INDEX

1 NGN, IMS AND SSTP

1.1 LEARNING OBJECTIVES:

- Learn about NGN architecture
- Protocols used in NGN
- Migration from PSTN to NGN
- IMS Architecture
- Objectives of SSTP
- SSTP network in BSNL

1.2 INTRODUCTION

This chapter deals with the architectures of Next Generation Networks, IP Multimedia Subsystem and Standalone Signal Transfer Point. It is generally agreed that the main difference between traditional telecommunications services and an NGN is the shift from separate vertically integrated application-specific networks to a single network capable of carrying any and all services. For telephone services, this includes a shift from a circuit-switched infrastructure to a packet-switched infrastructure. Current NGN activity is aimed at ensuring that next-generation IP-based networks will be able to meet the standards of service normally associated with public telecommunications networks, not only for telephone services, but also for the widest possible set of present and future multimedia applications. ITUNGN based on IMS (IP Multimedia Subsystem) will bring many benefits to network operators. Operators can offer a much wider range of applications and services, to subscribers irrespective of their location, at reduced cost and complexity. IMS will allow operators to increase their revenues through the additional services that can be offered, while their capital expenditure and operation expenses will decrease with their migration from legacy TDM networks to converged network architectures.

As the size of the network grew, it became more and more difficult to manage the direct SS7 links between the switches and from switches to other network elements like HLR, SMSC, SCPs etc. The introduction of Standalone Signal Transfer Point (SSTP) was a historic step from that perspective. It immediately solved issues related to the complexity by converting the mesh networks into the star networks. It is now able to handle the signaling very efficiently. This capability also offloaded some of the processing power required in the L-1 TAX in the legacy network and all switches could breathe easier. SSTP also handle the non call related messages efficiently. These messages exist in all the technology and may not be needed to be handled by a switch. Many times these will actually involve multiple technologies and in absence of the uniform signalling layer, the complexity increases many fold.

1.3 NGN ARCHITECTURE

The PSTN network is mainly optimized for voice calls and not much suited for data services. We have a separate network for data services. Today the world over trend is for a single converged network used for all type of services viz. voice, data, video which is called **Next Generation Network** and is a based on packet switching principle. To change over from current generation network to next generation network we have to move in a step-by-step manner to safeguard our existing network infrastructure and investment and therefore we have to follow an evolutionary path. The NGN concept takes into consideration new realities in the telecom industry characterized by factors such as

the need to converge and optimize the operating networks and the extraordinary expansion of digital traffic (i.e., increasing demand for new multimedia services, increasing demand for mobility, etc.).

The other reasons why we should evolve our existing network to NGN are that the existing circuit switched networks have following problems:

- Slow to develop new features and capabilities.
- Expensive upgrades and operating costs.
- Proprietary vendor troubles
- Large power and cooling requirements.
- Limited migration strategy to new technology.
- Model obsolescence.

1.4   WHAT IS NGN?

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 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 generalized mobility which will allow consistent and ubiquitous provision of services to users.   ETSI (European Telecommunication Standardization Institute) defines the NGN as a concept for defining and deploying networks, which due to their formal separation into different layers and planes and use of open interfaces, offers service providers and operators a platform, which can evolve in a step-by-step manner to create, deploy and manage innovative services.

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.

1.4.1   ACCESS LAYER:

Access Layers is responsible for direct subscriber attachment function. NGN can support all kind of existing access as well as upcoming access. 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 conversionmay be required at the NGN Gateways.

Access Layer consists of Gateways. Example of getaways is Media Gateway, Access gateway, Signalling gateway etc. 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. Access gateway is nearer to subscriber. 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.
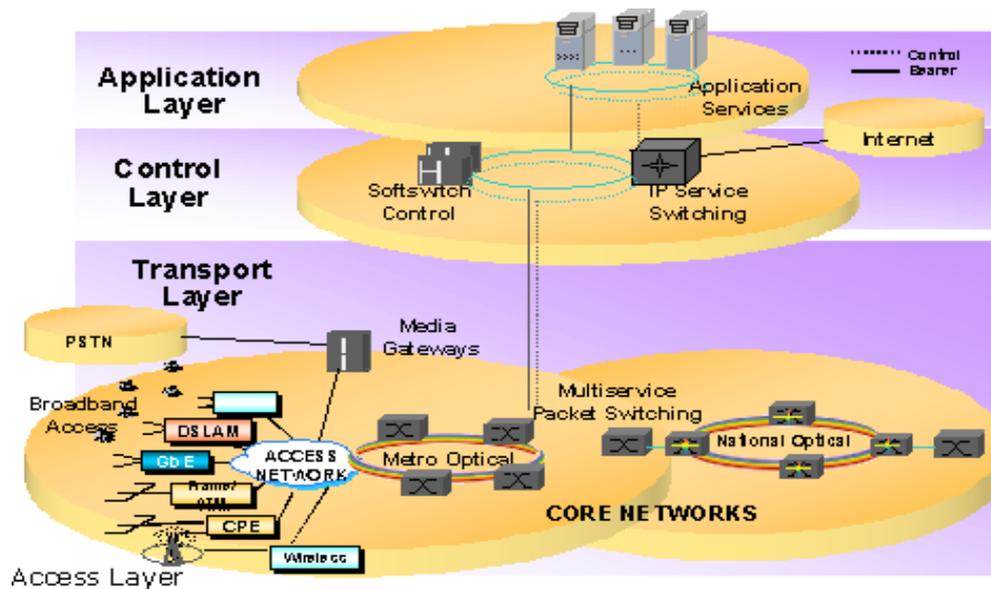
Figure 1:   **NGN Architecture**

1.4.2   TRANSPORT LAYER

Transport Layer of NGN is based on IP (Internet Protocol). It can utilize the advantage of MPLS (Multi Protocol Label Switching). 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 gateways is properly routed by those routers.

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

1.4.4   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.

For Restricted Circulation

1.5   PROTOCOLS USED IN NGN NETWORK

The main feature of NGN architecture is separation of service, transport and control layers, which are interconnected by open interfaces and use standards protocols.

MEGACO is protocol which is sponsored from IETF and ITU. It is used inside one MGC (media gateway controller) for controlling media gateways (MGs). This protocol allows the MGC to tell to the MG-s when to send and receive information towards/from different addresses. This protocol also is useful for sending all information to the MGC from MG-s regarding with detected events such is: on –hook, off hook etc. The equivalent protocol of MEGACO according to ITU is H248.

SIP-Session Initiation protocol: is protocol that resides into application layer and is signaling protocol. SIP plays a very important role for session creation for audio/ videoconferences, interactive games and for call orientation towards IP network. SIP is IETF standard which supports traditional telephony services within IP domain such are: routing, identification, call establishment and other services.The job of SIP is limited to only the setup and control of sessions. SIP does not define the structure or content of message body. It is defined by other protocols like SDP(Session Description Protocol). The job of SIP is to carry that description upto destination.

SIGTRAN Between Soft switch and Signalling gateway - sigtran suite of protocols :, shortened form of Signalling Transmission, is the standard for conversion, transport, and encapsulation of SS7 and ISDN over IP. It is one of the most important transition elements in moving from legacy TDM to **NGN** IP networks.

RTP(Real Time Protocol) Between two media gateways for actual packet transfer-:It is a network protocol for delivering audio and video over IP networks. RTP is used in communication and entertainment systems that involve streaming media, such as telephony, video teleconference applications.

Real Time Control protocol (RTCP): is a copy of RTP which offers control services. The main function of RTCP is identification of transport level for one RTP source.

1.6   MIGRATION FROM PSTN TO NGN

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

1.6.1   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.

In PSTN network Local Exchanges (LE) were 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.
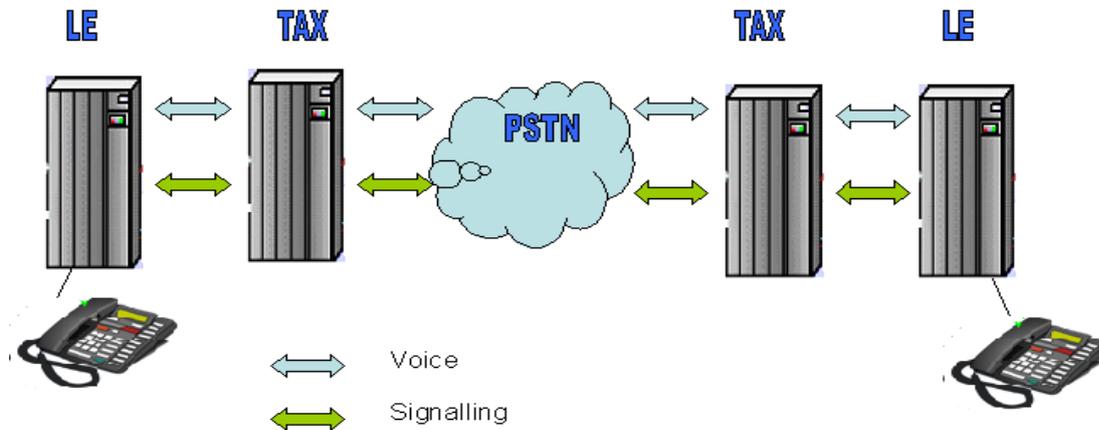

Figure 2:   **Setup of PSTN**

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.

*   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 Signalling Gateway 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.
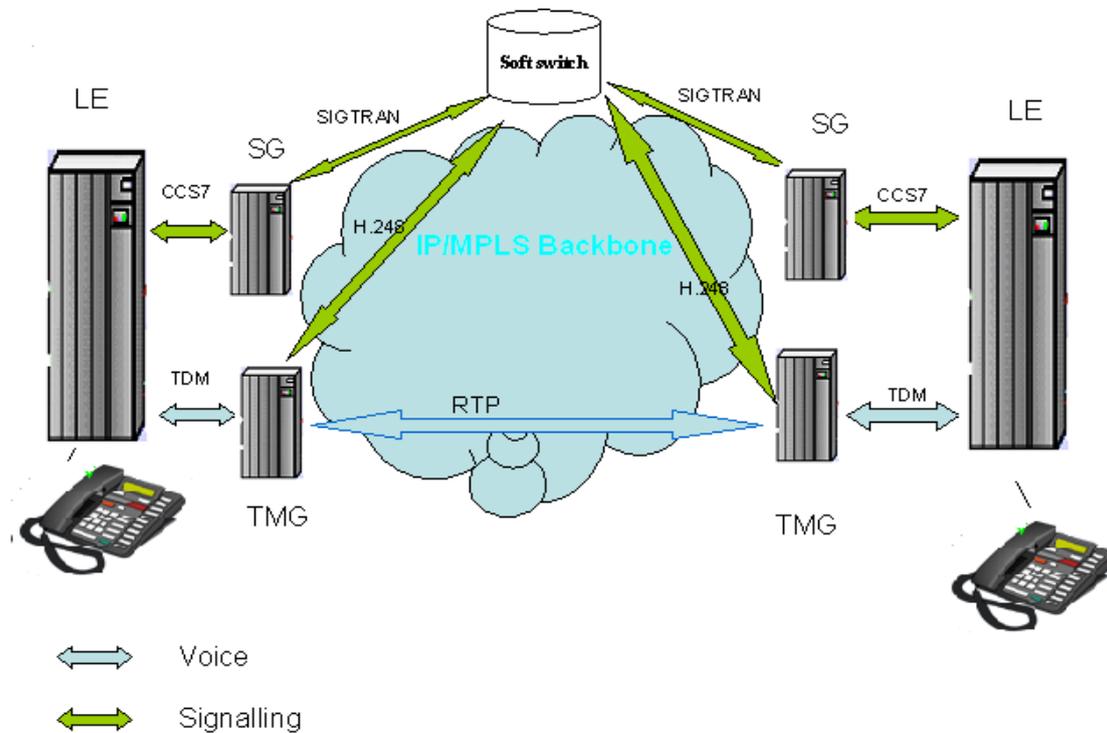
Figure 3:   **Phase I-Migration to NGN using TAX replacement**

1.6.2   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. AGWs 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.

In soft switch approach there are two types of NGN architecture: (i) Class -4 NGN Architecture (ii) Class -5 NGN Architecture.

 For migration the operators may first go for Class 4 NGN Architecture and then Class-5 NGN Architecture or some operators may follow reverse approach. BSNL has adopted the first approach and we have installed Class-4 NGN Architecture followed by Class-5 implementation.
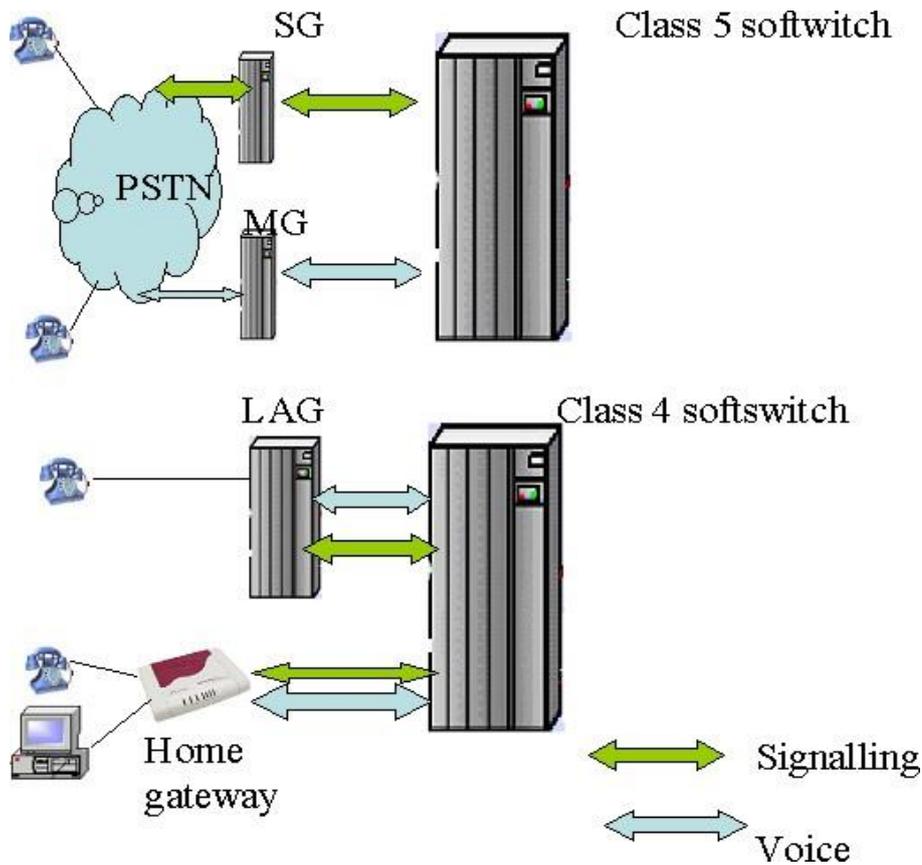
Figure 4:   **Phase II: Migration of Local Exchanges**

1.6.3 PHASE – III 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). New IN and value-added services may be implemented using Application Servers (AS) which is 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) is provided by Application Servers.

1.7   NGN DEPLOYMENT IN BSNL NETWORK

The strategy adopted by BSNL would be the overlay one as it has a huge base of circuit switched network that will coexist with packet switched network for a considerable period of time. The migration steps would be as follows :

- Introduce IP in Transit network at Level-1 TAX locations (IP TAX Project) - Class 4 NGN
- Extend IP network to Level-2 TAXs and large scale implementation in Access Network. – Class 5 NGN
- Develop MPLS core at Circle and LDCA Level.

- Offer Voice and Multimedia services to Broadband Subscribers using DSL, Optical Ethernet technologies.

1.8   IMS (IP MULTIMEDIA SYSTEM)

The IP Multimedia Subsystem is an architectural framework for delivering Internet Protocol (IP) multimedia services.

Need for IMS: IMS is required for enabling IP services in mobile networks along with following features:

- For Combination session establishment with QoS/ security provision
- Means for appropriate charge of multimedia sessions (e.g. flat rate, time/volume based, QoS based)
- Combination & integration of different type of (multimedia) services (own, 3rd party) by standard interfaces
- Overlay for fixed and mobile IP based networks; merging the cellular world with the internet

IMS supports authentication and other security arrangements. IMS utilizes SIP-based control. The services supported by IMS may include multimedia session services and some non-session services such as Presence services or message exchange services. In addition to services for the user, IMS defines a number of network reference points to support operator-provided services. IMS supports various application services via the services support architecture. IMS supports operation and interworking with a variety of external networks via defined reference points.

1.8.1   WHAT IS IMS

IMS offers standardized service enablers and network interfaces that will make interoperability of new MM services easier to achieve. IMS is a tool for operators to that enable the creation and delivery of PS based person-to-person MM services in a way that protects the operator business model and generates new revenue. Service scalability is solved by the IMS architecture. It offers support to compose services and expand existing services. IMS is developed with a core offering for both wireless and wireline operators and is a cornerstone for providing converged multimedia services across multiple accesses. IMS consists of a common core, enablers, support systems and interworking functions enabling operators and service providers to leverage on installed legacy networks, thus reducing cost, while providing key end-user benefits like reliability and security. IMS is based on the layered architecture, which separates functionality into three layers - an application layer, a control layer and a connectivity layer.

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

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

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

1.8.2   WHY IMS

The reason Why IMS can be understood from following Table-1

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

Table 1.   WHY IMS

1.9   IMS ARCHITECTURE

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

The IMS provides all the network entities and procedures to support real-time voice and multimedia IP applications. It uses SIP to support signaling and session control for real-time services.
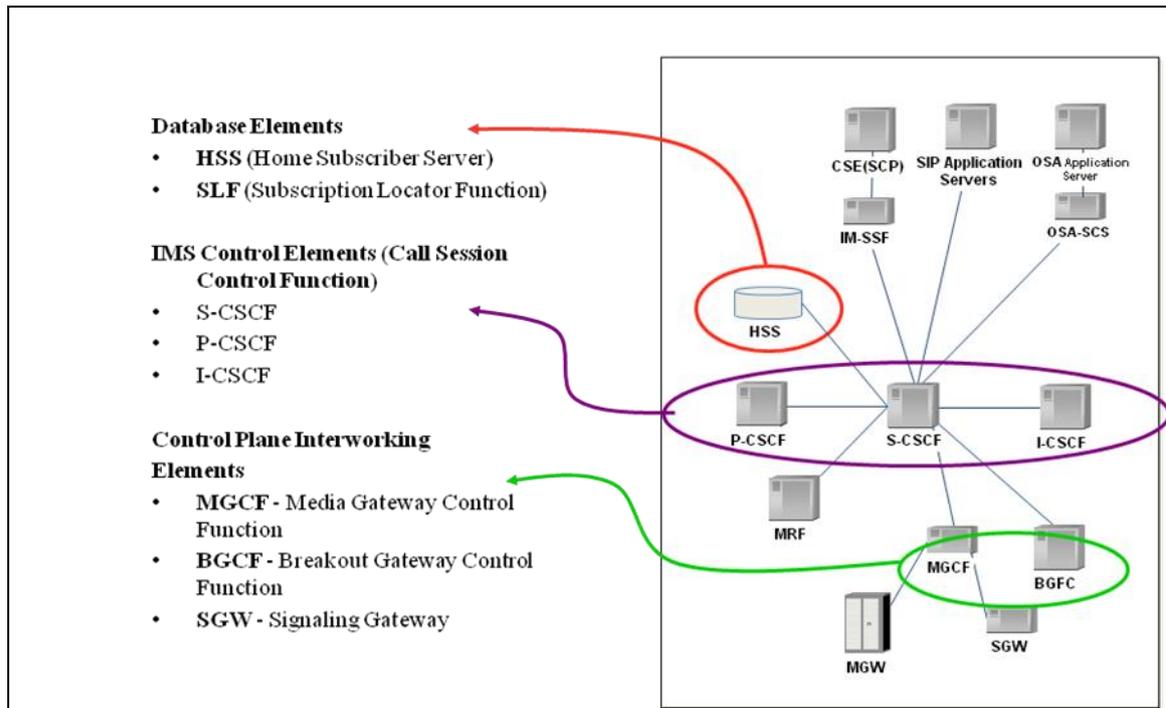
Figure 5:   **IMS elements**

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

- Database Elements (HSS, SLF)

- IMS Control Elements (P-CSCF, I-CSCF and S-CSCF)

- Control Plane Interworking Elements (MGCF, BGCF and SGW)

1. DATABASE ELEMENTS

HSS (Home Subscriber Server)

- The main database element is the HSS (Home Subscriber Server).

- This element is an evolution of the HLR element. The HSS

- contains the features of the HLR (subscriber data and authentication data) and other functions such as Location Register, IMS Service Profile Processing and IMS Subscription and Authentication Data.

- The HSS will be accessed by the I-CSCF, the S-CSCF and external platforms. The HSS uses the Diameter protocol with the Diameter Multimedia Application.

SLF (Subscription Locator Function)

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

2. IMS CONTROL ELEMENTS

- The main functional entity in an IMS is the Call State Control Function (CSCF). A CSCF is a SIP server.

- Depending on the specific tasks performed by a CSCF, CSCFs can be divided into three different types.

  a) Serving CSCF (S-CSCF).

  b) Proxy CSCF (P-CSCF).

  c) Interrogating CSCF (I-CSCF).

- The three IMS Control Elements are nodes that act on the control (SIP) signalling flows. These nodes provide Call Session Control Functions (CSCF)s and each separate node (Serving, Proxy and Interrogating) has a different role and function.

A) S-CSCF (Serving Call Session Control Function)

- The Serving-CSCF is the node that performs the session management within the IMS network for the UE. The S-CSCF operates in a stateful manner. The S-CSCF also ensures end-to-end reachability for users and services by interacting with other SCSCFs, SIP servers and application servers. The S-CSCF also authenticates the user.

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

  i. **Registration**: An S-CSCF can act as a SIP Registrar to accept users' SIP registration requests and make users' registration and location information available to location servers such as the HSS (Home Subscriber Server).

  ii. **Session Control**: An S-CSCF can perform SIP session control functions for a registered user. Relay SIP requests and responses between calling and called parties.

  iii. **Proxy Server**: An S-CSCF may act as a SIP Proxy Server that relays SIP messages between users and other CSCFs or SIP servers.

  iv. **Interactions with Application Servers**: An S-CSCF acts as the interface to application servers and other IP or legacy service platforms.

  v. **Other functions**: An S-CSCF performs a range of other functions not mentioned above. For example, it provides service-related event notifications to users and generates Call Detail Records (CDRs) needed for accounting and billing.

B) P-CSCF (Proxy Call Session Control Function)

- The Proxy-CSCF is the entry point towards the IMS network from any access network. The assignment of a P-CSCF to a user is determined by the access network configuration.

- The P-CSCF also includes the Policy Decision Function (PDF) which authorises the use of bearer and QoS resources within the access network for IMS services.

- A P-CSCF is a mobile's first contact point inside a local (or visited) IMS. It acts as a SIP Proxy Server. In other words, the P-CSCF accepts SIP requests from the mobiles and then either serves these requests internally or forwards them to other servers. The P-CSCF includes a Policy Control Function (PCF) that controls the policy regarding how bearers in the packet-switched network should be used. The P-CSCF performs the following specific functions:

    i. Forward SIP REGISTER request from a mobile to the mobile's home network. If an I-CSCF is used in the mobile's home network, the P-CSCF will forward the SIP REGISTER request to the I-CSCF. Otherwise, the P-CSCF will forward the SIP REGISTER request to an S-CSCF in the mobile's home network. The P-CSCF determines where a SIP REGISTER request should be forwarded based on the home domain name in the SIP REGISTER Request received from the mobile.

    ii. Forward other SIP messages from a mobile to a SIP server (e.g. the mobile's S-CSCF in the mobile's home network). The P-CSCF determines to which SIP server the messages should be forwarded based on the result of the SIP registration process.

    iii. Forward SIP messages from the network to a mobile.

    iv. Compression and decompression of SIP messages. Compression is required to minimize the air-interface time.

    v. Perform necessary modifications to the SIP requests before forwarding them to other network entities.

    vi. Maintain a security association with the mobile.

    vii. Detect emergency session.

    viii. Create CDRs.

C) CSCF (Interrogating Call Session Control Function)

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

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

    i. Capabilities required by the user.

    ii. Capabilities and availability of the S-CSCF and

   iii. Topological information, such as the location of an S-CSCF and the location of the users P-CSCFs if they are in the same operators network as the S-CSCF.

CONTROL PLANE INTERWORKING ELEMENTS (MGCF, BGCF AND SGW)

- **The Media Gateway Control Function (MGCF)** and the IM Media Gateway (IM-MGW) are responsible for signaling and media inter-working, respectively, between the PS domain and circuit-switched networks (e.g. PSTN).

- **The Breakout Gateway Control Function (BGCF)** selects to which PSTN network a session should be forwarded. IT will then be responsible for forwarding the session signaling to the appropriate MGCF and BGCF in the destination PSTN network.

1.10 SSTP (STANDALONE SIGNAL TRANSFER POINT)

1.10.1 NEED OF SSTP

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

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

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

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

Due to reasons explained above, BSNL decided to have a separate signalling network by installing a number of SSTPs at various locations. SSTPs are routers that are placed within the heart of the CCS Networks. SSTPs are packet switches that provide

common channel message routing and transport. SSTPs are stored programmed control switches that use information contained in messages in conjunction with information stored in memory to route message to the appropriate destination signaling point.

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

Advantages:

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

Disadvantages**:**

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

1.11   OBJECTIVES OF SSTP

Following were the main objectives:-

- Regulate, measure, and account for inter-network traffic including SMS messages from mobile networks including GSM and CDMA
- Achieve a flexibility and transparency in management of signalling for BSNL's wired and wireless networks.
- Optimal expansion of GSM & CDMA network of BSNL
- Introduction of new services.
- Offer CCS#7 & IP Signalling Services to other Wire line & Wireless Network Operators.

1.12   SSTP NETWORK IN BSNL

With the above objectives in mind, BSNL awarded a contract to Ms. ITI for the supply and installation of 10 SSTP nodes in September, 2005. Later on, the scope of the project was further expanded to provide 24 nodes in total covering all the major location including all the Level-1 TAX locations. This was a significant step in the direction of the giving the decades old BSNL network an uplift. The P.O.No. SE/PO/005/2016-17/SSTP/New/UTStarcom dtd.01.03.2017 was issued by BSNLCO, for Supply, Installation, Commissioning and Migration to replace the existing SSTP network of M/s.Tekelec (now M/s. Oracle), with a new SSTP network to M/s.UTStarcom India Telecom Private Ltd., Gurgaon. As per the tender and PO, there are total 18 SSTP nodes (with EMS NOC at Bangalore & DR EMS NOC at Mumbai. M/s UTStarcom has supplied all equipments, installed and ATed at all nodes.

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

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

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

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

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

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

1.13   CONCLUSION

The IP Multimedia Subsystem (IMS) seems to be the technology that will prevail in Next Generation Networks (NGNs) and its main goal is to make convergence between any IP networks and a vertical handoff may happening depend on the user requirements (services, QoS .etc). Migration to NGN and future networks brings many challenges to network and service providers, telecommunications and media regulators, equipment vendors, and other related business segments, but at the same it provides endless possibilities for rapid innovation of new networks, protocols and services.

With the introduction of SSTPs in the network, it immediately solved issues related to the complexity by converting the mesh networks into the star networks. SSTP also handle the non call related messages efficiently. The new SSTPs will be capable of supporting new signaling technologies like SIP and diameter, in addition to existing SS7/SIGTRAN and planned to cater to the signaling needs of BSNL network for future.

2   UNDERSTANDING FINANCIAL STATEMENTS

2.1   LEARNING OBJECTIVES

- Accounting mechanism
- Accounting Principles
- Balance Sheet
- Profit Loss Account

2.2   INTRODUCTION

A basic understanding of finance is very relevant to our lives. In both the public and private sectors, financial competence and understanding are essential for most managers and executives. Most of the managers have no formal training on finance. The company wants its revenues to exceed it expenses so that it will earn profit. Accounting helps executives measure the revenues, expenses, and profit (or loss) of the business. Accounting is the information system that measures business activities, processes that information into reports, and communicates the results to decision makers.

As a business executive or an interested party while dealing with other business firms, you would like to know their financial viability. Balance Sheet is one such financial statement that will help you to check the financial health of a firm. It has two sides, Liabilities payable and Assets owned. The total of these two sides is always equal. If it is so, how can one judge that the financial health of a business firm/company is better than that of the other? Given innumerable transactions, how does it happen that the two sides of a Balance Sheet always tally? The objective of this session is to provide answers to all these questions.

2.3   ACCOUNTING MECHANISM

Accounting in order to communicate the results of the operations of a business, records business transactions, classifies them, summarizes and presents them in manner useful for interpretation. Various steps involved in the accounting procedures are briefly discussed as under.

Transaction: The starting point for accounting is a business transaction, say, the purchase of raw material. Such a transaction is evidenced by a document called "voucher", in this case, material purchased bill. It gives the details of the material purchased, the name of the party from whom goods purchased either on credit, or if purchased for cash, the fact that payment has been made. Similarly, "receipt" for the payment of a rent is the voucher for the transaction of "payment of rent".

Recording: Transactions are recorded in various books of accounts on the basis of vouchers. Such books of accounts include cashbook, and journal. The transaction of purchase of raw material on credit will be recorded in the purchase book; similarly the payment of rent will be recorded in the cashbook. Transactions relating to credit sales will be recorded in the sales book. The journal is a book to record all those transactions, which are not recorded in any specific book.

Classification: The next step in the accounting procedure is to classify the transactions under appropriate heads like salaries, rent payments, raw material. This is done by analyzing the transaction recorded in the books of accounts and posting transactions of a similar nature under one head, called the "ledger account". The account book containing various account heads is called, the ledger. For example, all transaction relating to

"salaries" may be posted in"salaries account" or those relating to rent paid may be posted in rent payment account.

Summarization: The art of summarization relates to periodical presentation of the classified data in the form of ledger accounts balances in a statement called the trial balance. All ledger accounts are balanced periodically, say, at the end of a month, and the account balances are placed together in the form of a trial balance. In the trial balance, the total of debit balances equals the total of credit balances and this is one way to check the accuracy of the accounts books.

2.4   FINANCIAL STATEMENTS

The trial balance is normally the basis for the preparation of financial statements called Profit and Loss Account and Balance Sheet.

AUDITING: In the case of corporations, accounts are required to be audited by an auditor. The auditor is an independent person having expertise in accounting. He examines the accuracy of the account books and records and gives his report on the balance sheet and profit and loss account.   Audited financial statements are required to be submitted to the Registrar of Companies, and such audited statement become public documents and this form the means of reporting by the companies to various parties interested in the enterprise.

2.5   ACCOUNTING PRINCIPLES

Money Measurement Concept: Accounting records state only those facts about a business firm, which can be expressed in monetary terms. In other words, business events and facts that cannot be expressed in monetary terms, howsoever important they may be, are excluded. The operational implication of the Money Measurement Concept is that financial statements do not provide all information about the business.

Business Entity Concept: This accounting concept says that Business is to be treated separately from the proprietor or investor. In other it is necessary to record the business's transactions separately, to distinguish them from the owner's personal transactions.

Business transactions of a sole proprietorship are separate from the business owner's personal transactions. For *legal*purposes, a sole proprietorship and its owner are considered to be one entity, but for accounting purposes they are considered to be two separate entities.

Going Concern Concept: The Going Concern Concept implies that the firm will continue to operate in the foreseeable future. Without the 'going concern' concept, accountants would have to write off all assets in the current period including long term assets that still have an economic benefit for future periods.

Suppose Jo Bloggs acquired a widget making maching at £100,000 and this machine has an estimated life of 5 years. Let us also assume that the machine has no other use outside Jo Bloggs' business and could only be sold for scrap at £15,000 after one year. It is normal to write-off the cost of this asset to the profit and loss account, over this timeframe. That is, depreciation of £20,000 per annum would be charged to the profit and loss account. So, at the end of the first year, the value of the machine in the books, would be £80,000, rather than the £15,000 scrap value.

Although it doesn't seem very prudent, because Jo Bloggs will continue to trade and the machine will therefore be used in the business. It is the "Going Concern" concept that allows the higher valuation.

Cost Concept (or Historical **Cost** Accounting **Concept**): Assets/resources owned by the firm are shown at their acquisition cost and not at current market value/current worth. The rationale for this assumption is that it provides objective and verifiable basis for accounting records. Market valuation of assets in use is not only difficult to be made but also is related to subjectivity. Besides, market values may be constantly subject to change.

Dual aspect: Every business transaction has a dual effect, one receiving of a benefit and the other giving of a benefit. For example, when a firm acquires an asset (receiving of a benefit), it has to pay cash (giving of a benefit). Therefore, two accounts are to be opened in the books of account, one for receiving the benefit and the other for giving the benefit. Thus, there will be a double entry for every transaction. For each and every debit, there should be a corresponding credit and vice-versa. This is nothing but the principle of double entry system of accounting which, in other words, is known as dual aspect concept.

Another accounting implication of the dual aspect concept is that the initial amount (Capital) is contributed by the owner. If additional funds are required, bank loans are taken. As per the dual aspect concept, all these receipts create corresponding obligations for their repayment. In other words, a contribution to the business, either in cash or kind, not only increases its resources (assets) but also its obligations (liabilities) corresponding. Thus, at any given point of time, the total assets and the total liabilities should be equal. This equality is called "balance sheet equation" or "accounting equation."

> **Liabilities = Assets or, *Capital* + Liabilities = Assets,**
>
> **or, Assets - Liabilities = Capital.**

Conservative Concept: As the name suggests, Conservative Concept warrants use of conservatism in business records. In relation to Profit and Loss Account, the principle is, "anticipate no profits unless realised but provide for all probable future losses". Stock of finished goods is valued at the cost of the market price whichever is lower. Likewise, it is normal for the firms to provide for likely irrecoverable sum from debtors by creating provisions for bad and doubtful debts at the end of accounting year. This assumption safeguards over-estimation of profits.

