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सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
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National
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Transforming the skill landscape

Telecom
Sector
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Council

Participant Handbook

Sector
Telecom

Sub-Sector
Network Managed Services

Occupation
Network Operation & Maintenance

Reference ID: **TEL/Q6207, Version 2.0**
NSQF Level 4

Grass Root Telecom Provider

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This book is sponsored by

Telecom Sector Skill Council of India

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"Skilling is building a better India. If we have to move India towards development then Skill Development should be our mission."

Shri Narendra Modi
Prime Minister of India

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COMPLIANCE TO QUALIFICATION PACK NATIONAL OCCUPATIONAL STANDARDS

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TELECOM SECTOR SKILL COUNCIL

for

SKILLING CONTENT : PARTICIPANT HANDBOOK

Complying to National Occupational Standards of
Job Role / Qualification Pack: 'Grass Root Telecom Provider'
QP No. **'TEL/Q6207 NSQF Level 4'**

Date of Issuance: **27/01/2022**
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**Valid up to the next review date of the Qualification Pack or the 'Valid up to' date mentioned above (whichever is earlier)*

Authorised Signatory
(Telecom Sector Skill Council)

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The preparation of this handbook would not have been possible without the Telecom Industry's support. Industry feedback has been extremely encouraging from inception to conclusion and it is with their input that we have tried to bridge the skill gaps existing today in the industry.

This participant handbook is dedicated to the aspiring youth who desire to achieve special skills which will be a lifelong asset for their future endeavors.

About this book

The Indian Telecom Industry is the second largest in the world with a subscriber base of 1.17 bn as of Apr 2022(wireless_wireline subscribers). India wired broadband market is projected to grow from around $ 200 million in 2019 to $ 243 million by 2024.

Over the next five years, a rise in mobile-phone penetration and a decline in data costs will add 500 million new internet users in India, creating opportunities for new businesses.

By 2025, India will need ~22 million skilled workers in 5G-centric technologies such as Internet of Things (IoT), Artificial Intelligence (AI), robotics, and cloud computing.

This Participant handbook is designed to impart theoretical and practical skill training to students for becoming a Grass Root Telecom provider.

Individuals at this job needs to keep ONT site operational on 24x7 basis; maintain and repair basic faults/issues at ONT site; promote use of devices among local population and provide services.

This Participant Handbook is based on Grass Root Telecom Provider Qualification Pack (TEL/Q6207) & includes the following National Occupational Standards (NOSs)

1. Maintain Site Hygiene and Implement Security
2. Perform Preventive Maintenance of Optical Network Terminal (ONT) components
3. Promote usage of devices and provide services
4. Organise resources and work effectively and safely
5. Communicate effectivey with Team members and customers

The Key Learning Outcomes and the skills gained by the participant are defined in their respective units.

Post this training, the participant will be able to maintain ONT site in order to keep it operational, promote use of devices and provide services.

We hope that this Trainee Manual will provide a sound learning support to our young friends to build an attractive career in the telecom industry.

Symbols Used

Learning Outcomes

Unit Objectives

Tips

Steps

Notes

Exercise

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1. Role and Responsibilities of a Grass Root Telecom Provider

Unit 1.1 – Introduction to Communications
Unit 1.2 – Industry Outlook Global & National
Unit 1.3 – Role and responsibilities of Grass Root Telecom Provider and Scope of GRTP
Unit 1.4 – Electro Magnetic Spectrum
Unit 1.5 – Introduction to Mobile technology
Unit 1.6 – Introduction to Optical Communication System

Key Learning Outcomes

At the end of this module, you will be able to understand:

1. Know the History of Telecom
2. Types of Communication Systems
3. Various Transmission Media
4. Telecom Growth in India
5. Learn Key aspects of Electro Magnetic Spectrum
6. Features of Electro Magnetic Wave
7. Learn about key Regions of Electro Magnetic Spectrum and their Functions
8. Overview of Mobile Technology
9. Need for Fiber-Optic Communications
10. Optical Communication Systems
11. Optical Fibers as a Communication Channel
12. Optical Transmitters & receivers

UNIT 1.1: Introduction to Telecommunications

Unit Objectives

At the end of this module, you will be able to understand:

1. History of Telecom
2. Types of Communication Systems
3. Various Transmission Media

1.1.1 History of Telecom

By using the modulated light beam from photo-phones, Scientists Bell and Charles Sumner Tainter conducted the first wireless telephone call in the world in 1880. Even after several years of this invention, the scientific principle wouldn't utilize and first deployed in military and optical fiber communication. Historical Mile-Stones of Communications & Tele-Communications are as follows: A glimpse of Historical Telecom Evolutions 1936: First public video-phone network in the world 1946: Mobile telephone with limited capacity Service for automobiles 1672: First experimental acoustic (mechanical) telephone 1956: Transatlantic telephone cable 1790: Semaphore lines (optical telegraphs) 1964: Fiber optical telecommunications 1877: Acoustic phonograph 1965: First North American public video-phone network 1838: Electrical telegraph 1858: First trans-Atlantic telegraph cable 1969: Computer networking 1876: Telephone 1973: First modern-era mobile (cellular) phone 1893: Wireless telegraphy 1979: INMARSAT ship-to-shore satellite communications 1896: North America initiated very first Radio at 1914: which could perform intercontinental calling of telephone. By 1981 cellular mobile phones, which are first of digital phone network introduced to market, and by 1982- smps, emails are showcased as an additional facility. 1927: Television & First commercial radio-telephone service 1983: Internet 1998: Mobile satellite hand-held phones 1930: First experimental video-phones 2003: VOIP Internet Telephony.

1.1.2 Basics of Communications System

Communication is an exchange of Information between 2 parties/person/ nodes. Any communications system aims at best and effective exchange of information. Communication system communicate Voice, SMS, Video, text, Music, live sessions from one point to other. Technically on Network front communication system consists of device which transmits the information, and a device which receives it. Channel is a medium through which the communication takes place. Channel could be wired medium or wireless medium (over AIR). Any information transmitted get affected by Noise. Refer to Fig 1.1.1

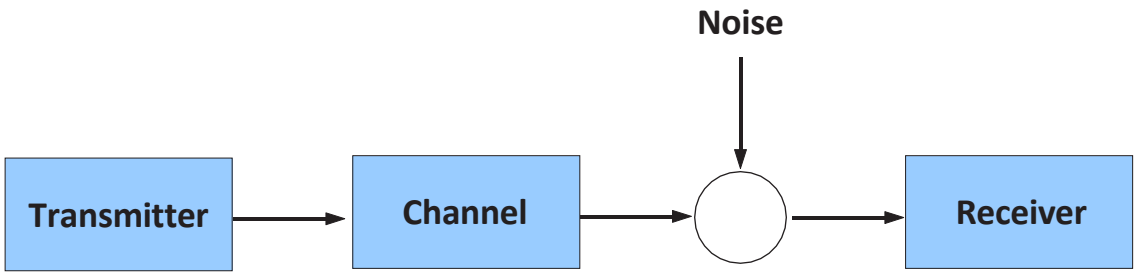


Fig. 1.1.1. Communication system

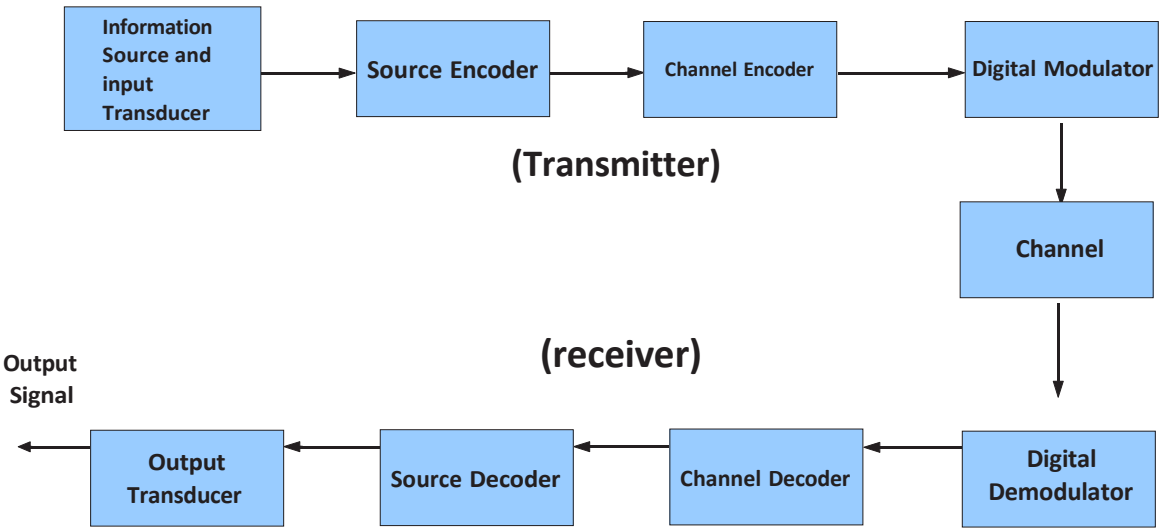


Fig. 1.1.2. Communication system

Refer to Fig 1.1.2 shows a typical communication functional Block diagram.
Initial information could be voice, SMS, text, Video, Live session all are analog in nature and have l capacity to travel for small distance. To ensure the security of transmitted information, initial information is coded with key.

In specific, Transmitter consists of source coder, channel coder & modulator units. Receiver receives the signal (transmitted by transmitter) & feeds it to demodulator followed by channel decoder and source decoder to obtain the original information. Channel is a media through which the signal travels.

We have two type of media widely used for communications.

1. Wired Media { with wire }
2. Wireless Media { without wire }

1.1.3 Types of Communication System

Simplex System:

Simplex communication is a communication channel that sends information in one direction only. The International Telecommunication Union (ITU) defines the system as communication-channel that operates in one direction at one given time.

Fig. 1.1.3. Simplex system –Radio Transmission

Half Duplex System:

In Half-duplex system there should be clearly two paths defined and both end can be communicating each other but not simultaneously; one-way communication at a time. Walkie- talkie that has a "push-to-talk" button is the best example for half duplex communication.

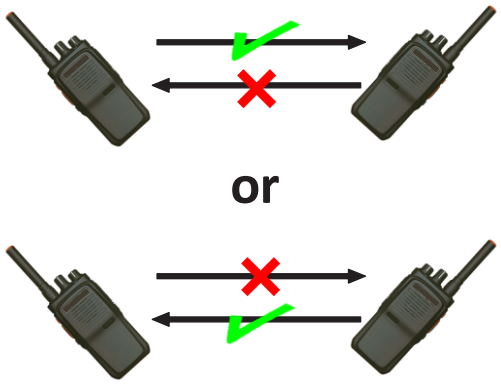


Fig. 1.1.4. Half Duplex System

Full Duplex System:

In a duplex communication system two connected parties or nodes that can communicate with each other in both directions simultaneously. Example of a Full-duplex device island-line and mobiles. (Refer to Fig 1.1.5)

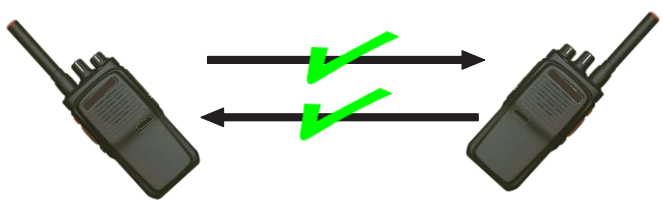


Fig. 1.1.5. Full Duplex System

1.1.4 Transmission Medium/Media/Channel

Transmission Media/Medium:

The media through which transmission takes place is called as Transmission Media. Medium for the Transmission generally considered as physical such as Hard-solid, liquid, gas, or plasma) which could be used for wave energy propagation. media is required for sound signals, most Normally air is used as medium. Below listed 2 types of transmission medias.

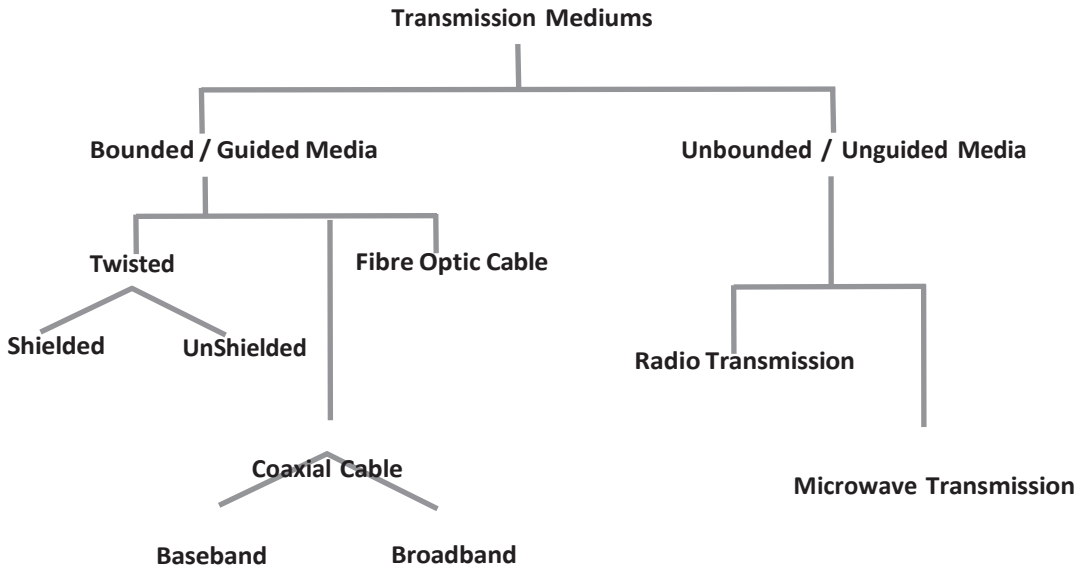


Fig. 1.1.6. Types of-Transmission Mediums

(Refer Fig. 1.6), Transmission mediums are categorized into bounded & unbounded Mediums. Bounded media further gets classified into twisted, fiber optic & coaxial mediums. Unbounded media further gets categorized into radio transmission and Microwave transmission.

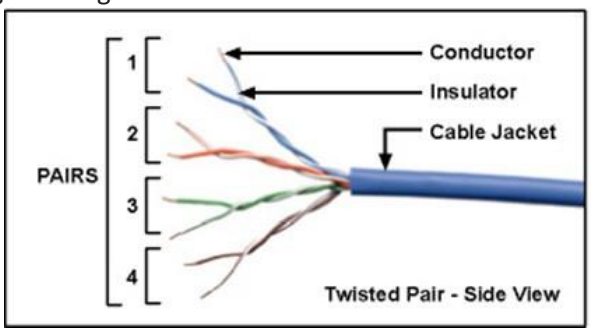


Fig 1.1.7 Twisted Pair Medium

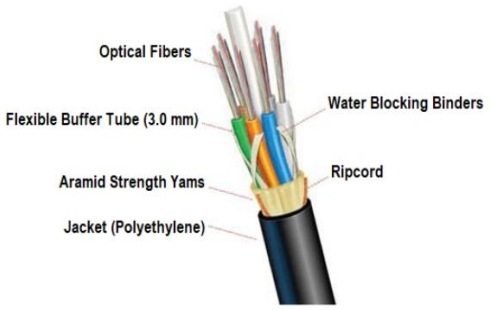


Fig 1.1.8 Optical Fiber Medium

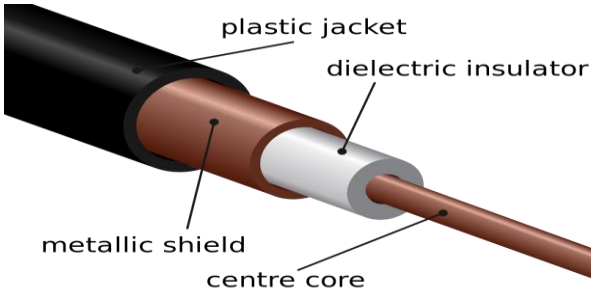


Fig 1.1.9 Coaxial Cable Medium

Fig 1.2.0 Coaxial Cable Medium

Exercise

1. Describe basic communication System.

Ans. _____

_____

_____

2. List & explain the types of Communication System.

Ans. _____

_____

_____

3. Define Transmission Media.

Ans. _____

_____

_____

4. Define Half Duplex and Full Duplex Communication System.

Ans. _____

_____

_____

UNIT 1.2 : Industry Outlooks: Global & National

Unit Objectives

At the end of this module, you will be able to understand :

1. Telecom Growth in India

1.2.1 Telecom Growth in India

Following china India is in the 2ns rank in the commercial and productive telecommunication markets and in the case of number of internet users India is in 3rd.Compound Annual Growth Rate (CAGR) of India's telephone subscriber base increases 19.5 per cent to 1022.61 million between FY 2007-2016.

In the global platform factors like Globalization, privatization and liberalization pressurized and boosted revolution in all sectors, really in special consideration in the countries where its economy is developing, in the world. By the later 20th century, communication value is known to India. With refer to Department of Telecom (2016), Telecom sector of India continues to follow the title of largest world telecom network after china. The survey is Based on Indian telecom subscribers count.

The mega telephone networks & their competition in Indian market made lowest call tariffs in the world. India has 302.35 million internet connections according to the Department of Telecommunication of India (DoT), as on March 2015. Telephone, internet & television broadcast are the major sectors of Indian telecommunication Industry, and which is on the way of transforming to next generation network. Market liberalization and growth of Indian telecom industry happened after 1990s and now it becomes world's most competitive telecom market. In just ten years the growth was about 20 times, from near 40 million subscribers to over 900 million on 2001 to 2011.

