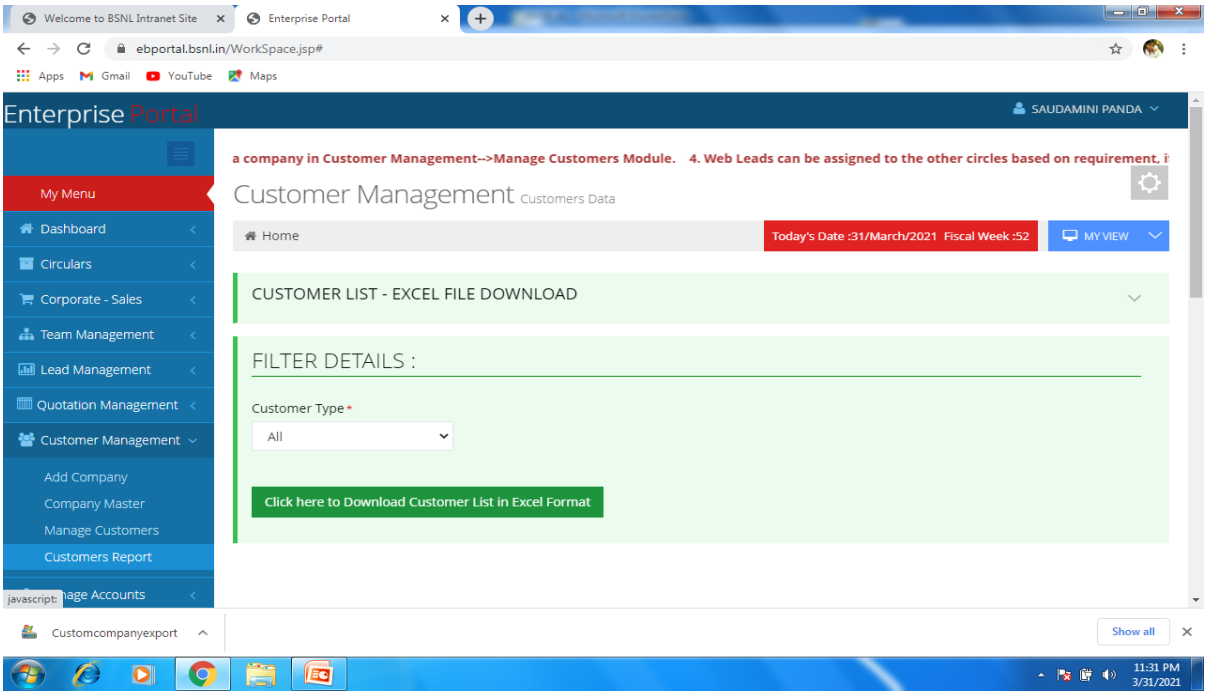




2. Manage customers



3)Customers Report :