Accrual (Realization) Concept: Accrual Concept is a fall-out of Accounting Period concept. This concept requires that expenses incurred for a particular accounting period should be reckoned in the same period, irrespective of the fact whether these expenses have been paid in cash or not in that year. The same holds true for revenues, i.e., revenues earned in a specific accounting period are construed as incomes of the same period, irrespective of their receipts. In the absence of Accrual accounting, the Income Statement may indicate more profit in one year at the cost of the profits of some other year, which is entirely inappropriate and illogical. In other words, cash basis of expense recognition will hamper comparison of profit figures over the years. Clearly, there is a very strong case for a business firm to adopt accrual basis of accounting, known as Accrual accounting to determine correct profits.

Materiality: It states that if the value of any asset is very low, it might be expensed in the year of purchase itself rather than amortizing over its useful life. (Through depreciation).

2.6   PREPARING A BALANCE SHEET

When someone, whether a creditor or investor, asks how a company is doing the way to show off the success of company is a balance sheet. A balance sheet is a

documented report of a company's assets and obligations, as well as the residual ownership claims against equity at any given point in time. It is a cumulative record that reflects the result of all recorded accounting transactions since the enterprise was formed. By analyzing the balance sheet, investors, creditors and others can assess firm"s ability to meet short-term obligations and solvency, as well as the ability to pay all current and long-term debts as they come due. The balance sheet also shows the composition of assets and liabilities, the relative proportions of debt and equity financing and the amount of retained earnings.

Collectively, this information will be used by external parties to help assess the company's financial status, which is required by lending institutions and investors.

Balance Sheet is snap shot picture of an organization. Usually it is as on 31st March of a particular year. It is the statement of Liabilities (Sources of Fund) and Assets (Applications of Fund) as on that date.

Common Classifications: On the balance sheet you list your assets and equities under classifications according to their general characteristics. It is a relatively simple matter to make a comparison of one classification with another or to make comparisons within a classification because similar assets or similar equities are listed together. Some of the most commonly used classifications are:

Current Assets: Current assets include cash and other assets that in the normal course of events are converted into cash within the operating cycle. For example, a manufacturing enterprise will use cash to acquire inventories of materials. These inventories of materials are converted into finished products and then sold to customers. Cash is collected from the customers. This cycle from cash back to cash is called an operating cycle. In a merchandising business one part of the cycle is eliminated. Materials are not purchased for conversion into finished products. Instead, the finished products are purchased and are sold directly to the customers. Several operating cycles may be completed in a year. The time required to complete an operating cycle depends upon the nature of the business. The other assets are only held because they provide useful services and are excluded from the current asset classification. Current assets are usually listed in the order of their liquidity and frequently consist of cash, temporary investments, accounts receivable, inventories and prepaid expenses.

Cash: Cash is simply the money on hand and/or on deposit that is available for general business purposes. It is always listed first on a balance sheet. Cash held for some designated purpose, such as the cash held in a fund for eventual retirement of a bond issue, is excluded from current assets.

Marketable Securities: These investments are temporary and are made from excess funds that are not immediately needed to conduct operations. These investments in securities that can be converted into cash easily and are usually short-term government obligations.

Accounts Receivable: Accounts receivable are the amounts billed and owed to company on record date of balance sheet.

Inventories: Inventories are goods that are available for sale or products that are in a partial stage of completion, and the materials that will be used to create products.

Prepaid expenses: These expenses are payments made for services that will be received in the near future. Prepaid expenses will not be converted to current assets in order to

avoid penalizing companies that choose to pay current operating costs in advance rather than to hold cash. Often your insurance premiums or rentals are paid in advance.

Investments: Investments are cash funds or securities that you hold for a designated purpose for an indefinite period of time. Investments include stocks or the bonds you may hold for another company, real estate or mortgages that you are holding for income-producing purposes. Your investments also include money that you may be holding for a pension fund.

Plant Assets: Often classified as fixed assets, or as plant and equipment, plant assets include land, buildings, machinery, and equipment that are used in business operations over a relatively long period of time. It is not expected that these assets will be sold or converted into cash. Plant assets simply produce income indirectly through their use in operations.

Intangible Assets: Assets that lack physical substance are referred to as intangible assets and consist of valuable rights, privileges or advantages. Although intangibles lack physical substance, they still hold value for company. These valuable assets include items such as patents, franchises, organization expenses and goodwill. For example, in order to become incorporated you must incur legal costs. You can designate these legal costs as organizing expenses.

Other Assets: During the course of preparing balance sheet, it is noticed that certain assets cannot be classified as current assets, investments, plant assets, or intangible assets. These assets are listed on balance sheet as other assets. Frequently, other assets consist of advances made to company officers, the cash surrender value of life insurance on officers, the cost of buildings in the process of construction, and the miscellaneous funds held for special purposes.

Current Liabilities: Similar to Assets side of the Balance Sheet there Liabilities are classified as Current Liabilities and Long-Term Liabilities. Current Liabilities are obligations that will have to be discharged within the normal operating cycle of business. The amount you owe under current liabilities often arises as a result of acquiring current assets such as inventory or services that will be used in current operations. Amounts owed to trade creditors that arise from the purchase of materials or merchandise come under Accounts Payable. Other current liabilities may include the estimated amount payable for income taxes and the various amounts owed for wages and salaries of employees, utility bills, payroll taxes, local property taxes and other services.

Long-Term Liabilities: Debts that are not due until more than a year from the balance sheet date are generally classified as long-term liabilities. Notes, bonds and mortgages are often listed under this heading. If a portion of long-term debt is due within the next year, it should be removed from the long-term debt classification and shown under current liabilities.

Deferred Revenues: Customers may make advance payments for merchandise or services. The obligation to the customer will, as a general rule, be settled by delivery of the products or services and not by cash payment. Advance collections received from customers are classified as deferred revenues, pending delivery of the products or services.

Owner's Equity: Owner's equity is subdivided on Balance Sheet - One portion represents the amount invested directly by owner and the other portion of Retained Earnings and Surplus. The other portion represents net earnings that are retained. This rigid distinction is necessary because of the nature of any limited liability corporation. Stockholders or

owners, are not personally liable for the debts contracted by a company and their liability is limited to their equity investment. The owner's equity in an unincorporated business is shown more simply. The interest of each owner is given in total, usually with no distinction being made between the portion invested and the accumulated net earnings. The creditors are not concerned about the amount invested. If necessary, creditors can attach the personal assets of the owners.

2.6.1   PREPARING BALANCE SHEET

a)   TITLE AND HEADING

In practice, the most widely used title is Balance Sheet; however Statement of Financial Position is also acceptable. Naturally, when the presentation includes more than one time period the title "Balance Sheets" should be used.

b)   HEADING

In addition to the statement title, the heading of balance sheet should include the legal name of your company and the date or dates that your statement is presented. For example, a comparative presentation might be headed:

XYZ CORPORATION

BALANCE SHEET as on March 31, 2010

c)   FORMAT

There are two basic ways that balance sheets can be arranged. In Account Form, your assets are listed on the left-hand side and totaled to equal the sum of liabilities and stockholders' equity on the right-hand side. Another format is Report Form, a running format in which your assets are listed at the top of the page and followed by liabilities and stockholders' equity. Sometimes total liabilities are deducted from total assets to equal stockholders' equity.

d)   CAPTIONS

Captions are headings within your statement that designate major groups of accounts to be totaled or subtotaled. Your balance sheet should include three primary captions: Assets, Liabilities and Stockholders' Equity. In the report form of presentation, the placement of your primary captions would be as follows:

2009 2010 ASSETS, LIABILITIES AND STOCKHOLDERS' EQUITY

Except in certain specialized industries your balance sheet should include the following secondary captions:

CURRENT ASSETS

CURRENT LIABILITIES

Remaining assets and liabilities are generally combined into two or three other secondary captions, based on their materiality.

e)   Order of Presentation of Captions

First, start with items held primarily for conversion into cash and rank them in the order of their expected conversion. Then, follow with items held primarily for use in operations but that could be converted into cash, and rank them in the order of liquidity. Finally,

finish with items whose costs you will defer to future periods or that you cannot convert into cash. Following these guidelines, your major assets should normally be presented in the following order:

- Cash
- Short-term marketable securities
- Trade notes and accounts receivable
- Inventories
- Long-term investments
- Property and equipment
- Intangible assets
- Deferred charges

Liabilities are ordinarily presented in the order of maturity as follows:
- Demand notes
- Trade accounts payable
- Accrued expenses
- Long-term debt
- Other long-term liabilities

Components of stockholders' equity are usually presented the following order:
- Preferred stock
- Common stock
- Additional paid-in capital
- Retained earnings
- Accumulated other comprehensive income
- Treasury stock

2.7   SAMPLE TRIAL BALANCE SHEET

Trial Balance		
Cash	10000	
Accounts Receivable	28000	
Inventory	55000	
Prepaid Expenses	2000	
Equipment	25000	
Computers	15000	
Accum. Depr Equip		8000
Accum. Depr Computers		6000
Goodwill	10000	

Accounts Payable		25000
Expenses Payable		5000
Payroll Taxes Withheld		2500
Loans Payable - Short Term		10000
Loans Payable - Long Term		30000
Capital Stock		10000
Paid In Capital		5000
Retained Earnings		22000
	145000	**123500**
Net Profit		21500
	145000	145000

Table 2.   Sample Trial Balance Sheet

Balance Sheet	
Assets	
Current Assets:	
Cash	
Accounts Receivable	
Inventory	
Prepaid Expenses	
Fixed Assets:	
Equipment	
Equipment Depreciation	
Computers	
Computer Depreciation	
Other Assets:	
Goodwill	

Liabilities	
Current Liabilities:	
Accounts Payable	
Expenses Payable	
Payroll Taxes Withheld	
Loans Payable (short term)	
Long-term Liabilities:	
Loans Payable (long term)	
Shareholders' Equity	
Beginning Retained Earnings	
Net Income	
Capital Stock	
Paid in Capital	
Current Assets	
Accumulated Depreciation	
Net Fixed Assets	
Other Assets	
Total Assets	
Total Current Liabilities	
Total Long Term Liabilities	
Total Liabilities	
Ending Retained Earnings	
Total Shareholders' Equity	
Total Liabilities and Shareholders' Equity	

Table 3.   Sample Trial Balance Sheet

2.8   INTRODUCTION TO THE PROFIT AND LOSS ACCOUNT

The Meaning of Profit: The starting point in understanding the profit and loss account is to be clear about the meaning of **"profit".** Profit is the **incentive**for business. Profit is the reward for taking risk; generally speaking there is a direct relationship between risk and reward. All business are risky, so no reward means no business. No business means no jobs, no salaries and no goods and services.

Profit also has an important role in **allocating resources** (land, labour, capital and enterprise). Put simply, falling profits signal that resources should be taken out of that business and put into another one; rising profits signal that resources should be moved into this business. Without these signals we are left to guess as to what is the best use of society's scarce resources.

Profit and Loss Account is also known as Income Statement.

2.9   THE TASK OF ACCOUNTING - MEASURING PROFIT

The main task of accounts, therefore, is to monitor and measure profits.

Profit = Revenue minus Costs

So monitoring profit also means monitoring and measuring revenue and costs. There are two parts to this:-

 1) **Recording financial data**. This is the „book-keeping" part of accounting.

2) **Measuring the result.** This is the „financial" part of accounting. If we say "profits are high" this begs the question "high compared to what?" (You can look at this idea in more detail when covering Ratio Analysis)

Profits are "spent" in three ways.

- **Retained** for future investment and   growth.
- **Returned** to owners e.g. a „dividend".
- **Paid** as tax.

2.10   PARTS OF THE PROFIT AND LOSS ACCOUNT

The Profit & Loss Account aims to monitor profit. It has three parts.

1) The Trading Account.

This records the money in (revenue) and out (costs) of the business as a result of the business" „trading" i.e. buying and selling. This might be buying raw materials and selling finished goods; it might be buying goods wholesale and selling them retail. The figure at the end of this section is the **Gross Profit**.

2) The Profit And Loss Account

This starts with the Gross Profit and adds to it any further costs and revenues, including overheads. These further costs and revenues are from any other activities not directly related to trading. An example is income received from investments.

3) The Appropriation Account. This shows how the profit is „appropriated" or divided between the three uses mentioned above.

2.10.1 USES OF THE PROFIT AND LOSS ACCOUNT

1) The main use is to monitor and measure profit, as discussed above. This assumes that the information recording is accurate. Significant problems can arise if the information is inaccurate, either through incompetence or deliberate fraud.

2) Once the profit (loss) has been accurately calculated, this can then be used for comparison i.e. judging how well the business is doing compared to itself in the past, compared to the managers' plans and compared to other businesses.

3) There are ways to "fix" accounts. Internal accounts are rarely "fixed", because there is little point in the managers fooling themselves but public accounts are routinely "fixed" to create a good impression out to the outside world.

2.10.2 EXAMPLE OF PROFIT AND LOSS ACCOUNT

	Year N	Year N-1
	Rs '000	Rs '000
Revenue	12,500	10,000
Cost of Sales	7,500	6,000
Gross Profit	**5,000**	**4,000**
Gross profit margin *(gross profit / revenue)*	40%	40%
Operating Costs		
Sales and distribution	1,260	1,010
Finance and administration	570	555
Other overheads	970	895
Depreciation	235	210
Total Operating Costs	3,035	2,670
Operating Profit *(gross profit less operating costs)*	**1,965**	**1,330**
Operating profit margin (operating profit / revenue)	15.7%	13.3%
Interest	(450)	(475)
Profit before Tax	**1,515**	**855**
Taxation	(455)	(255)

Profit after Tax	**1,060**	**600**
Dividends	650	400
Retained Profits	**410**	**200**

Table 4.   Profit And Loss Account

2.11 CONCLUSION

Financial analysis determines a company's health and stability, providing an understanding of how the company conducts its business. But it is important to know that financial statement analysis has its limitations as well. Different accounting methods adopted by different firms' changes the visible health and profit levels for either better or worse. Different analysts may get different results from the same information. Hence, we must conclude that financial statement analysis is only one of the tools (although a major one) while taking an investment decision.

3   FINANCIAL STATEMENTS ANALYSIS

3.1   LEARNING OBJECTIVES

- Importance of financial statement analysis
- Types of financial statements
- Basics of financial ratios analysis and various types of ratios
- Uses and Limitations of Ratio analysis

3.2   INTRODUCTION

Financial statement analysis involves analyzing the firm's financial statements to extract information that can facilitate decision-making by the management or other stakeholders.

For example, an analysis of the financial statements can reveal:-

(a)   Whether the firm will be able to meet its long-term debt commitment,
(b)   Whether the firm is financially distressed,
(c)   Whether the company is using its physical assets efficiently,
(d)   Whether the firm has an optimal financing mix,
(e)   Whether the firm is generating adequate return for its shareholders,
(f)   Whether the firm can sustain its competitive advantage etc.

While the information used is historical, the intent is clearly to arrive at recommendations and forecasts for the future rather than provide a "picture of the past".

This lesson describes the importance of financial statement analysis, various types of financial statements prepared by the organisations, basics of financial ratios analysis, types of ratios, uses and limitations of ratio analysis.

3.3   IMPORTANCE OF FINANCIAL STATEMENT ANALYSIS

Financial statement analysis is an important tool to know about financial performance of the firm. By analysing financial statements and computing key ratios, the performance of a firm or organisation can be assessed on following parameters:- (a) How is the firm performing relative to the industry?

a.   How is the firm performing relative to the leading firms in its industry?
b.   How does the current year performance compare to the previous year(s)?
c.   What are the variables driving the key ratios?
d.   What are the linkages among the ratios?
e.   What do the ratios reveal about the future prospects of the firm for various stakeholders such as shareholders, bondholders, lenders, employees, customers etc.?

The information derived after analysis can be presented through a series of graphs and figures so that informed decisions can be taken. Financial analysis can be performed by both internal management and external groups. Firms would perform such an analysis in order to evaluate their overall current performance, identify problem/opportunity areas, develop plans and implement strategies for the future. External groups (such as investors, credit rating agencies, regulators, lenders, suppliers, customers etc.) also perform financial analysis in order to decide whether to invest in a particular firm, whether to extend credit etc. There are several rating agencies (such as

CRISIL, ICRA, FITCH etc.) that routinely perform financial analysis of firms in order to arrive at a credit rating.

3.4   ANNUAL REPORTS AND FINANCIAL STATEMENTS

The annual reports of companies typically contain: (a) Chairman's/Managing Director's/ CEO's letter to shareholders (b) Financial statements (c) Other information

Chairman's/Managing Director's/ *CEO's* letter which summarizes the operations of last year, explanations for good/bad performance and a discussion on the plans/goals for the immediate and long-term future.

3.4.1   FOUR FINANCIAL STATEMENTS

The firms are, typically, publishing financial statements every quarter/annually in the media for information of general public. These statements are prepared according to **Generally Accepted Accounting Principles (GAAP).** Generally Accepted Accounting Principles refers to the standard framework of guidelines for financial accounting used in any given jurisdiction; generally known as Accounting Standards. GAAP includes the standards, conventions and rules that accountants follow in recording and summarizing transactions and in the preparation of financial statements. These statements are audited by "independent auditors". However, as the recent corporate scandals have revealed, there are definitely too many gaps/loopholes in how the GAAP is implemented.

Nonetheless, financial statements are an invaluable source of information.

3.4.2   BALANCE SHEET

Balance sheet is also known as the Statement of Financial Position. This provides the value of firm's assets (what the firm owns), liabilities (what the firm owes to outsiders) and equity (what the shareholders or owners own) on a particular date. The value of assets will be equal to the value of liabilities plus owner's equity i.e. Assets = Liability + Equity. Items in the balance sheet are listed based on conservative principle i.e. if estimating or in doubt of the actual value, the value of assets is not be overstated and the value of liabilities is not be understated.

3.4.3   WHAT DO WE SEE IN THE BALANCE SHEET?

Assets: The balance sheet of a firm records the monetary value of the assets owned by the firm. Two major asset classes are tangible assets and intangible assets. Tangible assets contain various subclasses, including current assets and long-term/fixed assets. Current assets include cash, marketable securities, accounts receivable, inventory, pre-paid expenses etc. while long-term/fixed assets include such items as land, buildings, equipments, long-term bonds etc. Current assets are more liquid than fixed assets.

Marketable Securities: These are liquid securities that can be converted into cash quickly at a reasonable price. Examples of marketable securities include commercial paper, Treasury bills and other money market instruments.

Accounts Receivable: Accounts receivable represent money owed by other entities to the firm on the sale of products/services on credit. For example, pending bills for which payments are yet to be received.

Pre-paid Expenses: These are expenses paid in cash and recorded as assets before they are used or consumed (a common example is insurance).

Intangible assets are non physical resources and rights that have a value to the firm because they give the firm some kind of advantage in the market place. Examples of intangible assets are goodwill, copyrights, trademarks, patents, computer programmes etc.

Liabilities could include current liabilities (ex. bank advances, income tax payable, accounts payable, accrued expenses), deferred income taxes (difference between the tax reported on the income statement and tax reported on the tax return), minority interest in subsidiary companies (representing outside ownership in subsidiary companies), longterm debt (ex. Bonds, capital leases).

Accounts Payable: Accounts payable is the obligation that a firm owes to its creditors for buying goods or services. It is the unpaid invoices, bills, or statements for goods or services rendered by outside contractors, vendors or suppliers.

Accrued Expenses: Accrued expenses are the opposite of prepaid expenses. Firms will typically incur periodic expenses such as wages, interest and taxes. Even though they are to be paid at some future date, they are indicated on the firm's balance sheet from when the firm can reasonably expect their payment, until the time they are paid. An example would be accruing interest that is building up on a bank loan.

Shareholder Equity is the net worth of a company. It represents the stockholders' claim to the firm's' assets after all creditors and debts have been paid. Shareholder's Equity is also referred to as Owner's or Stockholders' Equity. It can be calculated by taking the total assets and subtracting the total liabilities. Equivalently, it is share capital plus retained earnings minus treasury shares (A treasury share is any stock that a company issues and then repurchases back from the investors).

Shareholder's Equity or Net Worth = Total assets – Total liabilities

<div align="center">Or</div>

Shareholder's Equity = Share capital + retained earnings – treasury shares

Shareholders' Equity comes from two main sources. The first and original source is the money that was originally invested in the company, along with any additional investments made thereafter. The second comes from retained earnings which the company is able to accumulate over time through its operations. In most cases, the retained earnings portion is the largest component.

If shareholder's Equity is negative, then firm is technically bankrupt.

Net worth in business is generally based on the value of all assets and liabilities at the carrying value which is the value as expressed on the financial statements. To the extent items on the balance sheet do not express their true (market) value, the net worth will also be inaccurate.

Net worth in this formulation is *not* an expression of the market value of the firm: the firm may be worth more (or less) if sold as a going concern.

Net worth or Book Value of a firm is the accounting value of a firm. It has two main uses:-

      (a)   It is the total value of the company's assets that shareholders would theoretically receive if a company were liquidated.

      (b)   By being compared to the company's market value, the book value can indicate whether a stock is under or overpriced.

Book Value per Share : A measure used by owners of common shares in a firm to determine the level of safety associated with each individual share after all debts are paid. Accordingly,

Book Value per Share =   Total shareholder's equity – preferred equity

Total outstanding shares

In simple terms it would be the amount of money that a holder of a common share would get if a company were to liquidate.

If shares of a firm are traded in the stock exchanges then market value of all outstanding shares shall indicate the market value of the company also known as market capitalisation of a company.

All assets (except land) lose their value over time and this is accounted for through depreciation (for fixed assets), depletion (for natural resources) and amortization (for intangible assets).

3.4.4   LIMITATIONS OF BALANCE SHEET

The balance sheet records the values of assets and liabilities in terms of their original cost. This is especially misleading for fixed assets as value of fixed assets may change over period of time. Also, it is difficult to value intangible assets. Current assets are less troublesome, partly because of their short-term nature (inventories and marketable securities are listed at lower of their cost or market values). Liabilities are also not biased (since they are generally contractual, and market values will be equal to their book values); For example, if the company has taken a loan, the rupee amount of loan obligation does not change with time.

3.4.5   INCOME STATEMENT

It is also known as The Statement of Earnings or Profit & Loss Statement or the Statement of Operations.

The income statement provides information on the various revenue and expense items during a certain period. Thus, this statement shows the total income generated in a certain period. Items in the income statement are based on accrual principle i.e. transactions (such as sales) are recognized when they occur and not when actual cash is received. Furthermore, the expenses are matched to when the revenue is recognized and not when the actual payment is made. The above principle makes it obvious that there could be wide discrepancy between a firm's revenue and actual cash flow.

There are several forms of income statement. An example of a generic form is as follows:

Sales Revenue - Cost of goods Sold

=   Gross Profit

-        Selling and Administrative expenses - Depreciation

=   Earnings Before Interest and Taxes (EBIT)

-        interest expenses (on bank loans and bonds) + interest income

=   Earnings before Taxes (EBT)

-        taxes (current and deferred)

=   Earnings after Taxes (EAT)

+ income from subsidiaries +/- Gains/Losses from discontinued operations

+/- Gain/loss on extraordinary items

=   Net Earnings

-           Preferred Stock Dividends

= Earnings available for common shareholders

3.4.6   LIMITATIONS OF INCOME STATEMENT

In finance, the focus is on "valuation" that requires knowledge of expected cash flows rather than historical earnings. It may be noted that net income does not equal the actual cash flow. This is because the income statement reports revenue/expenses when they are earned/accrued and not when actual cash is received. Further, several items are subjectively determined like depreciation. Further, depreciation is based on historical cost of the asset.   Thus, during periods of inflation, depreciation expense will be understated as it is based on historical cost while the revenues reflect the current market price. Such non-synchronization leads to inflated earnings. Furthermore, a traditional income statement only records transactions and not "opportunities".

3.4.7   STATEMENT OF RETAINED EARNINGS

(also known as Statement of Owner's Equity, Equity Statement or Statement of Shareholder's Equity)

It explains the changes in a company's retained earnings over the reporting period. It breaks down changes affecting the account, such as profits or losses from operations, dividends paid, and any other items charged or credited to retained earnings.

It may appear in the balance sheet, in a combined income statement & changes in retained earnings statement, or as a separate schedule.

Therefore, the statement of retained earnings uses information from the income statement and provides information to the balance sheet.

3.4.8   CASH FLOW STATEMENT

It shows how the company obtained cash and for what purpose they were used. Thus cash balance at the end =   Cash in the beginning + Net Cash flow from operations

+ Net Cash flow from financing (ex. proceeds from sale of bonds, repayment of   loan, payment of dividends)

+ Net Cash flow from investing activities (ex. Sale/purchase of assets).

3.4.9   OTHER INFORMATION IN THE ANNUAL REPORT

- •   Notes to financial statements
- •   The Auditor's report

3.4.10 WHAT YOU NEED TO KNOW ABOUT FINANCIAL STATEMENTS

Many financial scams in the past have brought to light that there is plenty wrong with the way financial results are reported. It is difficult to determine how much troubles were due to criminal activity, and how much due to poor judgment and loopholes.

So, here is a list of things to look for in financial statements that will tell you as much or more about the company than the actual reported results.

Frequent Restructuring Charges and Write-Downs - As businesses adjust their internal structure, they incur costs for shutting down one activity and starting another. In a small company, charges for these activities would occur infrequently, but in a large company, they will be routine. If charges and write downs for restructurings occur regularly, the company may be classifying normal business expenses as extraordinary to create the illusion that the core business is more profitable than it really is.

Reserve reversals - Companies generally establish reserves to cover the costs of restructuring. Reserves allow management to "store profits" for later use if the reserves are unusually large. At a later time, they can reverse the reserve for the amount that was not spent and it flows directly to the bottom line.

Footnotes to Financial Statements – Footnotes provides very important information related to the operations of the firm. It may indicate utilisation of funds raised, stock split, segment information, accounting practices used etc.

Sales/Non-Sales - Look at the revenue and receivable numbers over several years. Is the ratio of receivables to sales increasing? If yes, then the company is shipping goods faster than customers are paying for them. Are deferred revenues dropping? If so, the company is living off last year's sales.

Cash Flow is King - The professionals know that it is too easy to manipulate earnings numbers. So they focus on cash flow as being a more reliable indicator of performance because the cash is either there or it isn't.

3.5   FINANCIAL RATIO ANALYSIS

A popular way to analyze the financial statements is by computing ratios. A ratio is a relationship between two numbers, e.g. ratio of A: B = 30:10==> A is 3 times B. A ratio by itself may have no meaning. Hence, a given ratio is compared to (a) ratios from previous years - internal trends, or (b) ratios of other firms in the same industry - external trends.

Ratios are more of a diagnostic tool that helps us to identify problem areas and opportunities within a company. Obviously, since ratio is simply a comparison of two variables, the possibilities for number of ratios are endless. There is no "one" way of classifying various ratios so you may find different groupings depending on what text or article you read. Also, there are no specific rules on what is an "ideal or acceptable" number for a ratio, although there are some thumb rules being used in the industry.

The key ratios that are determined by the financial analysts provide insights on (a) liquidity (b) degree of financial leverage or debt (c) profitability (d) efficiency and (e) value.

3.5.1   ANALYZING LIQUIDITY

Liquid assets are those assets that can be converted into cash quickly. The short-term liquidity ratios show the firm's ability to meet short-term obligations. Thus a higher ratio would indicate a greater liquidity and lower risk for short-term lenders. As a rule of thumb, Current Ratio of 2:1 and Quick Ratio of 1:1 are acceptable. While high liquidity means that the company will not default on its short-term obligations but on the other hand by retaining assets as cash, valuable investment opportunities might be lost.

Obviously, Cash by itself does not generate any return. We will only get future return by investing the cash.

In quick ratio, we subtract the inventories from total current assets since they are the least liquid (among the current assets).

(a)   Current Ratio = Total Current Assets/Total Current Liabilities

(b)   Quick Ratio = Total Current Assets - Inventories /Total Current Liabilities

3.5.2   ANALYZING DEBT

These ratios show the extent to which a firm is relying on debt to finance its investments / operations and how well it can manage the debt obligation (i.e. repayment of principal and periodic interest). Obviously, if the company is unable to repay its debt or make timely payments of interest, it will be forced into bankruptcy. On the positive side, use of debt is beneficial as it provides valuable tax benefits to the firm.

3.5.3   LEVERAGE RATIOS

(i)   Asset-Equity Ratio or Leverage Ratio= Assets/Shareholder's Equity

This ratio shows firm's reliance on external debt for financing (or the degree of leverage). Any number above 1 shows that the company relies on external debt for financing some of its assets. If the number equals 1, it implies that the assets are fully financed by the shareholders.

Some analysts tend to use the Debt ratio and Debt/Equity ratio as defined below. These ratios also show company's reliance on external sources for financing its assets. Long term debt to capital ratio shows what proportion of the total long-term capital comes from debt.

(ii)   Total Debt Ratio = Total Debt/Total assets

(iii)   Debt-Equity Ratio = Total Debt/Equity

(iv)   Long-term Debt to Capital Ratio = Debt/Debt + Equity

For a lender, more important than the degree of leverage is the firm's ability to service the debt and this is captured in the following two ratios.

(v)   Interest Coverage Ratio = Earnings Before Interest & Taxes/ Annual Interest Expense

This shows the firm's ability to cover fixed interest charges on both short-term and longterm debt. The margin of safety that is acceptable will vary within and across industries, and will also depend on the earnings history of a firm.

(vi)   Cash Flow Coverage Ratio = Net Cash flow/Interest Expense

Net Cash flow is equal to Net Income +/- non-cash items (equity income + minority interest in earnings of subsidiary + deferred income taxes + depreciation + depletion + amortization expenses). Since depreciation is the biggest item in rupee term, often analysts would approximate net cash flow as being equivalent to EBIT + depreciation.

Cash flow is a "critical variable" in assessing a company. If a company is showing strong profits but has poor cash flow, you need to investigate further before passing a favorable opinion on the company. Financial analysts prefer this ratio to be 2 to 3.

3.5.4   ANALYZING SALES AND PROFITABILITY

Profitability is a relative term. It is hard to say "what % of profits" represents a profitable firm as the profits will depend on the product life cycle (for example profits will be lower in the initial years), competitive conditions in the market, borrowing costs, expense management etc.   Analysts will be interested in the (historical and forecasted) "trend" of sales/expenses/profits. Are the profits generally on the rise, are the sales stable or rising,

how do the profits compare to the industry average, is the market share of the company rising/stable/falling, are the expenses rising, stable or falling? The set of ratios here include some of the traditional earnings based performance measures such as ROA, ROE etc. For a better understanding of growth rates, it will be useful to know the "real growth rate" as opposed to "nominal growth rate". For example, it is quite possible that the sales growth rate figures are impressive due to inflation (rather than an increase in the number of items sold).

(a)   Sales Growth Rate = {(Current year sales – last year sales)/last year sales} x 100

(b)   Gross Profit Margin = (Sales - Cost of sold goods) / Sales

(c)   Operating Profit Margin = Operating Profit i.e. EBIT /Net Sales

(d)   Net Profit Margin = Net Profit /Net Sales

(e)   Return on Assets (ROA) = Net Income/Total Assets

(f)   Return on Equity (ROE) = Net Income or Profit/Shareholders' Equity

(g)   Payout Ratio = Cash Dividends/ Net Income

(h)   Retention Ratio = Retained Earnings/Net Income

(i)   Sustainable Growth Rate =   ROE x Retention ratio

Sustainable growth rate (SGR) is the maximum rate at which a company can grow revenue without having to invest new equity capital.

3.5.5   ANALYZING EFFICIENCY

These ratios reflect how well the firm's assets are being managed.   The inventory ratios show how fast the inventory is being produced and sold.

Inventory Turnover Ratio

It shows how quickly the inventory is being turned over (or sold) to generate sales. Higher ratio implies the firm is more efficient in managing inventories by minimizing the investment in inventories. High ratio by itself does not mean high level of efficiency as high ratio could also mean shortages. Ensure that there has been no change in inventory reporting policy (Last In First Out, First In First Out) during the analysis period. It is defined as:-

Inventory Turnover Ratio = Cost of Goods Sold/Average Inventory

Days in Inventory Ratio

It is referred to as the "shelf-life" i.e. how many days the inventory was held in the shelf. Days in Inventory Ratio = (Average Inventory/Cost of Sales) x 365

Assets Turnover Ratio

It shows how much sales the firm is generating for every rupee of investment in assets. Naturally, higher the better. However, note that this ratio is biased (as assets are listed at historical costs while sales are based on current prices).

Assets Turnover Ratio = Net Sales/Total Assets

Receivable Turnover and Average Collection Period Ratios

These ratios show the firm's efficiency in collections from credit sales. While a low ratio is good but it could also mean that the firm is being very strict in its credit policy and it

may drive away some customers. These are defined as:-- Receivables Turnover Ratio = Credit Sales/Accounts Receivables

Average Collection Period = (Accounts Receivable/Net Sales) x 365

Accounts Payable Turnover and Days AP Outstanding Ratios

These ratios focus on efficiency in making payments. Combining inventories, accounts receivable and accounts payable we get financing period ratio which shows the financing period to fund working capital needs. Longer the period, greater the short-term liquidity risk. These ratios are as under:--

Accounts Payable Turnover Ratio = Purchases/Accounts Payable

Days AP Outstanding Ratio = (Accounts Payable/Cost of Sales) x 365

Financing Period = Average Collection period + days in inventory – days AP outstanding

3.5.6   ANALYZING VALUE

Earnings per share (EPS) is a very important parameter for investors while making investment decisions. It indicates earnings generated by the firm per share. Due to regulatory requirements, the firms are reporting basic as well as diluted EPS. Basic EPS uses the actual number of shares currently outstanding while diluted EPS uses currently outstanding shares + all potential shares (due to convertibility of debt or preferred stock as well as exercise of stock options, rights and warrants).

Dividend yield, while widely reported, may not contain much useful information by itself (especially when comparing across firms) since dividend policies vary across firms. Further, appreciation of share price (as opposed to dividends) is more important source of income for the shareholders than dividend income.