Telecom Growth in India Continued Table 1.2.2 (ITU) The International Telecommunication Union the ITU organizes the mutual worldwide utilization of the radio range, advances global collaboration in allocating satellite circles, attempts to enhance media transmission foundation in the creating scene, and aids the improvement and coordination of overall specialized measures. The ITU is dynamic in zones including broadband Internet, most recent age remote advancements, aeronautical and sea route, radio space science, satellite-based meteorology, internet access, information, voice, TV broadcasting and future networks.

Telecom Growth in India Continued

Telephony	
Total Telephone subscribers	1.052 billion (Feb 2016)
Mobile subscribers	1.027 billion (Feb 2016)
Fixed line subscribers	25.22 Million (Feb 2016
Monthly telephone additions (Net)	8.59 Million (Feb 2016)
Teledensity	82.89% (Feb 2016)
Urban teledensity	153.93% (Feb 2016)
Rural teledensity	50.76% (Feb 2016)

Fig. 1.2.1. Indian Telecom Users

Internet Access	
Internet Users	462.12 Million (Jan 2016)
Broadband Internet users	144.07 Million (Feb 2016)
Internet Penetration	34.8% (Jan 2016)
Share of world Internet Users	13.5% (Jan 2016)
Country code top-level domain	.in
Broadcasting	
Television Channelss	869 (Jan2016)
Radio Stations	345 (Mar 2016)

Fig. 1.2.2. Indian Internet Users

1.2.2 International Telecommunication Union (ITU)

The International Telecommunication Union

The ITU coordinates the shared global use of the radio spectrum, promotes international cooperation in assigning satellite orbits, works to improve telecommunication infrastructure in the developing world, and assists in the development and coordination of worldwide technical standards. The ITU is active in areas including broadband Internet, latest-generation wireless technologies, aeronautical and maritime navigation, radio astronomy, satellite-based meteorology, convergence in fixed-mobile phone, Internet access, data, voice, TV broadcasting, and next-generation networks.

ITU also organizes worldwide and regional exhibitions and forums, such as ITU TELECOM WORLD, bringing together representatives of government and the telecommunications and ICT industry to exchange ideas, knowledge and technology. ITU, based in Geneva, Switzerland, is a member of the United Nations Development Group. ITU has been an inter governmental public-private partnership organization since its inception.

Exercise

1. Discuss telecom growth in india.

Ans. _____

_____

_____

2. Define ITU and its role in telecom Standardization.

Ans. _____

_____

_____

UNIT 1.3 Role and responsibilities of Grass Root Telecom Provider and Scope of GRTP

Unit Objectives

At the end of this unit you will be able to:

1. Describe the roles and responsibilities of a Grass Root Telecom Provider
2. Understand the organizational policies pertinent to GRTP
3. Identify the standard checklists and schedules recommended by OPCOs

A Grass Root Telecom Provider (GRTP) is intended to carry out the following duties:

Job Description:
The tasks a Grass Root Telecom Provider (GRTP) is expected to perform include:

- Keeping the ONT site functioning on a 24-hour basis
- Maintaining and fixing minor faults/issues at the ONT site
- Promoting local devices

Key Competencies:

- Understanding how the CCU, SPV, TJB, battery bank, and fire extinguisher operate.
- Skilled in using laptops, smartphones, tablets, and other electronic devices.
- Familiar with how cables, UPSs, and other devices work.
- Familiar with the rules for keeping the site's equipment clean.
- An understanding of pigtails, patch cords, and basic electrical wiring.
- Familiar with FAQ for simple problem-solving.
- An understanding of fundamental software and hardware configuration.

Character Traits:

- Technically qualified
- Self-disciplined
- Assertive
- Team player
- Action-orientated
- Possess analytical skills
- Problem solving ability
- Effective communication skills
- Ability to work under pressure
- Result-oriented

Work Environment:

- It's hardly a desk job, either.
- There is no possibility to work from home.
- Some cities provide contract work and part-time employment.
- Local travel may be required as part of this work.
- Not required to manage a team.
- Hours of work.
- The typical workday lasts 9 to 10 hours on six days per week. Depending on the firm, this could change.
- There may be a shift system.

Health & Safety:

This work is regarded as being rather dangerous or hazardous. Electric shocks, cuts, abrasions and wounds, as well as backaches, are examples of occupational dangers. Exposure to hardware components, sharp tools, etc., pose health concerns.

Progression Pathway:

India currently has 920 million telecom subscribers and 12 million more sign up each month. Telecom is undoubtedly one of India's businesses with the quickest growth rates. There are many new career opportunities in the hardware and software sectors of telecommunications due to the advent of newer technologies.

- Will give access to GRTP technician.

Organizational policies on incentives, delivery standards, personnel management, and public relations (PR)

Incentives

Offering people a reward for good work and a punishment for poor performance will motivate them to put in extra effort. If you provide subpar work, the result is frequently that you will be dismissed and lose your benefits as well as your salary. But how can one inspire (or reward) someone to produce their finest work? The answer is based on the company's culture, the person's needs or preferences, and the options available.

Software development is one business that provides a staggering array of benefits and incentives to its employees. There are numerous businesses in Silicon Valley that provide their employees everything from free food to massages. Particularly Google is renowned for fostering a positive work environment and offering tools to relieve stress. Some of the benefits it provides include free haircuts, free dry cleaning, personal trainers in the gyms and swimming pools, nap pods, discounted massages, and on-site doctors.

Characteristics of Incentive Plan:

a) There is a direct link between incentives and performance.
b) Rewards encourage employees to achieve at their highest possible level as opposed to their current level.
c) It boosts productivity by assisting in the advancement of technology.
d) Financial measurements can be made of incentives.
e) The inception of effective incentive plans, including the timing, precision, and frequency of incentives.
f) An incentive programme boosts attendance and lowers absenteeism.
g) According to each individual's performance, incentives differ.
h) All employees are entitled to the minimum wage.

Written codes of behaviour known as customer service policies provide personnel with rules to abide by in a variety of customer service situations. For instance, you might have a policy for how to handle refunds or how to respond to consumer inquiries. Written policies are established to instruct your staff on customer service procedures and the right actions to take in different circumstances.

Customer service rules assist your employees in adhering to a regular procedure, such as determining the most expedient way to fix problems or respond to frequently requested queries (FAQs). They assist you in continuously enhancing your customer service while keeping everything as structured and efficient as they can be.

Customer service policies may include a number of details based on your industry and needs. Typical examples are:

- Product and service description: Describe the goods and services your business provides in general terms. You can include illustrative videos, written explanations, and articles that are updated frequently.
- Workflows for customer service: What is acceptable and what is not? What steps are involved in onboarding a new customer? These workflows are defined and laid out in detail by your customer service policies. They are essentially instructions for usage for customer care agents.
- Benchmarks for customer service include: A customer service policy incorporates industry-recognized standards to aspire for, as was previously said.
- Customer service commitments: These represent the guiding principles of your business. When you are honest about the services you provide, your customers will trust you more.

The administrative task of assessing and categorising the human resource requirements for achieving organisational objectives through the interaction of individuals at work is known as **personnel management.**

In personnel management, tactics are used to guarantee that there is the ideal mix of talent, education, and work performance.

The following are some examples of the broad range of personnel management:

- Organizational Planning and Development
- Staffing and Employment
- Training and Development
- Compensation, Wage and Salary Administration
- Employee Services and Benefits
- Employee Records
- Labour Relations, and
- Personnel Research and Personnel Audit

Public relations (PR) refers to the range of actions taken by a business to advance and safeguard the public's perception of the business, its policies, and its products. Thus, it seeks to control how the public perceives the organisation.

Public Relations should not only be an addition to advertising but also a significant yet understated component of the promotional mix.

The following are the most significant gains:

- Credibility – The credibility element is significantly increased if the public learns about the advantages of a company's products through an independent source that is not receiving payment from the company in question.
- Greater readership – When perusing a newspaper, adverts rarely receive the majority of the reader's attention. Editorial or news sections receive a lot more attention. Similar to this, when advertising are on television, viewers are more inclined to turn away and do something else.
- Contain more information – The public can learn more from public relations than from advertisements. An advertisement typically just receives a cursory glance, but when presented as news, public relations receives more attention and is therefore able to provide much more extensive information.
- Cost benefits – The media is not paid directly for public relations work. Obviously, there are expenditures involved, but budgets for PR are much smaller than those for advertising.
- Speed – The advantage of public relations is its quickness. An important development's information can frequently be released and publicized in a short period of time. Additionally adaptable and responsive are public relations.

Identify the standard checklists and schedules recommended by the operating companies (OPCOs)

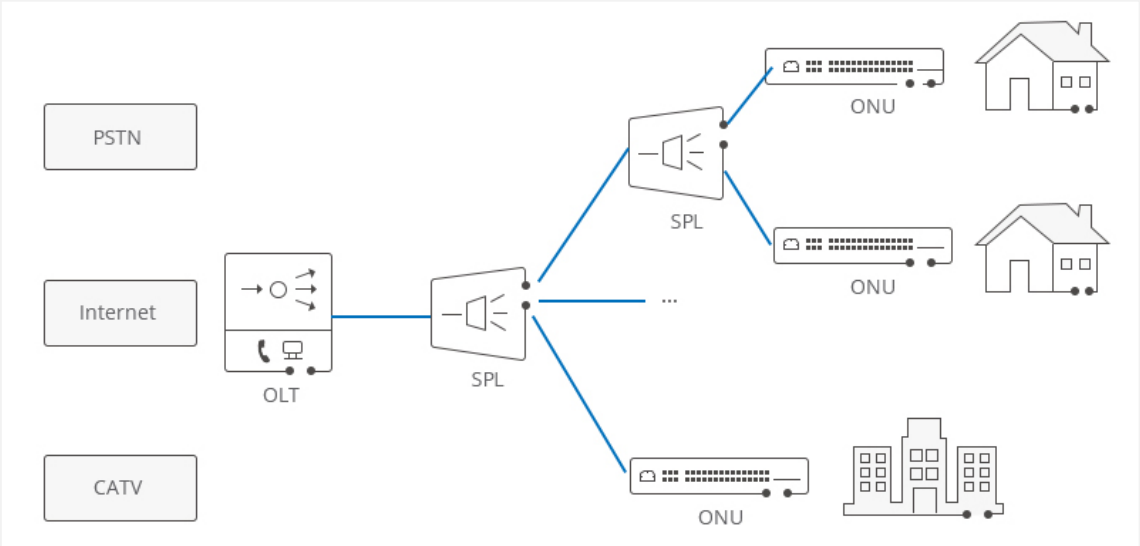
ONT stands for Optical Network Terminal. It serves as a fiber-optic Internet outlet, similar to how a cable modem serves as a coaxial cable Internet outlet. To get a fiber-optic Internet connection in your home or workplace, it is a device that speaks directly with an Internet service provider (ISP). An ONT cannot be used with an Ethernet over Coax or MoCA device, such as a cable modem, router, or cable modem router, because it is designed only for fiber-optic Internet.

Only if fibre has been deployed in your home, an ONT device is required for your home network. This is due to the fact that fiber-optic Internet does not support the use of any modem or router. A fibre router and an ONT or OLT are required.

The ONT functions as the modem in your fibre network. The ONT communicates with your ISP using infrared light pulses. This is how a fiber-optic network connects your home to the Internet. You can then obtain and transmit a Wi-Fi signal to your devices using the fibre router.

The procedure is comparable to an Ethernet over coax Wi-Fi network, so this will sound familiar. The type of cabling in your home makes a difference. The coax wires required to operate a cable modem or cable modem router are already present in the majority of residences. However, using fibre necessitates the costly installation of fibre cables as well as specialised fiber-optic equipment such an ONT and a fibre router.

For usage by your router, the ONT transforms fibre network signals from light into copper and electric. At the Termination Point, or TP, set up by your provider, the ONT connects to the fibre network of your provider using an optical fibre cable. The ONT and your router are linked together using a LAN or Ethernet wire.



ONU transforms fiber-transmitted optical impulses into electrical signals. The individual subscribers are then sent these electrical impulses. Between the premises of the end user and the ONU, there is typically a distance or other access network. Additionally, ONU can communicate, combine, and groom various forms of consumer data before sending it upstream to the OLT. The process of grooming involves restructuring and optimising the data stream in order to increase delivery efficiency. OLT offers bandwidth allocation that enables float data, which typically flows from the customer in bursts, to be delivered to the OLT smoothly. There are many ways to link ONU, including twisted-pair copper wire, coaxial cable, optical fibre, and Wi-Fi.

The term optical network terminal may also be used to refer to end-user devices (ONT). Actually, ONT and ONU are conceptually equivalent. While ONU is an IEEE word, ONT is an ITU-T term. They both refer to the user side devices in the GEPON system but are from distinct standard bodies. However, depending on their location, ONT and ONU differ slightly in practise.

Key tasks in a network maintenance checklist:
Network maintenance is essential, but operations like designing and installing a new network segment or introducing a new application can frequently conflict with these tasks. The following network maintenance chores cannot be ignored by network teams, notwithstanding the urgency of these kinds of projects.

Network maintenance checklist:

1. **Data backups:** The most important maintenance task is data backup. It's critical to be able to retrieve current data in the event of any network calamity. Some businesses only need an end-of-day backup, while others need a continuous one. Both locally and remotely accessible backups are possible. To safeguard them from fire or other potential threats, local backups should be kept off-site. Network teams should periodically verify that backups are completed and readable. The worst scenario is when teams require the backed-up data but discover that, for some reason, backups haven't been made or can't be located.
2. **Malware protection:** Malware defence is becoming more and more crucial. Run scans, keep an eye out for emerging attack types, and update your security software. Additionally, it's crucial to maintain network device software and server operating systems current. Maintain a test network that is disconnected from the primary network, if at all practicable. Before updating OSes, try any upgrades on the test network.
3. **Network documentation updates:** Maintain current network documentation. It's simple for teams responding to an emergency to unintentionally omit this step. Every time a fix is done, note the time and date, the person's name, and a brief explanation of the reason for the fix.
4. **Device inventory:** Continually update your device inventory. Create a list of device names that describe the type of device and the location of the device in the network. Add the MAC and IP addresses.
5. **Power checks:** Teams often overlook the possibility of power failures when they are preoccupied with all the other network issues that can arise. Connect to two poles of power if at all possible, and test UPS systems on a regular basis. When expanding the network, increase the UPS's capacity.
6. **Device filter dusting:** On network devices and air conditioners, dust can clog the device intake filters. When necessary, swap out the filters. Filters that are clogged up might reduce airflow, which raises the temperature. Devices that are hotter require more energy and operate slower.

7. **Cable organization:** Cables should be organised and kept in a place where they won't be disturbed by a janitor or someone tripping over one while passing by. These kinds of accidents have brought down crucial networks.

Although new types of devices and administration have been made possible by technological advancements, network maintenance chores have always been important and are not anticipated to alter significantly in the future.

Exercise

1. List a few tasks to take care of during network maintenance and briefly explain them.

2. Write down a few characteristics of using an Incentive Plan.

3. Name a few tasks a Grass Root Telecom Provider needs to perform.

UNIT 1.4 : Electromagnetic Spectrum (EMS)

Unit Objectives

At the end of this module, you will be able to understand :

1. Learn Key aspects of Electromagnetic Spectrum
2. Features of Electromagnetic Wave
3. Learn about key Regions of Electro Magnetic Spectrum and their Functions

1.4.1 Electromagnetic Spectrum

The Electromagnetic Spectrum

The Spectrum of Electromagnetic is a group of frequency ranges arranged in a manner. Electromagnetic wave is transverse wave, where line of propagation is in perpendicular to the oscillations. So, it can be defined as a transverse wave with mutually perpendicular electrical and Magnetic waves originating from it. The electromagnetic spectrum is range of waves on a manner of increasing or decreasing order of wavelength/Frequency.

The EM- (electromagnetic spectrum) holds range of frequencies categories as

1. gamma rays
2. X-rays
3. Ultraviolet
4. light visible
5. Infrared
6. Microwave
7. Radio waves

the division between the above listed wave types occupies a definite space, but continues and fused into another.

(Refer Fig. 1.4.1)

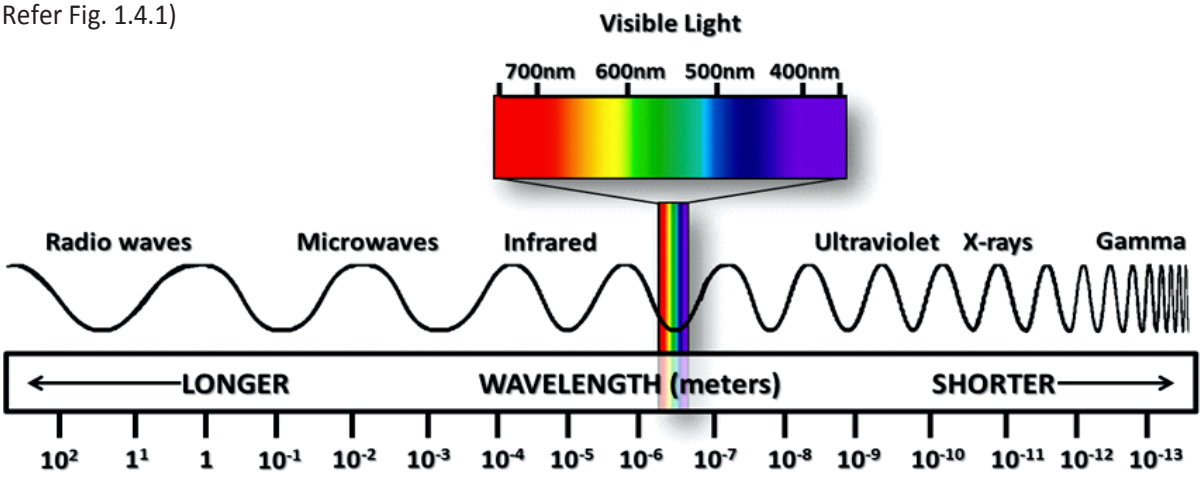


Fig. 1.4.1. Electro Magnetic Spectrum

1.4.2 Features of Electromagnetic Wave

Collective term for all possible frequency/wavelength can be combinedly called as electromagnetic spectrum in general. Radio communication being the best use of very first spectrum layer known as RF spectrum which comprise of low frequencies, as the frequency value raises eventually get classified into very high frequency gamma radiation or very high wavelength radio waves to very short wavelength gamma waves. So, it covering wavelength starts as small as atom to large as thousands of km. Visible light is laying in the shorter wavelength side of spectrum; range is in between 400 to 700nm. Electro Magnetic Wave Maxwell had suggested that Waves carried out a force and has wave phenomenon travelled with a certain speed. And he suggested that the speed of this waves is same as speed of light ie, 300000000 m/s and invented that electromagnetic interaction included not only electricity & magnetism but also the light properties. After this theory Hertz confirmed the Maxwell's theory regarding light properties by showing generated electromagnetic radiation from electric current while studying the behaviour of electric current. Hertz found that the stream of electrical charges could be influenced by light under specific conditions.