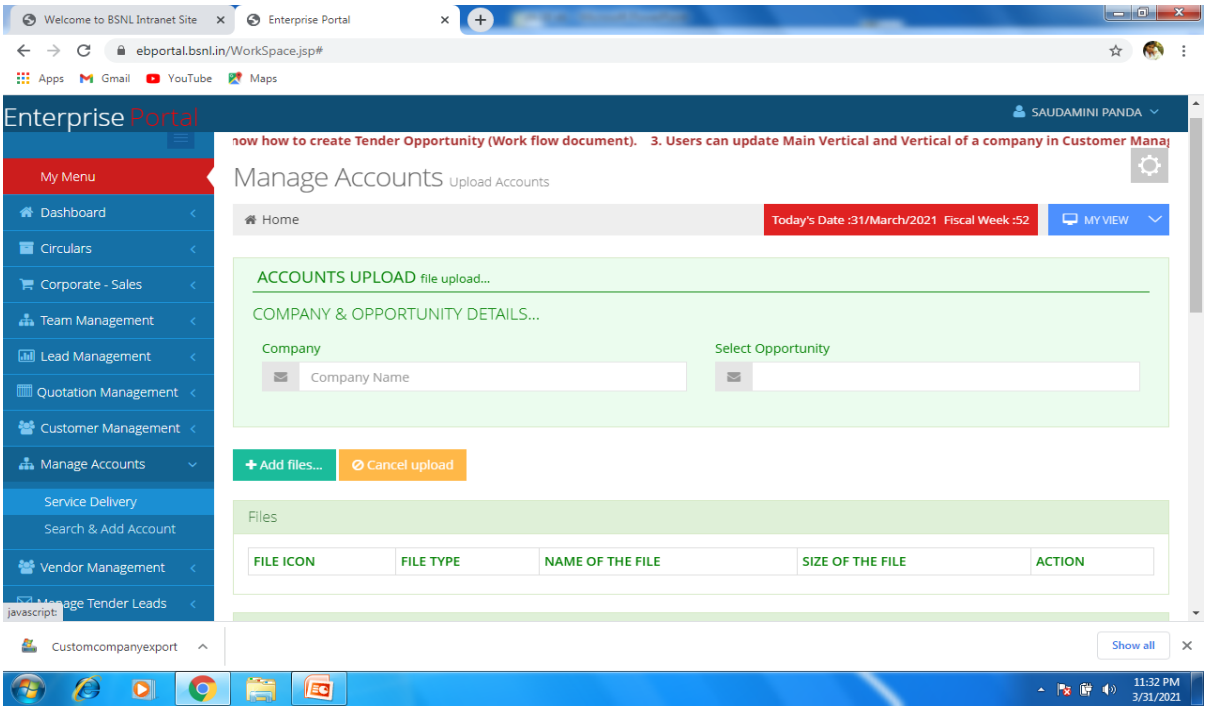
MANAGE ACCOUNTS :

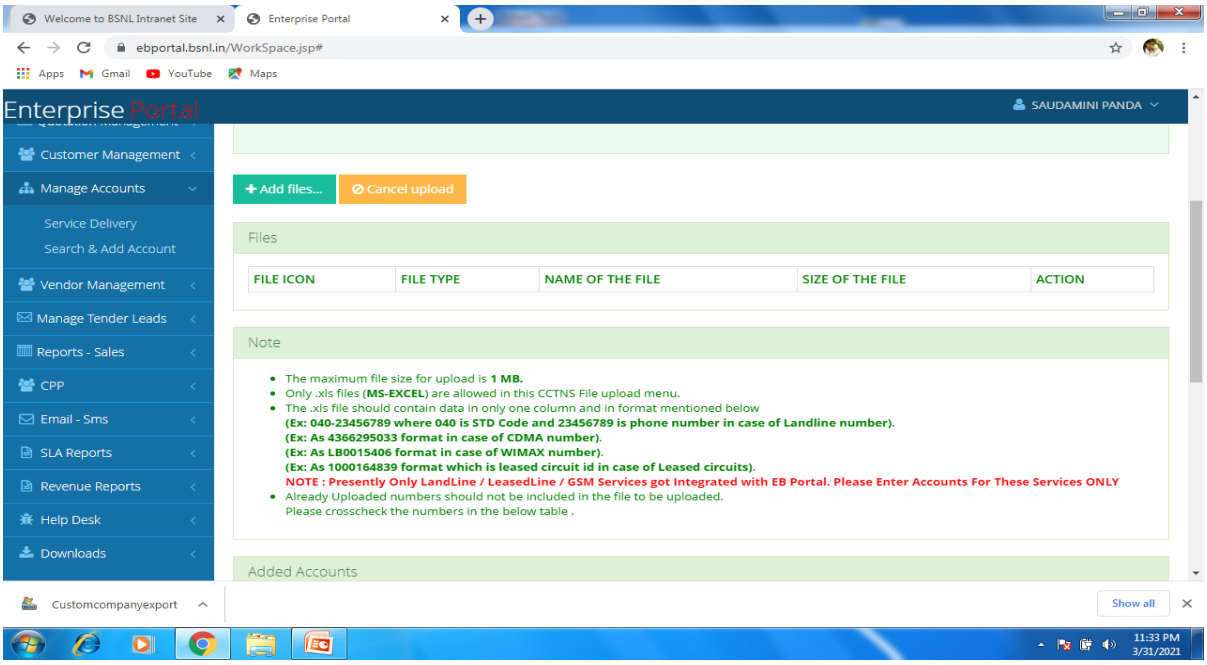
It is used to collectively manage the individual assetwise services installed on the computer.we canstart or stop all assetwise serviceson a particular computer at the same time. It consists of :