Value ratio such as Price to Earnings (P/E) ratio is also used by the investors as an important parameter before making their investments. For example, a high P/E ratio may be regarded by someone as being a sign of "over pricing". When the markets are bullish or if the investor sentiment is optimistic about a particular stock, the P/E ratio will tend to be high indicating that investors are willing to pay a high price for company's earnings. For example, in late 1990s stocks of Internet companies had extremely high P/E ratios (despite their lack of earnings) reflecting investor's optimism about the future prospects of these companies. Of course, the burst of the bubble showed that such confidence was misplaced. Some of the most commonly used ratios are defined as under:--

(a)   Earnings per Common share (EPS)   = (<u>Net Earnings - Preferred Dividend)</u>

No. of shares outstanding

(b)   Earnings Yield   = 1/EPS

(c)   Cash flow per Share (CPS)   =   Net Cash Flows / No. of shares outstanding

(d)   Dividend Yield = Annual Dividend / Current Market price of share

(e)   Price-Earnings Ratio (P/E) = Market Price per Share / EPS

3.6   USES AND LIMITATIONS OF RATIO ANALYSIS

The ratio analysis can be used :

- To evaluate performance of the firm(compared to previous years & peers);
- To set benchmarks or standards for performance
- To highlight areas that need to be improved or highlight areas that offer the most promising future potential
- To enable external parties (such as investors/lenders) in assessing the creditworthiness/profitability of the firm.
- Though ratio analysis provide insights into the performance of the firms and is being widely used in the industry but it has certain limitations as mentioned below:
- There is a considerable amount of subjectivity involved as there is no theory as to what should be the "right" number for the various ratios. Further, it is hard to reach a definite conclusion when some of the ratios are favourable and some are unfavourable.
- Ratios may not be strictly comparable for different firms due to a variety of factors such as different accounting practices, different fiscal year etc. Furthermore, if a firm is engaged in diverse product lines, it is difficult to identify the industry category to which the firm belongs. Also, just because a specific ratio is better than the average does not necessarily mean that the company is
- doing well (it is quite possible rest of the industry is doing very poorly)
- Ratios are based on financial statements that reflect the past and not the future.   Unless the ratios are stable, one cannot make reasonable projections about the future trend.
- Financial statements provide an assessment of the costs and not value. For example, the market value of items may be very different from the cost figure given in the balance sheet.
- Financial statements do not include all items. For example, it is hard to put a value on human capital (such as management expertise).
- Accounting standards and practices vary across countries and thus hamper meaningful global comparisons.
- Management decision making is a dynamic process in a constantly changing environment while ratio analysis is a static analysis based on historical data.
- The linkage among various ratios is not readily obvious.

3.7   CONCLUSION

An annual report contains basic financial statements, viz., Balance Sheet, Statement of Profit and Loss and Cash Flow Statement. It also carries management's discussion of corporate performance of the year under review for futuristic prospects. Commonly used tools of financial analysis are: Comparative statements, Common size statement, trend analysis, ratio analysis, and cash flow analysis. An important tool of financial statement analysis is ratio analysis. Accounting ratios represent relationship between two Accounting numbers. Financial statements aim at providing financial information about a Business enterprise to meet financial the information needs of the decision-makers.

Financial statements prepared by a business enterprise in the corporate sector are published and are available to the decision-makers. These statements provide financial data which require analysis, comparison and interpretation for taking decision by the external as well as internal users of accounting information. This act is termed as financial statement analysis. It is regarded as an integral and important part of accounting.

4   ANALYSIS OF FINANCIAL PERFORMANCE

4.1   LEARNING OBJECTIVES:-

- Introduction of Financial Performance

- Financial performance analysis

4.2   INTRODUCTION

Finance is a branch of economics concerned with providing funds to individuals, businesses, and governments. Finance allows these entities to use credit instead of cash to purchase goods and invest in projects. For example, an individual can borrow money from a bank to buy a home. An industrial firm can raise money through investors to build a new factory. Governments can issue bonds to raise money for projects. Finance plays an important role in the economy. As banks, credit unions, and other financial institutions provide credit, they help expand the economy by directing funds from savers to borrowers. For example, a bank acquires large amounts of money from the deposits of individual savers. The bank does not let this money sit idle but instead provides loans to borrowers who might then build a house or expand a business. The savings of millions of people percolate through many financial institutions, spurring economic growth.

A wide variety of financial institutions have different roles in finance and the economy. Some institutions, such as banks, link lenders and borrowers. These institutions act as an intermediary among consumers, businesses, and governments by lending out deposits. Other institutions, such as stock exchanges, provide a market for existing securities, which include stocks and bonds. Stock exchanges encourage investment because they enable investors to sell their securities when the need arises. Many aspects of finance are studied individually. Corporate finance centers on how businesses can best raise and spend their funds. Public finance focuses on the financial role of federal, state, and local governments. Public Finance is the field of economics concerned with how governments raise money, how that money is spent, and the effects of these activities on the economy and on society. Public finance studies how governments at all levels whether national, state, and local provide the public with desired services and how they secure the financial resources to pay for these services.

Governments provide public goods, government-financed items and services such as roads, military forces, lighthouses, and street lights. Private citizens would not voluntarily pay for these services, and therefore businesses have no incentive to produce them. Public finance also enables governments to correct or offset undesirable side effects of a market economy. These side effects are called spillovers or externalities. For example, households and industries may generate pollution and release it into the environment without considering the adverse effect pollution has on others. If it costs less to pollute than not to, people and businesses have a financial incentive to continue polluting. Pollution is a spillover because it affects people who are not responsible for it. To correct a spillover, governments can encourage or restrict certain activities. For example, governments can sponsor recycling programs to encourage less pollution, pass laws that restrict pollution, or impose charges or taxes on activities that cause pollution. Public finance provides government programs that moderate the incomes of the wealthy and the poor. These programs include social security, welfare, and other social programs. For example, some elderly people or people with disabilities require financial assistance because they cannot work. Governments redistribute income by collecting taxes from

their wealthier citizens to provide resources for their needy ones. The taxes fund programs that help support people with low incomes.

Financial analysis is something of an art. Experienced managers, investors and analysts develop a data bank of information over time, and after doing many such analyses, that they bring to bear every time they review a company. One cannot analyze the numbers in a vacuum. The numbers only provide indicators to trigger further questions. Financial indicators vary from industry to industry; the ratios can only be interpreted when compared and contrasted with other companies in that industry. For example, financial indicators are (and should be) different among financial institutions, manufacturing companies, companies that provide services, and technology and computer information and services companies.

4.3   FINANCIAL PERFORMANCE ANALYSIS

refers to an assessment of the viability, stability and profitability of a business, sub-business or project. It is performed by professionals who prepare reports using ratios that make use of information taken from financial statements and other reports. These reports are usually presented to top management as one of their bases in making business decisions. Based on these reports, management may:

• Continue or discontinue its main operation or part of its business; Make or purchase certain materials in the manufacture of its product;

• Acquire or rent/lease certain machineries and equipment in the production of its goods;

• Issue stocks or negotiate for a bank loan to increase its working capital;

• Make decisions regarding investing or lending capital;

Financial analysts often assess the firm's:

Profitability - its ability to earn income and sustain growth in both short-term and long-term. A company's degree of profitability is usually based on the income statement, which reports on the company's results of operations;

Solvency- its ability to pay its obligation to creditors and other third parties in the long-term;

Liquidity - its ability to maintain positive cash flow, while satisfying immediate obligations; Both 2 and 3 are based on the Company's Balance Sheet, which indicates the financial condition of a business as of a given point in time.

Stability- the firm's ability to remain in business in the long run, without having to sustain significant losses in the conduct of its business. Assessing a company's stability requires the use of both the income statement and the balance sheet, as well as other financial and non-financial indicators.

Below given are the generic steps that can be followed to get deeper into the meaning of the numbers.

STEP 1. Acquire the company's financial statements for several years. As a minimum, get the following statements, for at least 3 to 5 years.

• Balance sheets
• Income statements
• Shareholders equity statements
• Cash flow statements

STEP 2. Quickly scan all of the statements to look for large movements in specific items from one year to the next. For example, did revenues have a big jump, or a big fall, from one particular year to the next? Did total or fixed assets grow or fall? If one finds anything that looks very suspicious, research the information you have about the company to find out why. For example, did the company purchase a new division, or sell off part of its operations, that year?

STEP 3. Review the notes accompanying the financial statements for additional information that may be significant to desired analysis.

STEP 4. Examine the balance sheet. Look for large changes in the overall components of the company's assets, liabilities or equity. For example, have fixed assets grown rapidly in one or two years, due to acquisitions or new facilities? Has the proportion of debt grown rapidly, to reflect a new financing strategy? If one finds anything that looks very suspicious, research the information about the company to find out why.

STEP 5. Examine the income statement. Look for trends over time. Calculate and graph the growth of the following entries over the past several years.

·   Revenues (sales)
·   Net income (profit, earnings)

Are the revenues and profits growing over time? Are they moving in a smooth and consistent fashion, or erratically up and down? Investors value predictability, and prefer more consistent movements to large swings.

For each of the key expense components on the income statement, calculate it as a percentage of sales for each year. For example, calculate the percent of cost of goods sold over sales, general and administrative expenses over sales, and research and development over sales. Look for favorable or unfavorable trends. For example, rising G&A expenses as a percent of sales could mean lavish spending. Also, determine whether the spending trends support the company's strategies. For example, increased emphasis on new products and innovation will probably be reflected by an increased proportion of spending on research and development.

Look for non-recurring or non-operating items. These are "unusual" expenses not directly related to ongoing operations. However, some companies have such items on almost an annual basis. How do these reflect on the earnings quality? If you find anything that looks very suspicious, research the information about the company to find out why.

STEP 6. Examine the shareholder's equity statement. Has the company issued new shares, or bought some back? Has the retained earnings account been growing or shrinking? Why? Are there signals about the company's long-term strategy here?

STEP 7. Examine the cash flow statement, which gives information about the cash inflows and outflows from operations, financing, and investing.

While the income statement provides information about both cash and non-cash items, the cash flow statement attempts to reconstruct that information to make it clear how cash is obtained and used by the business, since that is what investors and creditors really care about.

If one finds anything that looks very suspicious, research the information about the company to find out why.

STEP 8. Calculate financial ratios in each of the following categories, for each year. You may use the formulas found in the textbook, or other materials you have from your finance and accounting courses. Some of the useful ratios are :

Liquidity ratios
Leverage (or debt) ratios
Profitability ratios
Efficiency ratios
Value ratios

Graph the ratios over time, to find the trends in the ratios from year to year. Are they going up or down? Is that favorable or unfavorable? This should trigger further questions in your mind, and help you to look for the underlying reasons.

STEP 9. Obtain data for the company's key competitors, and data about the industry.

For competitor companies, you can get the data and calculate the ratios in the same way you did for the company being studied. Compare the ratios for the competitors and the industry to the company being studied. Is the company favorable in comparison? Do you have enough information to determine why or why not? If you don't, you may need to do further research.

STEP 10. Review the market data you have about the company's stock price, and the price to earnings (P/E) ratio.

Try to research and understand the movements in the stock price and P/E over time. Determine in your own mind whether the stock market is reacting favorably to the company's results and its strategies for doing business in the future.

STEP 11. Review the dividend payout. Graph the payout over several years. Determine whether the company's dividend policies are supporting their strategies. For example, if the company is attempting to grow, are they retaining and reinvesting their earnings rather than distributing them to investors through dividends? Based on your research into the industry, are you convinced that the company has sufficient opportunities for profitable reinvestment and growth, or should they be distributing more to the owners in the form of dividends? Viewed another way, can you learn anything about their long-term strategies from the way they pay dividends?

STEP 12. Review all of the data that you have generated. You will probably find that there is a mix of positive and negative results. The analysis leads answer to the question "Whether *this company is worth investing in for the long term?"*

A popular way to analyze the financial statements is by computing ratios. A ratio is a relationship between two numbers, e.g. ratio of A: B = 1.5:1 ==> A is 1.5 times B. A ratio by itself may have no meaning. Hence, a given ratio is compared to:

• Ratios from previous years for internal trends

• Ratios of other firms from the same industry for external trends.

4.4   CONCLUSION

Financial analysis determines a company's health and stability, providing an understanding of how the company conducts its business. But it is important to know that financial statement analysis has its limitations as well. Different accounting methods adopted by different firms' changes the visible health and profit levels for either better or worse. Different analysts may get different results from the same information. Hence, we

must conclude that financial statement analysis is only one of the tools (although a major one) while taking an investment decision.

5   VARIABLE COSTS & FIXED COSTS

5.1   LEARNING OBJECTIVES

- Introduction to Fixed and Variable Cost.
- Marginal Cost (mc) & Average Total Cost (atc)
- Break-Even Point
- Margin of Safety

5.2   INTRODUCTION

Variable Costs and Fixed Costs: All the costs faced by companies can be broken into two main categories: fixed costs and variable costs.

Fixed Costs are costs that are independent of output. These remain constant throughout the relevant range and are usually considered sunk for the relevant range (not relevant to output decisions). Fixed costs often include rent, buildings, machinery, etc.

Variable Costs are costs that vary with output. Generally variable costs increase at a constant rate relative to labor and capital. Variable costs may include wages, utilities, materials used in production, etc.

In accounting they also often refer to mixed costs. These are simply costs that are part fixed and part variable. An example could be electricity--electricity usage may increase with production but if nothing is produced a factory still may require a certain amount of power just to maintain itself.

5.3   MARGINAL COST (MC) & AVERAGE TOTAL COST (ATC)

Total cost is variable cost and fixed cost combined.

TC=VC+FC

Now divide total cost by quantity of output to get average total cost.

ATC=TC/Q

Average total cost can be very handy for firms to compare efficiency at different output or when adjusting different factors of production.

MARGINAL COST is what it costs to produce *one more unit*. It's hard to find exactly what the cost of the last unit is, but it's not hard to find the average cost of a group of a few more units. To find this, simply take the change in costs from a previous level divided by the change in quantity from the previous level.

MC = Change in TC / Change in Q

Take a look at the table below to see how marginal cost was computed. For example, the marginal cost when the quantity is 56 is $2.82. This was computed by taking TC at 55.90Q ($350) minus TC at 38.16Q ($300) divided by 55.9Q minus 38.16Q (17.74Q).

MARGINAL REVENUE: Revenue is simply the amount of money a firm receives. If a firm is selling one product at a homogenous price (each unit sold is the same price) then total revenue will equal price times quantity.

TR = P * Q

Marginal revenue is another important measure. Marginal revenue is the revenue obtained from the *last unit* sold. This is computed by taking the change in total revenue divided by the change in quantity.

MR = Change in TR / Change in Q

For competitive firms, marginal revenue isn't very interesting. If all units are sold for the market price, then marginal revenue will simply be the market price. In the table below, you can see that the marginal revenue is constant for all cakes sold--$6. From that information, and by remembering that we are talking about a competitive market, we can easily tell that the market price for cakes is $6. So the *last cake* will be sold for $6 as long as the market price remains constant. Competitive firms have a constant MR curve. A cake sold for $6 is $6 of additional revenue.

However, marginal revenue is very different for monopolies. Monopolies have a decreasing marginal revenue curve. The marginal revenue a monopoly gets from selling an additional unit will always be less than the price the unit is sold for. Since a monopoly's output affects the market price (unlike a competitive firm's output), the monopolist will get revenue equal to the price from selling an additional unit; however, in order to sell an additional unit, the monopolist must decrease the price for all units sold, and this is revenue that the monopolist loses. The sum of the revenue gained from selling the additional unit and the revenue lost from lowering the price on all units is the monopoly's marginal revenue.

Price	Quantity Demanded	Total Revenue	Marginal Revenue
$ 9	1	9	9
$ 8	2	16	7
$ 7	3	21	5
$ 6	4	24	3
$ 5	5	25	1
$ 4	6	24	-1
$ 3	7	21	-3
$ 2	8	16	-5
$ 1	9	9	-7
$-	10	0	-9
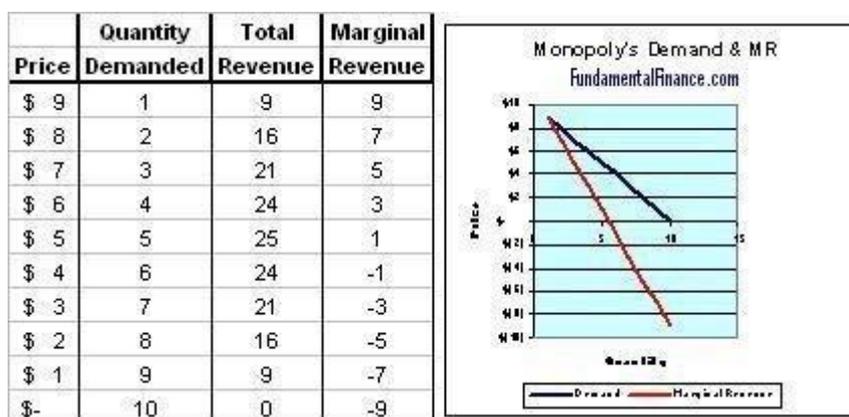
Figure 6:   **Marginal Revenue curve**

Below is an example of a firm's cost schedule and a graph of the fixed and variable costs. Noticed that the fixed cost curve is flat and the variable cost curve has a constant upward slope.

Bakers (Labor)	Cakes (Q)	Total Revenue (TR)	Marg. Rev. MR=ΔTR/ΔQ	Fixed Cost (FC)	Variable Cost (VC)	Total Cost TC=FC+VC	Avg. TC ATC=TC/Q	Marginal Cost MC=ΔTC/ΔQ
1	19.53	$ 117	$ 6.00	$ 200	$ 50	$ 250	$ 12.80	$ 2.56
2	38.16	$ 229	$ 6.00	$ 200	$ 100	$ 300	$ 7.86	$ 2.68
3	55.90	$ 335	$ 6.00	$ 200	$ 150	$ 350	$ 6.26	$ 2.82
4	72.80	$ 437	$ 6.00	$ 200	$ 200	$ 400	$ 5.49	$ 2.96
6	104.17	$ 625	$ 6.00	$ 200	$ 300	$ 500	$ 4.80	$ 3.19
8	132.50	$ 795	$ 6.00	$ 200	$ 400	$ 600	$ 4.53	$ 3.53
10	157.99	$ 948	$ 6.00	$ 200	$ 500	$ 700	$ 4.43	$ 3.92
13	191.36	$ 1,148	$ 6.00	$ 200	$ 650	$ 850	$ 4.44	$ 4.49
16	219.44	$ 1,317	$ 6.00	$ 200	$ 800	$ 1,000	$ 4.56	$ 5.34
20	249.61	$ 1,498	$ 6.00	$ 200	$ 1,000	$ 1,200	$ 4.81	$ 6.63
25	277.32	$ 1,664	$ 6.00	$ 200	$ 1,250	$ 1,450	$ 5.23	$ 9.02
30	295.78	$ 1,775	$ 6.00	$ 200	$ 1,500	$ 1,700	$ 5.75	$ 13.55
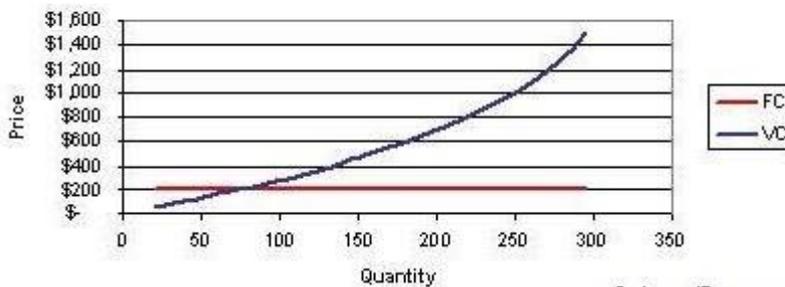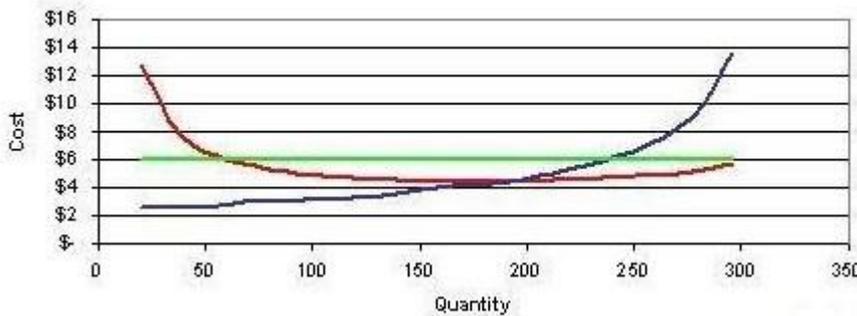
Figure 7:   **Fixed and Variable costs graph**

Take a look at the graph. ATC curve is a U-shape. This is always the case if there are increasing marginal costs. You'll also notice that the MC curve intersects the ATC curve at the ATC curve's minimum point. This will always be the case if there are increasing marginal costs.

In other words, the marginal cost is factored into the average total cost at every unit. Because of fixed cost, marginal cost almost always begins below average total cost. As quantity increases, ATC will decrease and MC will increase. Eventually they intersect, then MC continues to increase and pulls ATC up after it.

5.4   BREAK-EVEN POINT

Break-even point for a product is the point where total revenue received equals the total costs associated with the sale of the product ($T_R = T_C$). A break-even point is typically calculated in order for businesses to determine if it would be profitable to sell a

proposed product, as opposed to attempting to modify an existing product instead so it can be made lucrative. Break even analysis can also be used to analyze the potential profitability of an expenditure in a sales-based business. Break-even point (for output) = fixed cost / contribution per unit contribution (p.u) = selling price (p.u) - variable cost (p.u) break-even point (for sales) = fixed cost / contribution (pu) * sp (pu)

5.5   MARGIN OF SAFETY

Margin of safety represents the strength of the business. It enables a business to know what is the exact amount he/ she has gained or lost and whether they are over or below the break-even point.

margin of safety = (current output - breakeven output/current output margin of safety% = current output - breakeven output/current output x 100 If P/V ratio is given then profit/ PV ratio

In unit sales: If the product can be sold in a larger quantity than occurs at the break-even point, then the firm will make a profit; below this point, the firm will make a loss. Breakeven quantity is calculated by:

Total fixed costs / (selling price - average variable costs). Explanation - in the denominator, "price minus average variable cost" is the variable profit per unit, or contribution margin of each unit that is sold. This relationship is derived from the profit equation: Profit = Revenues - Costs where Revenues = (selling price * quantity of product) and Costs = (average variable costs * quantity) + total fixed costs. Therefore, Profit = (selling price * quantity) - (average variable costs * quantity + total fixed costs).

Solving for Quantity of product at the breakeven point when Profit equals zero, the quantity of product at break-even is Total fixed costs / (selling price - average variable costs).

Firms may still decide not to sell low-profit products, for example those not fitting well into their sales mix. Firms may also sell products that lose money - as a loss leader, to offer a complete line of products, etc. But if a product does not break even, or a potential product looks like it clearly will not sell better than the break even point, then the firm will not sell, or will stop selling, that product.

An example:

- Assume we are selling a product for Rs2 each.
- Assume that the variable cost associated with producing and selling the product is 60p.
- Assume that the fixed cost related to the product (the basic costs that are incurred in operating the business even if no product is produced) is Rs1000.
- In this example, the firm would have to sell (1000 / (2.00 - 0.60) = 715) 715 units to break even.

Total Income (Net profit) = Total expenses (costs)

NI = TC = Fixed cost + Variable cost

Selling Price x Quantity = Fixed cost + Quantity x Variable cost (cost/unit)

SP x Q = FC + Q x VC

Quantity x (SP-V) = Fc Break Even = $FC / (SP - VC)$

where FC is Fixed Cost, SP is Selling Price and VC is Variable Cost

Cost-Volume-Profit(CVP), in managerial economics is a form of cost accounting. It is a simplified model, useful for elementary instruction and for short-run decisions.

Cost-volume-profit (CVP) analysis expands the use of information provided by breakeven analysis. A critical part of CVP analysis is the point where total revenues equal total costs (both fixed and variable costs). At this breakeven point (BEP), a company will experience no income or loss. This BEP can be an initial examination that precedes more detailed CVP analysis.

Cost-volume-profit analysis employs the same basic assumptions as in breakeven analysis. The assumptions underlying CVP analysis are:

The behaviour of both costs and revenues is linear throughout the relevant range of activity. (This assumption precludes the concept of volume discounts on either purchased materials or sales.) Costs can be classified accurately as either fixed or variable. Changes in activity are the only factors that affect costs. All units produced are sold (there is no ending finished goods inventory). When a company sells more than one type of product, the sales mix (the ratio of each product to total sales) will remain constant.

The components of Cost-Volume-Profit Analysis are:

- Level or volume of activity
- Unit Selling Prices
- Variable cost per unit
- Total fixed costs
- Sales mix

ASSUMPTIONS: CVP assumes the following:

- Constant sales price;
- Constant variable cost per unit;
- Constant total fixed cost;
- Constant sales mix;
- Units sold equal units produced.

These are simplifying, largely linearizing assumptions, which are often implicitly assumed in elementary discussions of costs and profits. In more advanced treatments and practice, costs and revenue are nonlinear and the analysis is more complicated, but the intuition afforded by linear CVP remains basic and useful.

One of the main Methods of calculating CVP is Profit volume ratio: which is (contribution /sales)*100 = this gives us profit volume ratio.

- Contribution stands for Sales minus variable costs.

Therefore it gives us the profit added per unit of variable costs. Basic graph
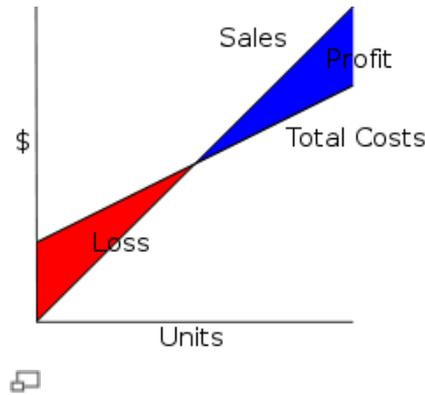
Figure 8:   **Basic graph of CVP**

Basic graph of CVP, demonstrating relation of Total Costs, Sales, and Profit and Loss. The assumptions of the CVP model yield the following linear equations for total costs and total revenue (sales):

$$\text{Total Costs} = \text{Fixed Costs} + \text{Unit Variable Cost} \times \text{Number of Units}$$
$$\text{Total Revenue} = \text{Sales Price} \times \text{Number of Units}$$

These are linear because of the assumptions of constant costs and prices, and there is no distinction between Units Produced and Units Sold, as these are assumed to be equal.

Note that when such a chart is drawn, the linear CVP model is assumed, often implicitly. In symbols:

$$TC = TFC + V \times X$$
$$TR = P \times X$$

where

TC = Total Costs

TFC = Total Fixed Costs

V = Unit Variable Cost (Variable Cost per Unit)

X = Number of Units

TR = S = Total Revenue = Sales

P = (Unit) Sales Price

Profit is computed as TR-TC; it is a profit if positive, a loss if negative.

Break down Costs and Sales can be broken down, which provide further insight into operations.
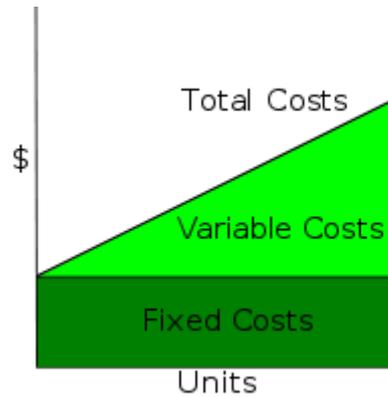
Figure 9:   **Decomposition of total costs**

Decomposing Total Costs as Fixed Costs plus Variable Costs.

One can decompose Total Costs as Fixed Costs plus Variable Costs:

$$TC = TFC + V \times X$$
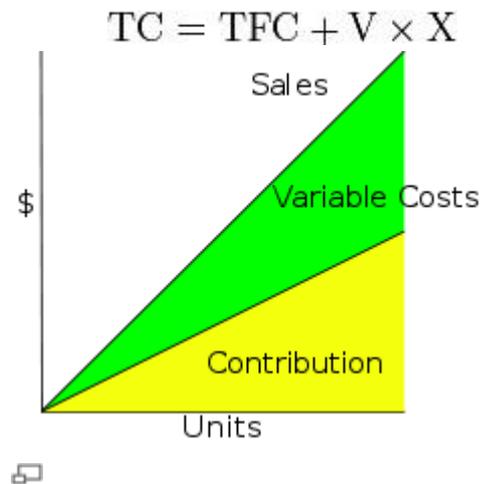
Figure 10:   **Decomposition of sales**

Decomposing Sales as Contribution plus Variable Costs.

Following a matching principle of matching a portion of sales against variable costs, one can decompose Sales as Contribution plus Variable Costs, where contribution is "what's left after deducting variable costs". One can think of contribution as "the marginal contribution of a unit to the profit", or "contribution towards offsetting fixed costs". In symbols:

$$TR = P \times X$$
$$= \big((P - V) + V \big) \times X$$
$$= (C + V) \times X$$
$$= C \times X + V \times X$$

where C = Unit Contribution (Margin)
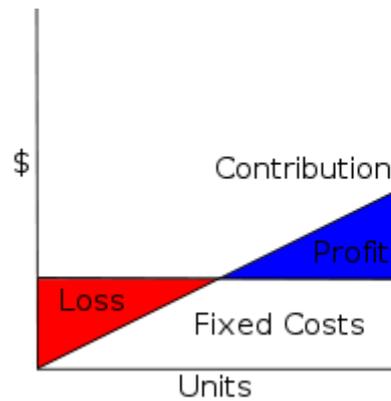
Figure 11:   **Profit and Loss**

Profit and Loss as Contribution minus Fixed Costs.

Subtracting Variable Costs from both Costs and Sales yields the simplified diagram and equation for Profit and Loss. In symbols:

$$\begin{aligned} PL = TR - TC \\ = (C + V) \times X - (TFC + V \times X) \\ = C \times X - TFC \end{aligned}$$
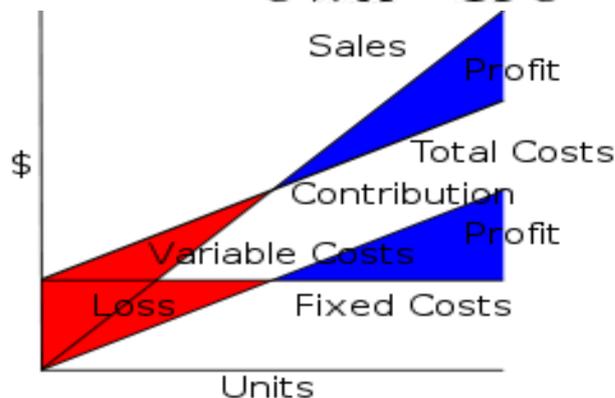
Figure 12:   **Simplified graph for profit and loss**

APPLICATIONS: CVP simplifies the computation of breakeven in break even analysis, and more generally allows simple computation of Target Income Sales. It simplifies analysis of short run trade-offs in operational decisions.

LIMITATIONS: CVP is a short run, marginal analysis: it assumes that unit variable costs and unit revenues are constant, which is appropriate for small deviations from current production and sales, and assumes a neat division between fixed costs and variable costs, though in the long run all costs are variable. For longer-term analysis that considers the entire life-cycle of a product, one therefore often prefers activity-based costing or throughput accounting.

5.6   CONCLUSION

A set of cost management tools out of the box to help you manage, monitor, and, ultimately, optimize your costs. To get started, identify someone to set the standard for cloud excellence at your organization, get started using cost management tools, and define and track against a set of cost-related benchmarks for cost optimization. As your cost management capabilities grow, you can begin to use more advanced metrics, set budgets and alerts, and use advanced analytics to identify additional savings opportunities.

6   REVENUE AND PROFIT ANALYSIS AND FORECASTING

6.1   LEARNING OBJECTIVES

- Understanding how cost and revenue analysis can help financial sustainability
- Considering the benefits of cost and revenue analysis.
- Forecasting Methods

6.2   UNDERSTANDING HOW COST AND REVENUE ANALYSIS CAN HELP FINANCIAL SUSTAINABILITY

Managers today in both the public and private sectors must determine what actions to take now to ensure the financial sustainability of their organizations in the future. Analyzing the costs involved in providing services and the sources and flow of revenues helps managers make decisions about the best use of resources and ways to recover costs. Conducted together, cost and revenue analyses help managers answer key management questions, such as:

- What portion of the organization's costs is covered by service revenues?
- How can a facility or an organization provide quality services at the lowest cost?
- What are the financial implications of changing the mix of services?

Managers can use electronic spreadsheets to look at both the clinical and the financial factors that affect cost recovery and financial sustainability. These factors include the:

- mix of services;
- staffing patterns;
- amount of time staff members spend delivering services;
- amount of time staff members spend on administrative tasks;
- use of non-staff resources (supplies, facility, etc.);
- income of a service measured against its costs;
- achievement of established performance objectives;
- sharing of revenues among different categories of service and/or among several facilities.

It is important to keep in mind that the information provided by a cost and revenue analysis is only one aspect of strategic planning. Factors such as quality, equity, the presence of alternative service providers, and client needs must also be taken into account. Managers should consider the findings from a cost and revenue analysis along with other factors when making decisions.

6.3   CONSIDERING THE BENEFITS OF COST AND REVENUE ANALYSIS

Cost and revenue analyses provide you with the financial and operational information needed for making good management decisions. These analyses help you to take a close look at the efficiency of your existing programs and identify changes to improve cost efficiency. Cost and revenue analyses also help you to explore the potential impact of your management decisions.

Cost and revenue analyses can help you determine:

•   how to reduce costs in order to ensure the long-term viability of your organization;

•   how to produce the greatest total increase in your revenues relative to your costs; the most cost efficient process for delivering your services.

6.3.1   PROFIT ANALYSIS:

It refers to the techniques used to generate an overall performance evaluation from the financial perspective. It is a broader level of analysis than the standard cost variance analysis for manufacturing costs and includes those variances as well as several others.

