
UNIT 1: ADSL BROADBAND INTERNET

Unit Structure

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1.0 Learning Objectives

After learning this unit, you will be able to understand:

- About ADSL broadband technology
- About PSTN
- About Wi-Fi Modem and Router
- About configuring wired ADSL Modem

1.1 Introduction to ADSL broadband technology

ADSL broadband is a famous internet connectivity technology which is termed as Asymmetric Digital Subscriber Line. It is a type of internet connection which can be worked on existing telephone line. Such type of broadband communications technology is used for connecting to Internet which allows data to be sent over existing telephone lines and works in the similar manner as normal modem lines. For using ADSL, a microfilter, is installed on subscriber's telephone line which allows ADSL and telephone services to be used at the same time. It makes use of special ADSL modem and subscriber's position should be within the required network locations so that the subscriber should receive signal in the modem. Normally it is seen that the required distance of ADSL working is within radius of 1 kilometer. In ADSL, the data rates ranges from 1.5 to 18 Mbps when receiving data and 1.6 to 4 Mbps for sending data.

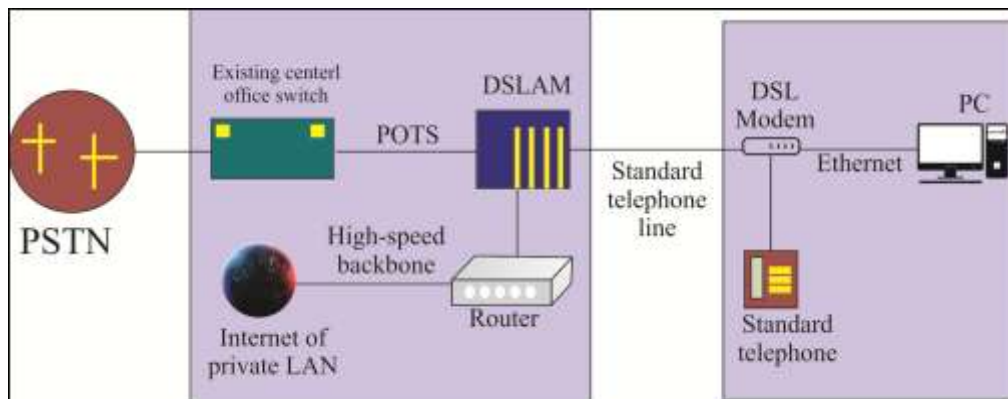


Fig 1.1 ADSL connection

It is noted that at user place, the ADSL connection will collect high frequency digital data and keep it for transmission to Computer or network. In the exchange, Digital Subscriber Line Access Multiplexer will connect ADSL user to wider Internet which totals the incoming lines into one data connection for transmission of voice and data networks. Further, it is noticed that the phone signals hereby send the switched telephone network and digital data which will route required data to Internet by using high speed backbone.

There are many forms of ADSL modems which are directly connected to Computer through USB port or can be by way of Ethernet. It is noticed that many devices allow Internet connection which gets shared across many computers.

1.2 Motivation for ADSL Broadband

Asymmetric digital subscriber line which is ADSL is a form of digital subscriber line technology where data communications technology makes faster data transmission by way of copper telephone lines instead of standard voice band modem. This is different from less common symmetric digital subscriber line. In this the bandwidth is more with customer premises as compared to the reverse, for this reason it is asymmetric. Nowadays ADSL is commonly used in metro cities as the network providers are commonly expanding. It is much advanced as compared to normal modem because of its connectivity speed. It is noted that technically and with business point of view, ADSL in many places are commonly applied at home users. With technical aspect, there exists crosstalk from circuits at DSLAM end which is located at customer premises.