UV light had just been recognized, and Hertz demonstrate a beam of UV ray on the contrarily charged side of a gap in a current loop. Hertz's invention of electromagnetic waves emanating from a current loop prompted the creation of radio by Italian physicist and designer Guglielmo Marconi (1874-1937) and others.

1.4.3 Electromagnetic Wave Use and Frequency ranges

Electromagnetic Spectrum Uses / Application

Radio Waves : Used for Broadcasting & communication purpose -their longer wavelength means they travel further in the earth's atmosphere, reflecting off hills and the upper atmosphere.

Microwaves : Used for Cooking food (microwave are absorbed by water molecules causing them to vibrate -heat up) & Satellite transmission (their wavelength penetrates our atmosphere).

Infrared : Used for Heater & night vision equipment - all objects, including people, give out infrared rays which can be detected even at night. Its also used for television remote controls.

Visible Light : Used for Human vision, photography & optical fibers it's fine only part of the spectrum we can see.

Ultraviolet : Used for Florescent lamps - they have chemicals inside them which absorb ultraviolet rays & convert the energy to visible light.

X-Rays : Used for Medical equipment - they enable us to see the internal structure of objects & materials by passing through some substances (Eg: Body tissue) but being observed by others(Eg:Bone).

Gramma Rays : Used for Sterilizing food & medical equipment - they are highly penetrative & can kill cancer cells.

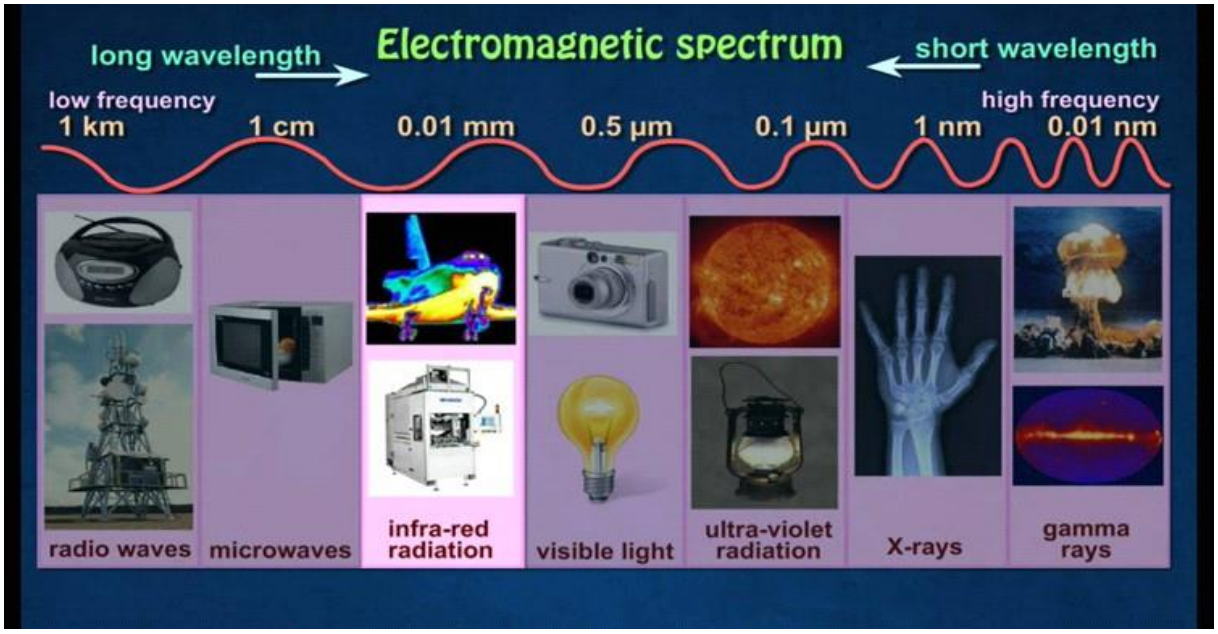


Fig. 1.4.2. EM Wave Uses

Electromagnetic Wave Use and Frequency ranges Continued

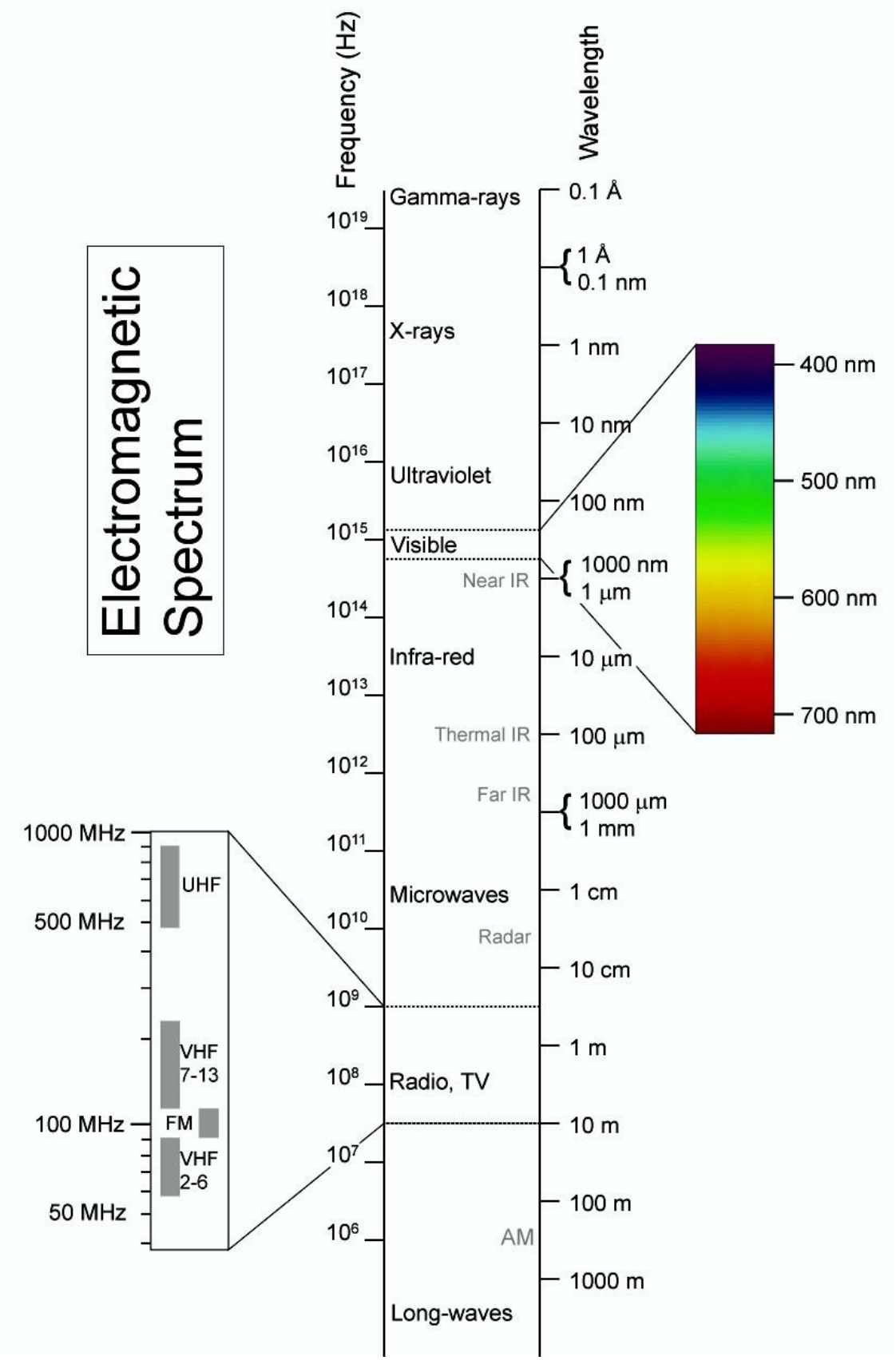


Fig. 1.4.3. Electro Magnetic Spectrum Frequency Range

Electromagnetic Wave Use and Frequency ranges Continued

Visible - LIGHT In Spectrum

Visible light in spectrum starts from Violet and ends By Red color. The below figures show the Individual light frequency in the units of nanometers. (Refer Fig. 1.2.6)

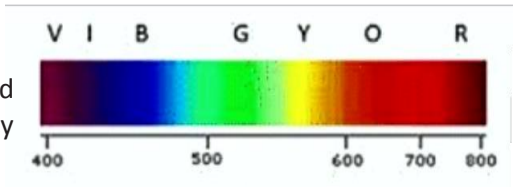


Fig. 1.4.4. Light visible range

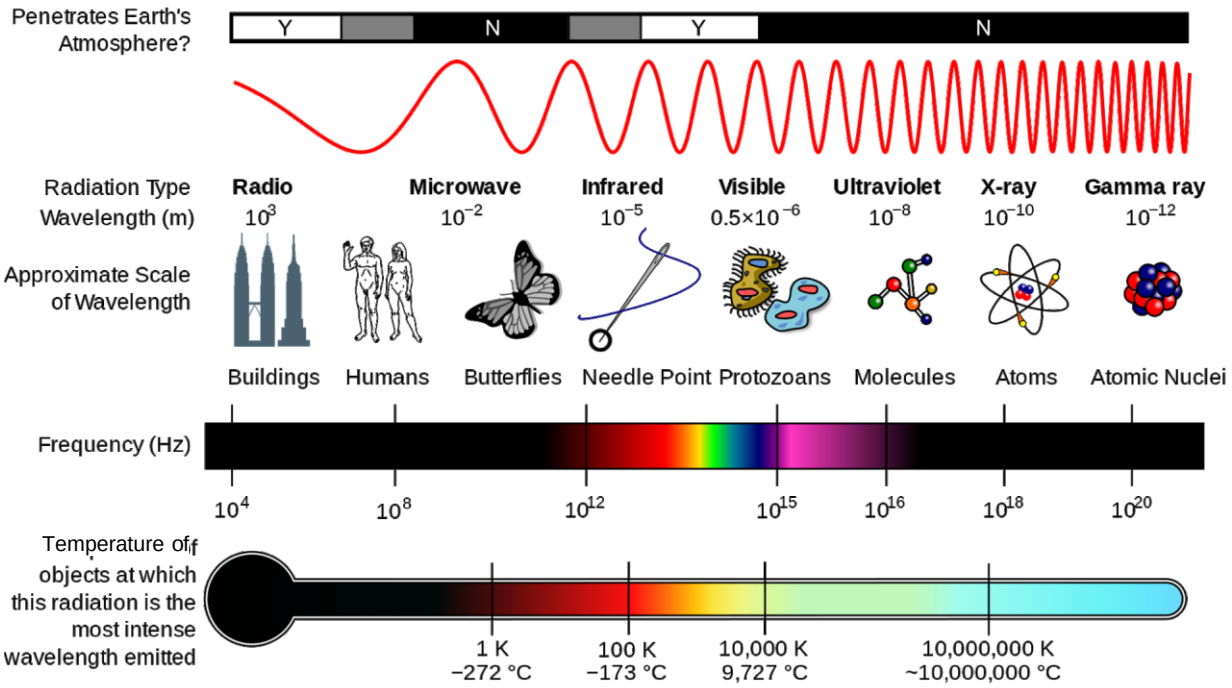


Fig. 1.4.5. Electromagnetic Spectrum Light visible range

Electromagnetic radiation (EM radiation or EMR): Energy emanated from the specific electromagnetic processes is the radiant energy given up from specific electromagnetic processes. Example: Visible light; Rest of the waves are insensitive to human eye and hence invisible such as UV, x- ray, infrared & radio waves.

Electromagnetic waves can be characterized by using Frequency or wavelength of waves, in the increasing or decreasing order of frequency/ wavelength. Radio waves, microwaves, infrared radiation, light, ultraviolet radiation, X- rays and gamma rays.

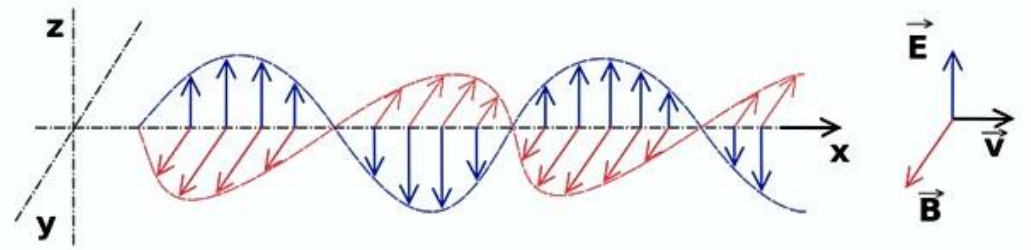


Fig. 1.4.6. Electromagnetic waves

Exercise

1. Explain Electromagnetic Spectrum.

Ans. _____

_____

_____

2. List all the divisions of Electromagnetic Spectrum.

Ans. _____

_____

_____

3. List all the features of Electromagnetic Spectrum.

Ans. _____

_____

_____

3. List Electromagnetic Spectrum applications.

Ans. _____

_____

_____

UNIT 1.5 : Introduction to Mobile Technology

Unit Objectives

At the end of this module, you will be able to understand:

1. Overview of Mobile Technology

1.5.1 Overview of Mobile Technology

History of Mobile Communication

Wireless communication was an enchantment to our predecessors however Marconi started it with his wireless telegraph in 1895. Wireless Communication can be characterized into three periods.

1. Pioneer Era -Till 1920
2. Pre-Cellular Era 1920-1979
3. Cellular Era- beyond 1979

Bell lab on 1946 launched first Commercial mobile telephone system in USA.

Cellular Era

The principle of cellular concept introduced by Bell lab, to overcome bandwidth scarcity and to provide wireless network for larger sections by the end of 1980s Second-generation (2G) mobile systems were introduced. Which supports traditional voice service and low bit rate data services. With refer to first generation, 2nd generation (2G) systems are efficient in terms by having digital multiple access technologies, Systems of 1G are: TDMA & CDMA [Time division multiple access, Code division multiple access].

1.5.2 Mobile Communication Technologies

Wireless telecom industry started to explore new technologies revolution and evolution by 1970s, and in the past three four decades wireless mobile technologies experienced 4 generations of revolution and evolution from 1G to 5G. 1G termed as the First-generation wireless mobile communication technology.

Until being replaced by 2G digital mobile communication system in 1980s, these analog telecommunication were standard. 2G Company called Radio Linja launched First 2G (Second generation) wireless telephone communication system on GSM standard in Finland on 1991.The important advantages of 2G networks over 1G were the digital encryption of call, introduction of data service & message services (SMS, MMS) 3G is the third-generation wireless telecommunication technology.

IMT-2000 (international Mobile Telecommunication) comply with this set of standards that used for mobile devices and mobile telecommunications formed by International Telecommunication Union. various application which supported by 3G are mobile phones, internet accessing devices fixed and mobility devices, video call video conference services, mobile TVs. 3.5G is a grouped mobile technology designed to give better performance than previous technologies like 3G on data & voice services.