There are four factors that affect any type of multi-product profit measurement. These include: 1) Sales prices, 2) Unit costs, 3) Sales volume, and 4) Sales mix. Remember the underlying assumptions in the master budget and conventional linear cost-volume-profit analysis, i.e., constant sales prices, constant unit variable costs, and constant sales mix. This chapter shows how to analyze the differences between the static master budget and actual performance recognizing that prices, costs and sales mix are not constant. Profit measurements that can be analyzed include manufacturing margin, contribution margin, gross profit, throughput and net income. Measurements based on the ABC cost hierarchy could also be used such the contributions at the unit, batch, product and facility levels. Each type of analysis involves explaining the difference between the actual and budgeted (or some previous period's) profit measurements in terms of sales price, unit cost, sales volume and, when applicable, sales mix. An overall view of profit analysis appears in the graphic illustration presented below.
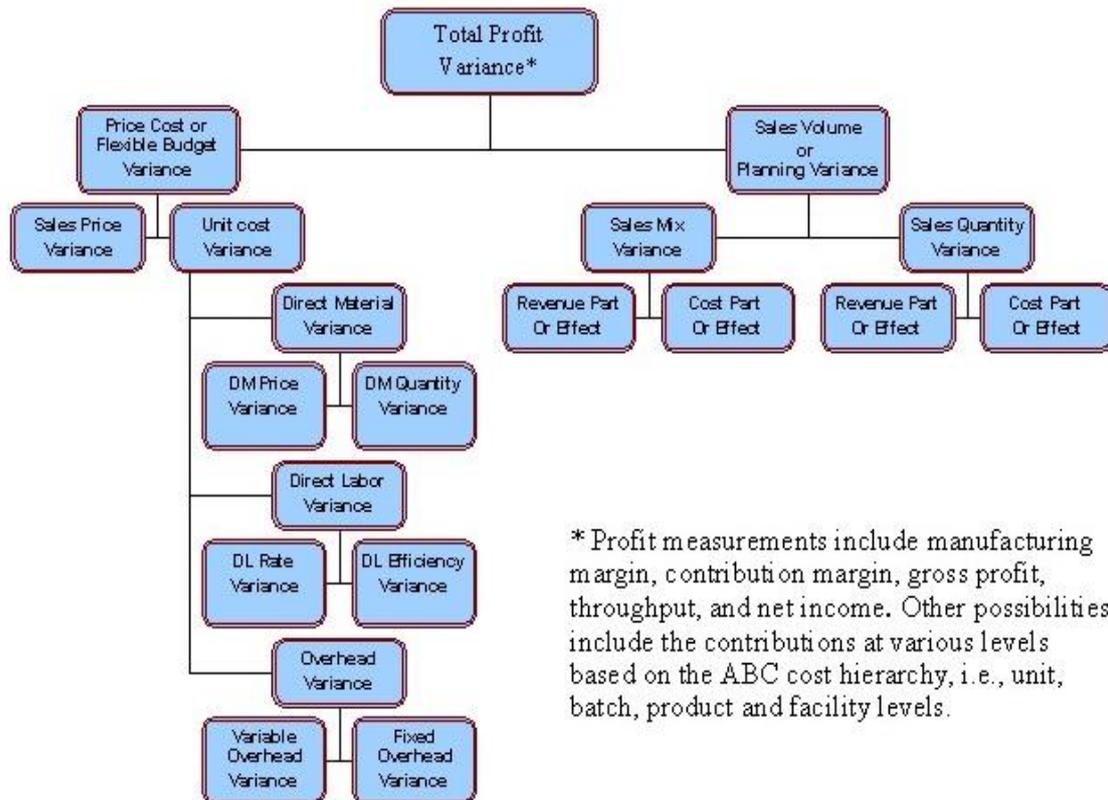
Figure 13:   **Profit Analysis**

The approach to profit analysis is essentially the same regardless of the type of profit measurement involved. However, the form of the data available to the analyst determines the specific calculations required. The data may be in the form of: 1) Units and dollars, or

2) Dollars only. If the data are in the form of units and dollars, i.e., unit sales, unit prices, and unit costs, then the effects of all four elements, i.e., sales price, unit cost, sales volume, and sales mix can be determined. However, if the data are in the form of dollars only, then only the effects of sales prices, unit costs, and sales volume can be accurately determined. This is usually not a problem however, since the sales mix variances are only useful when the products involved may be purchased as substitutes for each other.

A **variance** is the difference between a budgeted, planned or standard amount and the actual amount incurred/sold. Variances can be computed for both costs and revenues.

The concept of variance is intrinsically connected with planned and actual results and effects of the difference between those two on the performance of the entity or company.

Forecasting: Forecasting involves the use of analytical techniques to project the amount of financial resources available in the future, the costs likely to incur thereby allowing projections of cash flow and profit statements. Forecasting attempts to identify the relationship between the factors that drive revenues and the revenues a company collects. The ability to accurately project future resources is critical to avoiding budgetary shortfalls.

6.3.2   THE FORECASTING PROCESS

The following steps are applied to each type of revenue to be forecast.

•   The first step involves selecting a time period over which revenue data is examined. The length of time depends on the availability and quality of data, the type of revenue to be forecasted, and the degree of accuracy sought.

•   In the second step, the data is examined to determine any patterns, rates of change, or trends that may be evident. Patterns may suggest that the rates of change are relatively stable or changing exponentially. Once the trend is identified, the forecaster needs to decide to what degree the revenue is predictable. This is done by examining the underlying characteristics of the revenue, such as the rate structures used to collect the revenue, changes in demand, or seasonal or cyclical variation.

•   Forecasters next need to understand the underlying assumptions associated with the revenue source. They need to consider to what degree the revenue is affected by economic conditions, changing citizen demand, and changes in government policies.

These assumptions help determine which forecasting method is most appropriate.

•   The next step is to actually project revenue collections in future years. The method selected to perform the projection depends on the nature and type of revenue. Revenue sources with a high degree of uncertainty, such as new revenues and grants or asset sales, may employ a qualitative forecasting method, such as consensus or expert forecasting. Revenues that are generally predictable will typically be forecast using a quantitative method, such as a trend analysis or regression analysis.

•   After the projections have been made, the estimates need to be evaluated for their reliability and validity. To evaluate the validity of the estimates, the assumptions associated with the revenue source are re-examined. If the assumptions associated with existing economic, administrative, and political environment are sound, the projections are assumed valid. Reliability is assessed by conducting a sensitivity analysis. This involves varying key parameters used to create the estimates.

If large changes in the estimates result, the projection is assumed to have a low degree of reliability.

•   In the sixth step, actual revenue collections are monitored and compared against the estimates. Monitoring serves both to assess the accuracy of the projections and to determine whether there is likely to be any budget shortfall or surplus.

•   Finally, as conditions affecting revenue generation change, the forecast will need updating. Fluctuations in collections may be caused by unexpected changes in economic conditions, policy and administrative adjustments, or in patterns of consumer demand.

6.4   FORECASTING METHODS

There are a wide range of forecasting techniques available. They range from relatively informal qualitative techniques to highly sophisticated quantitative techniques. In revenue forecasting, more sophisticated does not necessarily mean more accurate. In fact, an experienced finance officer can often "guess" what is likely to happen with a great deal of accuracy. In general, forecasters use a variety of techniques, recognizing that some perform better than others depending on the nature of the revenue source.

6.4.1   QUALITATIVE FORECASTING METHODS

Qualitative forecasting methods rely on judgments about future revenue collection. These techniques are often referred to as judgmental or non-extrapolative approaches. In addition to their relatively small dependence on numbers, these techniques frequently do not provide a rigorous specification of underlying assumptions. Among the most commonly used methods of forecasting is *judgmental forecasting*. This technique involves having an individual or small group of people make assessments of likely future conditions. While sounding ad hoc, the technique can produce very good estimates, especially when experienced persons are involved. The forecaster will utilize experience in conjunction with consideration of historical trends, current economic conditions, and other factors relevant to the revenue source. Judgmental approaches tend to work best when background conditions are changing rapidly. When economic, political or administrative conditions are in flux, quantitative methods may not capture important information about factors that are likely to alter historical patterns. A variation of the judgmental approach is *consensus forecasting*. As might be suspected, however, judgmental approaches can be subject to bias and other sources of error. Following are the major weaknesses of qualitative forecasting methods:

a) anchoring events – allowing recent events to influence perceptions about future events, e.g. the city hosting a recent major convention influencing perceptions about future room taxes
b) information availability – over-weighting the use of readily available information
c) false correlation – forecasters incorporating information about factors that are assumed to influence revenues, but do not
d) inconsistency in methods and judgments – forecasters using different strategies over time to make their judgments, making them less reliable
e) selective perceptions – ignoring important information that conflicts with the forecaster's view about causal relationships
f) wishful thinking – giving undue weight to what forecasters and government officials would like to see happen

g) Group think – when the dynamics of forming a consensus tends to lead individuals to reinforce each other's views rather than maintaining independent judgments.

h) Political pressure – where forecasters adjust estimates to meet the imperatives of budgetary constraints or balanced budgets.

6.4.2 QUANTITATIVE FORECASTING METHODS

Quantitative methods relay on numerical data relevant to the revenue source. Quantitative methods also make explicit the assumptions and procedures used to generate forecasts. Finally, quantitative methods will also generally assign a margin of error to forecasts, providing a indication of the degree of uncertainty associated with the estimates.

There are two general types of quantitative forecasting methods. The first is a time series approach that consists of a large number of techniques that generally use past trends to project future revenues. The second general approach, while still incorporating time series data, constructs causal models that use the variables assumed to influence the level of particular revenue. Today, computer software exists that automatically applies the appropriate technique given the characteristics of the data entered. The underlying assumption of time series techniques is that patterns associated with past values in a data series can be used to project future values. In general, quantitative methods do a better job of predicting future revenues than do qualitative methods.

6.5   CONCLUSION

Proper demand forecasting enables better planning and utilization of resources for business to be competitive. Forecasting is an integral part of demand management since it provides an estimate of the future demand and the basis for planning and making sound business decisions. A mismatch in supply and demand could result in excessive inventory and stock outs and loss of profit and goodwill. Both qualitative and quantitative methods are available to help companies forecast demand better. Since forecasts are seldom completely accurate, management must monitor forecast errors and make the necessary improvement to the forecasting process.

Forecast made in isolation tend to be inaccurate. Collaborative planning, forecasting, and replenishment are an approach is which companies work together to develop mutually agreeable plans and take responsibility for their actions. The objectives of CPFR is to optimize the supply chain by generating a consensus demand forecast, delivering the right product at the right time to the right location, reducing inventories, avoiding stock outs, and improving customer services. Major corporations such as Wall-Mart, Warner-Lambert, and Proctor & Gamble are early adopters of CPFR. Although the benefits of CPFR are well recognized, wide spread adoption has not materialized.

7   TELECOM STRATEGY CONCEPTS

7.1   LEARNING OBJECTIVES

- Explain strategy concepts
- Elaborate strategy formulation
- Understand strategy evaluation
- Explain general approaches to strategic management
- Explain strategy hierarchy
- Explain reasons why strategy plans fails
- Strategic Competitive Advantage
- Limitations of strategic management

7.2   INTRODUCTION

Strategy refers to a plan of action designed to achieve a particular goal . The word is of military origin, deriving from the Greek word *strategos*, which roughly translates as *general*. In military usage strategy is distinct from tactics, which are concerned with the conduct of an engagement, while strategy is concerned with how different engagements are linked. How a battle is fought is a matter of tactics: the terms and conditions that it is fought on and whether it should be fought at all is a matter of strategy.

In game theory, a strategy refers to one of the options that a player can choose. That is, every player has a set of possible strategies, and must choose one of the choices.

7.3   STRATEGY CONCEPTS

Strategic or institutional management is the conduct of drafting, implementing and evaluating cross-functional decisions that will enable an organization to achieve its long-term objectives.

It is the process of specifying the organization's mission, vision and objectives, developing policies and plans, often in terms of projects and programs, which are designed to achieve these objectives and then allocating resources to implement the policies, and plans, projects and programs. A balanced scorecard is often used to evaluate the overall performance of the business and its progress towards objectives.

Strategic management is a level of managerial activity under setting goals and over Tactics. Strategic management provides overall direction to the enterprise and is closely related to the field of Organization Studies.

In the field of business administration it is useful to talk about "strategic alignment" between the organization and its environment or "strategic consistency". There is strategic consistency when the actions of an organization are consistent with the expectations of management, and these in turn are with the market and the context.

Strategic management is an ongoing process that evaluates and controls the business and the industries in which the company is involved; assesses its competitors and sets goals and strategies to meet all existing and potential competitors; and then reassesses each strategy annually or quarterly [i.e. regularly] to determine how it has been implemented and whether it has succeeded or needs replacement by a new strategy to meet changed circumstances, new technology, new competitors, a new economic environment., or a new social, financial, or political environment.

Strategic Management basically seeks to answer the question: How and why do some firms outperform others?

7.3.1   WHY STRATEGIC MANAGEMENT?

Strategic Management is necessary because it:

a) Provides a framework for thinking about the business.

b) Creates a fit between the organization and its external environment.

c) Provides a process of coping with change and organizational renewal

d) Fosters anticipation, innovation, and excellence

e) Facilitates consistent decision-making

f) Creates organizational focus

g) Acts as a process of organizational leadership

h) Helps the organization to succeed (outperform) against its competition

7.4   STRATEGY FORMULATION

It refers to the process of choosing the most appropriate course of action for the realization of organizational goals and objectives and thereby achieving the organizational vision. The process of strategy formulation basically involves six main steps. Though these steps do not follow a rigid chronological order, however they are very rational and can be easily followed in this order.

1. Setting Organizations' objectives - The key component of any strategy statement is to set the long-term objectives of the organization. It is known that strategy is generally a medium for realization of organizational objectives. Objectives stress the state of being there whereas Strategy stresses upon the process of reaching there. Strategy includes both the fixation of objectives as well the medium to be used to realize those objectives. Thus, strategy is a wider term which believes in the manner of deployment of resources so as to achieve the objectives.

2. While fixing the organizational objectives, it is essential that the factors which influence the selection of objectives must be analyzed before the selection of objectives. Once the objectives and the factors influencing strategic decisions have been determined, it is easy to take strategic decisions.

3. Evaluating the Organizational Environment - The next step is to evaluate the general economic and industrial environment in which the organization operates. This includes a review of the organizations competitive position. It is essential to conduct a qualitative and quantitative review of an organizations existing product line. The purpose of such a review is to make sure that the factors important for competitive success in the market can be discovered so that the management can identify their own strengths and weaknesses as well as their competitors' strengths and weaknesses.

4. After identifying its strengths and weaknesses, an organization must keep a track of competitors' moves and actions so as to discover probable opportunities of threats to its market or supply sources.

5. Setting Quantitative Targets - In this step, an organization must practically fix the quantitative target values for some of the organizational objectives. The idea behind this is to compare with long term customers, so as to evaluate the

contribution that might be made by various product zones or operating departments.

6. Aiming in context with the divisional plans - In this step, the contributions made by each department or division or product category within the organization is identified and accordingly strategic planning is done for each sub-unit. This requires a careful analysis of macroeconomic trends.

7. Performance Analysis - Performance analysis includes discovering and analyzing the gap between the planned or desired performance. A critical evaluation of the organizations past performance, present condition and the desired future conditions must be done by the organization. This critical evaluation identifies the degree of gap that persists between the actual reality and the long-term aspirations of the organization. An attempt is made by the organization to estimate its probable future condition if the current trends persist.

8. Choice of Strategy - This is the ultimate step in Strategy Formulation. The best course of action is actually chosen after considering organizational goals, organizational strengths, potential and limitations as well as the external opportunities.

7.5 STRATEGY EVALUATION

Measuring the effectiveness of the organizational strategy, it's extremely important to conduct a SWOT analysis to figure out the strengths, weaknesses, opportunities and threats (both internal and external) of the entity in question. This may require to take certain precautionary measures or even to change the entire strategy.

In corporate strategy, a generic model exists in which strategic options are evaluated against three key success criteria:

a) Suitability (would it work?)
b) Feasibility (can it be made to work?)
c) Acceptability (will they work it?)

7.6 SUITABILITY

Suitability deals with the overall rationale of the strategy. The key point to consider is whether the strategy would address the key strategic issues underlined by the organization's strategic position.

• Does it make economic sense?

• Would the organization obtain economies of scale, economies of scope or experience economy?

• Would it be suitable in terms of environment and capabilities?

Tools that can be used to evaluate suitability include:

• Ranking strategic options

• Decision trees

7.7 FEASIBILITY

Feasibility is concerned with whether the resources required to implement the strategy are available, can be developed or obtained. Resources include funding, people, time and information.

Tools that can be used to evaluate feasibility

- cash flow analysis and forecasting
- break-even analysis
- resource deployment analysis

7.8   ACCEPTABILITY

Acceptability is concerned with the expectations of the identified stakeholders (mainly shareholders, employees and customers) with the expected performance outcomes, which can be return, risk and stakeholder reactions.

•   **Return** deals with the benefits expected by the stakeholders (financial and nonfinancial). For example, shareholders would expect the increase of their wealth, employees would expect improvement in their careers and customers would expect better value for money.

•   **Risk** deals with the probability and consequences of failure of a strategy (financial and non-financial).

•   **Stakeholder** reactions deal with anticipating the likely reaction of stakeholders. Shareholders could oppose the issuing of new shares, employees and unions could oppose outsourcing for fear of losing their jobs, customers could have concerns over a merger with regards to quality and support.

7.9   TOOLS THAT CAN BE USED TO EVALUATE ACCEPTABILITY INCLUDE:

- what-if analysis
- stakeholder mapping

7.10   GENERAL APPROACHES TO STRATEGIC MANAGEMENT

In general terms, there are two main approaches, which are opposite but complement each other in some ways, to strategic management:

7.10.1 THE INDUSTRIAL ORGANIZATIONAL APPROACH

- based on economic theory — deals with issues like competitive rivalry, resource allocation, economies of scale
- assumptions — rationality, self discipline behavior, profit maximization

7.10.2 THE SOCIOLOGICAL APPROACH

- deals primarily with human interactions
- Assumptions — bounded rationality, satisfying behavior, profit suboptimality. An example of a company that currently operates this way is Google

Strategic management techniques can be viewed as bottom-up, top-down, or collaborative processes. In the bottom-up approach, employees submit proposals to their managers who, in turn, funnel the best ideas further up the organization. This is often accomplished by a capital budgeting process. Proposals are assessed using financial criteria such as return on investment or cost-benefit analysis. Cost underestimation and benefit overestimation are major sources of error. The proposals that are approved form the substance of a new strategy, all of which is done without a grand strategic design or a strategic architect. The top-down approach is the most common by far. In it, the CEO, possibly with the assistance of a strategic planning team, decides on the overall direction

the company should take. Some organizations are starting to experiment with collaborative strategic planning techniques that recognize the emergent nature of strategic decisions.

7.11 THE STRATEGY HIERARCHY

In most (large) corporations there are several levels of management. Strategic management is the highest of these levels in the sense that it is the broadest - applying to all parts of the firm - while also incorporating the longest time horizon. It gives direction to corporate values, corporate culture, corporate goals, and corporate missions. Under this broad corporate strategy there are typically business-level competitive strategies and functional unit strategies.

Corporate strategy refers to the overarching strategy of the diversified firm. Such a corporate strategy answers the questions of "which businesses should we be in?" and "how does being in these businesses create synergy and/or add to the competitive advantage of the corporation as a whole?"

Business strategy refers to the aggregated strategies of single business firm or a strategic business unit (SBU) in a diversified corporation. According to Michael Porter, a firm must formulate a business strategy that incorporates either cost leadership, differentiation or focus in order to achieve a sustainable competitive advantage and long-term success in its chosen areas or industries. Alternatively, an organization can achieve high growth and profits by creating a Blue Ocean Strategy that breaks the previous value-cost tradeoff by simultaneously pursuing both differentiation and low cost. Blue Ocean strategy is to create new demand in an uncontested market space, than by competing head-to-head with other suppliers for known customers in an existing industry

Functional strategies include marketing strategies, new product development strategies, human resource strategies, financial strategies, legal strategies, supply-chain strategies, and information technology management strategies. The emphasis is on short and medium term plans and is limited to the domain of each department's functional responsibility. Each functional department attempts to do its part in meeting overall corporate objectives, and hence to some extent their strategies are derived from broader corporate strategies.

Many companies feel that a functional organizational structure is not an efficient way to organize activities so they have reengineered according to processes or SBUs. A strategic business unit is a semi-autonomous unit that is usually responsible for its own budgeting, new product decisions, hiring decisions, and price setting. An SBU is treated as an internal profit centre by corporate headquarters. A technology strategy, for example, although it is focused on technology as a means of achieving an organization's overall objective(s), may include dimensions that are beyond the scope of a single business unit, engineering organization or IT department.

An additional level of strategy called operational strategy was encouraged by Peter Drucker in his theory of management by objectives (MBO). It is very narrow in focus and deals with day-to-day operational activities such as scheduling criteria. It must operate within a budget but is not at liberty to adjust or create that budget. Operational level strategies are informed by business level strategies which, in turn, are informed by corporate level strategies.

In case of multiple division company, each operating division (also called strategic business units) can be treated as a semi-independent profit centre with its own

revenues, costs, objectives, and strategies. Several techniques have been developed to analyze the relationships between elements in a portfolio.

Probably the most influential strategist of the decade was Michael Porter. He introduced many new concepts including; 5 forces analysis, generic strategies, the value chain, strategic groups, and clusters. In 5 forces analysis he identifies the forces that shape a firm's strategic environment. It is like a SWOT analysis with structure and purpose. It shows how a firm can use these forces to obtain a sustainable competitive advantage. Porter's generic strategies detail the interaction between cost minimization strategies, product differentiation strategies, and market focus strategies.

Figure 14:   **Porter's 5 Force Model**

7.12   REASONS WHY STRATEGIC PLANS FAIL

There are many reasons why strategic plans fail, especially:

7.12.1 FAILURE TO EXECUTE BY OVERCOMING THE FOUR KEY ORGANIZATIONAL HURDLES

- Cognitive hurdle
- Motivational Hurdle
- Resource hurdle
- Political hurdle

7.12.2 FAILURE TO UNDERSTAND THE CUSTOMER

- Why do they buy
- Is there a real need for the product
- Inadequate or incorrect marketing research
- Inability to predict environmental reaction

7.12.3   WHAT WILL COMPETITORS DO

- Fighting brands
- Price wars

7.12.4 WILL GOVERNMENT INTERVENE

- Over-estimation of resource competence
- Can the staff, equipment, and processes handle the new strategy
- Failure to develop new employee and management skills
- Failure to coordinate
- Reporting and control relationships not adequate
- Organizational structure not flexible enough
- Failure to obtain senior management commitment
- Failure to get management involved right from the start
- Failure to obtain sufficient company resources to accomplish task
- Failure to obtain employee commitment
- New strategy not well explained to employees
- No incentives given to workers to embrace the new strategy
- Under-estimation of time requirements
- No critical path analysis done

7.12.5 FAILURE TO FOLLOW THE PLAN

- No follow through after initial planning
- No tracking of progress against plan
- No consequences for above

- Failure to manage change
- Inadequate understanding of the internal resistance to change
- Lack of vision on the relationships between processes, technology and organization
- Poor communications
- Insufficient information sharing among stakeholders
- Exclusion of stakeholders and delegates

Competitive advantage: At the most fundamental level, firms create competitive advantage by perceiving or discovering new and better ways to compete in an industry and bringing them to market, which is ultimately an act of innovation. Innovations shift competitive advantage when rivals either fail to perceive the new way of competing or are unwilling or unable to respond. There can be significant advantages to early m overs responding to innovations, particularly in industries with significant economies of scale or when customers are more concerned about switching suppliers. The most typical causes of innovations that shift competitive advantage are the following:

- new technologies
- new or shifting buyer needs
- the emergence of a new industry segment

- shifting input costs or availability
- changes in government regulations

7.13 HOW IS COMPETITIVE ADVANTAGE IMPLEMENTED?

The value chain is a systematic way of examining all the activities a firm performs and how they interact. It scrutinizes each of the activities of the firm (e.g. development, marketing, sales, operations, etc.) as a potential source of advantage. The value chain maps a firm into its strategically relevant activities in order to understand the behavior of costs and the existing and potential sources of differentiation. Differentiation results, fundamentally, from the way a firm's product, associated services, and other activities affect its buyer's activities. All the activities in the value chain contribute to buyer value, and the cumulative costs in the chain will determine the difference between the buyer value and producer cost.

A firm gains competitive advantage by performing these strategically important activities more cheaply or better than its competitors. One of the reasons the value chain framework is helpful is because it emphasizes that competitive advantage can come not just from great products or services, but from anywhere along the value chain. It's also important to understand how a firm fits into the overall value system, which includes the value chains of its suppliers, channels, and buyers.

7.14 LIMITATIONS OF STRATEGIC MANAGEMENT

In an uncertain and ambiguous world, fluidity can be more important than a finely tuned strategic compass. When a strategy becomes internalized into a corporate culture, it can lead to group think. It can also cause an organization to define itself too narrowly.

7.14.1 THE LINEARITY TRAP

It is tempting to think that the elements of strategic management – (i) reaching consensus on corporate objectives; (ii) developing a plan for achieving the objectives; and (iii) marshalling and allocating the resources required to implement the plan – can be approached sequentially. It would be convenient, in other words, if one could deal first with the noble question of ends, and then address the mundane question of means.

But in the world in which strategies have to be implemented, the three elements are interdependent. Means are as likely to determine ends as ends are to determine means. The objectives that an organization might wish to pursue are limited by the range of feasible approaches to implementation. There will usually be only a small number of approaches that will not only be technically and administratively possible, but also satisfactory to the full range of organizational stakeholders. In turn, the range of feasible implementation approaches is determined by the availability of resources.

The process of developing organizational strategy must be iterative. It involves toggling back and forth between questions about objectives, implementation planning and resources. An initial idea about corporate objectives may have to be altered if there is no feasible implementation plan that will meet with a sufficient level of acceptance among the full range of stakeholders, or because the necessary resources are not available, or both.

Even the most talented manager would no doubt agree that "comprehensive analysis is impossible" for complex problems. Formulation and implementation of strategy must thus occur side-by-side rather than sequentially, because strategies are built

on assumptions which, in the absence of perfect knowledge, will never be perfectly correct.

Strategic management is necessarily a "repetitive learning cycle [rather than] a linear progression towards a clearly defined final destination." While assumptions can and should be tested in advance, the ultimate test is implementation. Organization will inevitably need to adjust corporate objectives and approach to pursuing outcomes and/or assumptions about required resources. Thus a strategy will get remade during implementation because "humans rarely can proceed satisfactorily except by learning from experience; and modest probes, serially modified on the basis of feedback, usually are the best method for such learning."

It serves little purpose (other than to provide a false aura of certainty sometimes demanded by corporate strategists and planners) to pretend to anticipate every possible consequence of a corporate decision, every possible constraining or enabling factor, and every possible point of view. At the end of the day, what matters for the purposes of strategic management is having a clear view – based on the best available evidence and on defensible assumptions – of what it seems possible to accomplish within the constraints of a given set of circumstances. As the situation changes, some opportunities for pursuing objectives will disappear and others arise. Some implementation approaches will become impossible, while others, previously impossible or unimagined, will become viable.

7.15   CONCLUSION

"Strategy is the direction and scope of an organization over the long-term: which achieves advantage for the organization through its configuration of resources within a challenging environment, to meet the needs of markets and to fulfill stakeholder expectations".

The essence of being ―strategic‖ thus lies in a capacity for "intelligent trial-and error" rather than linear adherence to finally honed and detailed strategic plans. Strategic management will add little value -- indeed, it may well do harm -- if organizational strategies are designed to be used as a detailed blueprints for managers. Strategy should be seen, rather, as laying out the general path - but not the precise steps - by which an organization intends to create value. Strategic management is a question of interpreting, and continuously reinterpreting, the possibilities presented by shifting circumstances for advancing an organization's objectives. Doing so requires strategists to think simultaneously about desired objectives, the best approach for achieving them, and the resources implied by the chosen approach. It requires a frame of mind that admits of no boundary between means and ends.

8   BROADBAND AND MPLS NETWORK

8.1   LEARNING OBJECTIVES

- Concept of Broad Band and MPLS network.
- MPLS based VPN

8.2   BROADBAND NETWORK

Core of BSNL's Broadband service is National Internet Backbone (NIB). NIB is a mission to build world-class infrastructure to help accelerate the Internet revolution in India. It has following features:

- It provides a diversified range of Internet access services including support for VPN (Layer-2, Layer-3 and Dialup and Broadband services)
- It also offers SLA Reports including security, QoS (quality of service) and any to any connectivity.
- 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
- 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
- Broadcast TV using IP Multicasting service
- Multicast video streaming services
- Interactive Distant learning using IP multicasting Services
- Video on demand
- Interactive gaming service

NIB has been implemented in four projects

Name of project	Description
Project 1	MPLS based IP Infrastructure (The backbone consisting of Core & Edge Routers)
Project 2.1	Narrowband Access (Dialup Remote Access)
Project 2.2	Broadband Access (DSL Access)
Project 3	Messaging, Storage, Provisioning, Billing, Security, Order Management, Enterprise Management, AAA, Help Desk and Inventory Management.

Table 5.   NIB Project

8.2.1   COMPONENTS OF BROAD BAND ACCESS NETWORK

- DSL CPEs (MODEM)
- Digital Subscriber Line Access Multiplexers (DSLAMs)
- Gigabit and Fast Ethernet Aggregation Switches (LAN Switches) / Tier-I, Tier-II Switches
- Broad band Remote Access Server (BBRAS)
- SSSS/SSSC (Subscriber Service Selection System/ Centre)
- Servers for AAA, LDAP at NOC.
- Provisioning and configuration management at NOC.
- 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 km.
- 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 capable of driving upto 10km on a single mode fibre.
- The SX or GBIC module in LAN Switch used for connecting Tier2 to Tier1. 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.

NIB-II A1,A2,A3,A4,B1& B2
ROUTER CONNECTIVITY DIAGRAM
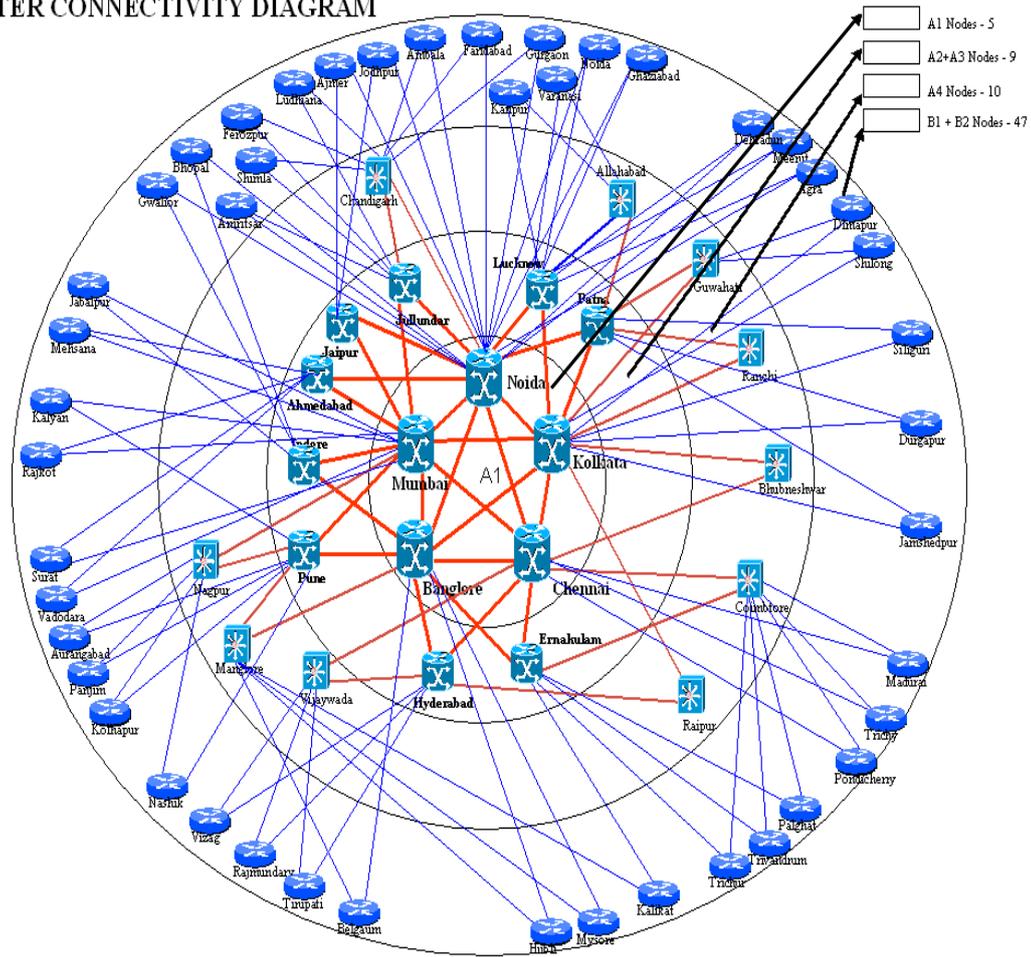
Figure 15:   **Router Connectivity Diagram**
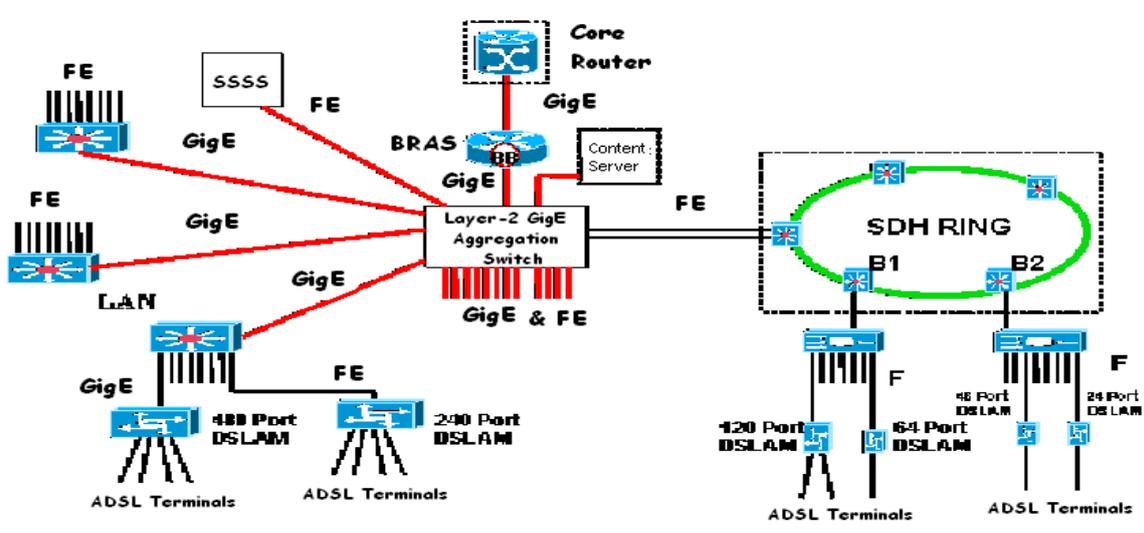
Figure 16:   **Block Schematic of Broadband Access Network**

8.2.2   COMPONENTS OF BROADBAND MULTIPLAY:

The BSNL's Broadband Multiplay network consists of the following 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) through L3PE
- RPR Tier-1 Switch
- Provides connectivity from BNG to Tier –2 network
- RPR Tier-2 Switch
- OC LAN Tier-2 Switch
- DSLAM
- ADSL CPE
- DSL Tester

8.2.3   CHANGES IN BROADBAND MULTIPLAY VIZ-A-VIZ BROADBAND

- T1 & T2 changed from star topology to RPR ring topology – High reliability
- IP-DSLAM connected on GE interface as compared to FE interface.
- BNG behaves as customer edge router whereas BRAS was a PE Router.
- BRAS were present at 23 "A" locations only whereas BNG is present up to "B" type cities.
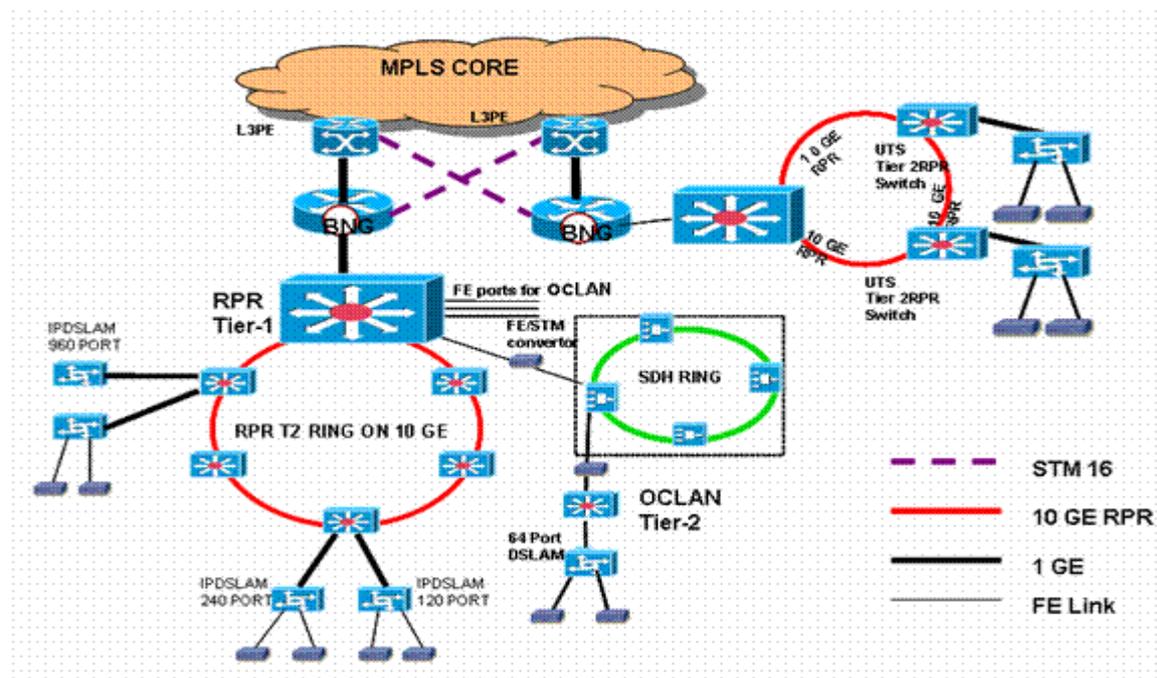
Figure 17:   **Network Architecture of Broadband Multiplay**

> **1**   **Services: -Data**
>
> **2**   **High speed Internet Access:** This is the always-on Internet access service with speed ranging from 256 kbps to 8 Mbps.
>
> **3**   **Dial VPN Service:** This service allows remote users to access their private network securely over the NIB-II infrastructure.
>
> **4**   **Services:** Video
>
> **5**   **IPTV or TVoIP**

8.3   MPLS & MPLS BASED VPN

8.3.1   COMPONENTS OF MPLS IP NETWORK

- Customer Edge, which works at IP level.
- Provider Edge is the entry point of MPLS Domain. It is called "Label Edge Router"
- Provider Routers are working as transit switches in between LERs. These are known as "Label Switching Routers".
- Label switched path is the data path between two routers, through which packets are traveling.