ADSL is preferred because it is:

- Instantaneous internet and voice/fax features which can be used with telephone line
- Continuous, high-speed internet access features
- Cheapest solution
- Carries data security which goes beyond technologies
- Fastest downloading speed

Check your progress 1

1. Telephone lines are made of:

- a. Aluminum
- b. Copper
- c. Tin
- d. Bronze

1.3 PSTN Basics

PSTN also known as Public Switched Telephone Network is a global mixture of interconnection which initial designed to handle circuit switched voice

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communication. It shows original Plain Old Telephone Service (POTS) which is a form of landline phone services used by residences and establishments. There are many parts of PSTN which uses DSL, VoIP and other Internet network technologies.

Public Switched Telephone Network is a domestic telecommunications network which is normally worked using telephones, key telephone systems, private branch exchange trunks with many different sort of data arrangements. It comprises of telephone exchanges which is network which describes nationwide telephone communications system. This network served as public since the system is present to anyone who will able to handle such services. Here, calls are switched where caller's conversation gets divided into several packets which are sent all together over several connections in order to reach receiver at other end. In this, single pieces are switched from one telephone device to another till both reach at required place at receiving end. It is noted that every phones in PSTN are arranged in web network where any phone involves in calling to other phone as local phone systems across the web are connected among each other.

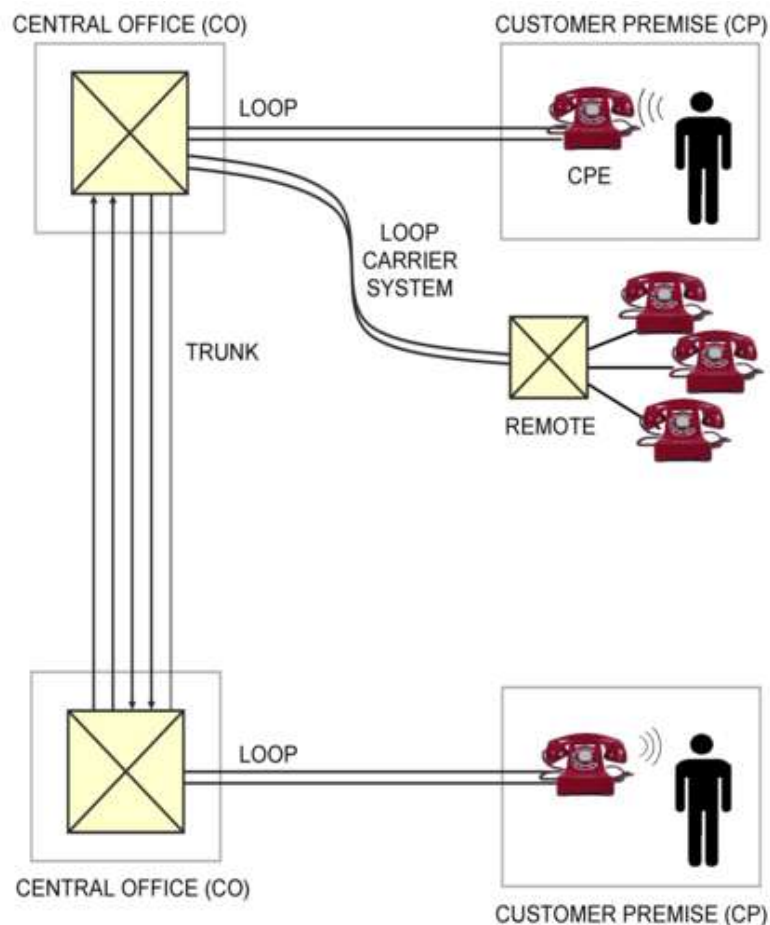


Fig 1.2 Public Switched Telephone Network

It is found that several communication technologies are designed on Public Switched Telephone Network (PSTN) technology which has options to work on voice, data or network. In fig 1.2, a telephone is placed in the Customer Premise while telephone switch is placed in Central Office (CO) which is commonly called as Customer Premise Equipment. In the figure, telephone is connected across telephone switch using two copper wires called as local or subscriber loop. Such looping system has a right to enter in the circuit from customer premise onto network.