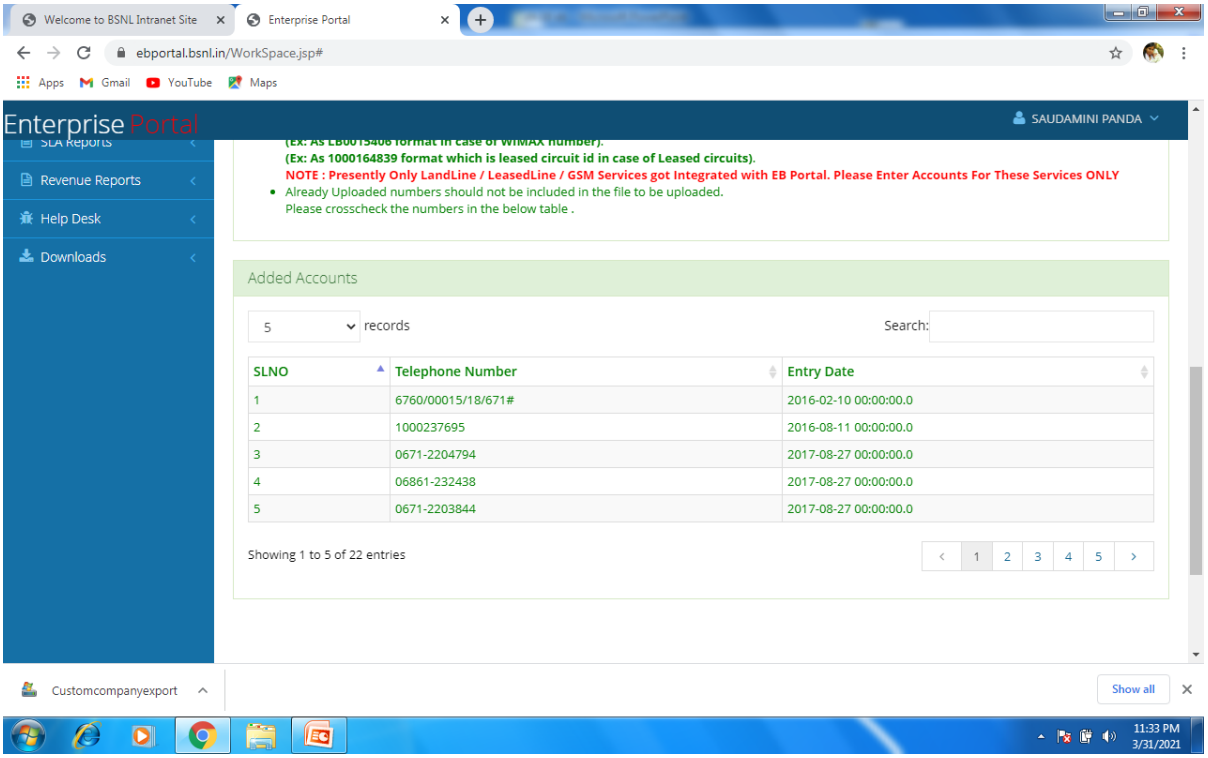
1)Service delivery