8.3.2   MPLS ARCHITECTURE
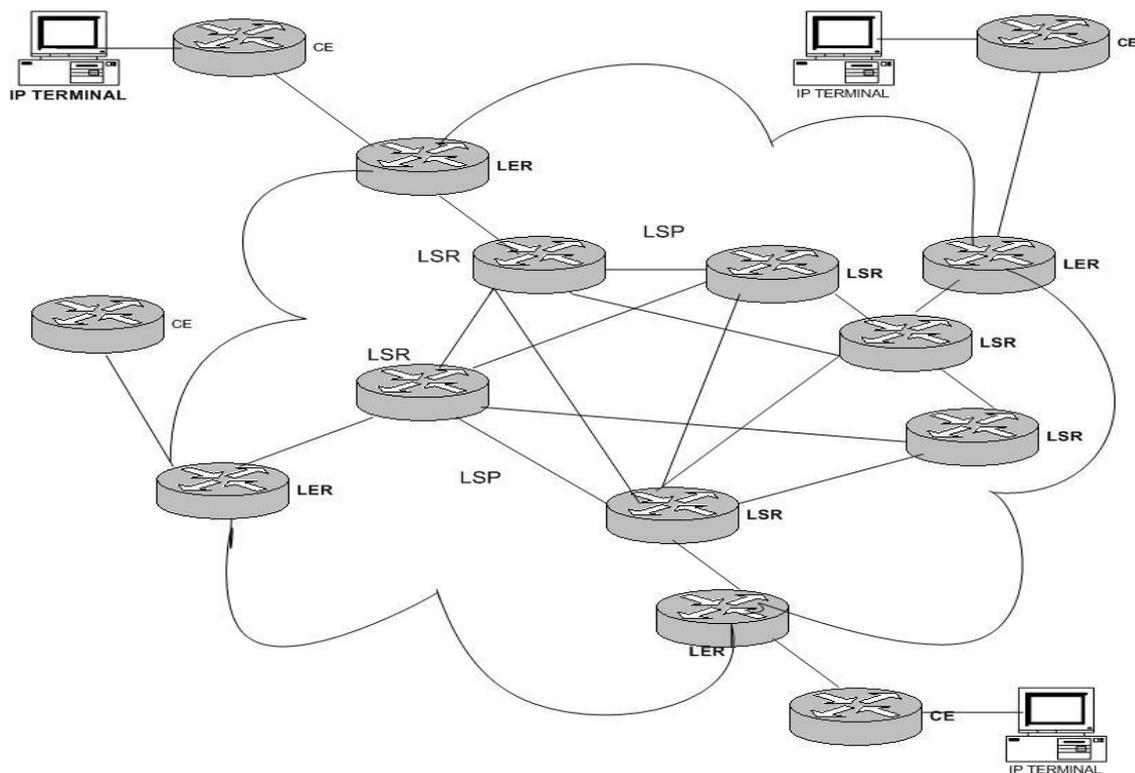
Figure 18:   **MPLS Architecture**

a) Customer Edge

It structures the customer message into IP Packets and sends to the entry node of MPLS domain. While receiving the IP Packets from the egress node of the MPLS domain, CE sends packets to Network layer of its own, after removing the IP address.

b) Label Edge Router

Label Edge Routers are working as the gateways of MPLS Domain. Ingress LER, it receives the IP Packet from CE, assigns the appropriate Label. After wrapping label, it sends labelled packet towards the next hop through the Label Switched Path, which is assigned for the specific Forward Equivalence Class. Assigning the Label is known as Label Binding. LER also acts as the egress Router. It receives the labeled IP Packets from the previous transit router, pops up the label (removes the label) and routes the IP packets towards the destined CE. LER receives the multiplexed input from CE, and extends the switched output towards the transit routers.

c) Label Switching Router

Label Switched Routers are basically working as transit switches in MPLS cloud. It receives Labelled IP packets through the appropriate LSP. It analyses the Label bound over the packet, consults the forwarding information table (LIB) and routes the packet through the appropriately mapped out going LSP. When the LSR is routing the packets from incoming LSP to outgoing LSP, it strips out the Incoming Label and assigns a new label to same packet to ensure the security from the intruders. This process is known as Label Swapping or Label Changing. MPLS Network architecture is as shown in the diagram. Lines, shown between CE and LER carry the IP Packets bi-directionally.

d) Label Switched Paths

Within an MPLS domain, a path is set up for a given packet to travel based on an FEC. The LSP is set up prior to data transmission. Lines, shown in the MPLS domain, are the Label Switched Paths that carry labeled IP Packets between the routers. There are two types of Label Switched Path. One is Static LSP and the other is Signaled LSP.
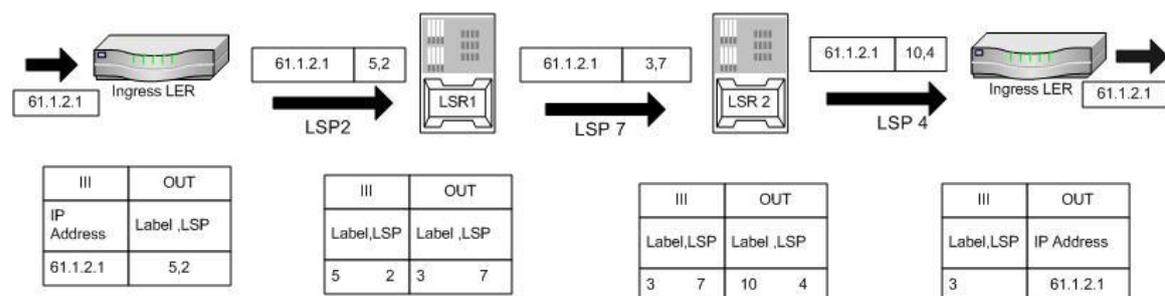
8.3.3 HOW MPLS WORKS?

Figure 19: **MPLS Function**

LER receives destined IP packet 61.2.1.1 from the Customer Edge and selects the correct label (5) from its LIB. It binds the selected label (5) according to the FEC over

the IP packet and sends it through the pre programmed LSP (2) towards the LSR 1. On receipt of labelled IP Packet, LSR1 analyses label only and it will ignore the IP address. It will consult its LIB for further routing. As the result it removes the incoming label (5), winds the newly assigned label (3) over the IP Packet and sends it towards the LSR2 over the assigned LSP (7). LSR2 consults its LIB and transmits the IP Packet after swapping the incoming Label (3) with outgoing Label (10) towards the egress LER over the pre assigned LSP (4). Egress LER stripes the label (10), goes through the destined IP address (61.1.2.1) and hands over it to the correct CE.

a)   Forward Equivalence Class

Forward equivalence class (FEC) is a representation of a group of packets that share the same requirements for their transport. All packets in such a group are provided the same treatment en route to the destination. As opposed to conventional IP forwarding, in MPLS, the assignment of a particular packet to a particular FEC is done just once, as the packet enters the network Forward Equivalence Class is created in the LER based on

▪   Class of service requirement.

▪   Quality of Service requirement.

▪   Prefixes of the IP addresses

b)   Label

A label in MPLS is used as the routing code like STD code in circuit switch. It identifies the path a packet should traverse in the MPLS domain. Label is encapsulated in a Data Link Layer 2 header. So, new layer is formed in between Network Layer and Data Link Layer in OSI Layer concept. The name of the new layer is MPLS SHIM Layer. Function of this layer is to bind the MPLS Label over the IP packet received from the customer edge. Label contains the information about next hop address. Value of the label is having local significance. So same label number can be reused in some other area.
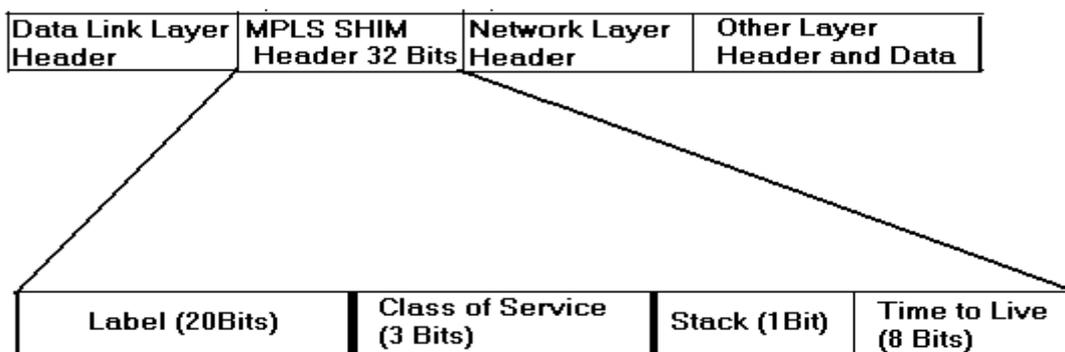
C)   Generic MPLS Label Format

Figure 20:   **MPLS Label Format**

MPLS layer works between Network layer and Data Link Layer as shown in the Diagram. Label binding and popping is done by the ingress and egress LERs respectively while LSR does the Label Swapping.

- VPI/VPC of ATM, DLCI of Frame Relay are used as Labels, while they are supported by MPLS.

- MPLS also supports the PPP. Shim Layer is created in between L3 header and L2 header in all LERs for the insertion of label to the IP packets received from Customer Edge.

D) Label Information Base

Label Information Base is Software database crated in both LER and LSR. It contains the mapping information of Incoming label & LSP with outgoing Label & LSP. This database is created during the installation of the router and subsequently updated automatically when the new LSR and LER is added by using Label Distribution Protocol. Label Information Base contains the following comSSponents: -

- FEC–to-label bindings.

- Forward Information Base.

E) Virtual Private Network

Virtual Private Network is Private Data Network, carved out from the Public Data Network. In this concept only switched paths(virtual paths) are assigned between the hosts. VPN can be constructed by using conventional IP network. But the users have to encounter with the defects in present IP backbone as discussed earlier. Since MPLS adopts the connection oriented routing, VPN can be overlaid on MPLS architecture, by constructing Tunnels. Other users according to their FECs can share tunnels.

There are two types of VPN model basically.

- Overlay VPN Model.

- Peer VPN Model.

Overlay VPN Model, which supports direct IP routing between CEs, by using Service Provider Backbone. CE is connected with "Provider Edge" that acts as the gateway of IP backbone. CE is connected with PE by using from L1toL3.VPN logic (L3 functions) resides in the customer Edge. CE performs routing between its coordinated CEs (Hub), before it gets connected with the Provider Edge. Hence it is also known as "CE-based VPN". Architecture of this type is as shown in the figure.
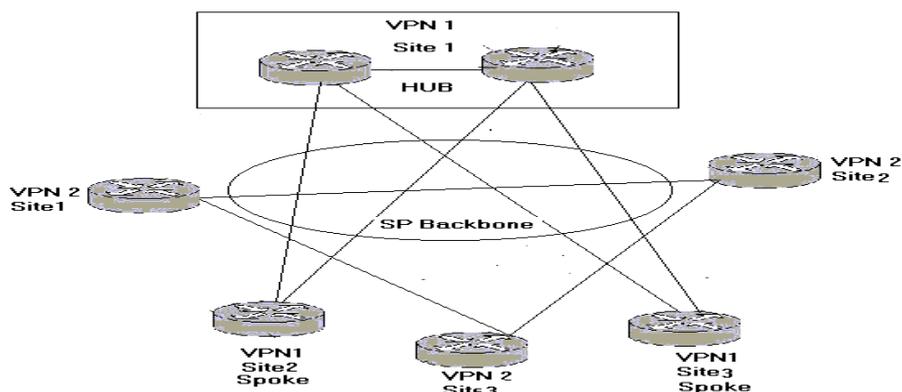

Figure 21: **Overlay VPN**

In this case Provider Edge performs Layer 2 Services only, since Customer Edge performs Layer3 functions. PE and P network is used to only   provide the routing and forwarding that supports the tunnel endpoints on between CE devices.

Peer VPN Model, in which CE is not having any routing resources for having direct routing with other CEs. It has direct routing adjacency within the HUB. Out side of the Hub it depends upon the Provider Edge. Here Provider Edge performs Layer3 function. It works as shown in the diagram.
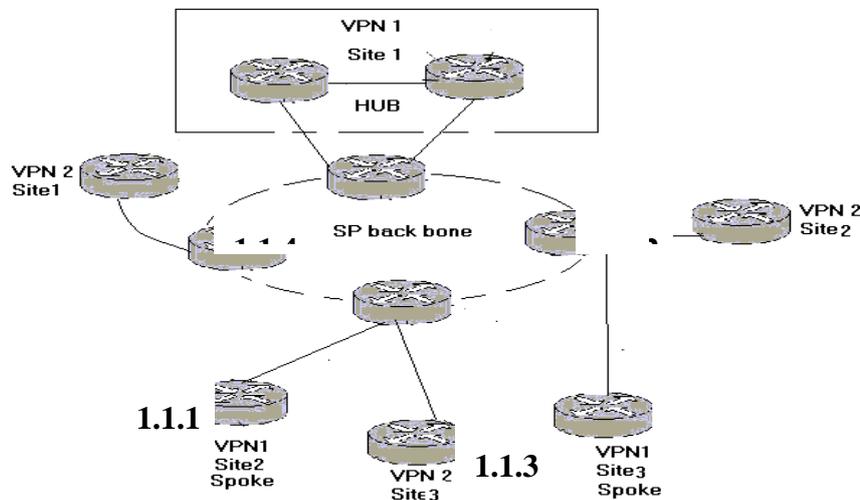
Figure 22:   **Peer to Peer VPN**

If the corporate customer wants Layer3 VPN, Service Provider has to configure the IP addresses of the all Branch Offices and Corporate Office. Serving Customer Edge will be configured and maintained by the Service Provider. Every VPN user is allotted with unique VPN address or tag or header, which is represented by **8 bytes**. While transmitting the IP packet from one of the VPN member, Customer edge adds VPN header with designated IP address and sends to LER of service provider. LER affixes appropriate Label according to the FEC and sends those packets through the designated LSP (Tunnel) by LER. At last the packet will reach the egress LER that will send that VPN IP packet to C.E after removing the label. Then the C.E.checks the VPN tag and routes the IP Packet to the destined terminal. VPN works as shown in the figure.

Customer Edge supports more than one IP Terminals. Path between CE can be a shared one. VPN Forwarding information (VFI) is available with the PE(LER).

8.4   CONCLUSION

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

9 PROJECT UDAAN AND CFA STRUCTURE

9.1 LEARNING OBJECTIVES

- Learn key responsibilities of Officers at Corporate level
- Learn key responsibilities of Officers at Circle level
- Learn basic of Project UDAAN and the process involve

9.2 JOB OBJECTIVE OF KEY OFFICERS OF CFA VERTICAL AT BSNL CORPORATE OFFICE

GM (Business Planning) – CFA: Articulation of overall business aspiration, strategy and business and financial plans for Consumer Fixed Access (CFA) business unit, monitoring performance against the same, designing, pricing and bundling of all fixed access products and management of all marketing & sales channels including company sales force, DSAs and alliances to drive growth of CFA business unit revenues.

DGM (Products & Pricing) – CFA: Design, pricing and bundling of all products for Consumer Fixed Access (CFA) business unit.

DGM (VAS) – CFA: Design, pricing and bundling of all Value Added Services (VAS) for Consumer Fixed Access (CFA) business unit.

DGM (Sales & Marketing) – CFA: Management of all Consumer Fixed Access (CFA) sales channels including company sales force, DSAs and alliances to drive growth of CFA revenues. Promotion of Consumer Fixed Access (CFA) business through marketing activities such as advertisements and promotions based on focused market research.

GM (Customer Service) – CFA: Management of customer service for Consumer Fixed Access (CFA) business unit including call centres and setting-up and management of online customer service support.

GM (Network Planning) – CFA: Planning, roll-out, up-gradation and back-integration of all Consumer Fixed Access (CFA) network assets.

GM (Network Operations) – CFA: Maintenance and operations of all Consumer Fixed Access (CFA) network assets, whilst ensuring priority in service delivery and service assurance for enterprise customers.

GM (Rural Network) – CFA: Planning and executing projects aiding in expansion of BSNL‟s telecom network in rural and far-flung areas (e.g. Village Public Telephones) thus fulfilling BSNL‟s social obligation of being the universal connectivity provider for India.

GM (Finance) – CFA: Creation of annual financial plan, evaluation and approval of policies and processes regarding tariff & costing. Ensuring billing, collections and recovery (revenue management) for Consumer Fixed Access (CFA) business unit.

DGM (Tariff & Costing) – CFA: Creation of annual financial plan, evaluation and approval of policies and processes regarding tariff & costing for Consumer Fixed Access (CFA) business unit.

DGM (Revenue Management) – CFA: Implementation of policies and processes on billing, collections and recovery (revenue management) for Consumer Fixed Access (CFA) business unit.

GM (IT) – CFA: Conceptualization and implementation of all projects specific to the Consumer Fixed Access (CFA) business unit, with specific emphasis on the CDR project.

9.3 JOB OBJECTIVE OF KEY OFFICERS OF CFA VERTICAL AT BSNL CIRCLE OFFICE

Head of Consumer Fixed Access at Circle – GM: Achieving profitable and sustainable growth of Consumer Fixed Access (CFA) business in the Circle through innovative and affordable products, excellence in sales, marketing and customer service, superior network operations backed by efficient IT-enabled processes.

1. Creation of annual business plan for CFA business unit at Circle by liaisoning with GM (Business Planning) – CFA at Head Office and Head of Business Planning at Circle, including

   ▪ Financial targets – overall budget (Revenue, CAPEX, OPEX), profitability, etc.

   ▪ Customer/ Market targets – connections, churn, market share, ARPU, etc.

   ▪ Operational targets – network roll-out & operations, customer service, etc.

2. Target-setting for all Regions within the Circle for CFA business unit by liaisoning with Region Heads

3. Development of comprehensive action agenda for CFA business unit, with particular focus on Product pricing and bundling, Marketing activities, Sales channel management – DSAs, CFA sales force, CSCs, alliances, Customer service with the objective of delivering best-in-class service at all stages of customer lifecycle (pre-sales, service delivery, after-sales) for retail customers, Management of access mechanisms – Call centres, CSCs, Setting-up of complaint and grievance management systems and processes at Circle level, Network planning, expansion, up-gradation and maintenance for all CFA network assets within the Circle, Media (OFC, UHF, µW, Copper), All PSTN switches (including Level 1 TAX), All Broadband access and aggregation equipment (BNG & below) by liaisoning with Broadband Networks, Non-tower passive infra (battery, generator, AC, etc) for sites where tower is co-located with exchange, Fixed VPTs and rural broadband.

4. Operationalisation of action agenda through multiple levers.

5. Interaction with Head Office and Region Offices for smooth day-to-day operations.

   ▪ Liaisoning with Head Office on policy matters, Recommendations to Head Office on key areas of strategy & planning based on local environment, Guidance to Region Offices on business matters

6. Monitoring performance against business plan at Circle level and taking corrective action as and when required.

Head of Product Management & Marketing for Consumer Fixed Access: Design, pricing and bundling of Consumer Fixed Access (CFA) products and promotion of CFA business through marketing activities in the Circle.

Head of Sales & Distribution for Consumer Fixed Access: Management of all Consumer Fixed Access (CFA) sales channels in the Circle including company sales

force, DSAs and alliances to drive growth of Landline (LL), Broadband (BB), IPTV, PCO and related Value Added Services (VAS) revenues.

Head of Customer Service for Consumer Fixed Access: Management of customer service for Consumer Fixed Access (CFA) business unit including Call centres.

Head of Network Planning for Consumer Fixed Access: Planning, roll-out and up-gradation of all Consumer Fixed Access (CFA) network assets within the Circle (except OFC, UHF, µW).

Head of Network Operations for Consumer Fixed Access: Maintenance of all

Consumer Fixed Access (CFA) network assets within the Circle (except OFC, UHF, µW).

Head of Transmission Network: Planning, roll-out, upgradation and maintenance of all OFC, UHF, µW within the Circle.

9.4 PROJECT UDAAN

PSTN or landline service continues to serve the people across the world, though its significance is getting diluted in wake of the growth of mobile services. Lot of improvements have happened in PSTN since its invention. Landline services contributed the most to overall revenue of Incumbent players, which day by day is eroding, threatening the survival of such operators. Although in declining phase, landline still has wide reach and acceptability in the market. Moreover with the introduction of VAS on landline it has promising potential for many more years. This handout dwells upon the strategy adopted by BSNL for strengthening its landline business.

9.4.1 NEED FOR SPECIAL CARE OF LANDLINE BUSINESS:

BSNL still has huge number of Landline customers (7168723) and is having highest market share (35.75%) as on 31.12.2020.

•   BSNL's share of Wired Broadband subscription is 34.5% with 7.70 million wired broadband subscribers as on 31.12.2020.

•   According to the available data there is an upward change in the wired broadband subscriber base.

So, wired broadband has strong potential and a strong strategy is required for saving landline and to increase the wired broadband customer base.

9.4.2 SALES IN BSNL

Three primary reasons identified for decline of landline customer base are poor customer service, un-economical landline tariff and increased mobile penetration. Since the customer experience of a product or a service is the sum of all encounters with the company, it is very important to understand the customer expectations and his emotional requirements. The key priorities for increasing fixed access business in BSNL will be better marketing and product management, efficient sales & distributions mechanisms, faster service provisioning and grievance redressal and wider coverage. Sales professional should have extensive knowledge of the product/services, maintain high standards of conduct and be market focus /customer oriented. Consequently proper sales reporting has become very important as it facilitates analysis of information, identifies the areas of strength/ concern, improves performance by taking timely corrective action, monitors the volume of sales and provides planning input to other departments.

As part of Project Shikhar, a special strategy titled Udaan has been launched. The main objective of this project is to rapidly expand broadband customer base while reducing churn of wire line voice customers and increase usage from existing customers. A pilot Project was started in three areas of Bangalore Telecom District with a view to create new sales force, make customer service processes more friendly and optimize service delivery/fast provisioning. In this Project special teams are constituted to focus on customer segmentation, product & pricing, sales & alliances, customer services and service delivery.

- Customer segmentation
- Product / pricing design & concept testing
- Customer service processes
- Service delivery & service assurance processes
- Sales force design

Customer Segmentation

Create discrete segments of customers based on their usage profile. For each customer segment, understand the key requirements from fixed access services and the issues being currently faced by them.

Product / Pricing, Design & Concept testing

Create pricing / product innovations that will address specific requirements of each of the customer segments identified. Elements of such plans may include bundled offers, special pricing tariffs and enhanced product / service features. These plans were concept-tested with potential customers to gauge interest levels prior to launch.

Customer service processes

Define key processes for various channels of customer service (e.g. CSC"s, call centers, broadband helpdesk etc.). In addition, define the interfaces of customer service with sales and service delivery / assurance to ensure monitoring and delivery of customer requirements.

9.4.3 NEW INITIATIVES:

- Efforts for connecting maximum homes in each town through fixed line service be it Broadband, Bharat Fiber (FTTH) or Bharat Air Fiber (new brand name of BSNL's BBoWiFi service).
- At least one partnership for Bharat Fiber and Bharat Air Fiber in each town (Registration process is online).
- Aggressive promotion of migration to annual plans.
- Active monitoring through the CFA dashboard must be daily activity at SSA/ Business area /Circle Level to ensure quality of service to the customer.
- New urban outsourcing policy can be a game changer for the quality of service of customers served by copper cable network but need to be implemented with due diligence.
- Affordable fixed line data services bundled with entertainment, education, smart home solution through our partners tie ups.

Customer service will play a key role in generating leads for landline & broadband connections.

Customer service processes updated to ensure efficient interactions with Sales & SD / SA teams		
	Activity	**Key changes in current process**
Learn	General / technical & tariff enquiries	Deliver product / plan brief to customer & route lead to sales for follow up
Get	New connection request	Route customer leads from call centre, BB helpdesk, SMS and online to sales
Fix/Change	Check status of complaint / connection request	Provide up-to-date status to customers on queries / new connections / complaints
	Connection not working (Not part of Udaan)	Capture nature of complaint and route to relevant SD / SA team
	Change of plan	Route to sales or SD / SA based on new or legacy customer respectively
Stay	Disconnection request	Understand reason for disconnection and escalate to sales team
	Change of location	Route to relevant sales team lead

Table 6.   Customer Service Process

9.4.4 SERVICE DELIVERY & SERVICE ASSURANCE PROCESSES

Analyze the key operational issues currently faced in delivering fixed access services. Create a dedicated team to identify and resolve issues, along with the associated interfaces to sales and customer service.

Setting up of Service Delivery-Service Assurance Teams	
Outdoor members	1or 2 members per Outdoor division
Indoor members	1 member per Indoor division
Support members	NIB Node-in-charges, CITOMS / DotSoft in-charge (if any)
Critical role and activity definitions within the SD / SA team	

SD / SA team at divisions will…	Outdoor team will ...
• Follow up on all network support (feasibility, activation) requests generated by sales team • Proactively track pending requests and contact outdoor team for faster service delivery • Work with cable's team to enable feasibility for requests where customers are ready to wait	• Regularly monitor the feasibility check requests coming from sales team through Wings. • Report feasibility expeditiously • Expedite work on outdoor installation steps for OBs raised for feasible requests above • Work closely with sales team to give the customer a delightful experience.

Table 7.   SD and SA

9.4.5   SALES FORCE DESIGN

Develop the structure of retail sales force for fixed access services. In addition, design the associated sales processes, incentive structures and training requirement to execute retail sales.
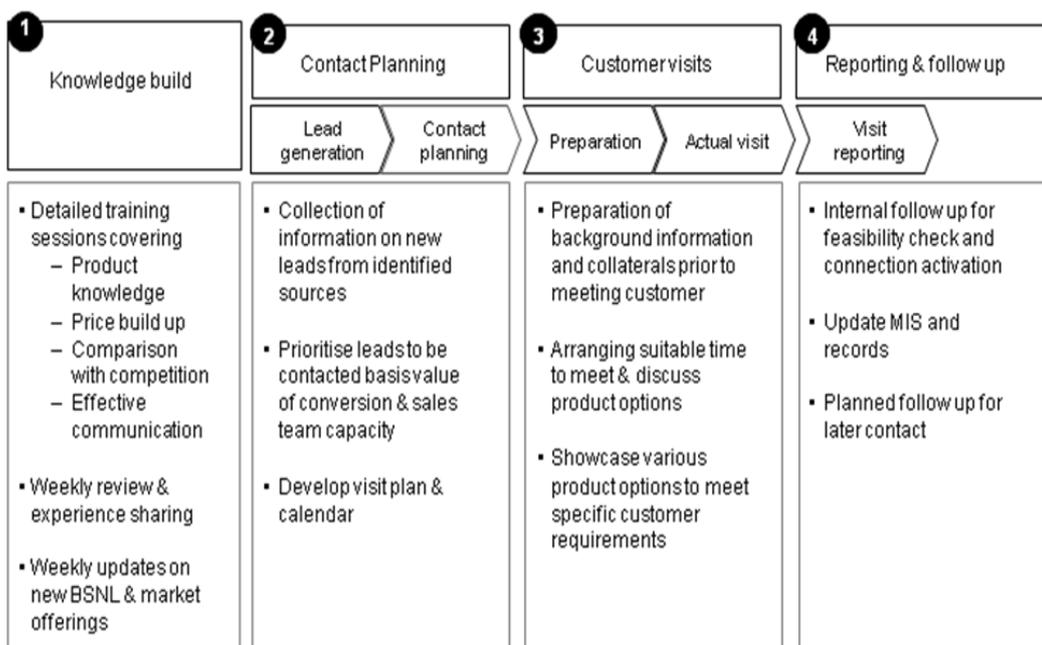
Figure 23:   **Sales Force Design**

For implementing above aspects, an overall team structure for Project Udaan is given below:

Figure 24:   **Team Structure for Udaan**

9.4.6   BRIEF ON APPROACH TOWARDS UDAAN CASES:

- Proactive ways introduced for capturing potential customers

- Introduction of BSNL Sales teams

- Feasibility check done before collecting documents and registration fees.

- The feasibility status informed to the customer invariably.

• The record of non-feasible requests which could not materialize, maintained with Cables team.

• Apart from the normal channels of monitoring, separate SD/SA team members help in monitoring and resolving the issues between Sales and Outdoor teams.

• Process wise time taken monitored to help narrow down and focus on the problem areas.

Udaan Approach (I)-Proactive Ways of Capturing Potential Customers Introduced

• Lead generation – Any customer enquiry about the various services   offered by BSNL entered as a lead for a potential customer.

• Leads booked by all customer interfaces – CSC, Call Centres, Commercial Sections, field offices.

• Leads viewed by Sales team leader and allotted to respective sales associate to contact the customer.

• Lead status can be tracked by anybody by giving lead number.

Udaan Approach (II) – For LL Requests, Feasibility Check Done Before Booking

• On receiving confirmation from the customer about his requirement for a Landline, the feasibility check is done before booking.

• For feasibility check, the Sales team leader raises a "ticket" and allots it to the concerned JTO Outdoor.

• JTO Outdoor on receipt of a ticket checks and reports the feasibility along with the Pillar number to the Sales Team.

• If the ticket has been wrongly allocated to his section, JTO has the option to reallocate the section.

• On getting the report;

• If the connection is feasible, the Sales associate approaches the customer, collects the documents and books the connection.

• If not feasible, Sales associate informs the customer and tries to sell some other service.

• Target for time taken to report feasibility is fixed (On the same day and definitely by the next day).

• Process is to be closely monitored and JTO wise analysis carried out.