It is noted that copper being good conductor of electricity is resistant to electricity which makes the signals to lower in intensity with distance. It is noted that maximum resistance which is allowed normally has 1200 ohms that uses 16,000 feet which can be 5 km using 26-gauge thickness cable. In the figure, the Central Office has serving area of 5 kilometers. Building of Central Office after every 5 miles with subdivisions are used using low capacity remote switches which are placed in small huts or underground. The remote in figure will help the telephone service locally to work in loops in particular subdivision.

It is further seen that the telephone switches are connected with trunks, while subscriber loops are fixed to work with circuits and trunks that can be shared with connection among Central Offices. In order to establish connection among customer premise and other, the required network address gets signalled to network over loop where switch gets seized on idle trunk circuit which moves in required direction and further connects loop with the trunk. Also, it is noted that the voice and data equipment that connects to PSTN over regular telephone lines needs to work using features of local loop.

Check your progress 2

1. In PSTN, phones are arranged in:
 - a. web network
 - b. individually
 - c. pairing
 - d. none of above

1.4 ADSL Modem basic architecture, working, standards

ADSL which is Asymmetric digital subscriber line is a type of digital subscriber line which allows quick data transmission over telephone lines. It provides speed up to 50 Mbps and handles video, voice and data which is normally available across every part of world.

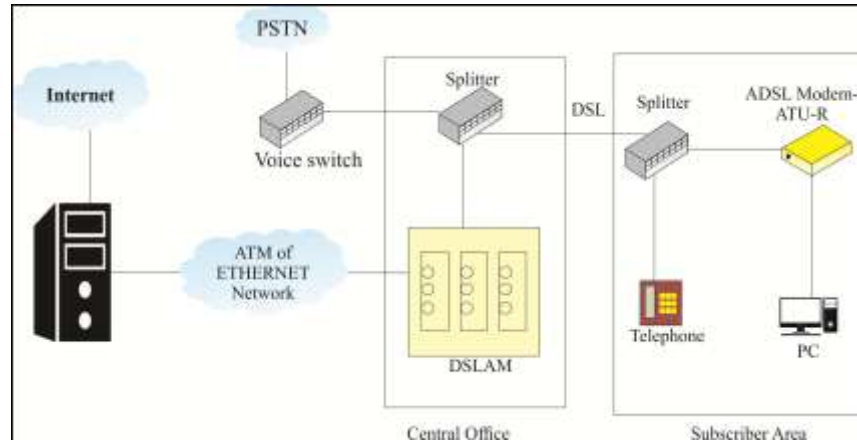


Fig1.3 Architecture of ADSL

ADSL Architecture

ADSL architectural layout uses ADSL modem which is connected at every end of twisted pair telephone line having data channels such as:

- High-speed downstream channel which ranges from 1.5 to 8 Mbps.
- Low-speed upstream channel having ranges from 16 to 640 Kbps.

It is found that the basic telephone service channel is separated from digital modem using filters or with plain old telephone service (POTS) splitters which gives uninterrupted basic telephone service. It is noted that upstream and downstream bandwidth ranges simply depends upon distance among customer place and DSL provider's place. It is noted that larger is the distance, smaller will be the bandwidth space.

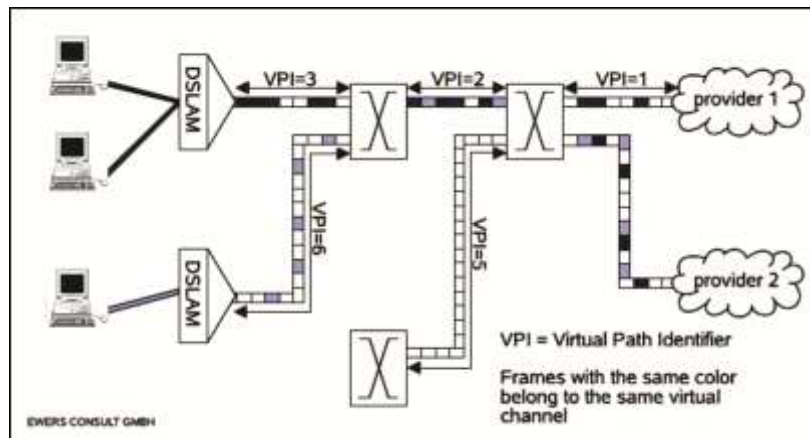


Fig 1.4 Arrangement of ADSL network

The ADSL architecture comprises of following components:

Transport System: The transport system of ADSL shows carrier backbone transmission interface for DSLAM system. It provides service interfaces such as T1/E1, T3/E3, OC-1/3 and STS-1/3.