4G provides huge data rate for downlink and uplink access. Improvements on voice and data services happened in 4G technology compared to 3G and additional to this mobile broadband internet access is also supported. Continuing with 4G, new technologies are again grouped to provide better performance than previous systems, as an pre step towards the 5G next generation deployment which includes LTE advanced /LTE plus
(Refer Fig. 1. 5 .1, Fig. 1.5.2 & Fig. 1.5.3)

Mobile Communication Technologies Continued

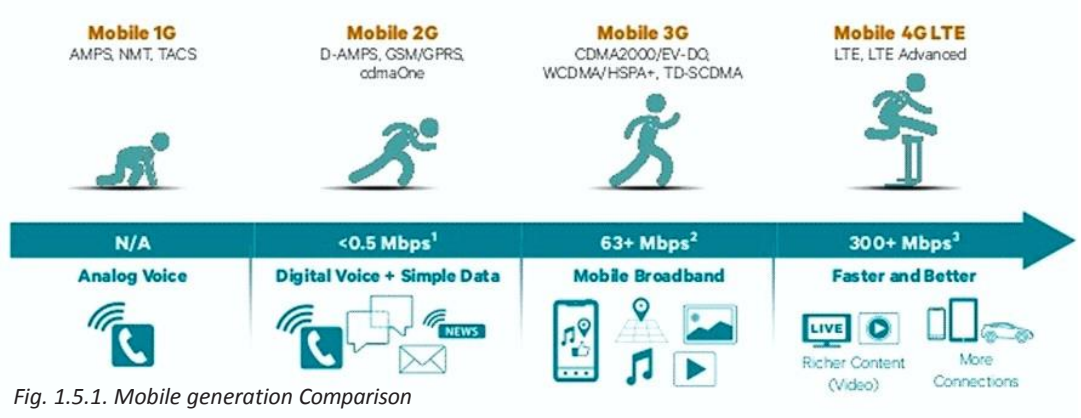


Fig. 1.5.1. Mobile generation Comparison

Fig. 1.5.2. Mobile generation Comparison

	Standard	Download	Upload
2.5G	GPRS	114 Kbps	20 Kbps
2.75G	EDGE	384 Kbps	60 Kbps
3G	UMTS	384 Kbps	64 Kbps
	W-CDMA	2 Mbps	153 Kbps
	HSPA 3.6	3.6 Mbps	348 Kbps
	HSPA 7.2	7.2 Mbps	2 Mbps
Pre-4G	HSPA 14	14 Mbps	5.7 Mbps
	HSPA+	56 Mbps	22 Mbps
	WiMAX	6 Mbps	1 Mbps
	LTE	100 Mbps	50 Mbps
4G	WiMAX 2	1 Gbps	500 Mbps
	LTE Advanced	1 Gbps	500 Mbps

Fig. 1.5.3. Mobile technology Standards & Default speeds

Exercise

1. Discuss the need of high data rate.

Ans. _____

_____

_____

2. List all the mobile technologies with data rate.

Ans. _____

_____

_____

UNIT 1.6 : Introduction to Optical Communication System

Unit Objectives

At the end of this module, you will be able to understand :

1. Need for Fiber-Optic Communications
2. Optical Communication Systems
3. Optical Fibers as a Communication Channel
4. Optical Transmitters & receivers

1.6.1 Need for Fiber Optic Communications

In recent explosive growth is happening as a trend in telecom industry application. New world of technology and information is opening through Internet for millions of people.

Bandwidth demand in this world increasing day by day and it can be achieved only through next generation media that is Optical fiber networks. Improvements and upgradation in optical fiber technologies directly increases the network transmission bandwidth usability. Fiber optic technology is a revolutionary invention in telecommunication industry. Bandwidth requirement can be confined with mainly three applications, Video voice and data. By introduce fiber optic cable in telecommunication system enabled the telecom system to be made over much greater distance with very less loss in the transmission. B Above all of this, fiber optic system is supporting much higher data rate along its length from backbone network to access.

Evolution of Light Wave Systems

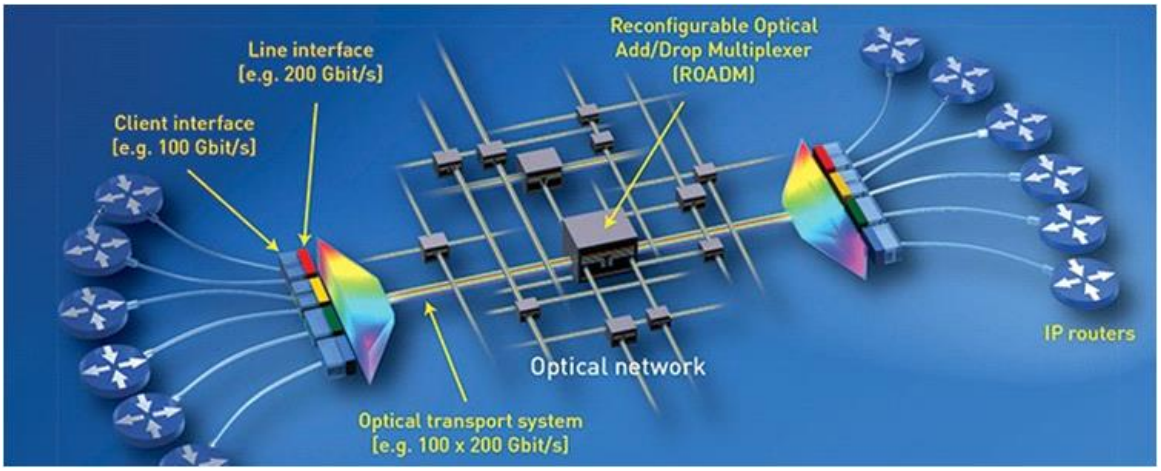


Fig. 1.6.1. Optical Network

1.6.2 Optical Communication System

Generic Optical Communication System

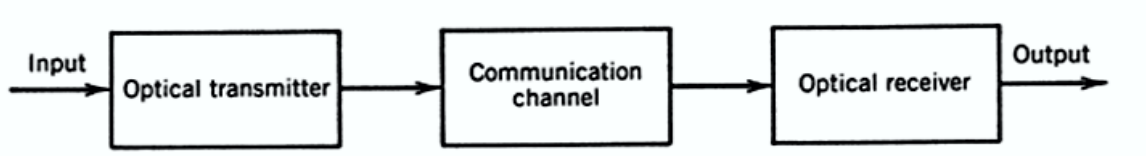


Fig. 1.3.3. Optical Communication System

Specified before, Optical communication system contrast on a fundamental level from microwave just with range of frequencies and data conveyed with the help of bearer wave.

Transporter frequency ranges used in optical system usually will be range of 200 THz, while microwave bearer ranges of 1 GHz frequency. An expansion in the data limit of optical system by a factor of up to 10,000 is normal just in view of such high transporter frequencies utilized for optical communication.

The use of optical fiber communication is as a rule conceivable in any zone that requires exchange of data starting with one place then onto the next. Be that as it may, fiber-optic communication system has been created for the most part for media communication applications. The important and primary categories of telecommunication systems are long haul and short haul, according to the distance that the signal is transmitting from source to destination/receiver compared with typical intercity distance of 100 km. High capacity trunk lines are required for the long-haul application system which can be achievable through optical fiber light wave system with less loss and attenuation. Otherwise, the long applications are driven the important optical fiber communication technology upgradation.

1.6.3 Optical Fibers as a Communication Channel

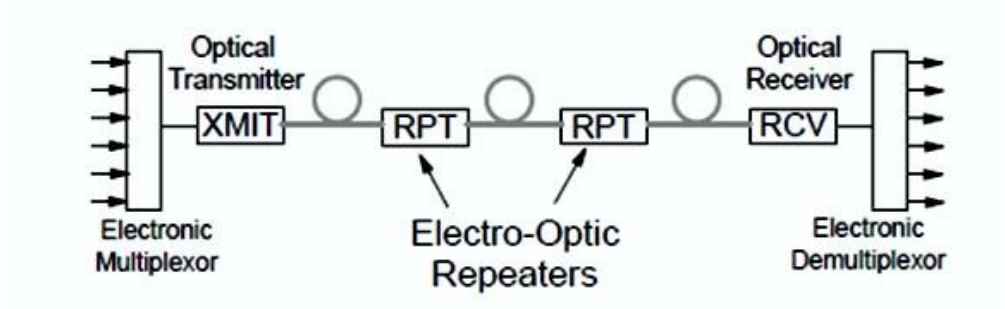


Fig. 1.6.2. Traditional Single Channel System

Conventional Long-Distance Fibre Optic System- Electronic repeaters will be used at intervals of about 40-60km which re-generate the signal and die out of signal power Shown, only one direction signal transmission.

Optical Fibers as a Communication Channel Continued

Picturise normal -usual link structure referred for long-distance communication used early in the optical technology development. Its characteristics are given:

1. By using TDM (Time division multiplexing) Many digital signals(electronic) are combined and single data stream presented to the optical transmission system.

2. This optical channel will support a stream of signal at a speed of value starts with 155 Mbps to 1.2 Gbps.

3. 1310 nm wavelength was mostly used in these applications.

4. After every 50km this light signal will be received by an optical detector at repeater station to convert it to electrical and relocked & reshaped and retransmitted again as light signal using modulations. With insignificant jitter which added by this system completely regenerate the original signal. These processes avoid all the noise and dispersion throughout the link length.

5. This system can be upgraded for the higher data rate as designed by replacing all existing devices in between, because repeater is a speed sensitive device.

Repeaters

Digital transmission is a revolutionized technology in telecommunication industry where we can able to transmit signal as far as we want without or very minimal loss or distortion. This can be achieved due refer to nature of the Digital signal. Characteristics and nature of the digital signals are predictable or pre-determined. This nature of the digital signal made it regenerative in to original form.

Communication is done through channel as medium which is the mode of signal exchange from source to destination detectors with no losses/distortion. So, in light-wave communication, light signal must transmit along its length of the channel without degrading optical power. Most of optical systems are using Optical fiber as the communication channel made up of silica because of its low loss light transmission characteristics.

For silica glass, the average loss is least as 0. 2 dB/ km. That means Optical power is reducing “only one percent “even after a 100km of transmission. Because of this, fiber loss is an important design criterion in fiber optic system and need to determine the amplifier and repeater spacing in optical system if required. Another fiber characteristic which impacts on fiber design issue is the dispersion. Dispersion is the signal broadening effect when light wave travels along the length of fiber.

Due to dispersion effect optical signal will be degraded severely and pulse signals will be spread significantly outside their allocated bit slot. After all it will be impossible to separate or distinguish original pulse signals with accuracy. Multimode fibers are more vulnerable for Dispersion affects, where signal waveforms will fast spread of (~10ns/km) as the different modes will have different light speed associated with it.

Optical Fibers as a Communication Channel Continued

That's why single mode optical fibers are mostly using in long haul optical communication systems. But material dispersion will be present (because of frequency dependency on refractive index) in single mode optical fiber and this will lead to signal broadening. Optical Fibers as a Communication Channel Continued Systems Overview Illustrated ideal 1G WDM – supports long distance configuration. Point to point Transmission is used for the system. A single fiber is carrying multiple channels by superimposing logically. So, each of the optical channel available in a single fiber will be independent with others. WDM fibre system with long distance transmission. Transmission shown below with single direction

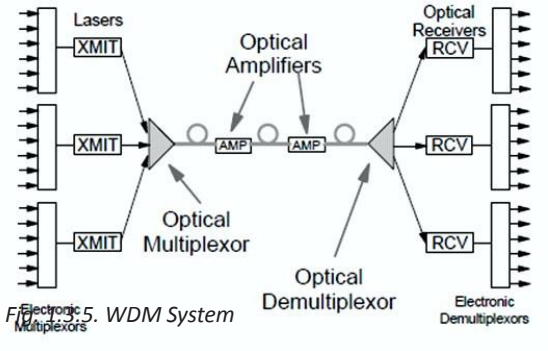
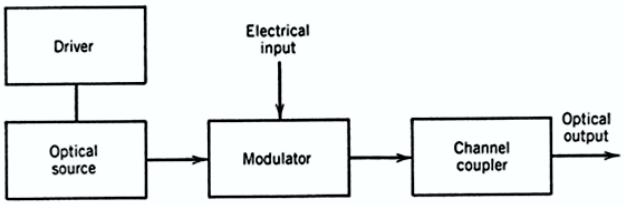


Fig. 1.3.5. WDM System

1.6.4 Optical Transmitters Receivers

Optical Transmitter is a circuitry module which is used to change electrical inputs to optical light & launching it in to optical fibers. Figure depicts architecture diagram of typical Transmitter of optical system. It comprises of a source (optical), channel joints (couplers) and modulator.

1) Light-wave System Components



2) Components of an optical receiver

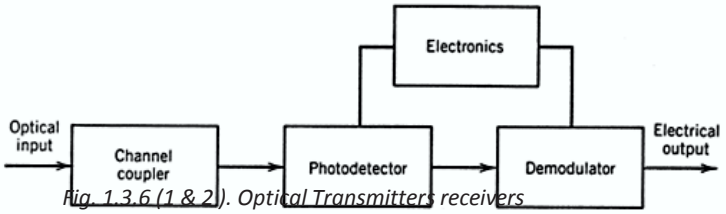


Fig. 1.3.6 (1 & 2). Optical Transmitters receivers

Optical receiver is a light detector which converts light signal received at the end of the fiber in to original electrical signal for processing.

Refer Fig.1.3.6 (1&2) It show case optical receiver block diagram. It comprises of a coupler, a photo-detector and a demodulator. It (Coupler)used to focus light signal on to photo- detector.

Exercise

1. Discuss the need of Fiber optics in communication.

Ans. _____

_____

_____

2. Explain Optical communication system.

Ans. _____

_____

_____

3. List few optical transmitter & receiver.

Ans. _____

_____

_____

Click/Scan the QR code to know more about Electro magnetic Spectrum Application

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Telecom
Sector
Skill
Council

2. Maintain Site Hygiene and Implement Security

Unit 2.1 - Overview of Computer Networks

Unit 2.2 - IP Addressing

Unit 2.3 - Configuring Network

Unit 2.4 - Optical Line Terminal(OLT)/Network Operation Center (NOC) - issues or up-gradation of technology

Unit 2.5 – Equipment used at site

TEL/N6226

Key Learning Outcomes

At the end of this module, you will be able to understand :

1. Overview of Computer Networks
2. Types of Network
3. Network Topologies
4. IP Address
5. Sub-netting
6. Configuring Network Connectivity

UNIT 2.1 : Overview of Computer Networks

Unit Objectives

At the end of this module, you will be able to understand :

1. Overview of Computer Networks
2. Types of Network
2. Network Topologies

2.1.1 Overview of Computer Networks

A network is an interconnection of a group of computers that can communicate and share resources such as hard disks and printers. This is a group of computers and other devices that are connected by some type of transmission media. The initial idea of a network was perceived by Department of Defense (DOD) in USA for the purpose of security Refer Fig. 2.1.0.

Some advantages of networks are: -

1. Sharing of information across the network
2. Optimum utilization of hardware resources
3. Centralization of data management

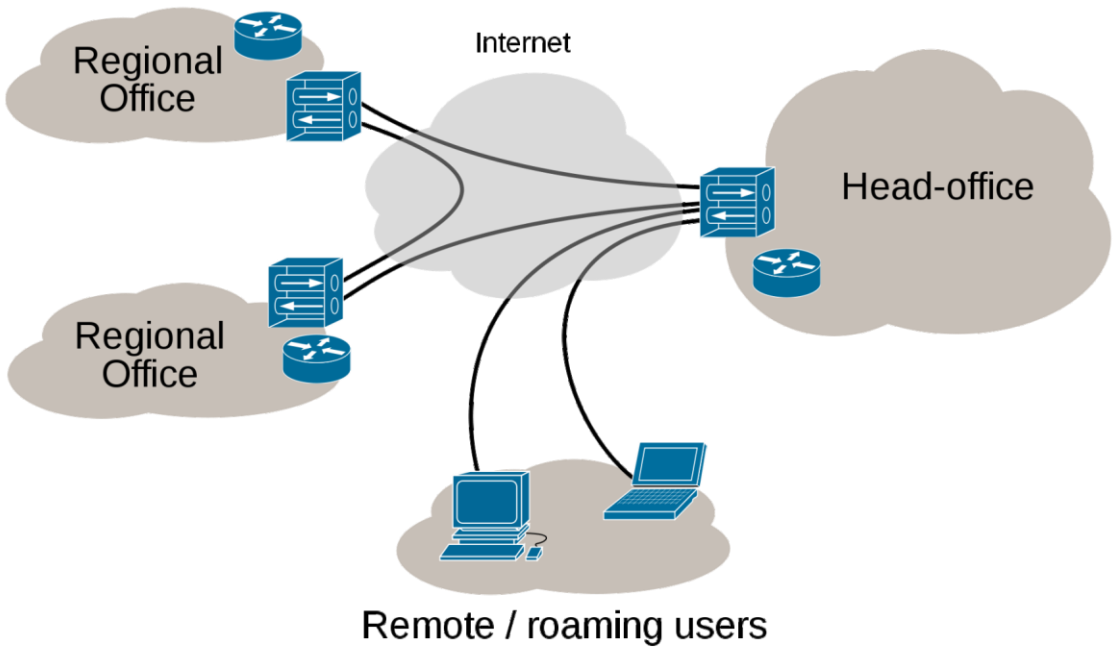


Fig. 2.1.0. Local Area Networks (LAN)

2.1.2 Types of Network

Local Area Networks (LANs):

A LAN is a small-scale network that extends over relatively small geographical area. Refer to Fig 2.1.1

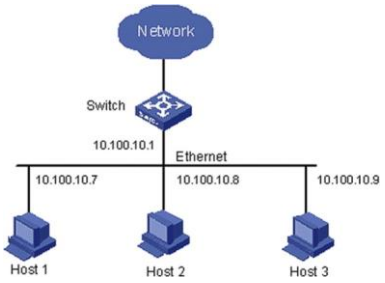


Fig. 2.1.1. Local Area Networks (LAN)

1. Metropolitan area network (MAN) : A network that interconnects users with computer resources in a geographic area or region larger than that covered by even a large local area network (LAN) but smaller than the area covered by a wide area network (WAN). Refer to Fig 2.1.2

2. Wide Area Networks (WANs) : Provides network connectivity spanning across the large geographical area. Refer to Fig 2.1.3

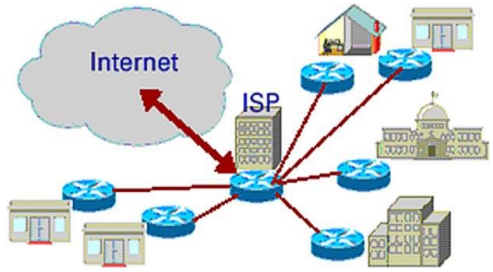


Fig. 2.1.2. Metropolitan Area Networks (MAN)

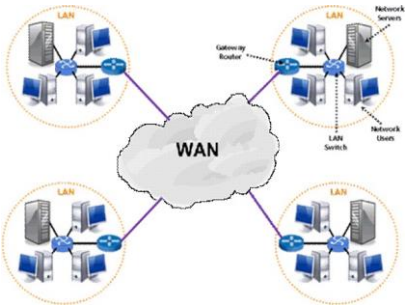


Fig. 2.1.3. Wide Area Networks (WAN)

Network Categories : The resources and software capabilities that nodes in a network share are commonly known as services.