Udaan Approach (III) – Inclusion of Cables Team as a Part of the Process:

• A ticket marked as non-feasible by JTO Outdoor is sent to Cables team

• Cables team can view the cases JTO wise

• If it can be made feasible, the cable team works on it and reports the feasibility back to Sales team

• The record of non-feasible cases is maintained and becomes an input for cable planning
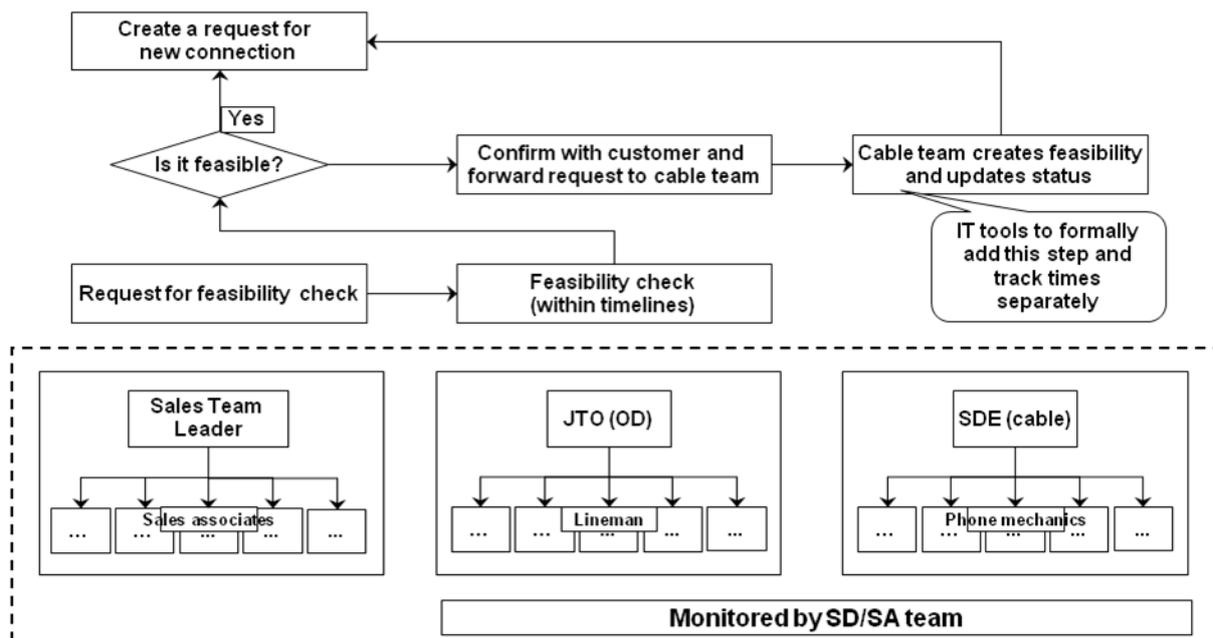
Figure 25:   **Udaan Approach**

Udaan Approach – IV

Prompt provisioning of feasible cases

•   The Obs booked against feasible tickets are marked with special flag Udaan.

• These Obs skip the Section Allotment and Feasibility Check stages and move directly to Number Allotment and outdoor installation.
• Process wise time taken monitored to help narrow down and focus on the problem areas.

Strengthened Monitoring System

• Apart from the normal channels of monitoring, separate SDSA team members help in monitoring and resolving the issues between Sales and Outdoor teams. Various reports made available to be able to effectively monitor the status and progress.

Pre Udaan	Post Udaan
No detailed data base for leads received at BB / Call Centre /SMS / website	Consolidated database for leads from all channels
No structured process to capture leads and contact potential subscribers at their door step	Interfaces between customer service, sales and network operations defined
No mechanism to follow-up and track status of leads	Web based IT Tool allows capture and tracking the status of leads
Status of feasibility unknown at the time of booking a connection	Feasibility verified prior to OB generation
Monitoring system, Admn. Report by Team Leaders - not available.	End-to-end tracking of leads from origination to provisioning of a connection is now possible
All customers receive a physical copy of bill by default	Provide the customer with option to opt for e-bill (under evaluation

Table 8.   Comparison pre and post Udaan

9.5   WINGS SOFTWARE FOR PROJECT UDAAN:

ITPC Pune has developed and launched lead management software in Jan 2010. It enables creation, distribution and management of leads, which are then entered in to the local commercial systems. All the stages of Lead before or after its entry in the commercial system are monitored, by a system of SLA, through various report generation and SMS generation till its completion. A system of User roles of Project Managers/Sales team leaders/Sales associates/SDE (Extl) has been created to facilitate the Lead during its entire life cycle.

9.6   CONCLUSION

The success of Project Udaan lies on each one of us. We must realize that at present BSNL is the market leader in Fixed Access with over 75% market share and Fixed Access contributes to 46% of the operational costs. With ever increasing usage of internet and massive Copper network of BSNL, only push selling approach is required. Unless we expand our wired broadband market now we may face stiff challenge when wireless broadband becomes fully operational with all its might.

10 CM TECHNOLOGY OVERVIEW (GSM 3G)

10.1 LEARNING OBJECTIVE

- Various sub system in GSM Technology.
- GPRS and its function
- Requirement of 3G ,Why WCDMA ?
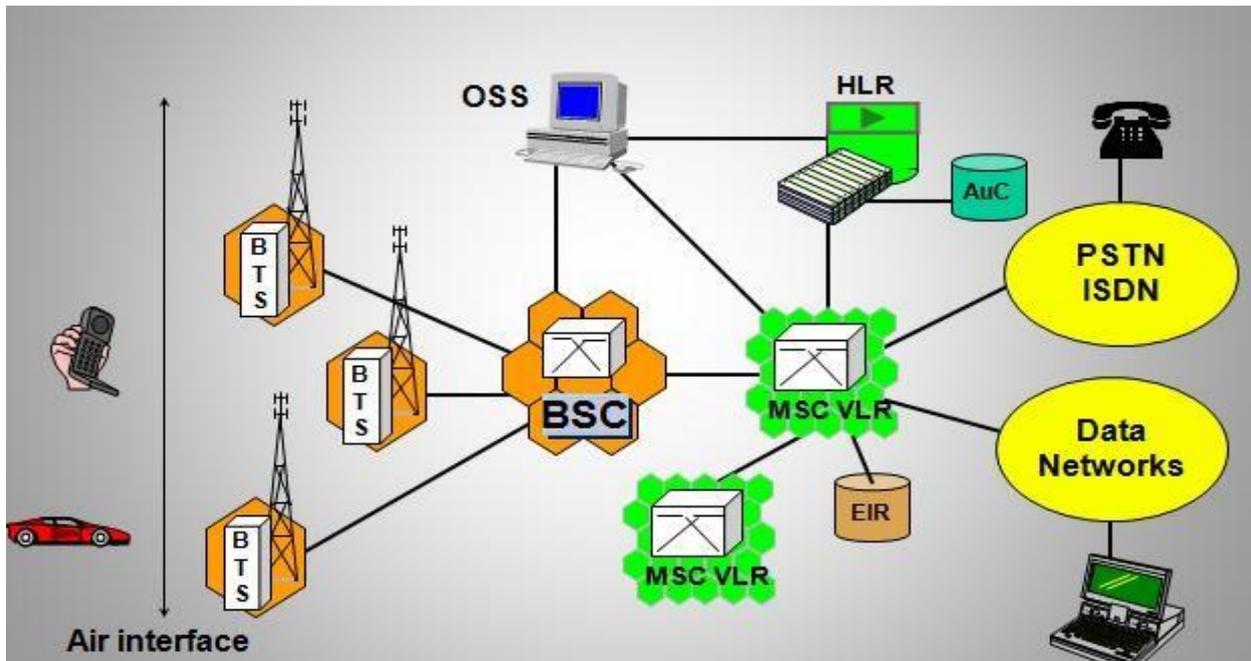- Function of nodes

GSM NETWORK ARCHITECTURE- TYPICAL
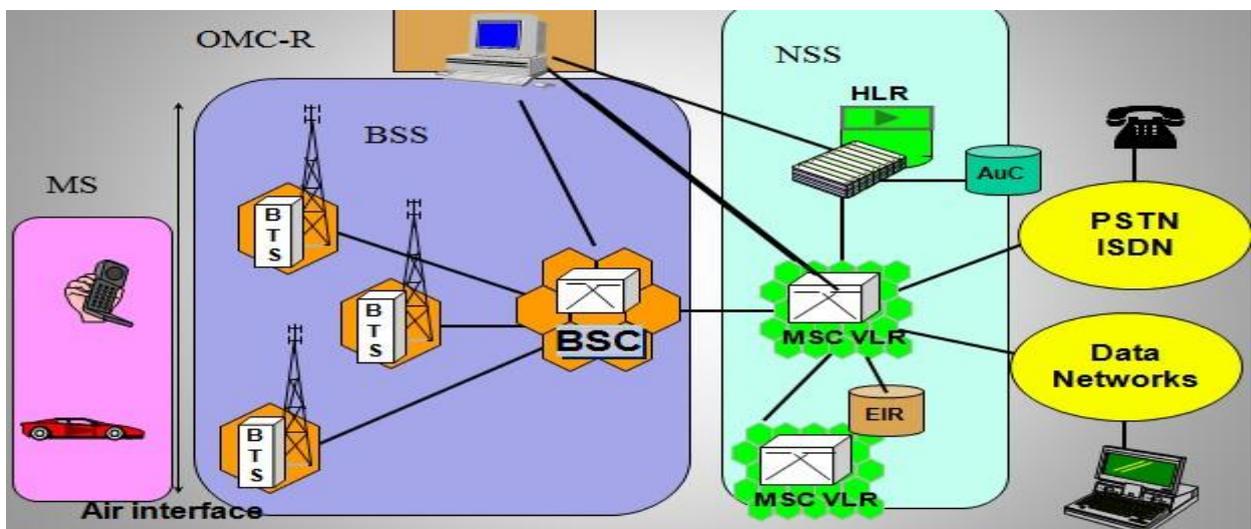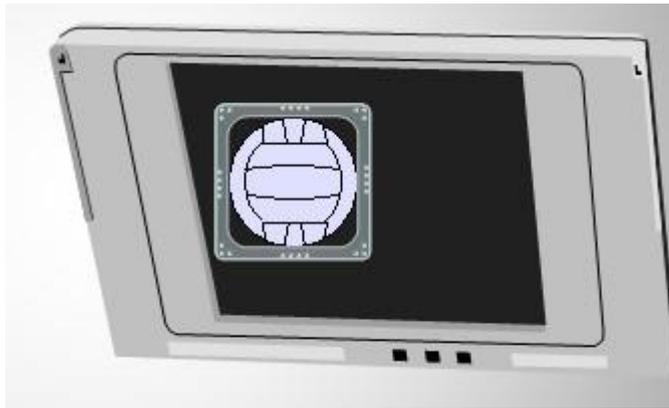

Figure 26:   **GSM Network Architecture**

Figure 27:   **GSM Network Architecture**

10.2 VARIOUS SUBSYSTEMS

  i. MS:-Mobile Station

ii. **Radio Subsystem** includes the equipments and functions related to the management of the connections on the radio path.

iii. **Network Subsystem**(NSS) includes the equipments and functions related to end-to-end call.

iv. **Operations and Maintenance subsystem** (OSS) includes the operation and maintenance of GSM equipment for the radio and network interface.

MOBILE STATION (MS)

| Mobile Hand Set | Subscriber Identity Module (SIM) |

MS	SIM
Mobile Hand set is one of the most complicated GSM device. It provides user the access to the Network. Each handset has unique identity no. called IMEI.	SIM is a removable module goes into the mobile handset. Each SIM has unique number called International Mobile Subscriber Identity (IMSI). It has built in Micro-computer & memory into it. It contains the ROM of 6 to 16KB,RAM of 128 to 256 bytes and EEPROM of 3 to 8KB.

The Mobile Station consists of the Mobile Equipment (ME) and the Subscriber Identity Module (SIM).

I)   MOBILE EQUIPMENT

The Mobile Equipment is the hardware used by the subscriber to access the network.

The mobile equipment can be Vehicle mounted, with the antenna physically mounted on the outside of the vehicle or portable mobile unit, which can be handheld.

Mobiles are classified into five classes according to their power rating.

CLASS	POWER OUTPUT
1	20W
2	8W
3	5W
4	2W
5	0.8W

II) SIM (SUBSCRIBER IDENTITY MODULE)

The SIM is a removable card that plugs into the ME.

It identifies the mobile subscriber and provides information about the service that the subscriber should receive.

The SIM contains several pieces of information

✓ International Mobile Subscribers Identity (IMSI) - This number identifies the mobile subscriber. It is only transmitted over the air during initializing.

✓ Temporary Mobile Subscriber Identity (TMSI) - This number also identifies the subscriber. It can be alternatively used by the system. It is periodically changed by the system to protect the subscriber from being identified by someone attempting to monitor the radio interface.

✓ Location Area Identity (LAI) - Identifies the current location of the subscriber.

✓ Subscribers Authentication Key (Ki) - This is used to authenticate the SIM card.

✓ Mobile Station International Subscriber Directory Number (MSISDN) - This is the telephone number of the mobile.

✓ Most of data contained within the SIM is protected against reading (e.g Ki) or alterations after the SIM is issued.

✓ Some of the parameters (e.g.. LAI) will be continuously updated to reflect the current location of the subscriber.

✓ The SIM card can be protected by use of Personal Identity Number (PIN) password.

✓ The SIM is capable of storing additional information such as accumulated call charges.

10.3 BASE STATION SUB-SYSTEM (BSS)

The BSS is the fixed end of the radio interface that provides control and radio coverage functions for one or more cells and their associated MSs.

It is the interface between the MS and the MSC.

The BSS comprises one or more Base Transceiver Stations (BTSs), each containing the radio components that communicate with MSs in a given area, and a Base Site Controller (BSC) which supports call processing functions and the interfaces to the MSC. Digital radio techniques are used for the radio communications link, known as the Air Interface, between the BSS and the MS.

The BSS consists of three basic Network Elements (NEs).

✓ Transcoder (XCDR) or Remote transcoder (RXCDR) .

✓ Base Station Controller (BSC).

✓ Base Transceiver Stations (BTSs) assigned to the BSC. .

10.3.1 BASE TRANSCEIVER STATION (BTS)

The BTS network element consists of the hardware components, such as radios, interface modules and antenna systems that provide the Air Interface between the BSS and the MSs.

The BTS provides radio channels (RF carriers) for a specific RF coverage area.

The radio channel is the communication link between the MSs within an RF coverage area and the BSS.

The BTS also has a limited amount of control functionality which reduces the amount of traffic between the BTS and BSC.

10.3.2 BASE STATION CONTROLLER (BSC)

The BSC network element provides the control for the BSS.

It controls and manages the associated BTSs, and interfaces with the Operations and Maintenance Centre (OMC).

The purpose of the BSC is to perform a variety of functions. The following comprise the functions provided by the BSC: ☐Controls the BTS components.-

✓ Performs Call Processing.

✓ Performs Operations and Maintenance (O & M).

✓ Provides the O & M link (OML) between the BSS and the OMC.

✓ Provides the A Interface between the BSS and the MSC.

✓ Manages the radio channels.

✓ Transfers signaling information to and from MSs.

10.3.3 TRANSCODER (XCDR)

✓ The speech transcoder is the interface between the 64 kb/s PCM channel in the land network and the 13 kb/s vocoder (actually 22.8 kb/s after channel coding) channel used on the Air Interface.

✓ This reduces the amount of information carried on the Air Interface and hence, its bandwidth.

✓ If the 64 kb/s PCM is transmitted on the air interface without compression, it would occupy an excessive amount of radio bandwidth. This would use the available radio spectrum inefficiently.

✓ The required bandwidth is therefore reduced by processing the 64 kb/s PCM data so that the amount of information required to transmit digitized voice falls to 13kb/s.

✓ The XCDR can multiplex 4 traffic channels into a single 64 kb/s timeslot. Thus a E1 serial link can carry 4 times as many channels.

✓ This can reduce the number of E1 leased lines required to connect remotely located equipment.

✓ When the transcoder is located between the MSC and the BSC it is called a remote transcoder (RXCDR).

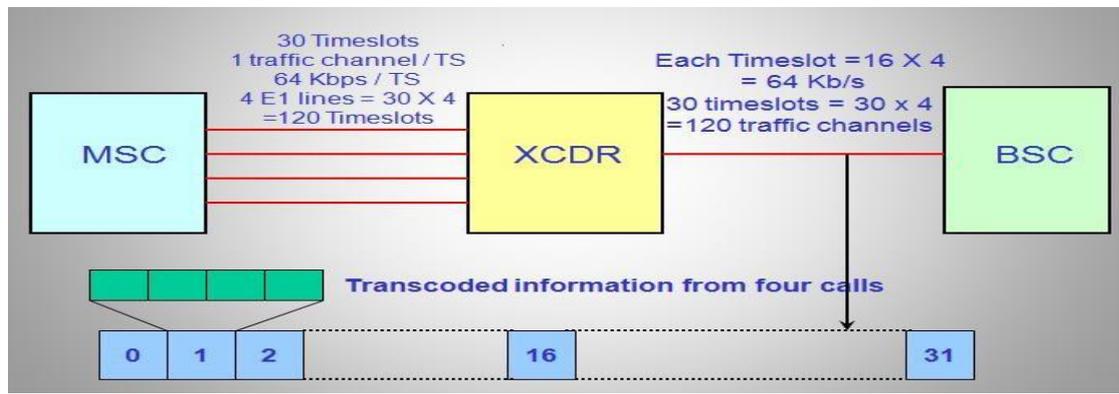**Transcoding: Transcoding is explained from below figure:-**

Figure 28:   **Transcoding**

10.4   NETWORK SWITCHING SUBSYSTEMS (NSS):

✓ The Network Switching Subsystem includes the main switching functions of GSM as well as the databases needed for subscriber data and mobility management. The NSS also manages the communications between the GSM users and other telecommunication network users.

✓ The basic switching function like setting up calls to and from GSM users is performed by the MSC. The MSC has interface with the BSS on one side (through which MSC/ VLR is in contact with GSM users) and the external networks on the other (ISDN/ PSTN/ PSPDN) & other PLMN or MSCs.

10.4.1 MOBILE SWITCHING CENTRE (MSC) :

✓ The Mobile services Switching Centre (MSC) co-ordinates the setting up of calls to and from GSM users.

✓ It is the telephone switching office for MS originated or terminated traffic and provides the appropriate bearer services, teleservices and supplementary services.

✓ It controls a number of Base Station Sites (BSSs) within a specified geographical coverage area and gives the radio subsystem access to the subscriber and equipment databases.

✓ The MSC carries out several different functions depending on its position in the network.

✓ When the MSC provides the interface between PSTN and the BSS in the GSM network it is called the Gateway MSC.

✓ Some important functions carried out by MSC are Call processing including control of data/voice call setup, inter BSS & inter MSC handovers, control of mobility management, Operation & maintenance support including database management, traffic metering and man machine interface & managing the interface between GSM & PSTN N/W.

10.4.2 HOME LOCATION REGISTER (HLR)

✓ The HLR contains the master database of all subscribers in the PLMN.

✓ This data is remotely accessed by the MSC´´s and VLRs in the network. The data can also be accessed by an MSC or a VLR in a different PLMN to allow inter-system and inter-country roaming.

✓ A PLMN may contain more than one HLR, in which case each HLR contains a portion of the total subscriber database. There is only one database record per subscriber.

✓ The subscriber's data may be accessed by the IMSI or the MSISDN.

✓ The parameters stored in HLR are

• Subscribers ID (IMSI and MSISDN)

• Current subscriber VLR.

• Supplementary services subscribed to.

• Supplementary services information (e.g.. Current forwarding address).

• Authentication key and AUC functionality.

• TMSI and MSRN

10.4.3 VISITOR LOCATION REGISTER (VLR)

✓ The VLR is a local subscriber database, holding details on those subscribers who enter the area of the network that it covers.

✓ The details are held in the VLR until the subscriber moves into the area serviced by another VLR.

✓ The data includes most of the information stored at the HLR, as well as more precise location and status information.

✓ The additional data stored in VLR are :

• Mobile status (Busy / Free / No answer etc.)

• Location Area Identity (LAI)

• Temporary Mobile Subscribers Identity (TMSI)

• Mobile Station Roaming Number (MSRN)

• The VLR provides the system elements local to the subscriber, with basic information on that subscriber, thus removing the need to access the HLR every time subscriber information is required

10.4.4 AUTHENTICATION CENTRE (AUC)

The AUC is a processor system that perform authentication function.

✓ It is normally co-located with the HLR.

✓ The authentication process usually takes place each time the subscriber initializes on the system.

✓ Each subscriber is assigned an authentication key (Ki) which is stored in the SIM and at the AUC.

✓   A random number of 128 bits is generated by the AUC & sent to the MS.

✓   The authentication algorithm A3 uses this random number and authentication key Ki to produce a signed response SRES(Signed Response).

✓   At the same time the AUC uses the random number and Authentication algorithm A3 along with the Ki key to produce a SRES.

✓   If the SRES produced by AUC matches the one produced by MS is the same, the subscriber is permitted to use the network.

10.4.5 EQUIPMENT IDENTITY REGISTER (EIR)

✓   The Equipment Identity Register (EIR) contains a centralized database for validating the international mobile station equipment identity, the IMEI.

✓   The database contains three lists:

•   The white list contains the number series of equipment identities that have been allocated in the different participating countries. This list does not contain individual numbers but a range of numbers by identifying the beginning and end of the series.

•   The grey list contains IMEI's of equipment to be monitored and observed for location and correct function.

•   The black list contains IMEI's of MS's which have been reported stolen or are to be denied service.

✓   The EIR database is remotely accessed by the MSC's in the Network and can also be accessed by an MSC in a different PLMN.
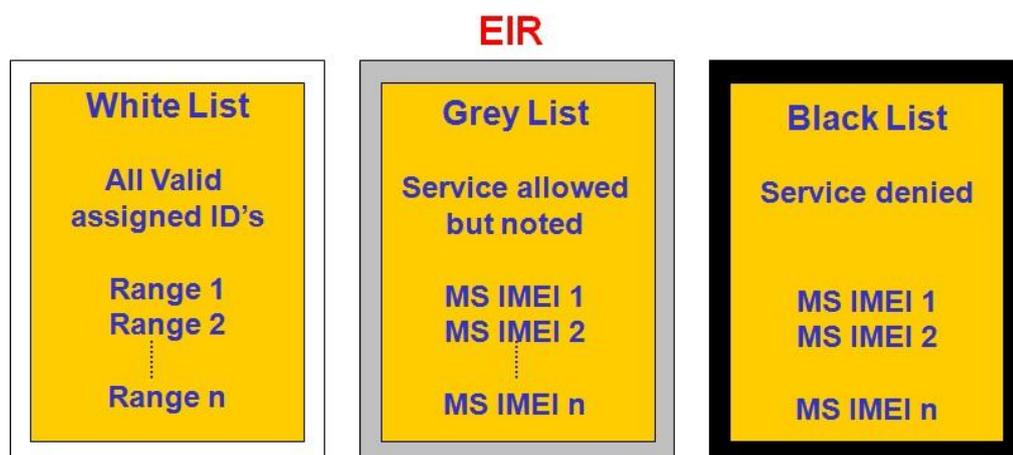

Figure 29:   **Equipment Identity Register (EIR)**

10.5 OSS (OPERATIONS AND MAINTENANCE SUBSYSTEM)

Operation and Maintenance Centre (OMC)

✓   The OMC controls and monitors the Network elements within a region.

✓   The OMC also monitors the quality of service being provided by the Network.

✓   The following are the main functions performed by the OMC

•   The OMC allows network devices to be manually removed for or restored to service. The status of network devices can be checked from the OMC and tests and diagnostics invoked.

• The alarms generated by the Network elements are reported and logged at the OMC.

• Maintenance personnel monitor and analyze these alarms and take appropriate action .

• The OMC keeps on collecting and accumulating traffic statistics from the network elements for analysis.

• Software loads can be downloaded to network elements or uploaded to the OMC.

10.6 GPRS

✓ GPRS is a new non-voice value added service that allows Mobile Phones to be used for sending and receiving data over an IP based network.

✓ GPRS as such is a data bearer that enables wireless access to data networks like Internet, enabling user to access E-mails and other Internet applications using Mobile phones.

✓ With GPRS we can enjoy a continuous wireless connection to data networks (Internet)

10.6.1 GPRS NETWORK ELEMENTS:-

✓ GPRS Architecture is same as GSM except few hardware modifications :

✓ GPRS includes GSNs in NSS

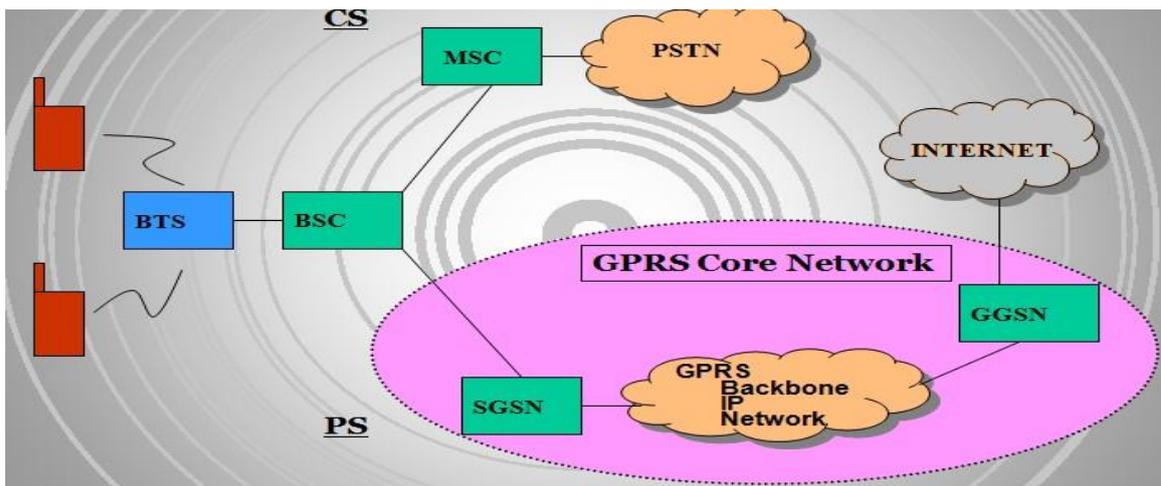• SGSN : Serving GPRS Support Node

• GGSN : Gateway GPRS Support Node

Figure 30:   **GPRS SYSTEM**

10.6.2 SERVING GPRS SUPPORT NODE(SGSN):-

✓ Delivers data packets to mobile stations & vice-versa.

✓ Detect and Register new GPRS MS in its serving area.

✓ Packet Routing, Transfer & Mobility Management.

✓ Authentication, Maintaining user profiles.

✓ Its location register stores location info. & user profiles.

10.6.3 GATEWAY GPRS SUPPORT NODE (GGSN):-

- ✓ Interfaces GPRS backbone network & external packet data networks
- ✓ Converts the GPRS packets from SGSN to the PDP format
- ✓ Converts PDP addresses change to GSM addresses of the destination user
- ✓ Stores the current SGSN address and profile of the user in its location register
- ✓ Performs authentication
- ✓ Many-to- many relations among SGSNs & GGSNs .

10.6.4 KEY REQUIREMENTS OF 3G

- ✓ Improved system capacity
- ✓ Backward compatibility with second generation (2G) systems
- ✓ Multimedia support
- ✓ High speed Packet data services
- ✓ Data Rates
  - • up-to 2 Mbps – for fixed or Indoor environments
  - • up-to 384 kbps – for pedestrian or urban environments
  - • up-to 144 kbps – for wide area mobile environments
- ✓ New air-interface in 3G WCDMA
- ✓ WCDMA stands for Wide Band – Code Division Multiple Access
- ✓ It is the **air –interface** technology for the **UMTS (Universal Mobile Telecommunication System)** systems.

10.6.5 WCDMA

- ✓ WCDMA for high speed data access up to 384 Kbps - 2 Mbps
- ✓ Demand for high Speed Data Access
  - ▪ Streaming
  - ▪ Video on Demand
  - ▪ Video Telephony
- ✓ Data Revenue is becoming significant
- ✓ Operators World wide have shown inclination to introduce WCDMA

10.6.6 MAIN NETWORK ELEMENTS IN WCDMA

- ✓ New Core Network- • MSC-MGW (CS)
- • SGSN-GGSN(PS)

[Same for GSM (2G) and UMTS(3G)]

- ✓ Radio Network- •GSM: BSC, BTS and
- • UMTS: RNC, Node B

[All other network element are common for 2G as well as 3G]
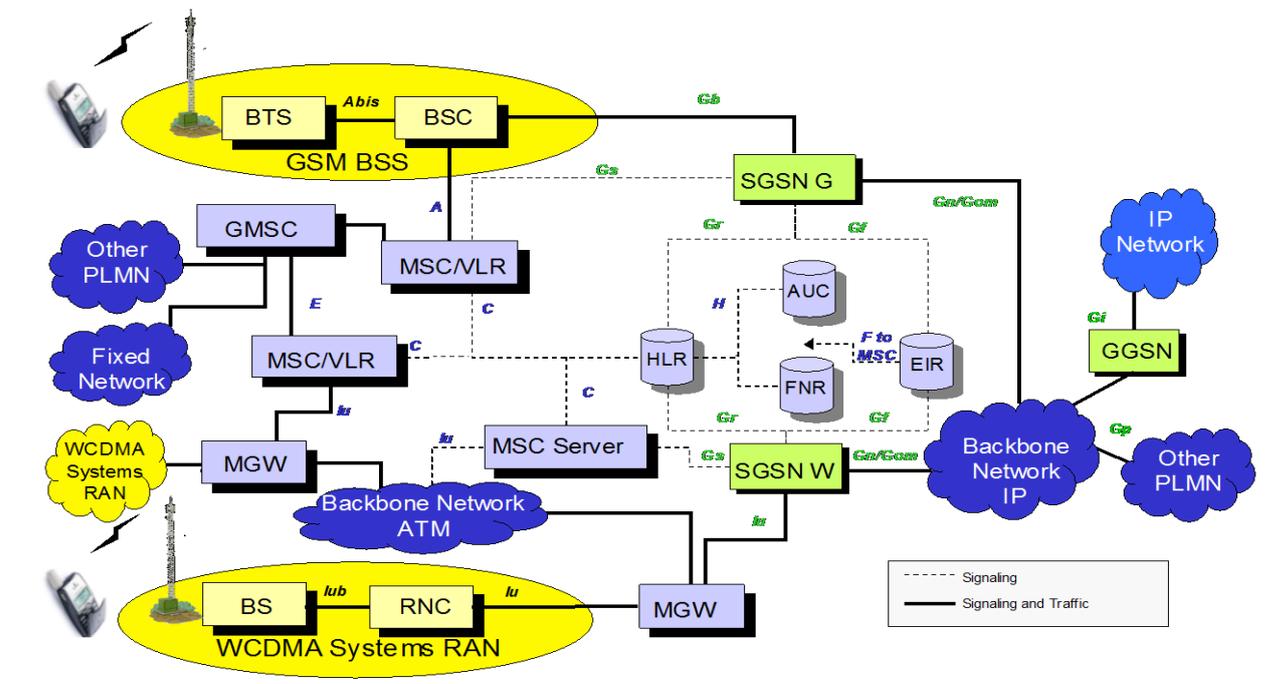
3G Network overview

Figure 31:   **3G Network Architecture**

10.6.7 RNC: MAIN FUNCTIONALITIES

- ✓ Manage and secure an optimal usage of the radio resources of the radio access network
- ✓ Control the mobility and handover within the radio access network
- ✓ RNC provide Handover functions between WCDMA RAN and GSM, and

    Cell Change between WCDMA RAN and GSM/GPRS

- ✓ Support radio access bearer (RAB) services with: Circuit Switched and Packet Switched data

Node B: Main Functionalities:-

- ✓ Provides radio interface to the UE.
- ✓ Transceiver Units and Dedicated Power Amplifiers for every sector.
- ✓ Executes power control to minimize interference.

10.7   CONCLUSION

3G is very successful technology due to its robust radio network design. By virtue of CDMA and code reuse the capacity of 3G system is increased tremendously. But with the introduction of Data demand on mobile 3G has lost its shine as it deliveries very less data rates. Thus 3G has been migrated to newer technologies such as 4G and 5G.

11 CM TECHNOLOGY OVERVIEW 4G-5G

11.1 LEARNING OBJECTIVES

- 1 G - First Generation - Analog - Only mobile voice services - AMPS, NMT-450, TACS etc. (Cellular Revolution)
- 2 G - Second Generation - Digital - Mostly for voice services & data delivery possible – GSM, CDMA (IS-95), DAMPS (IS-136), ETDMA, PDC etc (Breaking Digital Barrier).
- 3 G - Third Generation - Voice & Data - Mainly for data services where voice services will also be possible (Breaking Data Barrier)
- 4 G - Fourth Generation - The Fourth Generation of mobile communication upgrade existing communication networks and is expected to provide a comprehensive and secure IP based solution where facilities such as voice, data and streamed multimedia will be provided to users on an "Anytime, Anywhere" basis and at much higher data rates compared to previous generations.
- 5 G - Fifth Generation -The most important for 5G technologies are 802.11 Wireless Local Area Networks (WLAN) and 802.16 Wireless Metropolitan Area Networks (WMAN), Ad-hoc Wireless Personal Area Network (WPAN) and Wireless networks for digital Communication.

11.2 OVERVIEW OF GPRS

The existing GSM networks are based on circuit switching techniques. For data services that are based on Internet Protocol (IP) such as e-mail and web browsing, GSM circuit switching is inefficient.

GSM Release '97 has introduced the General Packet Radio Service (GPRS) which maintains the GSM BSS access technologies but provides packet switched data services to the mobile station (MS).

11.2.1 GPRS STANDARDIZATION

The ETSI standardization work on GPRS Phase 1 was officially finalized in Q1/1998. It includes point-to-point (PTP) services and the complete basic GPRS infrastructure. Air interface, mobility management, security, limited QoS, SMS service, GPRS support nodes, and the GPRS backbone are all part of Phase 1.