Local Access Network: In ADSL, local carrier Inter office network shows foundation with connectivity that exists among various service providers and services users.

Digital Subscriber Line Access Multiplexer: The DSLAM, will focus on data traffic from multiple DSL loops against backbone network to connect rest of network.

DSL Transceiver Unit-Remote: In ADSL, xTU-R is a customer site equipment which is applied for service connection to DSL loop.

POTS Splitters: It is sometimes used at Central Office and user locations which allows copper loop used for synchronized DSL and single line telephone service. The POTS splitters appear in two configurations:

- Single splitter
- Multiple splitter

POTS splitters are passive or active which requires external power source or no power and often has high mean time failure (MTBF) as compared to active splitter.

ADSL Standards and Associations

American National Standards Institute approves ADSL standard which rates ADSL to 6.1 Mbps. European Technical Standards Institute further contributes annex to T1.413 which reflects European requirements using single terminal

interface at premise side of access circuit. It is analysed that ATM Forum and Digital Audio Visual Council recognizes ADSL as physical layer transmission protocol which is particularly applied for unshielded twisted pair (UTP) media.

UTP which is unshielded twisted pair is a famous form of cable which has two unshielded wires that is twisted around each other. The UTP cable is cheap and is used mainly for local area networks and telephone connections. Such cable has low bandwidth or protection from interference which appears with coaxial or fiber optic cables.

Standard name	Common name	Downstream rate	Upstream rate
ITU G.992.1	ADSL (G.DMT)	8 Mbit/s	1.0 Mbit/s
ITU G.992.2	ADSL Lite (G.Lite)	1.5 Mbit/s	0.5 Mbit/s
ITU G.992.3/4	ADSL2	12 Mbit/s	1.0 Mbit/s
ITU G.992.3/4 Annex J	ADSL2	12 Mbit/s	3.5 Mbit/s
ITU G.992.3/4 Annex L	RE-ADSL2	5 Mbit/s	0.8 Mbit/s
ITU G.992.5	ADSL2+	24 Mbit/s	1.0 Mbit/s
ITU G.992.5 Annex L	RE-ADSL2+	24 Mbit/s	1.0 Mbit/s
ITU G.992.5 Annex M	ADSL2+	28 Mbit/s	3.5 Mbit/s

Table 1.1 ADSL Standards

Working of ADSL

Asymmetric digital subscriber line makes use of the vacant similar bandwidth which is present in wires. ADSL work with frequency splitter device which further split in standard voice telephone line having two frequencies.