Networks are categorized are as follows:

Peer-to-peer:

In a Peer-to-Peer network, there is no specific distinction between a client and a server. Every node can be communicated to other directly. So no computer or node has higher authority to access the network resource. Every computer or node can be send and receive information to other computer in a network also every computer can be access any resource that may be software or hardware. Refer to Fig.2.1. 4

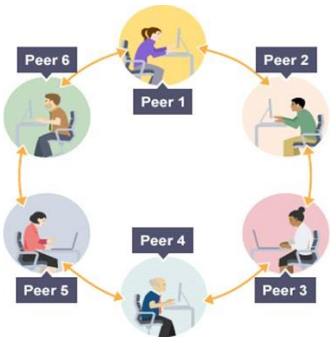


Fig. 2.1.4. Peer to peer Network

Client / Server:

In a client - Server network, the requests are processed centrally by one or more servers. The server is a node with high processing power than all other node in a network which serves the services to others in a network. So it will be worked as a centralized manager to help client node to access resource available in the same network. In this server-client communication the main functionality of the server system is to process the request coming from the client nodes. Refer to Fig.2.1.5

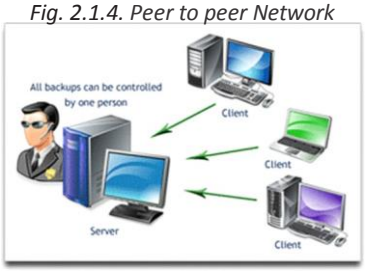


Fig. 2.1.5. Client / Server Network

2.1.3 Network Topology

Network topology is a schematic layout or a map of the arrangement of nodes over a network. There are five types of network topologies are as follows: -

Bus:

In bus topology all the nodes will be connected to a main high capacity cable called bus. In this topology each packet or data which send by any node with source and destination address will be forwarded towards both sides of the bus cable. All nodes other than the original destination node will get the data but discard it. Entire cable setup needs to be reconfigured to add a node. Refer to Fig. 2.16.

Star:

The star topology connects nodes over a network using a central control unit called the hub. Nodes to a star-based network can be easily attached to the hub. All the odes are connected to the hub thus requiring lot of cabling and cost. A faulty hub can disrupt the entire network. Refer to Fig. 2.1. 7

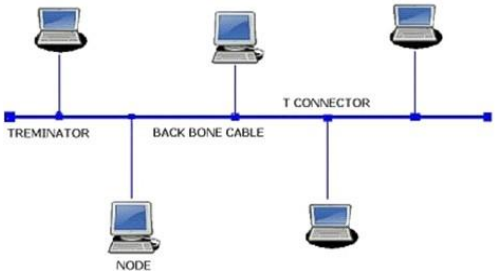


Fig. 2.1.6. Bus Topology

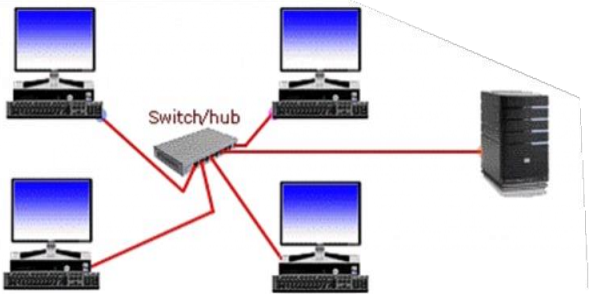


Fig. 2.1.7. Star Topology

Ring :

The ring topology connects the nodes on a network to other two nodes provide point-to-point connection. Easy to locate cable faults in a ring and the entire network stops functioning, if any of the nodes in the network malfunctions. Refer to Fig. 2.1.8

Mesh :

The mesh topology involves point-to-point connection between every node in the network. This is high reliable as network connectivity does not depend on any one node and used for large network connections. This involves high installation and setup costs due to complex cabling required connecting each node with the other node. Difficult to manage as the size of the network increases. Refer to Fig. 2.1.9

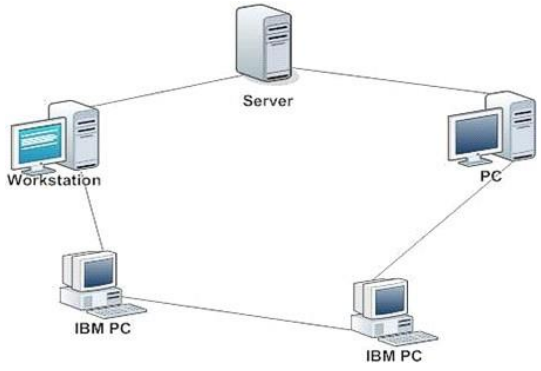


Fig. 2.1.8. Ring Topology

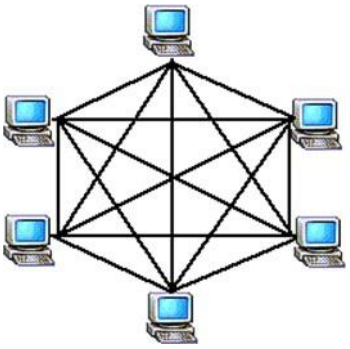


Fig. 2.1.9. Mesh Topology

Network Topology Continued

Cellular :

The cellular topology is a wireless topology, where geographic area is divided into cells or regions. In this each cell is a separate entity that is controlled by a central station. This Operates on wireless media which do not require cabling. This is easy to install as only requirement is the availability of a central location and signal strength

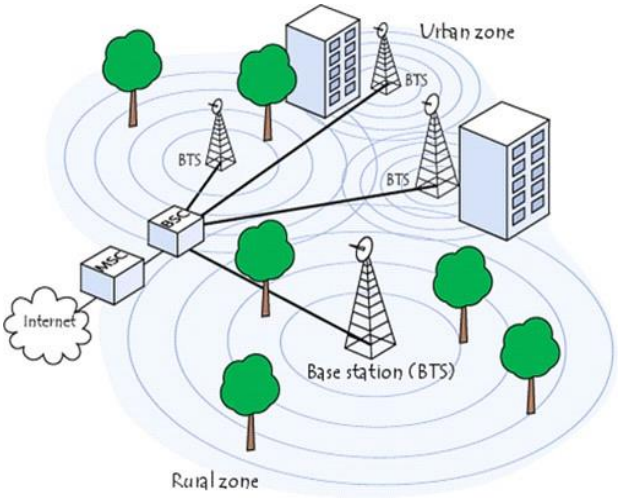


Fig. 2.2.0. Cellular Service Block Diagram

Exercise

1. List all the types of Networks.

Ans. _____

_____

_____

2. Explain LAN, MAN & WAN.

Ans. _____

_____

_____

3. Explain Star, Ring, Bus, Mesh Topology.

Ans. _____

_____

_____

UNIT 2.2 : IP Addressing

Unit Objectives

At the end of this module, you will be able to understand :

1. IP Address
2. Sub-netting

2.2.1 IP Addressing

The purpose of using addressing system is to exchange data between any two host from one network to another in the form of packets or datagrams. A packet consists of two independent data pieces called header and trailer information, in which header contain source and destination addresses along with various control information. These addresses are helping them to reach appropriate destination. The packets reached at the destination can be reassembled in the proper sequence by the receiving machine. Delivery of the packets in the correct destination is involving three critical components:

1. Individual valid IP address used to identify every host in a network.
2. The gateway address for every network to receive & send packets from and to different networks.
3. Subnet mask used to separate the network portion and host Portion. (we will be studying about subnet in the next section)

This addressing technique is working as same like as our post office system, where it uses home address to deliver letter. Without the addresses delivery of the packet at the destination is impossible.

Note: IPV4 available IP addresses are 4,294,967,296.

Concepts of the IP addressing:

IPv4 is 32 bit, which is divided into four blocks of each of 8 bits. Dots separate each 8 bits (octet). IP address is consists of two distinct parts

1. Network address
2. Host address.

Network address	Host address

To make you understand better about the Network address and Host address Let us understand the classes of IP address

Classes of IP address

Ipv4 addresses are divided into five structured classes of addresses Class A, Class B, Class C, Class D & Class E, Which help in identification and made ease of Administration.

1. The first three classes A, B & C are the commercially available classes.
2. Classes D and E are reserved for the Multicast and the Research & Development.

IP Addressing Continued

Class	1st 8 bit	2nd 8 bit	3rd 8 bit	4th 8 bit
A Class	Network address	Host address	Host address	Host address
B Class	Network address	Network address	Host address	Host address
C Class	Network address	Network address	Network address	Host address

Class	Range Address	First Three Bits
A Class	1 – 126	0
B Class	128 – 191	10
C Class	192 – 223	110

A Class (1 -126):

8 bit (network address)	8 bit (host address)	8 bit (host address)	8 bit (host address)

As shown in the above table. It is 8 bit so, if we convert in the binary form 00000001 – 01111111 that is 1 – 127 in the decimal form. It is the simple method to convert binary to decimal.

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1
10000000	01000000	00100000	00010000	000001000	000000100	00000010	00000001
0	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1

The first bit of A should always be zero. “01111111” binary or 127 decimal is reserved for the loop back. To summarize A Class 1 -126 will be the network address range. The next three blocks will be the host address.

Network address	Host address	Host address	Host address
1 – 126	0 - 255	0 - 255	0 - 255

B Class (128 -191) :

8 bit (network address)	8 bit (network address)	8 bit (host address)	8 bit (host address)

As shown in the above table, class B holds 16 bit of network address and 16 bit of host address.

it is notified as N:N:H:H. Network address range: 128- 191.

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1
10000000	000000	00100000	00010000	000001000	000000100	00000010	00000001
1	0	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1

Network address	Network address	Host address	Host address
128 - 192	0 - 255	0 - 255	0 - 255

IP Addressing Continued

C Class (192 -223) :

8 bit (network address)	8 bit (network address)	8 bit (network address)	8 bit (host address)

As shown in the above table, class B holds 24 bit of network address and 8 bit of host address.

it is notified as N:N:H:H. Network address range: 192- 223.

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1
10000000	01000000	00100000	00010000	000001000	000000100	00000010	00000001
1	1	0	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1

Network address	Network address	Network address	Host address
192 – 223	0 - 255	0 - 255	0 - 255

Reserved Address: Class D and E are reserved for special purposes and not available for host addressing.

1. Class D Address range is 224.0.0.0 to 239.255.255.255.This address range is reserved for Multicast Operations.
2. Class E Address range is 240.0.0.0 to 254.255.255.255.This address range is reserved for Research and Experiments.

Another reserved address is two of the main ones designated

1. Default route 0.0.0.0
2. Loop Back address 127.0.0.0

Default route: IP is using routing information to reach destination. So default route will simplifying the routing information that IP uses. Any failure happened, route look up defaults back to this route.

Loop Back: It is used as test address and treating local host as it remote to the network. This is a virtual network interface that could be utilised for sharing data between system in server & client model network use cases on the same.

Private IP address

Private IP addressing originally created to mitigate this issue by using locally allocated IP address (Not Globally). Because of this anyone can utilize these blocks of reserved IP address on their network without register with IANA. But these IP address could not be routed on the public network and need further assistance to access internet. It means that we should use translator like Network Address Translation (NAT), or a proxy server to allow hosts with private IP address access to the internet.

Private network Address range is as below:

Class	Range from	Range to
A	10.0.0.0	10.255.255.255
B	172.16.0.0	172.31.255.255
C	192.168.0.0	192.168.255.255

IP Addressing Continued

The benefits of private IP addressing are as follows

1. Allow multiple private networks to use one Public IP address
2. Improved security for local hosts
3. Save lot of IPV4 address space

It is also utilized for the pilot testing before it can be in the productions

CIDR

Classless Inter-Domain Routing (CIDR); This is the method that ISPs (Internet service providers) use to assign multiple address space to customers that may be a company, home or an Individual. While we obtain group of IP addresses by ISP provider , it look like as :192.168.10.32/28. Here the subnet mask is given by the / notation. This notation value indicating how many bits are turned on to 1 bit. So naturally the maximum '/' notation value is 32 because max number of bits that can be turned on is 32. But the maximum practical value could be only 30 because at least two number of host addresses should be available to assign in any smallest network.

Example: default mask of class A is 255.0.0.0. in the default mask the first byte of the subnet mask is placed only with ones (1s)/ look as 11111111. With refer to slash notation/8, default subnet mask will be 255.0.0.0, format as 11111111.00000000.00000000.00000000. Slash notation of /16,

Class B default mask will be 255.255.0.0, which holds 16 ones and 16 zeros format as shown:

(1s):11111111.11111111.00000000.00000000.

The below given table has a showing every available subnet mask and its equivalent CIDR

The CIDR value range of class A address can be from 8 to 30, here values 8 to 15 can be used only by Class A address. Values ranges from /16 to /23 can be utilized only by class A 7 class B networks. But values /24 -to 30 could be referred by all classes including class A, B & C addresses. This is the reason to utilize A- Class address by most of the company for getting maximum flexibility on network design.

Subnet Mask	CIDR Value
255.0.0.0	/8
255.128.0.0	/9
255.192.0.0	/10
255.224.0.0	/11
255.240.0.0	/12
255.248.0.0	/13
255.252.0.0	/14
255.254.0.0	/15
255.255.0.0	/16
255.255.128.0	/17
255.255.192.0	/18
255.255.224.0	/19
255.255.240.0	/20
255.255.248.0	/21
255.255.252.0	/22
255.255.254.0	/23
255.255.255.0	/24
255.255.255.128	/25
255.255.255.192	/26
255.255.255.224	/27
255.255.255.240	/28
255.255.255.248	/29
255.255.255.252	/30

IP Addressing Continued

Classless Inter-Domain Routing (CIDR):

To understand CIDR first, we must understand what subnet mask is. Now as we all know Host Id & Network ID are the parts of IP address logically separating by a line.

Subnet mask is using to separate these Network & Host IDs. Sub-netting: subnetting is a process in which the network and subnet mask gets separated, using the technique customized network and ip address could be derived. this technique involves bitwise AND operation.

Subnet Mask is made by setting host bits to all "0"s network with all bits to “1"s. In the given system of network, 2 host addresses are kept reserved for the special reason. The all "0" address is assigned a network address and all "1" is allocated to a broadcast address, and they cannot be assigned to a host/ computer.

Default Subnet masks

Class	Network address	Subnet mask
A	X.0.0.0	255.0.0.0
B	X.X.0.0	255.255.0.0
C	X.X.X.0	255.255.255.0

2.2.2 Understanding of Subnetting

You have learned to Define and calculate the usable host ranges applied in Class A, Class B, and Class C network address by changing the host bits all off and then all on respectively. This is magnificent, but here's the thing: we are defining only a single network. What will do if you required creating six networks from a single network address that you have? That's where we should do subnetting operations which helps in making many smaller networks from one larger network by break it.

Many lots of reasons in support of sub- netting, the following benefits included:

Network traffic reduction : Without good routers, the entire network will become down or near irresponsive. With routers, the traffic for local networks will remain on the same network. And the packet heading for other network will passes through router devices.

Optimized network performance : This is achieved by reducing Network traffic. Easy and simple management: It's easy to find out and troubleshoot issues of network in a lot of miniature networks in compare with big network.

Facilitated spanning of the major geographical distances : When we are comparing smaller network like LAN and big WAN link, WAN links are comparatively expensive and slower than LAN links. A big single network may be affected with problems in any of the geographical area that it covers. So efficient system is made by connecting multiple smaller networks while considering the running & troubleshooting.

To create a subnet follows these steps:

1. First calculate the number of wanted network IP addresses: -
   - One for each subnet – Start from the one for wide area networks connection
   - One for each TCP/IP host
   - One each for router interface
2. Depends on the above calculations, create the following: -
   - One subnet masks for your networks
   - Each physical segment of networks will have unique subnet ID.
   - A range of valid host IDs for each subnet

Understanding the Powers of 2

Powers of 2 has very powerful function to know and utilize for use with IP sub-netting. To analyse powers of 2, memorise that when you see a number with another number to its upper right (called an exponent), this means you should multiply the number by itself as many times as the upper number specifies. Example, 23 is 2 x 2 x 2, which equals 8. Here's a list of powers of 2 that you should commit to memory:

$21 = 2$	$2^8 = 256$
$22 = 4$	$2^9 = 512$
$23 = 8$	$2^{10} = 1,024$
$24 = 16$	$2^{11} = 2,048$
$25 = 32$	$2^{12} = 4,096$
$26 = 64$	$2^{13} = 8,192$
$27 = 128$	$2^{14} = 16,384$

Default Subnet Mask			
Class	**Format**		**Default Subnet Mask**
A		network.node.node.node	255.0.0.0
B		network.network.node.node	255.255.0.0
C		network.network.network.node	255.255.255.0

2.2.3 Steps to Crimping of Ethernet Cable

Crimping of the network cable:

We will be preparing the network cables using standard color code combination of straight cable and Cross cable. In this Lab session students are going to do the crimping of the Network cable with the guidance of the trainer.

