BROADBAND- AN OVERVIEW

Broadband is a high capacity communications pipeline capable of delivering simultaneously a range of voice, video and date services to the home in a truly interactive manner. However, the term broadband covers a host a new products, technologies, services and networks making it difficult to describe it by a simple definition as given above.

Bandwidth is the key and just how much bandwidth qualifies as broadband is currently up for debate. The federal Communication Commission (FCC) defines it as an information service with a carrying capacity in excess of 200 Kbit/s in both upstream and downstream directions, in the last mile. However some video providers and internet technology suppliers think that this rate is too low, and to spur the creation of truly new services such a VOD the definitional floor should be at least 750 Kbit/s.

2. The Infrastructure : The broadband infrastructure consists of a core or backbone network and an access network. The backbone is usually an optical fiber network. ATM (Asynchronous Transfer Mode) has been chosen as the communication principle on which the broadband networks will be based. The main reason for its selection is the flexibility that it offers for handling services requiring very different bit rates.

Currently telecommunication companies around the world have begun to run fiber-to-the curb (TRRC). This can have profound influence for consumers, especially combined with dense wavelength division multiplexing (DWDM), DWDM is the process of passing laser light at different wavelengths through a single strand of glass fiber. Each adjoining wavelength may be shifted by as little as five nanometers from the next and each can operate independently and transparently from others. Currently each wavelength may carry signals at rates upto 10 Gbits/s.

Today network switches and add/drop multiplexes running 160 wavelengths are being deployed in some network cores at 1.6 Tbit/s within a single strand of fiber. As this technology migrates to the curb it will become possible to deliver more and more bandwidth to the end user. Further more the present number of 160 wavelengths is only a starting point . Industry experts anticipate that it will be possible to run upto 1000 wavelength in a similar fashion within few years.

Synchronous optical network (SONET) is a data transmission service based on optical transmission. SONET is used in conjunction with ATM. The bandwidths available in SONET's optical Carrier (OC) standards range from OC-1 to OC-192, OC-1 service provides a bandwidth of 51.84 Mbit/s. Higher services provide

bandwidth that are multiples of 51.84 Mbit/s. The OC-192 service provides 9.9532 Gbit/s bandwidth.

ATM is the world's most widely deployed backbone technology ATM was designed to be true high speed providing support for quality of service (QoS) management and bandwidth control. ATM connections may be set up in advance or switched on demand (SVC-switched virtual circuits) using one of several different service categories viz. constant bit rate (CBR), available bit rate (ABR), Variable bit-rate (VBR) or unspecified bit- rate (UBR).

Let us now consider access networks.

3.0 Access Networks : Some brilliant technologies for long distance transportation are not so suitable for the 'last mile' to the ceiver user. In fact it is the last file provided by access network that has been the driving factor for data service deployment in recent _____. As the access network is the 1st step in the way of the data, it will determine the quality of the received transportation service, whatever technology was in the backbone network.

Access networks can broadly be classified into two main types:-
Wire line, and Wireless.

Wireline Access Networks

1. Copper Pair : Copper pair also known as twisted pair) is the most widespread access infrastructure in the world. Telecommunication companies with the purpose providing telephony , analog and narrowband services, installed this infrastructure many years ago. This infrastructure has for years been used for digital communication as well (such as connecting to the internet) by using the modem. The typical speed of such devices is used to 56 Kbit/s. The current modem speed is not the end of the _____ however. Depending on its ____ quality and length , copper ___ in most cases can be capable transmitting high speed data, by installing in both ends of the lop special devices known as DSL Digital subscriber Loop) modems.

The term DSL refers collectively to types of Digital Subscriber __ the two main categories _____ ADSL (Asymmetrical DSL) and SDSL (Symmetric DSL). Other types are RADSL (Rate _____ DSL) HDSL (High bit ____ DSL) and VDSL (Very high bit the DSL).

DSL, technology has the ability to support simultaneously voice, content rich data and video applications over the installed base of twisted pair copper wires with speeds as much as 32 Mbit/s for down stream traffic and form 32 Kbit/s to over 1 Mbit/s for upstream traffic.

ADSL is the most widespread XDSL solution. It typically offers 1.5 to 9 Mbit/s from source to receiver and 16 to 800 Kbit/s from user to source. HDSL delivers 1.544 Mbit/s in both directions.

3.1.2 Integrated Services Digital Network (ISDN) : ISDN started in the 1980s as an alternative to digital leased lines. It was designed to provide date rates in the range of Kbps to Mbps. To provide higher data rates Mbp to Gbps over ATM and SONET systems, the original ISDN was extended to Broadband- ISDN was extended to Broadband – ISDN (B-ISDN). The original ISDN can thus be called narrow band ISDN, but in practice it is only referred to as ISDN.

The main concept behind ISDN was to provide an end to end digital network that can integrate all types of services such as voice, digital data, text and video.