The ETSI standardization work on GPRS Phase 2 was frozen with GSM Release 99. Some work items were included in the GSM Release 98. Phase 2 adds additional services like enhanced QoS support and point-to-multipoint (PTM) connections. Some main point of GPRS phase 2 are the support of:

- IPv4 and IPv6
- BSS co-ordination of radio resource allocation for class A GPRS services
- Enhanced QoS support in GPRS
- Charging and billing for GPRS – AoC
- Charging and billing for GPRS – Pre-paid
- Point-to-multipoint (PTM) services

Access to ISPs and intranets in GPRS Phase 2, separation of GPRS bearer establishment and ISP service environment set-up

In GSM Release 4 (frozen March 2001) and GSM Release 5 (frozen June 2002), QoS enhancements for the GPRS backbone were introduced to support packet switched real-time services (on the long run). This goes hand-in-hand with the introduction of the

IP Multimedia Subsystem (IMS). The Nokia IP Multimedia Subsystem can be combined with terminals supporting downloadable applications, creating exciting opportunities for application developers and operators to develop and offer new IP multimedia services in GPRS and 3G networks. Further information on network details is available in the architecture module.

At the end of the year 2002, more that 120 operators are commercially offering GPRS and more than 40 operators are testing GPRS or building up a GPRS

Key points

GPRS uses a packet-based switching technique, which will enhance GSM data services significantly, especially for bursty Internet/intranet traffic.

Some application examples:

- Bus, train, airline real-time information
- Locating restaurants and other entertainment venues based on current Location
- Lottery
- E-commerce
- Banking
- E-mail
- Web browsing

The main advantages of GPRS for users:

- Instant access to data as if connected to an office LAN
- Charging based on amount of data transferred (not the time connected)
- Higher transmission speeds

The main advantages for operators:

- Fast network roll-out with minimum investment
- Excess voice capacity used for GPRS data
- Smooth path to 3G services

In circuit switching, each time a connection is required between two points, a link between the two points is established and the needed resources are reserved for the use of that single call for the complete duration of the call.

In packet switching, the data to be transferred is divided up into packets, which are then sent through the network and re-assembled at the receiving end.
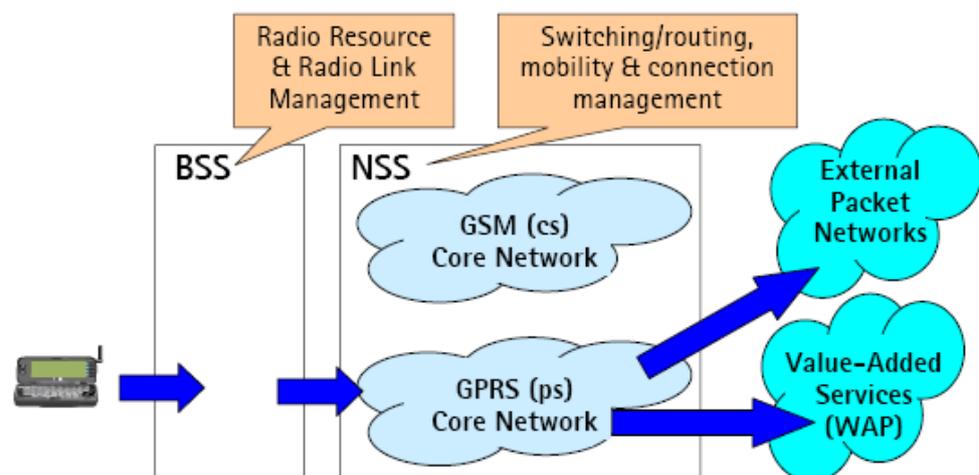

Figure 32:   **GPRS Architecture**

The GPRS network acts in parallel with the GSM network, providing packet switched connections to the external networks. The requirements of a GPRS network are the following:

The GPRS network must use as much of the existing GSM infrastructure with the smallest number of modifications to it.

Since a GPRS user may be on more than one data session, GPRS should be able to support one or more packet switched connections.

To support the budgets of various GPRS users, it must be able to support different Quality of Service (QoS) subscriptions of the user.

The GPRS network architecture has to be compatible with future 3rd and 4th generation mobile communication systems.

It should be able to support both point-to-point and point-to-multipoint data connections.

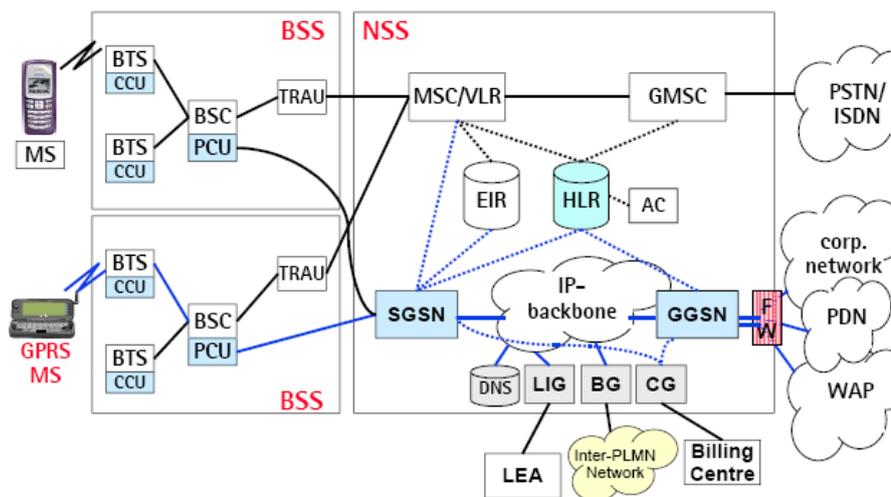It should provide secure access to external networks.

Figure 33:   **GSM GPRS Architecture**

Figure shows the architecture of a GPRS network. The GPRS system brings some new network elements to an existing GSM network. These elements are:

- Packet Control Unit (PCU)
- Serving GPRS Support Node (SGSN): the MSC of the GPRS network
- Gateway GPRS Support Node (GGSN): gateway to external networks
- Border Gateway (BG): a gateway to other PLMN Intra-PLMN backbone: an IP based network inter-connecting all the GPRS elements
- Charging Gateway (CG)
- Legal Interception Gateway (LIG)
- Domain Name System (DNS)
- Firewalls: used wherever a connection to an external network is required.

Not all of the network elements are compulsory for every GPRS network.

11.2.2 PACKET CONTROL UNIT (PCU)

The PCU separates the circuit switched and packet switched traffic from the user and sends them to the GSM and GPRS networks respectively. It also performs most of the radio resource management functions of the GPRS network. The PCU can be either located in the BTS, BSC, or some other point between the MS and the MSC. There will

be at least one PCU that serves a cell in which GPRS services will be available. Frame Relay technology is being used at present to interconnect the PCU to the GPRS core.

11.2.3 CHANNEL CODEC UNIT (CCU)

The CCU is realised in the BTS to perform the Channel Coding (including the coding scheme algorithms), power control and timing advance procedures.

11.2.4 SERVING GPRS SUPPORT NODE (SGSN)

The SGSN is the most important element of the GPRS network. The SGSN of the GPRS network is equivalent to the MSC of the GSM network. There must at least one SGSN in a GPRS network. There is a coverage area associated with a SGSN. As the network expands and the number of subscribers increases, there may be more than one SGSN in a network. The SGSN has the following functions:

- Protocol conversion (for example IP to FR)
- Ciphering of GPRS data between the MS and SGSN
- Data compression is used to minimise the size of transmitted data units
- Authentication of GPRS users
- Mobility management as the subscriber moves from one area to another, and possibly one SGSN to another
- Routing of data to the relevant GGSN when a connection to an external network is required
- Interaction with the NSS (that is, MSC/VLR, HLR, EIR) via the SS7 network in order to retrieve subscription information
- Collection of charging data pertaining to the use of GPRS users
- Traffic statistics collections for network management purposes.

11.2.5 GATEWAY GPRS SUPPORT NODE (GGSN)

The GGSN is the gateway to external networks. Every connection to a fixed external data etwork has to go through a GGSN. The GGSN acts as the anchor point in a GPRS data connection even when the subscriber moves to another SGSN during roaming. The GGSN may accept connection request from SGSN that is in another PLMN. Hence, the concept of coverage area does not apply to GGSN. There are usually two or more GGSNs in a network for redundancy purposes, and they back up each other up in case of failure. The functions of a GGSN are given below:

- Routing mobile-destined packets coming from external networks to the relevant SGSN
- Routing packets originating from a mobile to the correct external network
- Interfaces to external IP networks and deals with security issues
- Collects charging data and traffic statistics
- Allocates dynamic or static IP addresses to mobiles either by itself or with the help of a DHCP or a RADIUS server
- Involved in the establishment of tunnels with the SGSN and with other external networks and VPN.

From the external network's point of view, the GGSN is simply a router to an IP sub-network. This is shown below. When the GGSN receives data addressed to a specific user in the mobile network, it first checks if the address is active. If it is, the GGSN forwards the data to the SGSN serving the mobile. If the address is inactive, the data is discarded. The GGSN also routes mobile originated packets to the correct external network.

11.3   THE EDGE

EDGE, or the Enhanced Data Rate for Global Evolution, is the new mantra in the Global Internet Connectivity scene. EDGE is the new name for GSM 384. The technology was named GSM 384 because of the fact that it provided Data Transmission at a rate of 384 Kbps. It consists of the 8 pattern time slot, and the speed could be achieved when all the 8 time slots were used. The idea behind EDGE is to obtain even higher data rates on the current 200 KHz GSM carrier, by changing the type of the modulation used.

Now, this is the most striking feature. EDGE, as being once a GSM technology, works on the existing GSM or the TDMA carriers, and enables them to many of the 3G services.

Although EDGE will have a little technical impact, since its fully based on GSM or the TDMA carriers, but it might just get an EDGE over the upcoming technologies, and of course, the GPRS. With EDGE, the operators and service providers can offer more wireless data application, including wireless multimedia-mail (Web Based), Web Infotainment, and above all, the technology of Video Conferencing. Now all these technologies that were named earlier, were the clauses of the IMT-UMTS 3G Package. But, with EDGE, we can get all these 3G services on our existing GSM phones, which might just prove to be a boon to the user.

The current scenario clearly states that EDGE will definitely score higher than GPRS. The former, allows its users to increase the data speed and throughput capacity, to around 3-4 times higher than GPRS.

Secondly, it allows the existing GSM or the TDMA carriers to give the sophisticated 3G services. And with 1600 Million subscribers of GSM in over 170 countries, offer the full Global Roaming, anywhere between India to Japan and to San Fransisco.

- Based on an 8 PSK modulation, it allows higher bit rate across the air Interface.
- One Symbol for every 3 bits. Thus, EDGE Rate = 3x GPRS Rate.

11.4   UMTS

- UMTS is evolution from GSM and other (2G) mobile systems TO 3G.
- UMTS will provide people with fast, unlimited access to information and services at any time, from anywhere.
- UMTS is the convergence of mobile communications, Information Technology (IT) and multimedia technologies.
- UMTS creates new opportunities for network operators, service providers and content providers to generate revenue and seize market share.
- It provides interconnection with 2G networks as well as other terrestrial And satellite-based networks.
- Supports numerous protocols and transport technologies

3GPP Release		Radio Access Networks (RANs)		Core Network		
		BSS elements	UTRAN elements	CSCN elements	PSCN elements	common elements
R99		BSC BTS	RNC Node B	MSC GMSC IWF	SGSN GGSN BG	HLR VLR AuC
R00	**R4** (NGN architecture)			R99 elements + MSC server GMSC server MGW		EIR SMS MSCs
	R5 (All-IP core network)					R99 and R4 elements + HSS IM subsystem

Figure 34: **GSM elements**

11.5   IMT-2000

11.5.1 INTRODUCTION TO IMT-2000

International Mobile Telecommunications –2000 (IMT-2000) is an initiative of ITU that seeks to integrate the various satellite, terrestrial, fixed and mobile systems currently being deployed and developed under a single standard or family of standards to promote global service capabilities and interoperability after the year 2000.

These services are known as Third Generation or 3G services.

A future standard in which a single inexpensive mobile terminal can truly provide communications any time, any where.

Limitations of 2G Systems

- Multiple Standards - No Global Standards
- No Common Frequency Band
- Low Data Bit Rates
- Low Voice Quality
- No Support of Video
- Various Network Systems to meet Specific Requirements

11.5.2 IMT-2000 OFFERS

The 3G networks must be capable of providing the following data rates 144 Kbps at mobile speeds 384 Kbps at pedestrian speeds Mbps in fixed locations

3G systems will be capable of providing data rates up to 2 Mbps, in addition to voice, fax services.

3G networks will offer the high resolution video and multimedia services on the move such as mobile service, virtual banking, online billing, video conferencing etc.

11.5.3 IMT-2000 KEY FEATURES AND OBJECTIVES

- Incorporation of a variety of systems
- A high degree of commonality of design worldwide
- Compatibility of services within IMT-2000 and with the fixed network
- High quality and integrity comparable to the fixed network
- Use of small pocket terminal world wide

- Connection of mobile users to other mobile users or fixed users
- Provisioning of these services over wide range of user densities and coverage areas.
- Efficient use of radio spectrum consistent with providing service at acceptable cost.
- A modular structure which will allow the system to grow in size and complexity

Provision of a framework for the continuing expansion of mobile network services and access to services and facilities of the fixed network

An open architecture which will permit easy introduction of advances in technology of different applications

11.5.4 IMT-2000 WILL PROVIDE..

- Enhanced voice quality, ubiquitous coverage and enable operators to provide service at reasonable cost
- Increased network efficiency and capacity
- New voice and data services and capabilities
- An orderly evolution path from 2G to 3G systems to protect investments.

11.6 TERRESTRIAL RADIO INTERFACE SPECIFICATIONS

ITU NOMENCLATURE	COMMONLY KNOWN AS	TECHNOLOGY
IMT-DS DIRECT SPREAD	UTRA-FDD (UMTS TERRESTRIAL RADIO ACCESS)	W-CDMA
IMT-MC MULTI CARRIER	CDMA2000 1X & 2X	CDMA
IMT-TC TIME CODE	UTRA-TDD (UMTS TERRESTRIAL RADIO ACCESS) AND TD-SCDMA	CDMA + TDMA
IMT-SC SINGLE CARRIER	UWV-136 (UNIVERSAL WIRELESS COMMUNICATIONS)	TDMA
IMT-FT FREQUENCY TIME	DECT	TDMA + FDMA

Table 9.   Radio interface specifications

11.7 MIGRATION PATH

While a multiplicity of 2G standards have been developed and deployed, the ITU wanted to avoid a similar situation to develop for 3G.

Hence, the ITU Radio communication Sector (ITU-R) has elaborated on a framework for a global set of 3G standards, which will facilitate global roaming by

operating in a common core spectrum and providing migration path to all the major existing 2G technologies.

The major 2G Radio access networks are based on either cdma-One or GSM technologies and different migration path is proposed for each of these technologies.

11.7.1 GSM TO 3G

GSM can be upgraded for higher data rate upto 115 Kbps through deploying GPRS (General Packet Radio Service) network .This requires addition of two core modules

- SGSN (Serving GPRS Service Node)
- GGSN (Gateway GPRS Service Node)

GSM radio access network is connected to SGSN through suitable interfaces.

GPRS phase-II will support higher data rates up to 384 Kbps through incorporating EDGE (Enhanced Data Rate for GSM Evolution).

Further, to support data rates up to 2 Mbps, Third Generation radio access network (3G RAN)

W-CDMA is deployed. 3G RAN is connected to GSM MSC for circuit oriented services and to SGSN for packet oriented services (internet access). Therefore the migration path can be represented as :

> GSM $\longrightarrow$ GPRS $\longrightarrow$ EDGE $\longrightarrow$ W-CDMA.

11.7.2 CDMA ONE TO 3G

CDMA One progression towards higher speed data is in manageable steps. The present data rate of 14.4 is upgradeable to 64 Kbps (IS-95B).

Still higher data rates are supported through third generation (3G) networks. CDMA One supports a low risk and flexible phased evolution to 3G, called cdma2000.

The first step in this transition to CDMA 2000, also referred as 1xRTT (MC-CDMA) enables delivering peak data rates of 144 Kbps for stationary and mobile applications

Future evolutionary step will produce a harmonized 3xRTT (MC-CDMA) solution expected to deliver peak data rates of up to 2 Mbps.

In addition, both 1xRTT and 3xRTT are backward compatible to CDMA One. Therefore the migration path can be represented as:

> CDMA One $\longrightarrow$ CDMA 2000 (MC-CDMA)

11.8 3G CELLULAR SYSTEMS

3G systems are planned with objective of integration of all kinds of wireless systems into universal mobile telecommunication system. Work is continuing in European research consortium, RACE, and in ETSI towards developing UMTS (Universal Mobile Telecommunication System) on an joint European basis. At the same time ITU is working globally towards IMT-2000 (International Mobile Communication-2000) with mutual agreements and information exchange.

One of the main objective of 3G systems is that they will gather existing mobile services (cellular, cordless, paging etc.) into one single network. The multiplicity of services and features of the system will make it possible for the users to choose among multiple terminals and service provides. Terminals will become smarter and will be able to support several radio interface with the help of software radio technology. Among the objectives that have been assigned to 3G system designers are : voice quality as with fixed networks, satellite services for non-covered areas, low terminal and services costs, high bit rate mobile multi-media services (2 Mbps for indoor and reduced mobility users, 384 Kbps for urban outdoor ,

and 144 Kbps for rural outdoor), multiple services per user (speech at 8 Kbps, data at 2,4 or 6 x 64=384 Kbps, video at 384 Kbps and multimedia, security and antifraud features against access to data by non-authorized people or entities.

11.8.1 4G LONG-TERM EVOLUTION(LTE):

In 2004, 3GPP began a study into the long term evolution of UMTS.

The aim was to keep 3GPP's mobile communication systems competitive over timescales of 10 years and beyond,

by delivering the high data rates and low latencies those future users would require.

Evolution of the system architecture from GSM and UMTS to LTE.
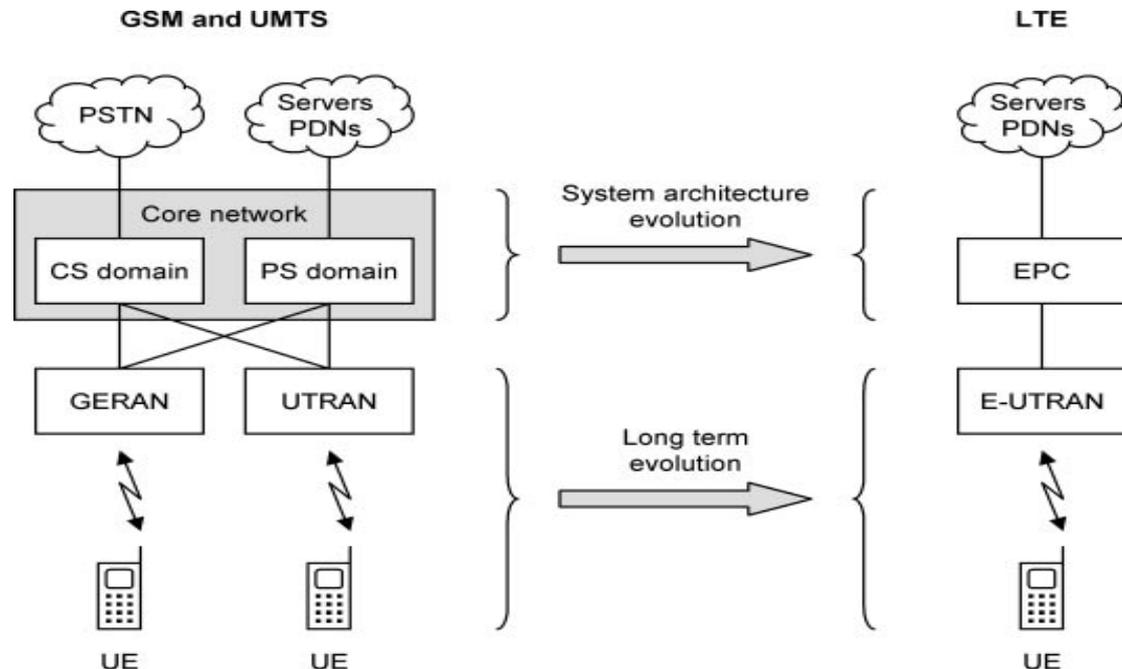
Figure 35:   **Evolution of the system architecture from GSM and UMTS to LTE.**

11.8.2 EVOLVED PACKET CORE (EPC):

- EPC is a direct replacement for the packet switched domain of UMTS and GSM.
- It distributes all types of information to the user, voice as well as data, using the packet switching technologies.
- There is no equivalent to the circuit switched domain.
- voice calls are transported using voice over IP.
- The evolved UMTS terrestrial radio access network (E-UTRAN) handles the EPC's radio communications with the mobile.

11.8.3 EVOLVED PACKET SYSTEM (EPS):

The new architecture has two parts namely:

- System architecture evolution (SAE) which covered the core network,
- Long term evolution (LTE) which covered the radio access network, air interface and mobile.
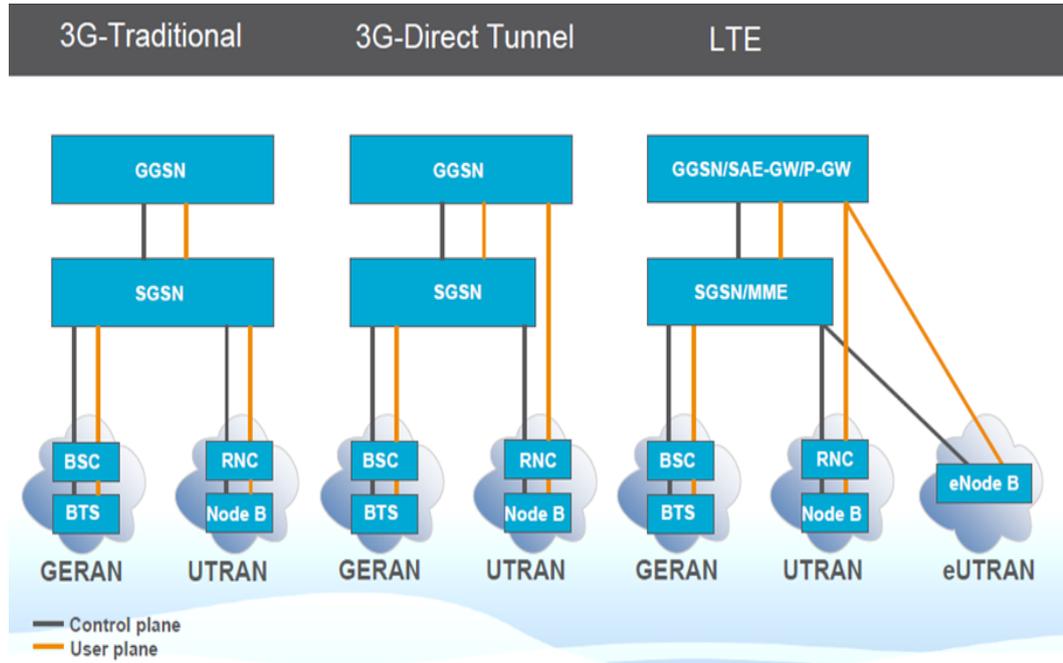
Figure 36:   **Evaluation Path Architecture**

11.8.4 FEATURES OF LONG TERM EVOLUTION:

- Downlink peak data rate is 100 Mbps
- Uplink data rate is to be 50 Mbps.
- Spectral efficiency of LTE is required to support three to four times greater than that of Release 6 WCDMA in the downlink and two to three times greater in the uplink.
- LTE is optimized for cell sizes up to 5 km.
- Latency is another important issue, particularly for time-critical applications such as voice and interactive games.

11.8.5 TECHNICAL FEATURES OF LTE:

Feature	WCDMA	LTE
Multiple access scheme	WCDMA	OFDMA and SC-FDMA
Frequency re-use	1	Flexible
Use of MIMO antennas	From Release 7	Yes
Bandwidth	5 MHz	1.4, 3, 5, 10, 15 or 20 MHz
Frame duration	10 ms	10 ms
Transmission time interval	2 or 10 ms	1 ms
Modes of operation	FDD and TDD	FDD and TDD
Uplink timing advance	Not required	Required
Transport channels	Dedicated and shared	Shared
Uplink power control	Fast	Slow

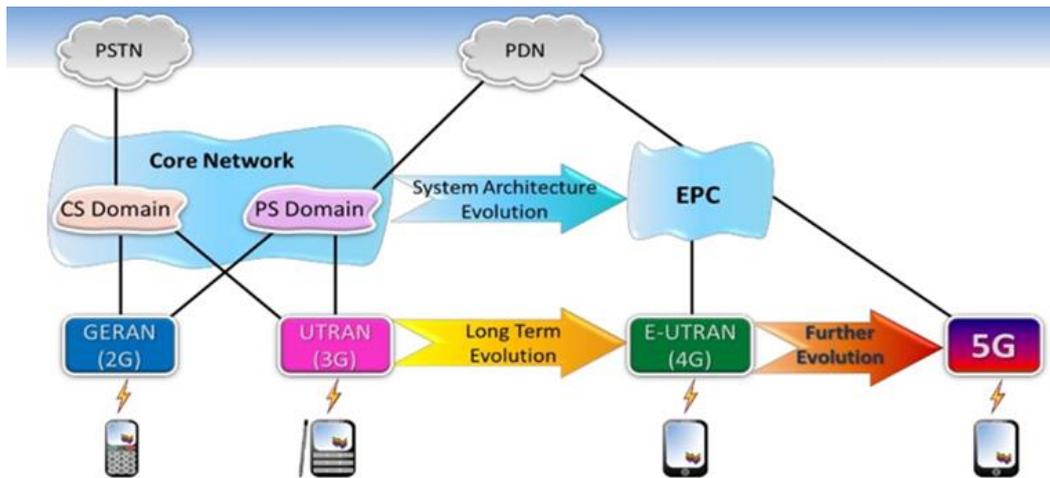**Table 10. Technical Features of LTE**

Figure 37:   **5G will be Evolution or Revolution**

11.9 LTE- ADVANCED

- Peak data rate of 1000 Mbps in the downlink, and 500 Mbps in the uplink.
- bandwidth of 100 MHz that is made from separate components of 20 MHz each.
- spectral efficiency 4.5 to 7 times greater than that of Release 6 WCDMA on the downlink, and 3.5 to 6 times greater on the uplink.
- LTE-Advanced is designed to be backwards compatible with LTE.

11.10 5TH GENERATION MOBILE NETWORK (M2M & IOT)

11.10.1DEFINITION

5G is an end-to-end ecosystem to enable a fully mobile and connected society. It empowers value creation towards customers and partners, through existing and emerging use cases, delivered with consistent experience, and enabled by sustainable business models.

11.10.2VISION OF 5G:

MT for 2020 and beyond", the capabilities of IMT-2020 are identified, to make IMT-2020 more flexible, reliable and secure than previous IMT when providing diverse services in the intended three usage scenarios,

- Enhanced mobile broadband (eMBB).
- Ultra-reliable and low-latency communications (URLLC),
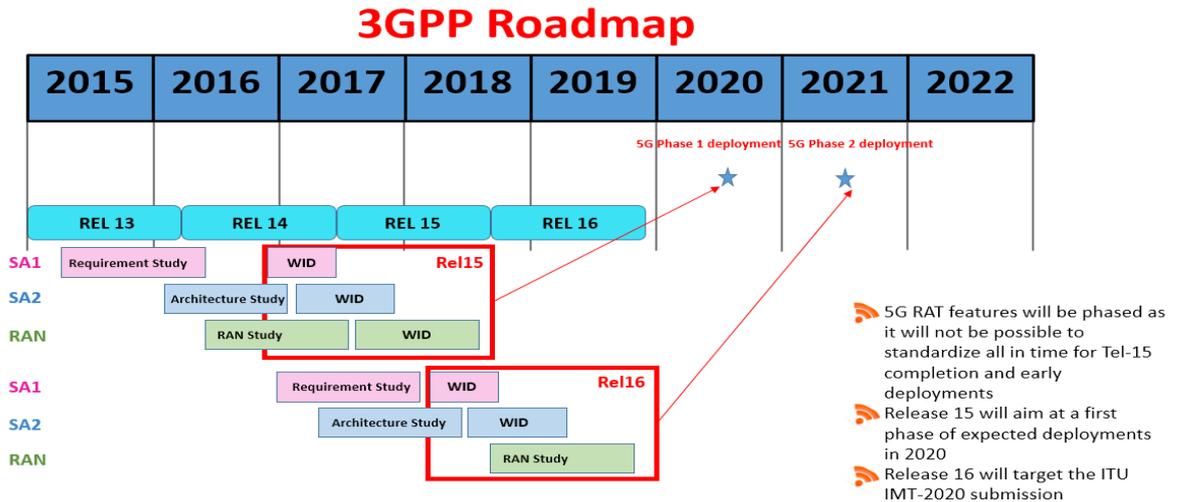- Massive machine type communications (mMTC).

Figure 38:   **3GPP RAN Progress on "5G".**

11.10.3 FEATURES OF 5G:

- 5G push the envelope of performance to provide much greater throughput,
- much lower latency,
- ultra-high reliability,
- much higher connectivity density, and
- higher mobility range.
- capability to control a highly heterogeneous environment, and
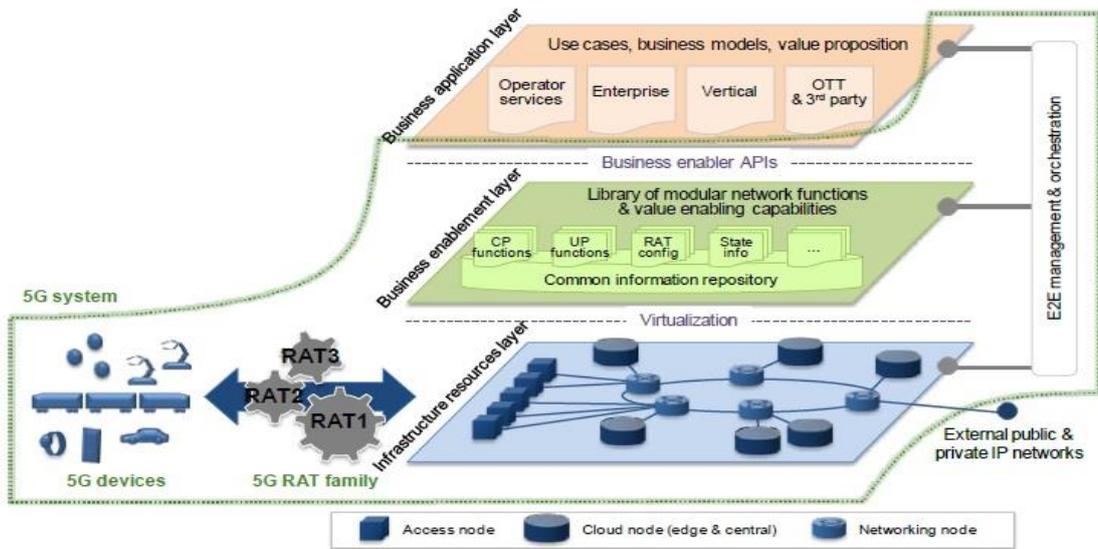- capability to ensure security and trust, identity, and privacy.

Figure 39:   **5G Architecture**

11.10.4 LAYERS IN 5G NETWORK:

- Infrastructure resource layer.
- Business enablement layer.
- Business application layer.
- E2E management and orchestration entity.

11.11 CONCLUSION

5G is new technology had has to have maturity in terms on network deployment and rollouts. In India 5G is going to play a significant role in Telemedicine , gaming, and AI, VR, AR.

12 CDR BILLING

12.1 LEARNING OBJECTIVES

- Concept of CDR used in BSNL
- Implementation of CDR based convergent billing and customer care system.
- Customer care and billing for the Landline, Broadband and Leased Line Services.

12.2 INTRODUCTION

BSNL has implemented a CDR based convergent billing and customer care system. This project has replaced all the existing systems of Commercial, TRA (Telecom Revenue Accounting), FRS (Fault Repair Service) and DQ (Directory Enquiry). The project covers the customer care and billing for the Landline, Broadband and Leased Line Services.

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

This project involved installation of provisioning and mediation systems which interface with around 3000 PSTN switches. The subscriber management is done through the Provisioning system. The CDRs generated for all the calls are pulled by the Mediation system.

We are having world renowned rating and billing systems which process the mediated CDRs. The combination of CRM and the billing system has enabled BSNL to introduce flexible user-friendly tariff Plans. It has also enabled us to introduce schemes which we were not able to do earlier with the old billing systems. CDR has also provided facility of Convergent Billing through e-stapling facility.

The project also involved implementation of Payment Management system. It is specially designed and developed by TCS for BSNL. This system is common for all the Circles in BSNL. It allows acceptance of payments from all types of channels i.e. online terminals, Post Offices, Banks, Internet payments, etc. The Payment Management system and the Billing system are integrated with an Accounting system which performs the accounting functionality and generation of sub-ledgers.

There is separate software for bill formatting. The software allows preparing the bills as per the design (uniform for all circles) that includes all types of graphics, logos, advertisements, etc. in multi-colour and bilingual formats. The system prepares a Print file, which is then given to the printer for printing. The printing sub system is not part of this project. The Print file is used by Zonal Printing systems.

12.3 IMPLEMENTATION

The entire project is implemented with four Data Centres at Hyderabad, Pune, Chandigarh and Kolkata. These four Data Centres 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 from M/s.Comverse. The same billing system as is being used in the GSM and Broadband is used in this project for the South East Zone. In the North West, the system for billing will be from M/s.Converges.

12.4   CONVERGENT BILLING

This project has implemented 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 is 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 has 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 also helps to introduce Combo Plans, offering flexible tariff plans to customers availing Landline, Broadband and GSM services.

12.4.1 HARDWARE

Data Centre (DC) Class servers which are high-end servers are having 64 cores/CPUs in each machine. These high end machines are used for hosting the main applications such as Billing and CRM. Low-end servers which are two-CPU servers are used 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 having 18 DC class servers and around 200 low-end servers.

12.4.2 NETWORK

This project has implemented a country-wide Intranet. This network connects 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. Different networks have been integrated to provide a country-wide IP network with MPLS as the backbone. The network is used not only for implementation of the CDR project, but also for implementing ERP and all other IT projects in future.