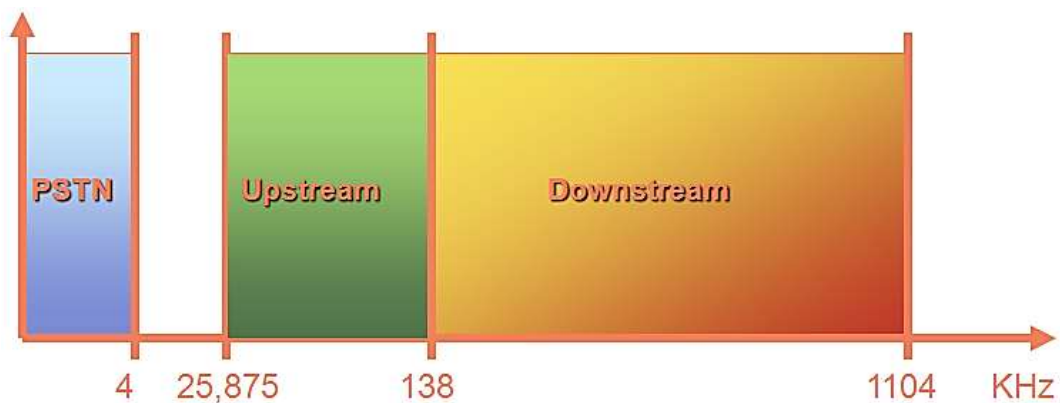


Fig 1.5 ADSL bandwidth

In this, modulation transfers the information by electronic or in form of optical carrier waveform where there shows two opposite and unsuited standards that is applied for modulating ADSL signal. The modulation is carried out using:

Carrierless Amplitude Phase: It is sort of encoding method which divides the signals in different bands:

- Upstream data channel having band range from 25 - 160kHz
- Downstream data channel having band range from 200kHz - 1.1MHz .

These data channels are commonly apart so as to lower the options of interfering which are present in the channels.

Discrete Multi-Tone: It is called as DMT which separates DSL signal that are used by frequency which carries range that is divided in 256 channels each having 4.31kHz. This type of multi tone carries will carry 224 downstream frequency and has 32 upstream frequency bins. The DMT continuously transfers signals with different channels to ensure that good channels can be used for transmission and reception.

Check your progress 3

1. In ADSL architecture, low speed upstream channel has range from:

- a. 160 to 200 Kbps
- b. 640 Kbps to 640 Kbps
- c. 8 to 84 Kbps
- d. 500 to 5064 Kbps

1.5 ADSL Wi-Fi Modem and Router

ADSL or Asymmetric Digital Subscriber Line is a type of digital subscriber line (DSL) which serves as data communications technology which allows faster data transmission over telephone lines as compared to standard voice band modem.

There are many types of ADSL connection which can be:

- G.DMT
- T1.413

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- ADSL2
- AnnexL
- ADSL2+
- AnnexM

ADSL is hi speed Internet connection having fastest dial-up modems having 56 kilobits per second (Kbps) that works at 53 Kbps under normal conditions. It has an efficient download speeds from 1.5 to 8 megabits per second (Mbps) as per grade of respective DSL services.

The ADSL wifi router has router and router for wifi connection in a single box whereas in case of normal wifi router, you have to use a separate Wired ADSL modem.

Check your progress 4

1. Wi-Fi Modem works with:
 - a. Battery
 - b. Cable
 - c. Antenna
 - d. All Of Above

1.6 Configuring wired ADSL Modem for Internet Access

You can configure wired ADSL Ethernet modem which can be used for Internet access by using the following steps:

Step 1:

Initially open web browser and then type IP address and then press Enter.

Step 2:

After that, enter Login name and password and click on Login option.

Step 3:

Once the username and password has entered, now click on Setup tab which is located at top panel where you have to choose Connection from left.

Step 4:

Now you need to configure following:

Type - Set connection Type

Name - Type name for connection

Encapsulation - Set encapsulation recommended by ISP

Username - Type ISP login username

Password - Type login password

Keep alive - leave default

MAX Fail - leave default

MTU - leave default

MRU - leave default

Set Route - enable set route

VPI - set to ISP recommended settings

VCI - set to ISP recommended settings

Click on Apply when done.

Step 5:

Select Status tab located at top and choose on Connection Status which is placed on left. Here the connection be seen in WAN section of page. Once the computer is connected, you have IP address from ISP.

Step 6:

Click on Tools which is located at top of panel window and choose on System Commands on left. Now, click on Save All to permanently save changes you have done.