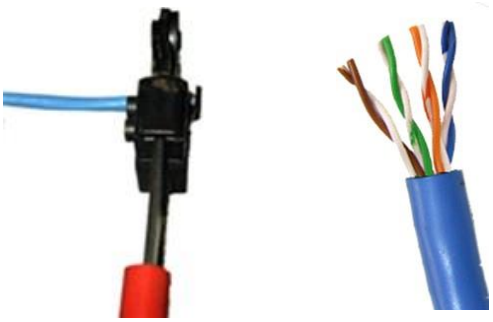


Fig. 2.2.1. Crimping tools

Step 1 : Take the ends of a cable and snip it to get straight end. Need to strip off about 1 inch of the cable jacket. If a jacket stripper is occupied with the jacket stripper, simply shove the cable end into the stripper until it stops, presses the crimper gently, and twist the cable as the blade cut through the jacket (Round Cut). Remove the cable and gently cut off jacket. Refer to Fig. 2. 2.1

Step 2 : By Removing the jacket, we will get four pairs of twisted wires. A solid colour represents each par and a striped colour. Thick colours are green, brown, orange and blue. Separate these pairs of cables so they are unbundled.

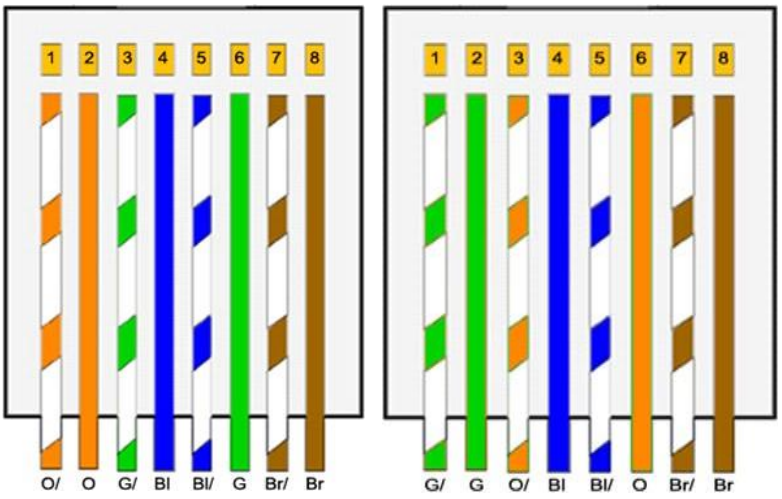


Fig. 2.2.2. 568 B & 568 A Wiring format

Step 3 : After separate the coloured wires, you will get eight different wires. Arrange them into the appropriate sequence that represented in the wiring diagram labelled EIA 568B. It may take some session for practice and to configure the wires into the exact sequence. They can be unruly and may need twisting and straightening. You must make the wires to be as close together as possible. Sometimes it helps to flex the wires lightly to better manipulate them into position. refer to Fig 2.2.2. The wiring sequence 568B is the most commonly using in Ethernet cable.

Crimping of Ethernet Cable Continued

Step 4 : Even after making the wire in sequence, recheck and verify it comparison to the architecture in case some wires may move out of correct slots /place. Utilize the cutter on your crimper, or a scissors, cut straight over the tips of the wires so they are inline and clean. Gets a RJ-45 plug, with the hook side looking down. Guide the wires into the attachment, being careful so as not to allow them out of grouping. As the link enters the attachment, each wire should slip into its own specific channel, enabling them to float easily into the slots. push the link to the extent that it can reach. You must have around 3/16 inch of link jacket inside the back of the plug connector. The wire ends should touch-extend as far as possible toward the front edge of the attachment.

Step 5: With the wires pushed into the fitting, fix the plug into the crimping tool slot. While holding the link set up with one hand, utilize your other hand to press the crimping tool with sensible power. This will press the pins inside the socket to the wires and attach the fitting onto the link

Step 6: Now flip the link around and repeat these steps for the opposite end. To have ideal , "straight-through" link, in place must use the same sequence precisely on both sides. Then again, you could select to manufacture a cross over cable — a less normal link setup occasionally used to straightforwardly arrange two gadgets without a centre point or switch in the middle. To make a hybrid link, finish the end concurrent to stages “one to five “.
For the opposite end, you will change the wiring arrangement by exchanging the orange and green sets. Which is called as a 568 A course of action. Actually, straight-through could be made as a link utilizing either 568B or 568A, if the two ends are the same. Blending different creates a cross over cable. Make certain mark on cross over cable you make, since they won't be compactable with straight- through cables. Although this is less of an issue than it used to be because most present day switches and network interfaces auto- recognize the cable type, and auto- arrange /configure the connection.

Fig. 2.2.3. RJ45 Plug

Fig. 2.2.4. Crimped RJ45 Plug

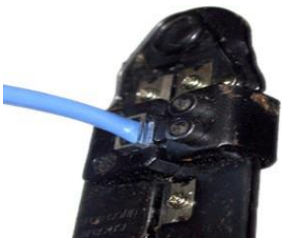


Fig. 2.2.5. Crimping RJ45 Plug using Crimping tool

Conclusion

Testing of cable is essential in network troubleshooting. Small mistakes can cause non-functional operations. The most common issue with cable is disconnection of RJ-45 pins and the wires. It can be happened because of wires could not have entered to the plug properly. So, in case of no connection, just snip RJ45 connector by checking Connecterization procedure again with new RJ-45 plug.

Exercise

1. List the arrangement of color codes in straight cable preparation.

Ans. _____

_____

_____

2. List types of IP address with its ranges.

Ans. _____

_____

_____

3. Discuss subnet and supernet concepts in the network.

Ans. _____

_____

_____

UNIT 2.3 : Configuring Network

Unit Objectives

At the end of this module, you will be able to understand :

1. Configuring Network Connectivity

2.3.1 Configuring Network Connectivity

The networking functionality built into Windows 7 enables you to share all kind of resources with computer users. Before we can share the resources, the first thing we have to do is configure the network, what are the Hardware requirement, how to connect to the network and share the resources.

1. Hardware Requirements
2. Installing the Hardware
3. Connecting to the Network
4. Network & Sharing Center
5. Troubleshooting Networks

Hardware Requirements: Most computers that exist in a family environment are used to share stuff, such as pictures, music, emails, etc., between members of the family. However, sharing data doesn't have to be so restricted; it can actually be shared with any computer, anywhere in the world.

Networks come in two types: Wired, which uses network cables and Wireless, which uses wireless radio signals. For the home user, the latter is the best option and is the one we describe here. To get going, you will need:

Wireless Adapter: This is a component that enables a computer to send and receive signals wirelessly. Many computers have this functionality built-in, but not all do. To find out if yours does, open the Settings app from the Start menu and go to Network & the Internet. If you see a Wi-Fi option at the top of the window, you're ready to go. Refer to Fig. 2.2.6

If you don't see a WiFi option, you need to go out and buy a wireless adapter from your local computer store. These cost a few dollars and simply plug into a USB port on the PC.

A Wireless Router Also known as a network controller, a router is a device that connects your computer to the Internet – wireless versions do it without the need for cabling. Many homes these days have a wireless router already installed as part of their broadband setup. If you don't have one, though, as with the adapter, you'll need to acquire one and install it. The router will come with an installation disc that lets you set up the device and configure various security settings.

Fig. 2.2.6. Wireless Network Connection Status

2.3.1 Configuring Network Connectivity

Definition of the router :

Process of routing is forwarding IP packet or IP datagram from starting/initiated node to reaching node which located in another remote network. This process is carried out by special devices called Routers. Routers can process and identify special address called IP address and which will examine and verify destination IP address and next hope IP addresses. A router forwards this packet to next hop address and which will continue this operation until it reaches destination node. Routers are utilizing routing tables to determine next hope address.

Connecting to the Network: Once you installed and configured the hardware, we need to set up the Network.

The steps followed are as follows:

1. Open the Settings app and click Network &The Internet
2. If all has gone to plan, you will see a Wi-Fi entry as shown below. This indicates the wireless network is up-and-running
3. Select the Wi-Fi entry to open the connection window: As seen in the Fig.2.2.7
4. Click the Connect button to connect your computer to the network. When it is, the network will show as Connected

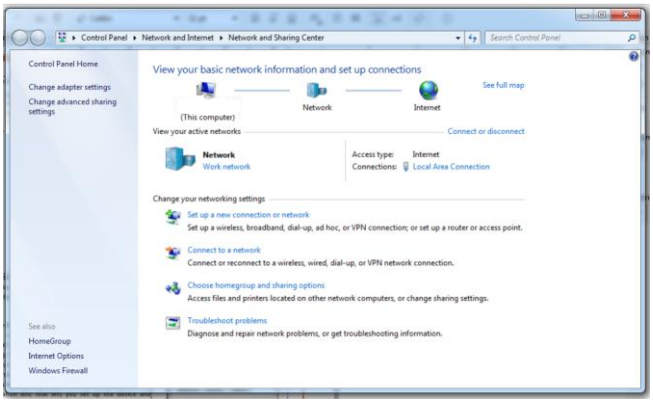


Fig. 2.2.7. Network Sharing Center

Fig. 2.2.8. Managing Wireless Network

Network & Sharing Center

Windows provide utility in the Control Panel that lets you see current network settings and change them if necessary.

1. Press the Windows key + X to open a menu at the boom-le of the screen
2. Click Control Panel and then click Network and Sharing Center. Refer to Fig.2.2.9

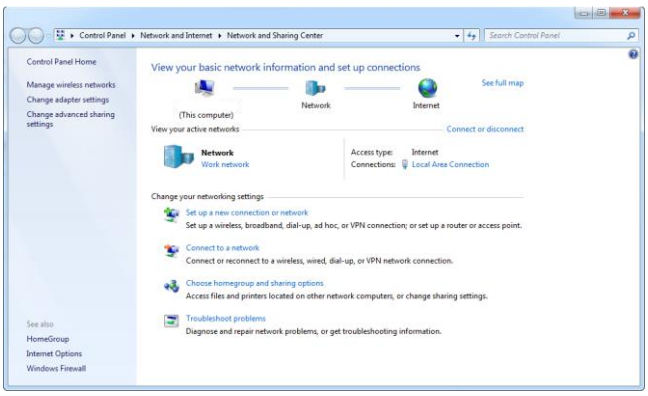


Fig. 2.2.9. Manage Wireless Network Setup Status

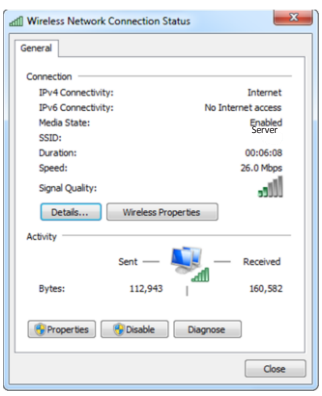


Fig. 2.3.0.Wireless Network Connection Status

Configuring Network Connectivity Continued

3. Details of the networks your computer is connected to are shown under View your active networks
4. Choose the Wi-Fi link at the right of Connections: to open a window that shows the connection's status. As seen in the Fig.2.3.3

Troubleshooting Networks:

There are any numbers of things that can bring a network down. To this end, Windows provides a useful trouble-shooter that can resolve many of the issues that affect networks. So, if you experience problems with your Home Group, your first move is to:

1. Open the Network and Sharing Center
2. Click Troubleshoot problems. Refer to Fig. 2.3.1

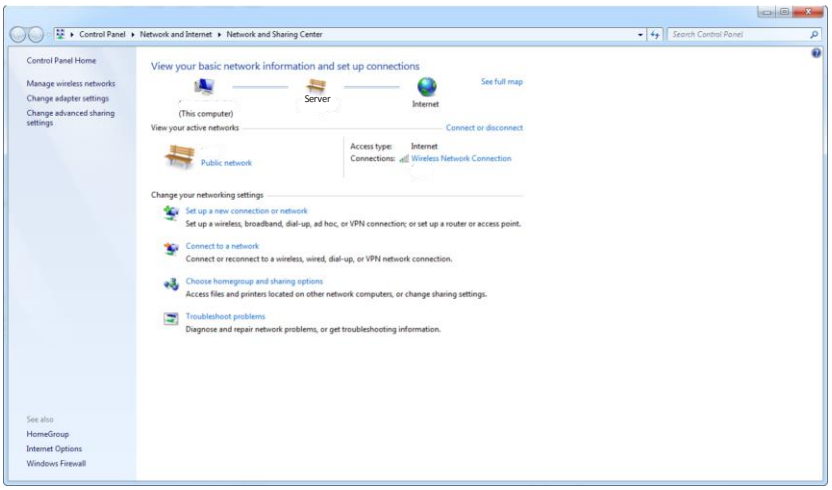


Fig. 2.3.1. Troubleshoot problems

3. Select the type of problem you are experiencing. Refer to Fig.2.3.2

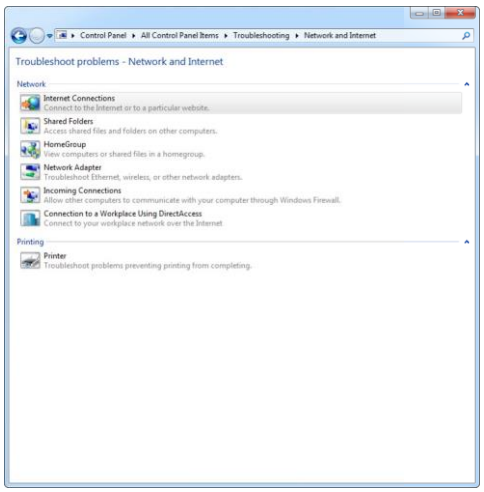


Fig. 2.3.2. Type of Problem you are Experiencing

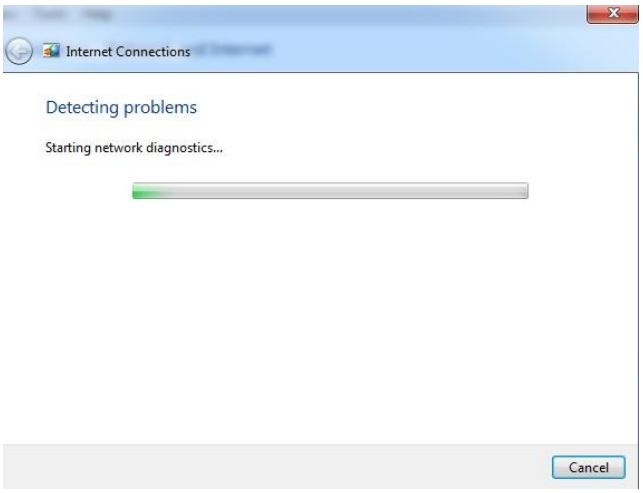


Fig. 2.3.3. Troubleshooting Database Solution

4. Windows will search its online troubleshooting database for likely solutions and inform you of any that it finds. Refer to Fig.2.3.3

Exercise

Define the following:

1. Define Router and Switch.

Ans. _____

_____

_____

2. List all the steps in Network configuration.

Ans. _____

_____

_____

_____

_____

_____

UNIT 2.4 Optical Line Terminal(OLT)/Network Operation Center (NOC) - issues or up-gradation of technology

Optical line terminal (OLT)

OLT is a piece of terminal hardware that is linked to the fibre network. It begins and manages the ranging operation, transmits Ethernet data to the ONU/ONT, and records the ranging data. The OLT allots bandwidth to the ONU/ONT and manages the transmission window size and start time for ONU/ONT transmission data.

The passive optical network's OLT serves as its hub and is connected through Ethernet wires to a core switch. The OLT's main duties include converting, framing, and transmitting signals for the PON network and coordinating the multiplexing of optical network terminals for shared upstream transmission. Rack, CSM (Control and Switch Module), ELM (EPON Link Module, PON card), redundancy protection -48V DC power supply modules or one 110/220V AC power supply module, and fans are the standard components of OLT equipment. PON card and power supply support hot-swap in these components, and an additional module is built within. The OLT has two float directions: upstream (getting distributing different types of data and voice traffic from users) and downstream (getting data, voice, and video traffic from the metro network or from a long-haul network and send it to all ONT modules on the ODN.) The maximum distance supported for transmitting across the ODN is 20 km.

Network Operations Center (NOC)

A network's performance and overall health can be regularly monitored by IT teams at a network operations centre (NOC), which is a centralised location. When a network fails or is disrupted, the NOC is the first point of contact.

Organizations are given complete network visibility through the NOC (pronounced "knock"), allowing them to spot anomalies and either take precautions against difficulties before they arise or respond rapidly to them when they do. The NOC is in charge of managing different network-related devices, including IoT and smart phones, wireless systems, databases, firewalls, infrastructure and equipment (including cables and servers), dashboards, and reporting. Its management services also include monitoring customer support calls and help desk ticketing systems, and integration with customers' network tools, so the NOC plays a huge role in ensuring a positive customer experience.

NOCs can be created in-house and placed on-site, frequently in the data centre, or the task can be contracted out to an outside business that specialises in network and infrastructure monitoring and management. No of the design, NOC workers are in charge of identifying problems and acting quickly to fix them.

Click/Scan the QR Code to know about Optical Line Terminal

.4

A security operations centre (SOC) is comprised of tools and staff who monitor, detect, and analyse an organization's security health 24/7/365 in contrast to the NOC, which is concentrated on network performance and availability.

While technicians in the SOC are responsible with identifying cybersecurity threats and responding to assaults, technicians in the NOC are looking for faults that could slow down network speed and availability. The SOC is concerned with safeguarding both intellectual property and customer data. SOCs virtually always respond to external threats aimed at the company network, whereas NOCs typically handle frequent and naturally occurring network events.

The NOC and SOC both perform vital tasks for the corporation, including identifying, looking into, and fixing problems. Both organisations put in a lot of effort to fix issues fast before they have an impact on business. Additionally, both frequently use a hierarchical method of incident resolution. They concentrate on quite dissimilar topics, though. As a result, each sets of employees have unique talents, expertise, and working methods. A NOC technician must understand the ins and outs of network and application monitoring and management, while a SOC analyst will focus exclusively on security.

Duties of supervisor will include, but are not limited to:

- Reporting findings to the deployment team and documenting site visits and audits.
- Communication with the customer, the deployment team, and outside parties.
- Aiding third-party field teams with immediate problems.
- Discussing action plans to increase workmanship quality with third-party providers.
- Deployment Team reporting of findings on a monthly basis.