ISDN is available in two variants basic rate interface (BRI) and primary rate interface (PRI). Basic rate ISDN divides the telephone line into three digital channels two B channels and one D channel. The two B channels are used for voice, data or video at rates of 64 Kbit/s. The D channel is used for control and signaling. The main advantage of ISDN is that one can access the internet on one channel and make or receive voice calls on the other. PRI divides the telephone lines into 30 B channels and one D channel which can be used simultaneously.

3.1.3 Fiber optics lines are made of glass or plastic and are smaller and cheaper than copper. They use light pulse rather than electronic pulses for communication and they have substantially higher bandwidth potential than copper over much longer distances. However, because of the high cost needed used for installing underground fiber, currently fiber is mainly used in backbone networks but will gradually get into homes. The fiber can get more or less close to the user. Some of the terminology use to express alternatives in this topology is given below :-

- Fiber-in-the loop (FITL)
- Fiber-to-the-home (FTTH)
- Fiber-to-the-business (FTTB)
- Fiber-to-the neighborhood (FTTN)
- Fiber-to-the Curb (FTTC)

Typical transmission rates over fiber range from 51.84 Mbit/s to 2.488 Gbit/s.

3.1.4 Coaxial Cable Networks : Cable is the second most widespread access path to the end user, although satellite is closing in-Cable network was designed to distribute TV in local environments. As TV has very rich broadband content these networks were designed to broadcast huge quantities of information. The coaxial cable provides much higher bandwidth over longer distances than copper pair. However, it should be in borne in mind that cable capacity is shared among

all users in each branch. In other words cable was not initially built for switched networking, though it is possible to add switching to cable networks. Currently, this is being implemented or has already been implemented in many cable networks around the world.

The typical cable network topology consists of a star of fiber optics from the Head End where TV signals are created and aggregated, and a tree branch coaxial cable from the terminating point of each fiber. Depending on the design of the network the fiber may terminate more or less close to the end user providing the scenario of FTTL, FTTC etc. where the last mile is coaxial cable instead of copper pair.

Traditional cable networks are designed with one way transmission in mind. However, cable television operators worldwide are now upgrading their networks so that they are able to support two –way communication as well.

A typical hybrid fiber-coaxial solution with cable modems will have an upstream bandwidth of 500 Kbit/s to 4 Mbit/s capacity and downstream transmission speeds of 30 Mbit/s.

3.2 Wireless Access Networks : Here the two main types are terrestrial and satellite networks.

3.2.1. Terrestrial networks : Terrestrial wireless is a communication infrastructure based on point to multipoint microwave distribution. The receiving device for terrestrial wireless may be either mobile or stationary.
" MMDS/MVDS" (digital Multichannel Multiprint Distribution /Video Services) are the most popular implementations. There are also, referred to as "Wirelss Cable" as they deliver multiple TV Channels in local environments. They use microwave antennas to deliver services directly from a headed to an antenna at the customers home. An MMDS/MVDS transmitter will typically reach homes within a 15-50 Km distance. All receiving homes must be in line-of-sight. Another important technology is "LMDS" (Local Multipoint Distribution Service) which uses two way microwave transmission. Transmitters for LMDS will normally reach homes within upto 2-5 Km distance and will also require that all receivers are in line- of-sight.

Uptill now broadcast networks were not considered suitable for providing last mile access in a broadband infrastructure. This was mainly because traditionally broadcast network are one to many networks and thus lacks the capability to provide one to one connectivity. However this situation has changed recently following the introduction of several DVB defined return (interaction) channel standards. For example DVB-RCT is a standard for a wireless return channel in the VHF/UHF bands for use in conjunction with the DVB terrestrial digital TV transmission network based on the DVB-T standard. This enables these networks to be used for the delivery of several interactive services to the home.

Further DVB has also developed standards for delivery of IP data over DVB networks using different transmission media such as terrestrial, cable & satellite etc. in short today, DVB networks when augmented with appropriate interaction channels can function as access networks in a broadband infrastructure.

Mobile: The largest market for mobile broadband multimedia will be within the are of “mobile phones” , which will go through a series of transitions during the coming years. A key distinction here is between the so called generations.

The first generation (IG) were analogue phones with very limited functionality second generation (2G) phones are digital phone with enhanced functionality. Third generation (3G) are digital phones with broadband communication speed.

Currently 2G is in use with 1G being gradually phased out. Within 2G the leading technology is GSM (Global System for Mobile Communication). From 2G to 3G there is a migration path where the intermediary solutions are called 2.5G. some of these solutions are described below :

HSCSD This stands for high speed circuit switched Data. This increases the data transmission rates from the current 2 G standard of 9.2 Kbit/s to 57.6 Kbit/s. This technology supports broadcasting. However it reduces the bandwidth available for traditional voice communication.