Check your progress 5

1. ADSL Modem runs:
 - a. Using password
 - b. Using username
 - c. Using login
 - d. All of above

1.7 Configuring Wi-Fi ADSL modem/Router for Internet Access

We see that ADSL Wi-Fi router serves as hardware component that can be typically applied to transfer data over ADSL phone line. While doing this, the router plays a role of interfacing among computer or network as per the needs of Internet. In order to configure Wi-Fi ADSL router/modem, you need to follow following steps:

Step 1 Locate the IP address:

To install the fresh router connection, you need to find the default IP address which is available on the label that is fixed on router or in document. If you are unable to locate the IP address, then you can obtain it through internet search by writing router/modem model number. The format of the IP addresses is grouping of four three digit numbers, separated by periods as shown 192.168.1.1, 192.168.0.1, or 192.168.2.1.

Step 2 Open a web browser on computer:

Once you have the IP address, you need to enter it on address bar and then finally press Enter. You will find that the browser will attempt to connect to router's configuration menu. You can also do it manually by referring router installation disc.

Step 3 Enter username and password:

To access the router/modem configuration page, you require being on router's IP address where you have to enter your valid username and password. Most routers have a basic account set up that you will need to use to log on which depends on model to model. It is noted that the default username is admin with default passwords as admin or password. It is found that mostly routers will need

only username and blank password where as many asked you to keep the particular space blank. You can also search with router or modem model on the internet for correct default password or username.

Step 4 Open Wireless Settings:

When you log in to your router, you will be taken to the router's main menu or status screen. There will be several options to choose from. The Internet section can usually be left at default settings, unless you received specific instructions from your internet service provider. The Wireless section will allow you to set up your wireless network.

Step 5 Enter a name for wireless network:

In Wireless section, in SSID or Name field, enter unique name for wireless network. Now check the box so as to start SSID broadcast which will turn on wireless network so that it can be seen by anyone.

Step 6 Select security methods:

From the list of security options you need to select WPA2-PSK as encryption method for security. Such type of security is hard to break and will give full protection from hackers.

Step 7 Create a passphrase:

After selecting security method, now you need to enter passphrase for network which should be a type of hard and complex password that should be combination of letters, numbers, and special symbols.

Step 8 Save your settings:

After completing naming and give security to wireless network, you now have to click on Apply or Save button. With this, all your changes get saved in few moments.

Step 9 Change your router's username and password from the default:

Once you have your network configured, you should change the username and password that you use to access your router. This will help protect your router from unauthorized changes. You can change these from the Administration section of the router configuration menu.

Step 10 Block sites:

Now if you need to save your device which is connected to network from accessing certain websites, you need to apply built-in blocking tools which will stop all the access. It is present in Security/Block section of router.

Check your progress 6

1. After configuring your router, you need to:
 - a. Save It
 - b. Erase It
 - c. Delete It
 - d. None Of This

1.8 Let Us Sum Up

In this unit we have learnt that ADSL broadband an important internet connectivity technology which is a type of internet connection that works on existing telephone line. It is found that Asymmetric digital subscriber line is a form of digital subscriber line technology where data communications technology makes faster data transmission through copper telephone lines rather than standard voice band modem.

It is noted that PSTN is Public Switched Telephone Network which is a global mixture of interconnection that is designed to handle circuit switched voice communication. An Asymmetric digital subscriber line uses vacant similar bandwidth that uses wires and works with frequency splitter device that split in standard voice telephone line with two frequencies.

1.9 Answers for Check Your Progress

Check your progress 1

Answers: (1 –b)

Check your progress 2

Answers: (1 -a)

Check your progress 3

Answers: (1 -b)

Check your progress 4

Answers: (1 -c)

Check your progress 5

Answers: (1 -d)

Check your progress 6

Answers: (1 -a)

1.10 Glossary

1. **ADSL** - It is a broadband for connecting internet that works on existing telephone line.
2. **PSTN** - It is Public Switched Telephone Network which is combination of interconnection which handle circuit switched voice communication.

1.11 Assignment

What are the features of ADSL?

1.12 Activities

Discuss steps how to configure a Wi-Fi Modem.

1.13 Case Study

Are you institute equipped with PSTN.

1.14 Further Readings

1. An Introduction to Modern Electronic Media, Joseph Dominick, Barry Sherman, and Fritz Messere
2. Introduction to Wi-Fi technology; Lawrence Harte.