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, are connected using X.25 cards and Ethernet interface (wherever available). All CDOT exchanges are connected to the LE router using CES equipment supplied by CDOT through HCL. All E10B exchanges are 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 are aggregated to the Aggregation Router. Each Aggregation Router in each SSA is connected over STM-1 link to the nearest MPLS node. For redundancy purposes, the connectivity is established to two MPLS nodes. The Data Centre was connected to the MPLS network through STM-1 links to start with, which were enhanced to 1 Gbps/10 Gbps link afterwards.
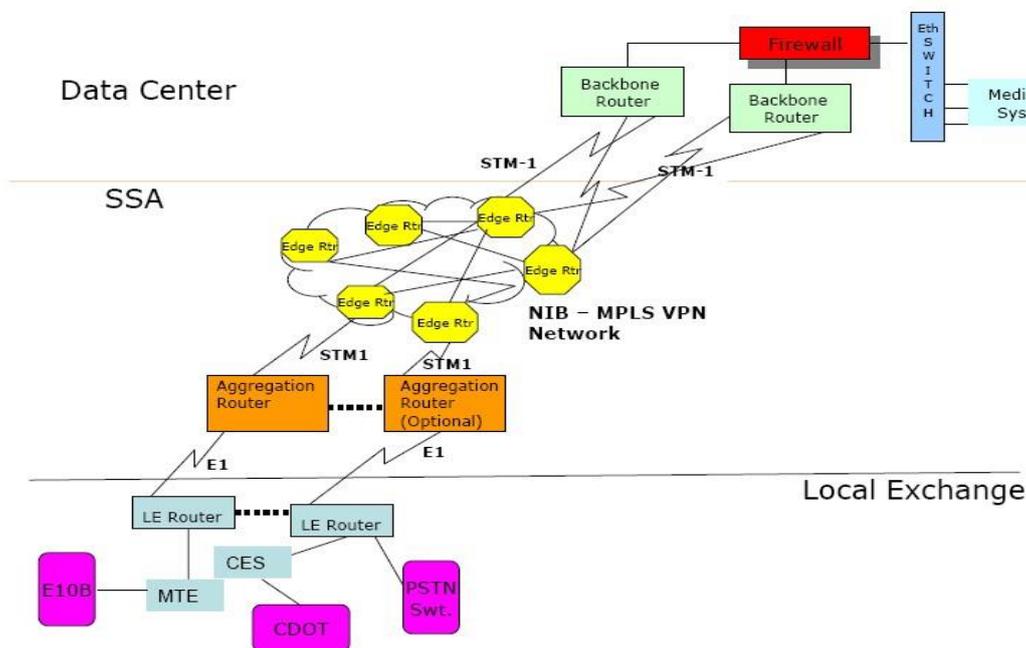

Figure 40:   **CDR Network**

12.4.3 IVRS AND INTEGRATION WITH CALL CENTRES

This project has centralized IVRS (in each zone), CTI (Computer Telephony Interface), IP EPABX, etc. The core equipment required for Call Centre operations is therefore installed at the Data Centres. The existing Call Centres have been connected to the Data Centres. The 1500 calls and the 198 calls are also routed to this IVRS. Depending upon the Number or the CLI, the call is 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 therefore has 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 have been integrated with the Data Centres.

12.4.4 SOFTWARE

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

a)   CRM (including FRS)

b)   Billing

c)   Accounting

d)   Mediation

e)   Provisioning

f)   Web Self Care (WSC)

g)   Bill formatter

h)   Revenue Assurance (RA)

i)   Inventory management, which takes care of customer inventory such as MDF particulars, Pillar, DP particulars, etc.

j)   Directory enquiry

k)   Inter Operator Billing and Accounting system (IOBAS)

l)   Fraud Management System (FMS)

m)   Enterprise Management System (EMS)

n)   Enterprise Application Interface (EAI)

12.4.5 DISASTER RECOVERY

The customer care and billing and other related operations of all SSAs have been 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 up to 50%. This means for example, a billing operation taking 8 hours in the normal course, can take up to 16 hours in case of a disaster.

12.5   AFTER CDR PROJECT

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

12.5.1 REVENUE ACCOUNTING:

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

12.5.2 SURCHARGE/LATE FEE

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

12.5.3 PCO BILLING

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

12.5.4 DEPOSITS

Deposits are already made uniform depending upon the type (Urban or Rural) and capacity of exchange. Therefore, we are not 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.

12.6 CDR BASED BILLING

Prior to CDR, the tariff, which was based on MCUs and number of calls, has been 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.

This project has been successful 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.

12.6.1 CDR BASED BILLING

a)   The previously existing tariff, which is based on MCUs and number of calls, has got migrated to MOU (Minutes of Usage) based system.

b)   The discounts can be given not in terms of Free Calls, but are in terms of Free Talk Time given as Minutes per month or Rupees per month.

c)   Though the system offers lot of flexibility in configuring different Plans, BSNL in turn is following certain discipline in offering various Plans to the customers.

d)   Circle Office team has been authorized to configure the plans as per business requirements and SSAs may not be able to configure new Plans on their own but can get is done through the Circle Office team.

e)   Each Plan is identified by a Plan Code in the system.

f)   This discipline is helping the organization in monitoring the launch of tariff Plans across the country and it is helping BSNL to take correct business decisions.

12.6.2 WHAT THE SSAS HAVE DONE IN PREPARING & MIGRATING TO THE CDR PROJECT

a) Provided connectivity of exchange routers to MPLS VPN.

b) Each exchange has been connected through one E1 link to the Aggregation Router.

c) A redundant (second) E1 link has been connected to the second Aggregation Router.

d) Connectivity of Aggregation Router of SSA has been done with two of the nearest MPLS nodes through STM-1 links

e) Connecting the previously existing CSR network has been done to the Aggregation Router of the SSA.

f) Have Provided Transmission media to all these connectivity in coordination with the Telecom Region to get channel allocation and connectivity to the MPLS node.

g) Coordination with NIB (Data network Circle) for allotment of STM-1 ports at all the MPLS nodes.

h) Have performed Cleaning and preparation of the data in the existing systems for data migration – to follow the guidelines given already by DDG (TRF).

i) Have performed Reconciliation of data between switches and the billing systems.

j) All the numbers found working in the telecom switch have been reconciled with those working in the billing system also.

k) The number of disconnected/closed connections, have also been reconciled between the switch and the billing system.

l) All connections, which are closed, have been settled and accounts finalized and are not to be transferred to the new system.

m) Thorough review of outstanding have been done and fictitious outstanding and other outstanding have been written off as per the Corporate Office guidelines.

n) Deposits data have been verified and corrected in the previously existing system before data migration is done.

o) All the facilities like CLIP, STD, ISD, Call forwarding, etc., have been gathered for all the customers and were kept ready before data migration.

p) All the accessories being charged to the customers in the previously existing billing system were thoroughly verified.

q) FRS data for all the customers regarding MDF, Pillar, and DP have been gathered and was kept ready before mogration.

r) To start with, it was 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 was very important. Instructions issued in this regard by CGM IT have been followed.

s) All the new technology switches, CDOT and E10 B exchanges have been kept ready for CDR generation for 100% of calls.

t) The requirements of X.25 interface cards and cables have been projected to the Corporate Office, keeping IT Circle informed.

u) The up-gradation and procurement of PCs have been done on top priority.

v) SSAs ensured the availability of Bar Code Scanners at all online counters and availability of A4 page scanners for scanning the application forms.

w) All the Circles have reviewed the previously existing network and project requirement of network elements for the Rollout phase of this project to the IT circle.

x) All the SSAs were requested to watch the CDR Project link provided in the BSNL Intranet Portal for regular updates and information on the progress of this project.

12.7 CONCLUSION

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

13 ERP PROJECT

13.1 LEARNING OBJECTIVES

- Concept of ERP
- ERP Modules in BSNL

13.2 WHAT IS ERP?

ERP stands for Enterprise Resource Planning. It is a system used to integrate the data and processes of an organization into one single system. Usually ERP systems will have many components covering various units and functions of an organisation. The term ERP originally referred to how a large organization planned to use organizational wide resources. In the past, ERP systems were used in larger industrial types of companies. The use of ERP has changed and is extremely comprehensive. Today the term can refer to any type of company, no matter what industry it falls in. In fact, ERP systems are used in almost any type of organization.

Today's ERP systems can cover a wide range of functions and integrate them into one unified database. For instance, functions such as Human Resources, Supply Chain Management, Customer Relations Management, Financials, Manufacturing functions and Warehouse Management functions were all once stand alone software application, usually housed with their own database and network, today, they can all fit under one umbrella - the ERP system.

Integration is an extremely important part to ERP's. ERP's main goal is to integrate data and processes from all areas of an organization and unify it for easy access and work flow. ERP usually accomplish integration by creating one single database that employs multiple software modules providing different areas of an organization with various business functions.

Before ERP system, each unit and department in an organization would most likely have their own computer system, data and database. Unfortunately, many of these systems would not be able to communicate with one another or need to store or rewrite data to make it possible for cross computer system communication. Once an ERP system is in place, usually all aspects of an organization can work in harmony instead of every single system needing to be compatible with each other. For large organizations, increased productivity and less types of software are a result.

13.3 WHY ERP?

Integration is an extremely important part of ERP and its main objective is to integrate data and processes from all areas of an organization.

Using ERP, a transparent information flow is achieved to facilitate better decision making, improvement in the performance of the organization processes.

Information available in current independent systems is available in a single system.

a)   Process standardization

b)   Single version of truth

c)   Real-time information availability

d)   MIS – Reports across functions

13.4   HOW DOES ERP WORK?

The traditional application systems, which the organizations generally employ, treat each transaction separately. They are built around the strong boundaries of specific functions that a specific application is meant to cater.

For an ERP, it stops treating these transactions separately as stand-alone activities and considers them to be the part of the inter-linked processes that make up the business. Similar to typical application systems ERP has provision to store data, process them and present them in the appropriate form However the data and processes are interlinked and integrated across modules

In Traditional application systems there is no link between the application systems being used by different departments. An ERP system also does the same thing, but in a different manner. There are hundreds of such data tables, which store data generated as a result of diverse transaction

Transactions are not confined to any departmental or functional boundaries, rather integrated to be used by multiple users, for multiple purposes and at multiple places.

13.5   ERP PROJECT

The Important partners for this project are M/s HCL Infosystem as SI, M/s SAP as ERP Solution Provider and M/s E&Y as BPR consultant. Business Process Re-engineering has been taken up along with ERP implementation

13.6   ERP IMPLEMENTATION APPROACH

Two of the CDR Project data centres are used. Hyderabad is the primary ERP site and Kolkata is DR site. ERP has been deployed like another application of CDR Project deployed in CDR Data centre. Security systems, Access Control System, Identity Management, UPS, and Storage etc of CDR system are being used. Development Centre for ERP is at ALTTC Ghaziabad.

13.6.1 CENTRALIZED ARCHITECTURE

ERP has Centralized Installation with a single database. All units access the central server. They have secure access to their own set of data & processes. Corporate Office can have a view of BSNL as a whole across circles.

IT Cell/ IT Project Circle will act as a facilitator for this exercise, setup, validate and maintain data center with required hardware, network and upkeep of ERP software as well.

13.6.2 IMPLEMENTED MODULES OF ERP FOR BSNL

•Project System (PS) module

•Materials Management (MM) module

•Plant Maintenance (PM) module

•Real Estate Management (REM) module

•Sales and Distribution (SD) module

•Finance and Controlling (FICO) module

•Human Capital Management (HCM) module with Employee / Manger Self Service (ESS/MSS)

**BSNL ERP- Organization Structure:**

Controlling Area	Organizational unit used for management accounting purposes. A controlling area may contain one or more company codes	Controlling Area for BSNL : 1000
Company Code	The company code is the smallest organisational unit for which you can have complete independent accounting It is a legal entity for which the financial statements such as Balance Sheet, Profit & Loss Account are created It may represent a company within a corporate group	Territorial Circles, Telecom Factory, Project Circle, Maintenance Region etc..,
Business Area	A Business area is an organizational unit within accounting that represents a separate area of operations or responsibilities in a business organization	For BSNL – All primary accounting units are considered as business area. E.g. SSAs, Sub-Regions, Project Areas etc..,
Profit / Cost Centres	Organizational unit in Accounting that reflects a management-oriented structure of the organization for the purpose of internal control. Cost centres are the smallest organizational unit within the Cost Centre accounting structure of a legal entity	CFA, Broadband, CM, EB etc.., CDMA-Radio Access Nw, Core-Fxd Access Broadand, etc..,
Plant	Usually a Manufacturing Facility, Warehouse, or a Location that Stocks , Manages, and Valuates Inventory Same can also be used as Maintenance Plant : A plant in which the technical objects i.e. Switches ,transmission systems ,E/A sets etc. of a company are installed and where maintenance is done	SSAs, Sub- Regions, Project Areas etc..,
Storage Location	A Location within a Plant where Inventory is Stored	Respective Stores under SSAs, Sub- Regions, Project Areas etc..,

Controlling Area	Organizational unit used for management accounting purposes. A controlling area may contain one or more company codes	Controlling Area for BSNL : 1000
Maintenance Planning Plant	The planning responsibility for a Maintenance plant is defined using a Planning plant. Maintenance plants are assigned to Planning plants. Maintenance tasks for the plant are planned and prepared in the Planning plants by planner groups.	SSAs, Sub- Regions, Project Areas etc..,
Maintenance Planner Group	Planner Group is a group of persons responsible for maintenance planning in a particular Planning plant. In BSNL, planner groups are defined as per various functions	Fixed Indoor/Outdoor, Broadband, Transmission, etc..
Purchasing Organization	Responsible for Procurement for One or More Plants Responsible for Negotiating Pricing and Delivery Terms with Vendors	Centralized Purchase, Decentralized Purchase
Purchasing Group	A separate group initiating or anlyzing the purchases	Corporate, Circle, SSAs etc..
Sales Organization	Sales organization stands for a selling unit in the legal sense. Regional subdividing of the market can also be carried out with the help of sales organizations	Corporate, Circles, Training centres etc..
Distribution Channel	Represent a means of distributing goods. Within a sales organization a customer can be supplied through several distribution channels.	Direct Sales, Channel sales, EB etc..,
Sales Division	Product groups, i.e. divisions, can be defined for a wide-ranging spectrum of products.	CFA, CM, Data Circuits etc..,
Business Entity	A means of forming coherent groupings of individual real estate objects, depending on their purpose and/or geographical location	SSAs, Sub- Regions, Project Areas etc..,

Controlling Area	Organizational unit used for management accounting purposes. A controlling area may contain one or more company codes	Controlling Area for BSNL : 1000
Business Entity	A means of forming coherent groupings of individual real estate objects, depending on their purpose and/or geographical location	SSAs, Sub- Regions, Project Areas etc..,
Personnel Area	A specific entity for Personnel Administration; a sub division of the company code	Territorial Circles, Telecom Factory, Project Circle, Maintenance Region etc..,
Personnel Sub Area	A sub division of the personnel Area	SSAs, Sub- Regions, Project Areas etc..,

Table 11. BSNL ERP Structure

13.7 BASIC WORKING OF ERP

After Successful login the SAP Window as shown below appears:

Figure 41:   **SAP ERP Window**

For Restricted Circulation
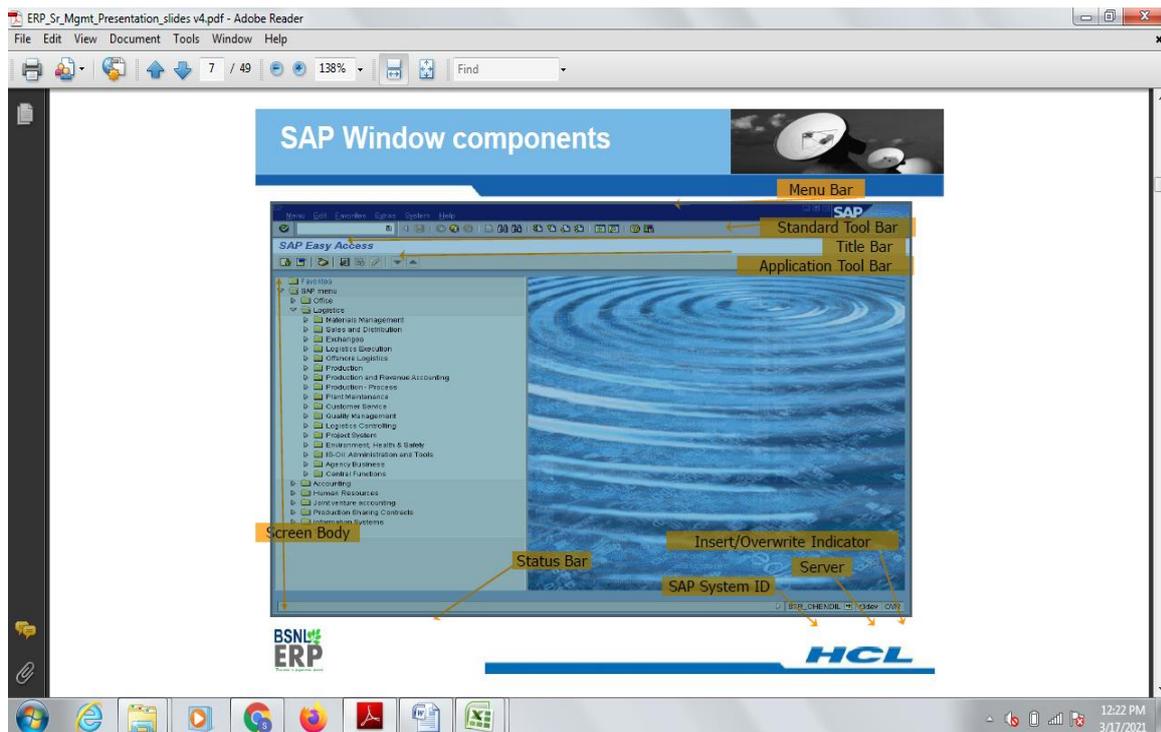
13.7.1 SAP WINDOW HAS FOLLOWING COMPONENTS:

- Manu Bar
- Standard Tool Bar
- Title Bar
- Application Tool Bar
- Status Bar
- Insert/ Overwrite Indicator
- Server (400 for Quality; 500 for Production Server)
- SAP System ID is also displayed with Pernr No. of the user

13.7.2 USING NAVIGATION AREA (SAP MENU):

You can expand and collapse menus in the navigation area by choosing the dropdown arrows to the left of the menu items as shown in diagram below. To open an application in the navigation area Double-click its node.

Favourites: You can Insert or drag and drop Transaction Codes into "Favorites" folder as shown in diagram below:
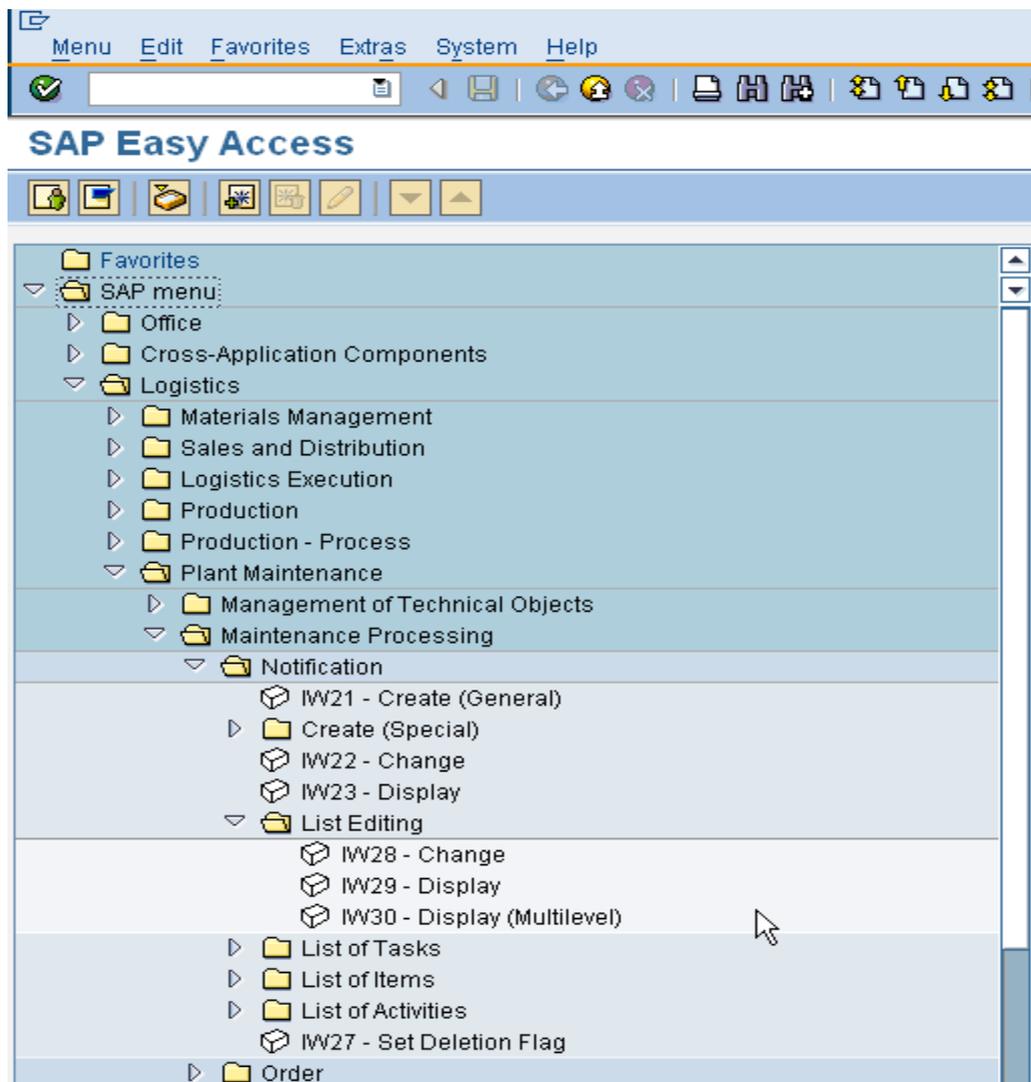
Figure 42:   **SAP ERP Menu**
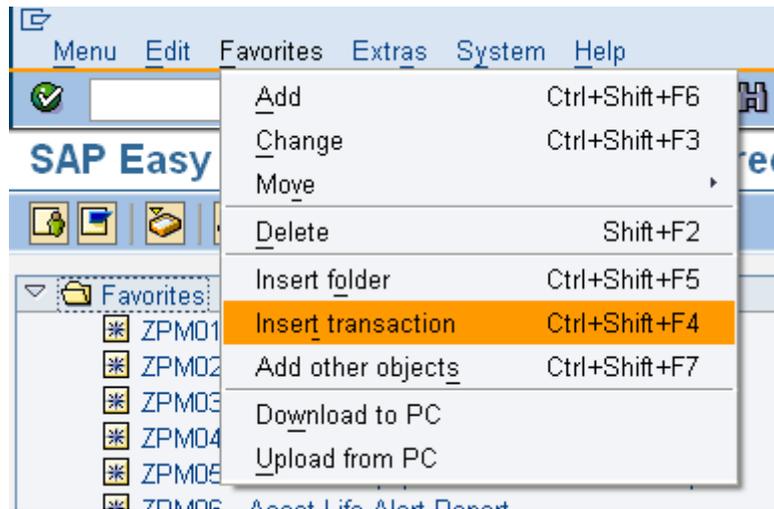
Figure 43:   **SAP ERP Command Field**

13.7.3 TRANSACTION CODES (T CODES):

A transaction code can be entered in the Command field.

If you precede the transaction code with /n then the transaction is the next screen opened in the current session. If you precede the transaction code with /o then a new session is opened for the transaction. This means you then have multiple sessions.

To start a transaction there are 4 options:

Position the cursor on the required transaction in the tree structure and press enter

Double-click on the required transaction in the tree structure

Position the cursor on the required transaction in the tree structure and select Edit

Execute (or press F2)

Expand the command field and enter the transaction code

13.7.4 STANDARD TOOL BAR

The Standard Toolbar contains the Command field and the standard SAP Toolbar buttons.

13.7.5 COMMAND FIELD

The Command field is used to enter transaction codes that take you directly to a system task without using menus.
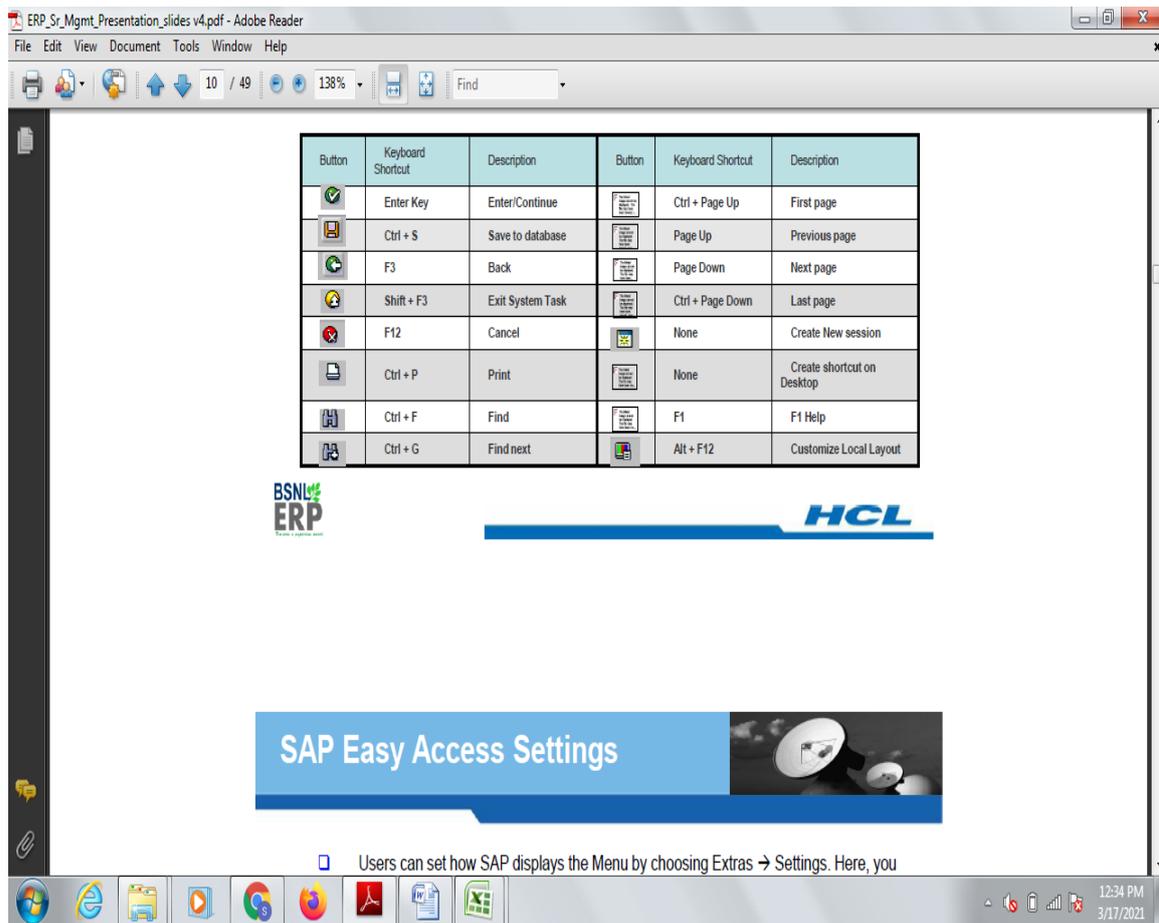
Figure 44:   **SAP ERP Key Shortcuts**

13.7.6 MESSAGES

Messages appear either in the status bar or in a pop-up window, depending on user settings Messages starting with:

"E" indicates an Error message

"W" indicates a Warning message

Messages not beginning with an "E" or a "W" are simply Information messages

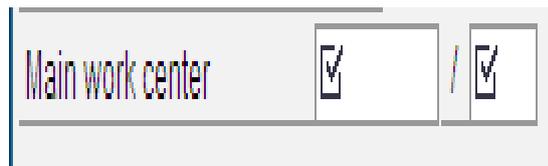Required fields are denoted by a check mark

Figure 45:   **SAP ERP Messages & Required Fields**

13.7.7 BUSINESS WORKPLACE

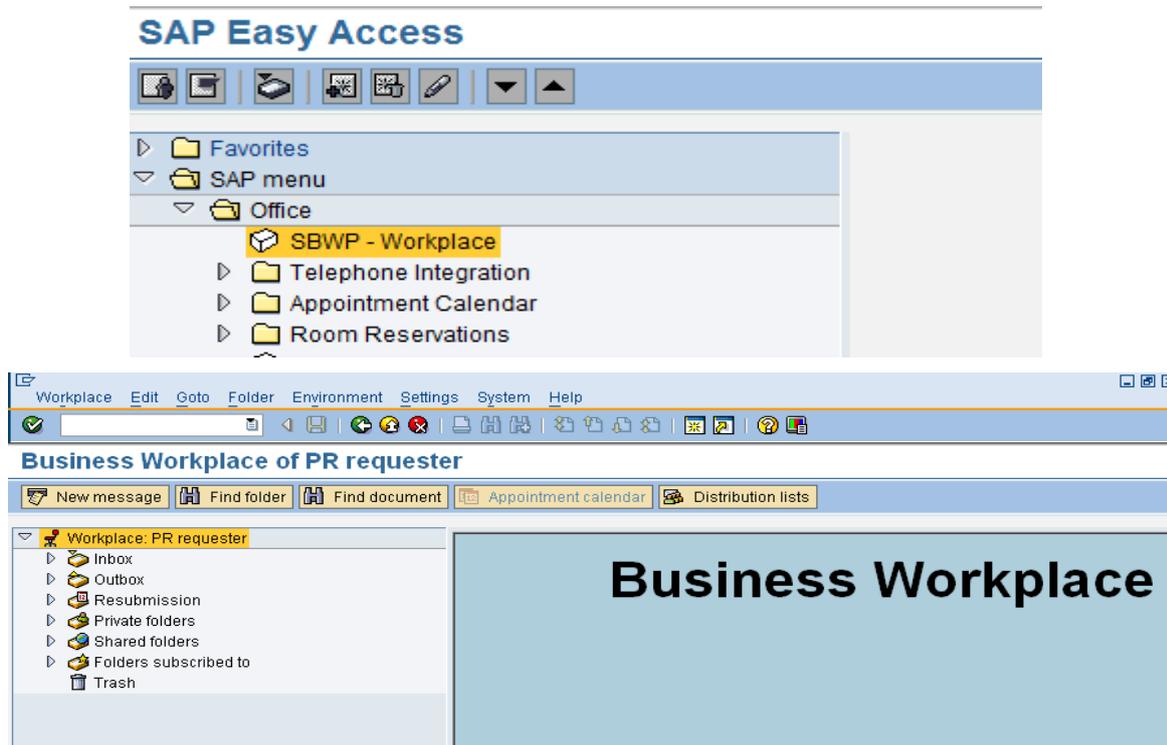Important messages can be seen here in the Inbox. One can also create and send messages using Business Workplace.
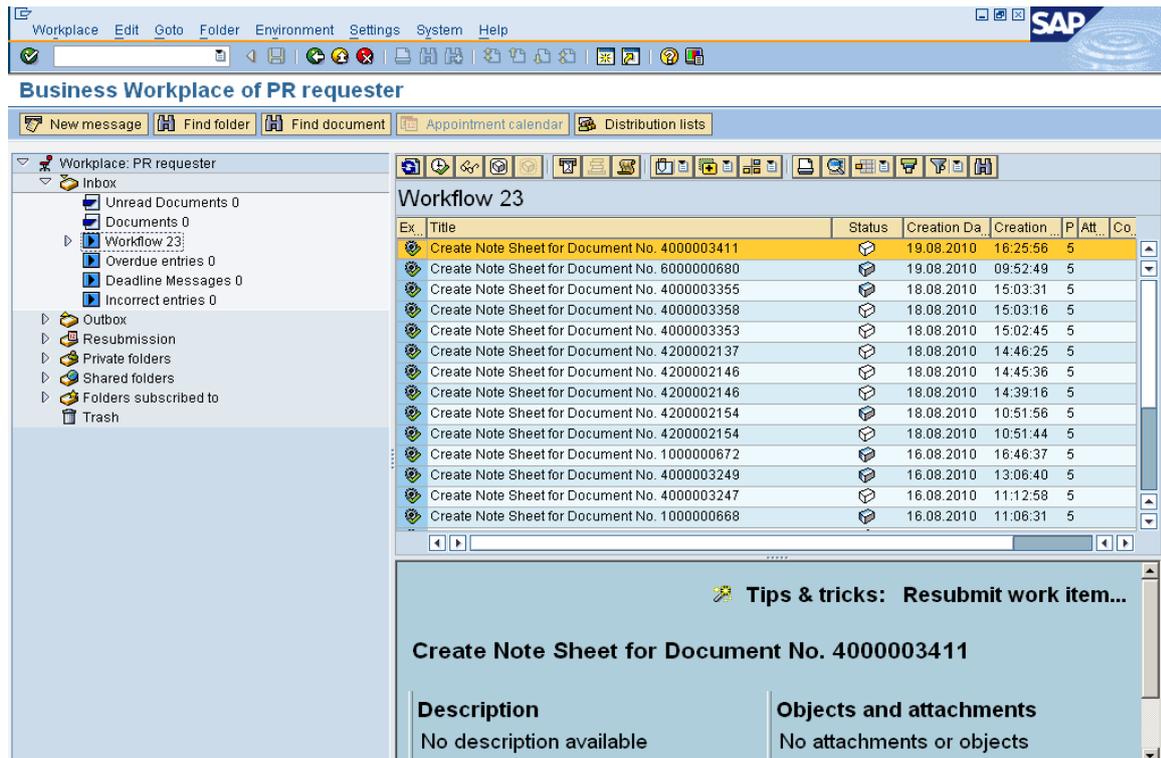

Figure 46:   **SAP ERP Business Workplace**

Figure 47:   **SAP ERP Business Workplace Inbox**

13.8   CONCLUSION

ERP system is implemented to integrate the data and processes of our organization into one single system. ERP gives a bird eye view to the top management on a single mouse click and provides the real-time data inputs for decision-making. It provides the enterprise wide picture of the organization and enables standardization and uniformity throughout the organization. Data is very safe in electronic form and with full security. The logs are available with time stamps, so ERP system brings efficiency in the working of the organization.