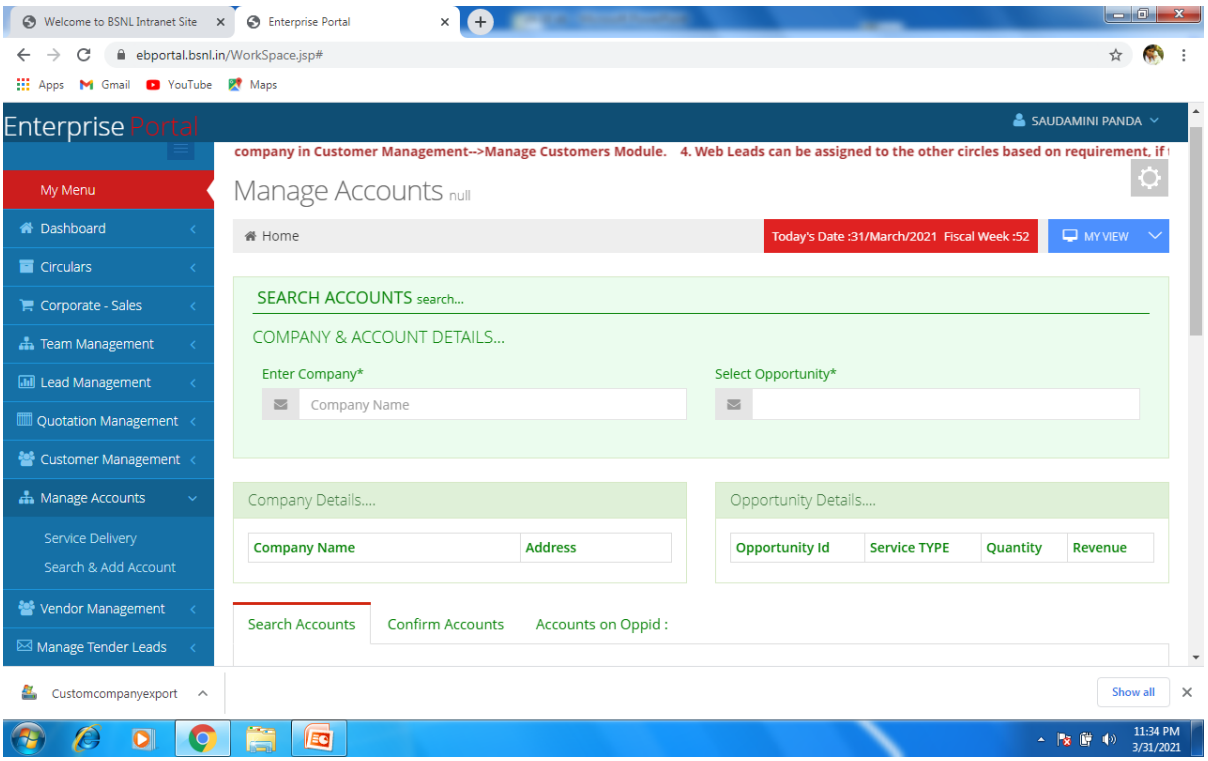
2)Search & add account

Service delivery:

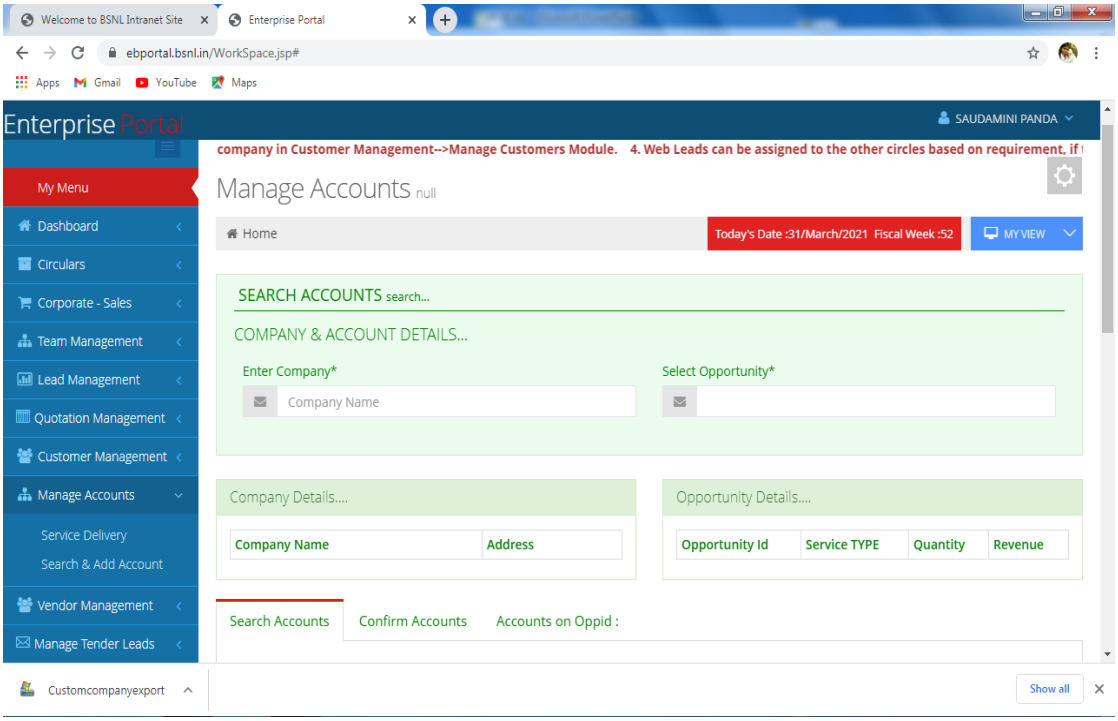


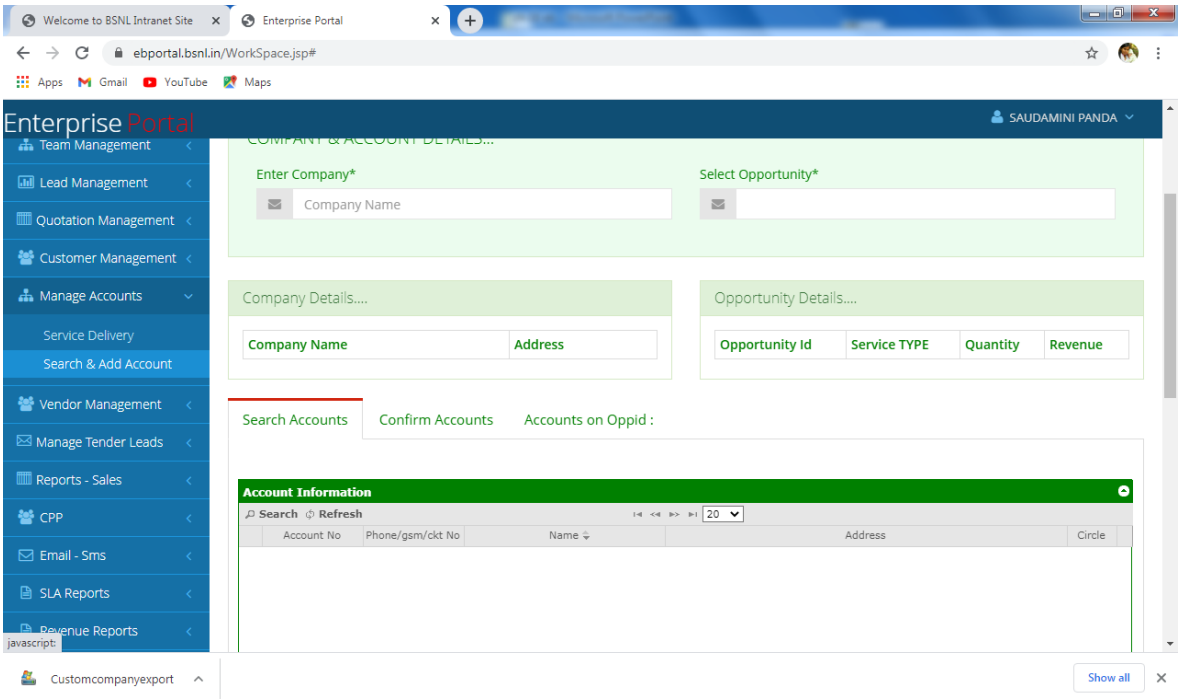






Search and add account :





16.17 CONCLUSION:

From this lesson trainee is able to understand the roles and responsibilities of Key Account managers and National Account Managers in details and EB customer expectations from the Key Account managers and National Account Managers to develop their own business. Also we have got the overall idea how to maintain records in EB account management about customer management and manage accounts.