GPRS : Stands for “ General Packet Radio Service” Package switching means that content is divided into digital packages that may share part of the bandwidth even if they have different final destinations. Hence GPRS is more bandwidth efficient that HSCSD an it supports data communication speeds of upto 115 Kbit/s.

DGE : Enhanced Data in the GSM Environment is a further development of GPRS providing more speed. Using EDGE operators can handle three times more subscribers than GPRS, triple their data rate per subscriber or add extra capacity to their voice communications.

DG will use three different versions of a technology called “CDMA” (Code Division Multiple Access) namely “ W-CDMA”, “ TD-CDMA” and “ CDMA 2000”.

CDMA enables data rates upto 2 Mbps. However this does not mean that all the time. There are two reasons for this. Communication speed depends on the speed with which the user is moving around. The requirement on user data rate in three different environments is as given below :-

Stationary user 2 Mbit/s
Pedestrian 384 Kbit/s
Vehicular 144 Kbit/s

In addition to this operators experience a trade off in their choice of bandwidth offered. They can either offer the full bandwidth to all phones or limited bandwidth to a higher number of phones or a combination of this.

DVB – H : A very important recent development is the emergence of a new DVB standard called DVB-H which enables the delivery of IP data cast services to mobile handheld devices. Either the full or a part of the bandwidth available on a DVB-T network cold be utilized for delivery of DVB –H signals. DVB-H combines broadcasting with a set of measures to ensure that the target receivers can operate from a battery and on the move and is thus an ideal companion to 3 G telecommunications, offering symmetrical and asymmetrical bi-directional multimedia services.

W1 max :- Is a standard for wireless metropolitan area network technology which will connect IEEE 802-11 hotspots to the internet and provide a wireless extension to cable and DSL for the last mile broadband access. W1max provides upto 31 miles of linear service area range and allows users connectivity without a direct line-or-sight to a base station. The technology also provides shared data rates of upto 70 Mbps, which according to W1Max is enough bandwidth to simultaneously support more than 60 businesses and hundreds of homes.

3.2.2. Satellite networks : One of the greatest advantages of satellite based distribution systems is their ability to reach geographically scattered audiences. To main concepts for satellite communication are :-

1. Very small aperture terminal (VSAT)
2. Director Broadcast Satellite (DBS)

VSAT : These are smaller stations used for two way communication with GEOS (Geostationary Satellite). They have typically been deployed for corporate solution s and use dishes with a diameter of 0.9 to 1.8 . The typical transmission speed is about 64 Kbit/s to 2 Mbit/s.

DTH : These are used for broadcast of television signals and unlike VSAT used for mass market applications. As the name indicates the concept here is that you broadcast directly to end-users rather than to intermediary redistributors. For this reason it also known as DTH (Direct to Home Service).

In the absence of any rather competing standard, the DVB-S standard has become the defacto world standard for DTH broadcasting. The DVB-RCS (Return Channel via Satellite) standard enables a satellite based return link from service provider. As a result of these developments, today DVB-RCS based satellite networks are being increasingly deployed as broadband access networks.

Currently a second generation digital satellite transmission standard, called DVB-S2, is under development. DVB-S2, is under development. DVB-S2 not only satisfies the needs of consumer direct to home broadcasters but also sets the stage for a paradigm shift in the delivery of broadband interactive services via satellite.

4.0 Broadband services and Applications :

Broadband services are the facilities that a network operator provide to support broadband application via an integrated subscriber access, where broadband applications are any end use of the broadband network capabilities. Some important broadband services and potential applications are listed below :-

TV Distribution

- Enables subscribers to receive a number of television programmes of a chosen quality (SDTV/HDTV)
- Is targeted at entertainment and educational applications.

HI-Fi Distribution

- Enables a subscriber to received one or more high quality sound programmes.
- Entertainment and educational application.

Video telephony

- Potential applications include :
- Face to face individual or group communication
- Still images (docu7ments, pictures etc.)
- Instruction and education
- Professional consultation games playing (interactive, multi-user)
- Business discussion s (individuals, group, conferences)
- Interviews
- Buying and selling
- Video and

Video Retrieval

- Application s include
- Video on demand
- Advertising
- Video publishing
- Video training

Data transfer services

- typical applications
- PC file transfer

- Image retrieval
- Electronic mail

High speed access to the internet

Conclusion : Once Broadband access becomes available to home users it will drastically change the way people work, play and live. The higher connection speeds enables several new exciting multimedia application such as real time internet audio/video streaming, viewing the video clips of news events and movie trailers and taking virtual tours of hotels and resort areas before making reservations etc. it is expected that services like video on demand, teleshopping telebanking etc. will take off in a big way. Broadband access will allow the people to telecommute effectively as though they are physically present in that office. The vision of Broadband home is that broadband multimedia , video, audio, voice and data will be delivered to and within the home to personal end point devices ushering in a new era of converged communication.