Coordinate with Gram Panchayat officials

In Indian communities, the Gram Panchayat is a fundamental institution for rural governance. In India, the grassroots have a democratic system in place. It serves as the village's cabinet and is a political organisation. The general body of the Gram Panchayat is known as the Gram Sabha.

The Government of India has envisioned BharatNet, formerly known as the National Optical Fibre Network (NOFN), as a project to digitally connect all of India's Gram Panchayats (GPs) and Villages. It is a signature project carried out by Bharat Broadband Network Ltd. (BBNL).

- A Special Purpose Vehicle (SPV) with a Rs. 1000 crore permitted capital was established by the Indian government under the Companies Act, 1956.
    - Initially, it was under the Ministry of Communications and Information Technology, which was split into the Ministry of Communications and the Ministry of Electronics and Information Technology in July 2016.
- Currently, it is being implemented by the Department of Telecommunication under the Ministry of Communications.

The purpose of BharatNet is to connect the more than 250,000 village panchayats dispersed across India's 6,600 blocks and 640 districts to high-speed broadband. From blocks to panchayats, it will serve as a middle-mile network that Internet service providers (ISPs), local cable operators, and other organisations can utilise to access its bandwidth and additional fibre. At the primary level of village government, this will make it easier for residents to access e-governance, telemedicine, e-education, and other digital services. By establishing Wi-Fi hotspots in villages, the project has also tried to provide last-mile connectivity since 2017.

Field Engineer must first communicate with GP Officials before carrying out such tasks:

- Monitor systems: Using a variety of techniques to keep tabs on computer systems' functionality and performance.
- Troubleshoot issues: Work to prioritise or resolve problems within their designated areas.
- Track issues: Using a specific ticketing system, track and thoroughly document all flaws and their fixes.
- Report incidents: As necessary, escalate complex problems to management, other IT personnel, third parties, and/or vendors.

Exercise

Fill in the blanks

1. _____ is a piece of terminal hardware that is linked to the fibre network.

2. _____ is the first point of contact in case a network disrupts or fails.

3. A security operations centre (SOC) is comprised of tools and staff who _____, _____ and _____ an organization’s security health 24/7/365.

UNIT 2.5 Equipment used at the site

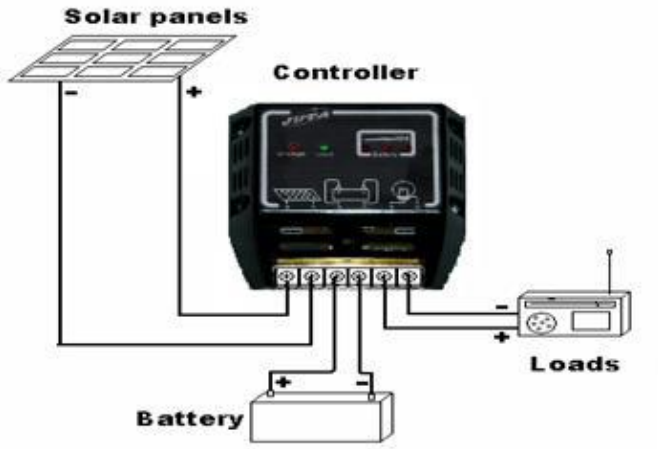
Unit Objectives

At the end of this unit you will be able to:

1. Describe the various equipment used at site
2. Understand the wiring set up at a site for maintenance and repair

2.5.1 Charge Controller Unit (CCU)

In order to prevent overcharging of the batteries, the charge controller controls the amperage and voltage given to the loads and directs any excess power to the battery system.



To charge the battery and prevent overcharging of the electric cells, a solar charge controller essentially functions as a voltage or current controller. It guides the voltage and current that the solar panels' launching solar panels produce to the electric cell. Since 12V boards and panels often output in the range of 16 to 20V, overcharging will cause damage to the electric cells if there is no regulation. Electric storage devices typically need between 14 and 14.5V to fully charge. The solar charge controllers come in a variety of sizes, prices, and features. Charge controllers have a range of 4.5A to 60 to 80A.

The three types of solar charge controllers are as follows:

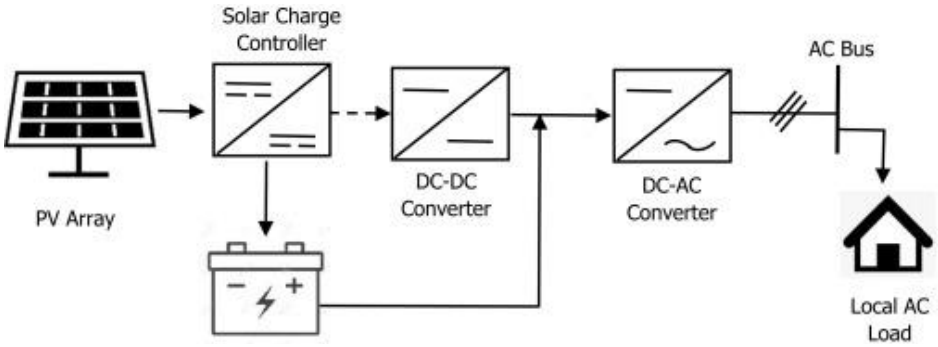
- Simple 1 or 2 stage controls
- PWM (pulse width modulated)
- Maximum power point tracking (MPPT)

2.5.2 Solar Photo Voltaic System (SPV)

Solar photovoltaic technology uses solar cells to transform sunlight into direct current (DC) electricity. The electricity produced can be used either immediately during the day or it can be stored in the batteries for use at night for a variety of purposes.

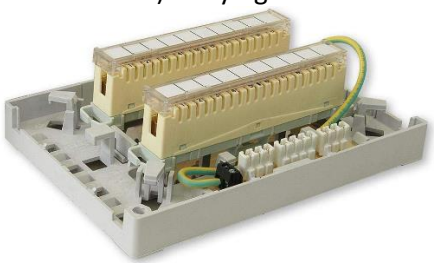
Salient Features of SPV Devices:

- No noise
- Easy to install
- Simple to operate
- Pollution free
- Low maintenance cost
- Solar Photovoltaic has a long life



2.5.3 Telephone Junction Box (TJB)

Due to its small size, telephone wiring boxes are simple to install. All local phone conversations can be carried on a considerably smaller network of lines thanks to the pairs from each home's digitizers. The digitizers separate the multiplexed lines into separate pairs, and this box may accept a number of longer lines (such as T1 or T3 lines) carrying voice channels.



When there is no place for future growth or when the expansion of connections is not necessary in the future, terminal boxes are utilised for specific connections. A junction box, on the other hand, has a tiny footprint and a lot of usable space. Future development may also include the planning of new linkages.

2.5.4 Battery Bank

The outcome of connecting two or more batteries for a single application is a battery bank. You can boost the voltage, amperage, or both by connecting batteries. You can build a battery bank for times when you need more power. Series and parallel connections of two or more batteries can both be made effectively.

In order to store energy in electrochemical form, one or more individual batteries are assembled to form a battery bank.

2.5.5 Fire Extinguisher

The risk may be significant given that IT equipment has become a crucial and common tool for business, industry, government, and research groups. Although the probability of a fire starting in digital equipment (servers, storage units) is very low because there is little energy available to any fault and little combustible material within the equipment, this risk may still be present.

- Automatic detection equipment shall be installed to provide early fire warning. The equipment used shall be a listed smoke-detection- type system.
- The alarms and trouble signals of automatic detection or extinguishing systems shall be arranged to annunciate in a constantly occupied location.

ABC extinguisher: It puts out fires that are burning in solids, liquids, and electrical equipment. Manufacturers use a variety of different media. It is considerably more expensive than a typical dry chemical extinguisher.

Wiring set up at a site for efficient maintenance and repair

Every industrial establishment or factory depends on its electrical cables and wires to function. The entire system shuts down if cables malfunction or experience any interruption, even for a brief period of time, costing you money and effort. Cables and wires need to be well-maintained in order to fix this. It's important to understand some of the fundamental dos and don'ts of cable and wire installation, maintenance, and preventative actions.

Preventing an issue is preferable to lamenting the devastating effects of a dire circumstance. Follow these advice before installing cable, then:

- Check the cable for any scratches that can reduce its durability.
- Never bend the cables more than the indicated bend radius.
- Check to make sure the wire or cable is not under tension.
- Prevent kinking and twisting during installing.
- Always take care to prevent cables and wires from coming into contact with anything that could hurt them.

Maintenance of wires and cables is crucial since it helps to decrease downtime, non-conformance problems, and boost overall efficiency with longer lengths. Let's discuss about some maintenance advice:

- **CHOOSE THE RIGHT WIRE AND CABLE**
  - Select the cable that is most suited for your industry's needs. Learn about the various types of cables that are sold on the market.
  - Select the cable size that is appropriate for your industry. You can check for things like mechanical strength, ambient temperature, carrying capacity, voltage loss, and safety restrictions.
  - Staff should receive periodic maintenance training and education so they can recognise any failure's symptoms.

- **PREVENTION OF DAMAGE**
  - Keep a watchful eye on the installation of the wiring. During installation, avoid twisting or kinking the wires. It is important to lay wires as straight as you can.
  - Prevent strife and collisions.
  - Note the smallest bent radius.
  - Avoid any collisions, piercings, or crushing that could rip the wire jacket apart.
  - Keep cables and wires away from flames.
- **MAKE CABLE REEL ADJUSTMENTS**
  - Reverse the cable ends to keep one from being exposed to the hostile environment for too long.
  - Tie the cable to stop it from rewinding.
  - Keep the appropriate tension.
  - The overload current is noted.
  - Take into account voltage drop; if neglected, this could result in an early machine failure from overheating.
- **MAKE REPAIRS ON TIME**
  - Regularly inspect cables and wires to prevent repeat catastrophes.
  - If and when necessary, promptly fix any damaged wires or cables.
  - Before it creates any harmful conditions, crushed and damaged cable should be removed.
- **ALWAYS MAINTAIN THE RECORDS**
  - Maintaining the collection of installed cables and wires in your industry is encouraged. It provides information on how long they will work.
  - Document the process of laying the cables for future reference.
  - Keep track of the locations where a breakdown typically happens.
  - To make repairs, cut the wire and cable.
  - Conduct frequent performance analyses of wires and cables.

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Skill Development
Corporation
Transforming the skill landscape

Telecom
Sector
Skill
Council

3. Perform Preventive Maintenance

Unit 3.1 - Fibre Optics Overview
Unit 3.2 - Light in Fiber
Unit 3.3 - Transmission of Light In fiber
Unit 3.4 - Optical Sources
Unit 3.5 – Gigabit Capable Passive Optical Network (GPON)
Unit 3.6 – Global Position System (GPS)
Unit 3.7 – PON Maintenance & ONT – CCU Indicators
Unit 3.8 – ONT Status Check
Unit 3.9 – ONT Srvice Configuration
Unit 3.10 – ONT Preventive Maintenance
Unit 3.11 – ONT Maintenance and Troubleshoot
Unit 3.12 – Record repairs/replacements

TEL/N6227

Key Learning Outcomes

At the end of this module, you will be able to understand :

1. History of Fiber Optics
2. Advantages and Disadvantages of Optical Fiber
3. Optical Fibre Standards
4. Fiber Structure
5. Know glass as a Medium
6. Transmission Capacity
7. Fibre refractive Index Profiles
8. Polarization
9. Interference
10. Chromatic dispersion
11. Propagation Modes
12. Snell's Law
13. Critical Angle
14. Dispersion
15. Noise and Loss
16. Light Production
17. LED
18. Laser
19. Fiber Optic Light Guides
20. Optical Radiation

UNIT 3.1 : Fiber Optics Overview

Unit Objectives

At the end of this module, you will be able to understand :

1. History of Fiber Optics
2. Advantages and Disadvantages of Optical Fiber
3. Optical Fiber Standards

3.1.1 History of Fiber Optics

1. The Ideas of fiber optics applications like transmission of images through fibers started in 1930s.
2. Efficient light source introduced in 1960s, Eg: First Laser source
3. Even in 1970s, transmission losses of optical fibers were very large, the loss of the light signal as it travelled through fiber limiting transmission distance.
4. To overcome this limitation, scientists developed glass fibers that include a separating glass coating. Innermost part made up of glass used to pass light through it and outer glass coating is used to prevent the leakage of light signal from core by reflecting the light in to inner glass boundaries.
5. Now optical fibers are using every communication applications like broadcasting industries and in wide varieties of applications like medical fields. It is used to transmit voice, video & data signals through small flexible thread of size of a human hair made up of glass or plastic.

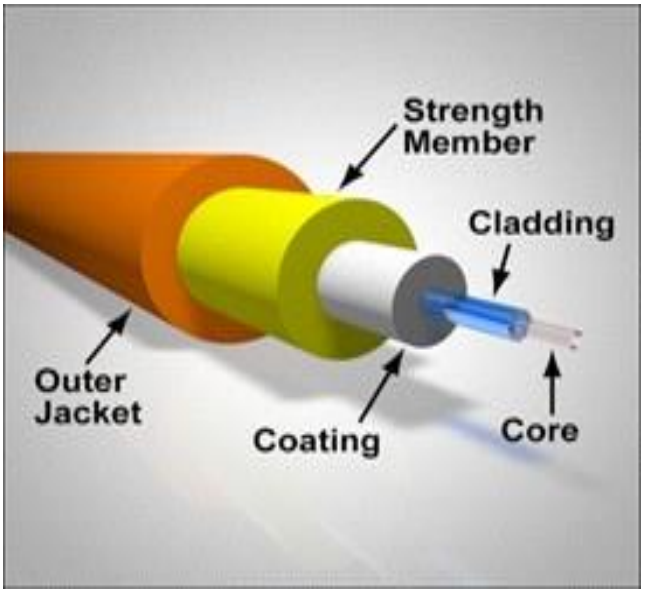


Fig. 3.1.1. Fiber Optical cable

3.1.2 Advantages and Disadvantages of Optical fiber

Advantage

Bandwidth - Fibre optic cables have a much greater bandwidth than metal cables. The amount of information that can be transmitted per unit time of fibre over other transmission media is its most significant advantage. With the high performance single mode cable used by telephone industries for long distance telecommunication, the bandwidth surpasses the needs of today's applications and gives room for growth tomorrow.

1. Low Power Loss – Optical fiber transmission media has very minimum transmission loss. This allows long distance transmission. Ie, the longest recommended copper distance in a network is 20 times lesser than the optical fiber system. So, for fibers it will be about 100m and 2000m for the fiber networks.

2. Immunity to Interference – Optical fiber cables are immune to electromagnetic interference. That means optical fibers can be laid even though an electrically noisy environment, because electrical field will not affect fibre signal

3. Size – Optical fibers are small less in weight. With a comparison to copper cables fiber optic cables have high capacity as 4.5 times of copper one with lesser cross-sectional area around 30 times less to fiber.

4. Fiber optic cables weigh much lighter and thinner compared to copper cables. So, it occupies small space compares to copper cables which hold equal capacity of data handling. So, handling and installation of optical fibers are much easier than metal wire cables.

5. Safety – It doesn't have hazard & sparking issues, because it made up of glass and plastics.

6. Security – It is hard to tap optical fibers as fibers do not emit electromagnetic signals/field, radiation cannot be disturbed. Physically tapping on fiber optic systems are easy for identify, so fibre become the safest medium in place for communicating confidential data.

7. Fiber has higher strength in tensile & flexibility compared to metallic wire cables with diameter. Optical fiber nature of flexibility helps in easy bend and acts as anticorrosive resister which acts against elements which are corrosive like in copper cable very easily.

8. Cost – In a long-haul application situation, optical fibers are more economical/cheaper than copper wires.

9. Extremely high bandwidth – Optical fibers providing much more bandwidth than any other transmission media offers.

10. Easy to accommodate increasing bandwidth –fresh device could be added to fiber optic cable by utilising multiple new generations of optical fiber cabling which could provide extended capacity compare to initial fiber placed. DWDM makes the optical fiber cable system to be works on flexibility to select various wavelength of light on and off at will.

11. Resistance to electromagnetic interference Bit error rate on Optical fiber is very less (10 EXP-13), As immunity to electromagnetic interference is property fiber. So, optical fiber cable is noise free in virtual.

Advantages and Disadvantages of Optical fiber Continued

12. Detecting cable damage very early stage could improv transmission security – as a transmission media fiber is the best one ; it is really hard to find out transmitted data by "observing -listening in" to the electromagnetic signal with the help of cable, this could be achieved by transmission of electron-based element . By looking after an optical network and by detail check out of the time taken by the light to reflect down the fiber, splices/ cuts & damages in the cable could be detected in simple.

Disadvantages

1. Cost – First time installation and optical fiber Cables are expensive but it lasts longer than copper cables.

2. Fragile – Fibers are very sensitive to sharp bending and can easily broke or have transmission losses when covered around in curve fashion of radius which goes up to few centimetres . By encasing fibers in a plastic protective sheath and central strengthen member, it is difficult to bend the cable into a small radius to break the fibre

3. Protection - Optical fibers require more protective mechanisms around the cable compared to copper.

4. Installation costs is still high –Despite the certainty that fiber establishment costs are dropping to the extent that almost sixty percent in one year , introducing cables of optical fibers will be moderately expensive. Similarly, its establishment and deploying cost does down, fiber applications may be expanded from its first domain of requisition in the backbone network, may be moving under the local loop & with innovations for example, like
FTTx (Fiber to the Home, Premises, etc) Furthermore PONs (Passive optical networks), providing users its end customer with Internet access.

5. Specific test devices is always preferred – The test equipment's that were used for the conventional & typical electron based system cannot be utilized for fiber optic network. So sophisticated optical devices like OTDR (Optical Time Domain Reflectometer), are very expensive must utilize for the optical fiber network system testing. Also, expensive optical probes would necessary at most fiber endpoints

6. chances of damage in physical – Fiber is very small in size and very sensitive to bending and other stresses. So, there is lot of probability to get damage the fiber in installation and construction fields compared to metal wire cables. Because rail-roads normally give rights-of-way for optic -fiber deployment, and it significantly showcase issues like damage threat in cables & this kind of functions and failures will stop all the services which provided to large number of people because a small fiber wire can support large bandwidth so, very high capacity of data handling. Due to this fact, while optic fibers used as path for transmission, obvious it become mandatory for restoring address, keeping mirror copies like backup and survivability.

7. Damages from Wildlife to optic cables –birds, may use the fibers as nesting & reinforcing material. Birds may take out fiber cable jackets to utilize as material for nests. some animals use it for sharpen their teeth's (like Beavers and other rodents). Fibers are get damages from insects, Sharks. Christmas tree plant treats fiber optic cable as a tree root may wraps itself around fiber under layed so tightly which may lead light impulses traveling down the fiber are choked off.

3.1.3 Optical Fibre Standards

International Standards for Optical fiber-ITU Specifications

1. ITU-T G. fiber standard 651 Multimode
2. ITU T G 652 p -T G.652 Standard Single mode fiber. 4 different categories (A, B, C, D) differ in the water peak attenuation around the 1383nm window Equivalent standards : Telcordia GR-20, IEC 60793-2, TIA/EIA-492CAAB
3. ITU-T G.653 Zero Dispersion Shifted Fiber (ZDSF), having zero dispersion around the 1550nm window
4. ITU-T G.654 Cut-off shifted and low attenuation fiber, designed mainly for submarine applications
5. ITU-T G.655 Non-zero Dispersion Shifted Fiber (NZDSF), having low dispersion in the 1550nm and 1625nm windows, the DWDM region. Suited for long-haul and backbone applications.
6. TU-T G.656 Medium Dispersion Fiber (MDF), designed for local access and long-haul fibre ITU-T G 657 TG.657 Latest standard (from 2008 Jan) for FTTH application. Designed to bend at small radius of down to 10mm radius and 7.5mm radius

Some other standards are given by

1. FOA Standards
2. United states with fiber standards
3. Fiber -EIA-TIA- Optic Standards
4. The standards defined will be continual get updated
5. A full catalog of TIA specs is at http://www.tiaonline.org/
6. FOA Standards is at http://www.thefoa.org/tech/standards.htm

Exercise

1. Discuss the need of Fiber optics in communication.

Ans. _____

_____

_____

2. List advantage's and disadvantage's of optical fiber.

Ans. _____

_____

_____

3. Discuss the optical fiber standards.

Ans. _____

_____

_____

UNIT 3.2 : Light in Fiber

Unit Objectives

At the end of this module, you will be able to understand :

1. Fiber Structure
2. Know Glass as a Medium
3. Transmission Capacity
4. Fibre refractive Index Profiles

3.2.1 Fiber Structure

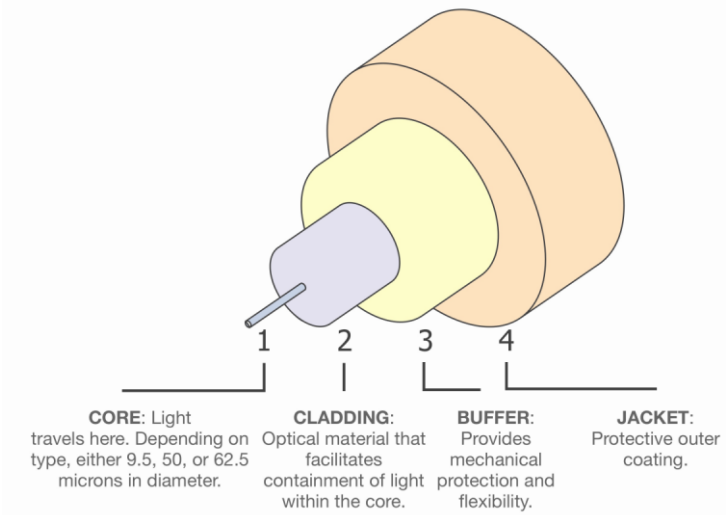


Fig. 3.1.2. Optical Fibre Cable - Structure

Optical Fibers are essentially a waveguide for light. The basic working principle of optical fiber is "Total Internal reflection". Fiber cable structure has internally two components, one is Core And cladding which surrounds the core. The core will have higher refractive index than cladding. The cladding Layer has a higher index of refraction than the core. When light tries to travel from higher refractive index of high value towards RI of medium to RI of low index , bending of light to the boundary between the medium and after a angle of incident light will completely reflected back to original medium. So here, this effect will allow light to travel along the length of core.

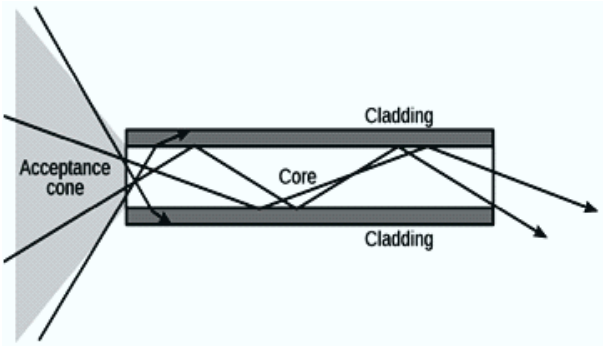


Fig. 3.2.3. Light travelling through OFC (Optical Fibre Cable)

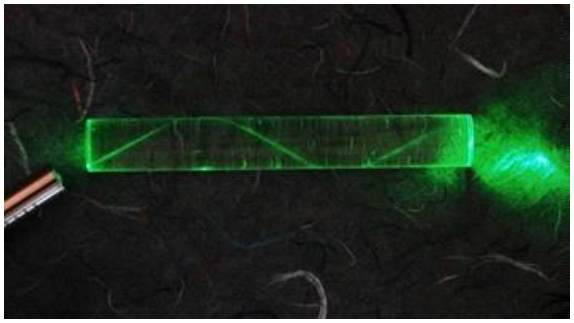


Fig. 3.2.4. Light travelling through glass

Fiber Structure Continued

Light Propagation

Visible light extends from 380 nm (violet) to 780 nm (red), for smaller wavelengths ultra-violet radiation (UV) occurs. Longer wavelengths correspond to the infrared region (IR). Optical Fibres communication elements operate in the micrometer wavelength zone of the frequency spectrum (frequencies between 1014Hz to 1015 Hz).

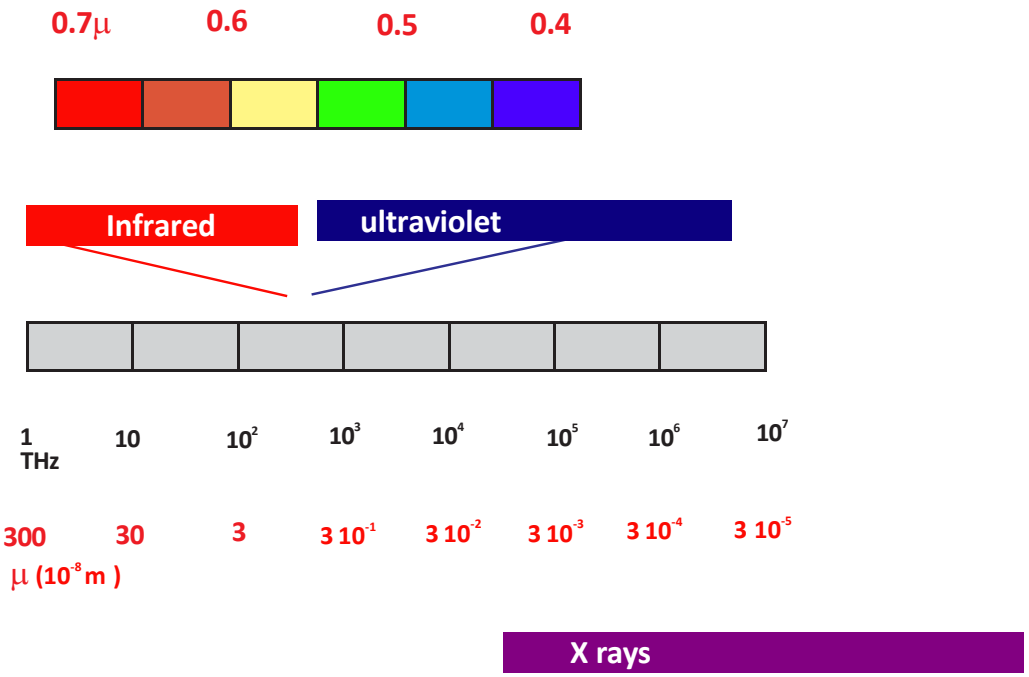


Fig. 3.1.5. Light frequency ranges (infrared & ultraviolet)

In an isotropic homogeneous medium, light ray will travels in straight line. Light is described by rays that travel in straight lines in an isotropic and homogeneous medium. When the light ray incident on an interface between two mediums, it's direction will gets changed. At the interface both the reflection and the refraction will take place.

The light direction differs in to the same path because of incident at the interface is known as reflection, while the change in direction of light ray in 2nd path is called as refraction.
In optics, the refractive index "n "of a material is a dimension less quantities that explains how and in what speed the optical signal flows over that medium. We know C is speed of light in vacuum and v is the phase velocity of light in the medium. Refractive index is a characterizing element of an isotropic and homogenous medium, which is a measure of velocity of light in that medium. The materials will generate different refractive index values for different colours or wavelengths corresponding to the rays.

There is Law of refraction and Law of reflection which will describes the refraction & reflection of light at the interface. These laws are the basics of geometrical optics. E.g.: The propagation of rays and the image formation by lenses and mirrors are explained by these laws. Under condition on these laws, light ray will completely get reflected to original or first medium. The phenomenon is known as total internal reflection it transports through fibers

Refraction of Light:

This section provides the information of TIR phenomenon interactively. By varying input parameters, angle of incident and refractive indices of medium we can study about the TIR phenomenon.

Light Guidance:

This section gives the interactive study of the light propagation through the Optical fibers. By varying the refractive indices of the mediums in coupling, mediums inside the fiber, and the angle of incidence and the passage of light in the meridional plane through the fiber can also be traced.

3.2.2 Fibre Glass as Medium

Optical Fiber Sizes

There are some international standards on the fiber structure and dimension. 125 microns (µm) is the international standard value for outer cladding diameter and 245 µm for the coating. These standards are important and mandatory to follow to ensure the compatibility of connectors, tools, splices, and other fiber optic elements throughout the industry. Single mode fibers are manufactured with small standard core size of that of multimode; normally 8 to 10um in diameter. And standard multimode fibers have a core size of 50 to 62.5um in diameter.

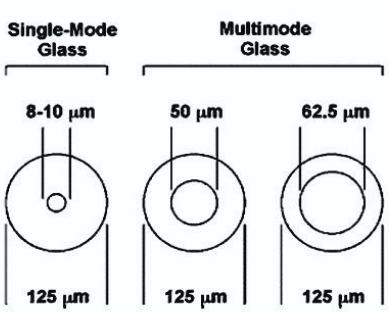


Fig. 3.1.6. Optical Cable Sizes

3.2.3 Transmission Capacity

TRANSMISSION CHANNEL	FREQUENCE OF OPERATION
Coaxial cable	1 MHz to 100 MHz
Microwave	1 GHz to 100 GHz
Optical fibers	100 THz to 1000 THz

Fig. 3.1.7.Transmission Capacity A

TRANSMISSION CHANNEL	CARRYING CAPACITY
Coaxial cable	13000 channels
Microwave terrestrial link	20000 channels
Satellite link	100,000 channels
Optical fibers	300,000 channels

Fig. 3.1.8.Transmission Capacity b

Transmission Capacity Continued

Technology and Maximum Bandwidth	
Techology	**Maximum Bandwidth**
Fiber Optics	10 Gbps (and beyond with DWDM)
Laser	1 Gbps
Ethernet	1 Gbps
ATM	622 Mbps (and beyond)
Microwave	155 Mbps
Satellite	155 Mbps (Experimental 622 Mbps)
Ultra Wideband	100 Mbps
LMDS	100 Mbps
TechNet's Recommendation	100 Mbps / Home or Small Business
VDSL	520 Mbps
Cable Codes	30 Mpbs
ADSL	9 Mbps
HDSL	2 Mbps
E1 leased line	2 Mbps
ISDN PRI	2 Mbps
Frame Relay	2 Mbps - specs up to 62 Mbps
ISDN BRI	128 Kbps
Analog	56 Kbps

Fig. 3.1.9. Technology different band widths

3.2.4 Fibre Refractive Index Profiles

Refractive index profile

Refractive index profile the diagrammatic representation of refractive index distribution within an fiber optics is called refractive index profile. There is multiple refractive index profiles associated with different types of optical fibers. One of the type is step-index profile, where the core is such a uniform - distributed index with the e cladding which have uniformly-distributed index with lower value. Alternative one is graded –index profile, in which the refractive index differs slowly as a parameter of radial distance from the fiber core centre. Graded –index profiles consists another two profiles, power- law index profiles and parabolic index profiles.

A step index profile has an equilibrium refractive index inside of core from central axis to outer diameter and at the joint of cladding refractive index value suddenly falls to lower value compared to core in an optical fiber. Most of the single mode fiber and few multimode fibers are using step index refractive index profile. The step-index profile is same as a power-law index profile when the profile features comes to infinite values.

A step-index fiber is characterized by the core and cladding refractive indices n1 and n2 and the core and cladding radii a and b. Standard core and cladding diameters are:2a/2b are 8/125, 50/125, 62.5/125, 85/125, or 100/140 (units of μm). The fractional refractive-index change $\Delta = \frac{n_1 - n_2}{n_1} << 1$ The value fractional refractive – index change (n1 & n2 is typically between 1.44 and 1.46) , $\triangle$ is typically between 0.001 and 0.02. By doping high-purity fused silica glass (SiO2) with different concentrations of materials like titanium, germanium or boron, Step index fibers are manufacturing.

Pulse dispersion in a step index optical fiber is given by $\triangle$

$$\text{Pulse dispersion} = \frac{n_1 l}{c}$$

where $\triangle$ is the difference in refractive indices of core and cladding. n1 is the refractive index of core l is the length of the optical fiber under observation, c = 3 x 108 ms-1

Exercise

1. Explain fiber structure.

Ans. _____

_____

_____

2. List the operational frequency of Coaxial, Microwave & Fiber optics.

Ans. _____

_____

_____

3. Describe the Refractive Index Profiles.

Ans. _____

_____

_____

UNIT 3.3 : Light Propagation and Related losses

Unit Objectives

At the end of this module, you will be able to understand:

1. Polarization
2. Interference
3. Chromatic dispersion
4. Propagation Modes
5. Snell's Law
6. Critical Angle
7. Dispersion
8. Noise and Loss

3.3.1 Polarization

2 electrical signals which are orthogonal & magnetic components with vector fields which are differ in frequencies with amplitudes are a beam of light. Whenever the referred 2 components differ in phase or amplitude, light is considered as polarized. There are so many studies happened on this phenomenon and numbers of practice made approachable to either minimize it or exploit for applications. Polarization is characterized by using the pattern traced on transverse plane by the electric field vector as a function of time. Polarization can be classified as linear, elliptical or circular, in them the linear polarization is the simplest. Whichever polarization can be a problem in the fiber optic transmission. Refer to Fig. 3.2.0.

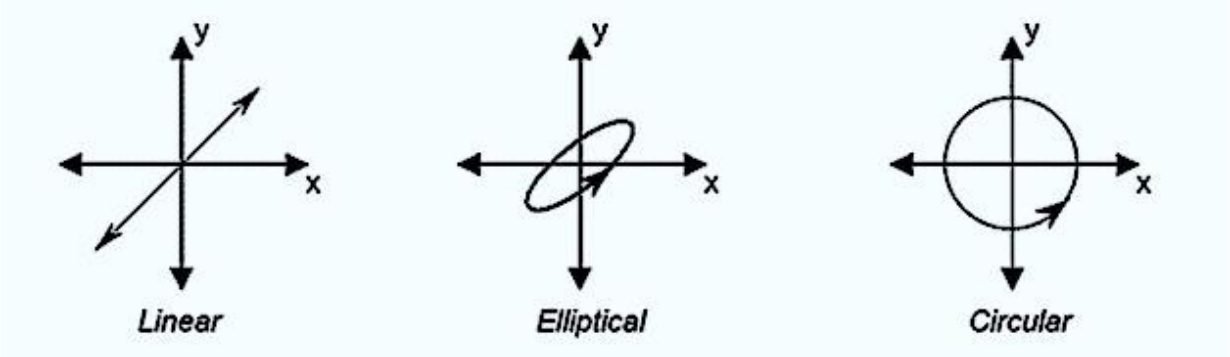


Fig. 3.2.0. Polarization

Polarization Continued

Measurable Polarization Properties

DOP

Degree of Polarization (DOP) is defined as n_1 I

DOP = Ipol / (Ipol + Iunp)

In which Ipol intensity of polarized light and Iunp is intensity of unpolarized light, respectively.
2

When DOP = 0, light is considered as un-polarized, and it is fully polarized, while DOP = 1. Partially polarized light is called as In-between cases.

PER

Polarization Extinction Ratio (PER) – dB is used to express ratio of minimum polarized power to the maximum polarized power. Random component of polarization could represent a value as a specification.

PDL

Polarization Dependent Loss (PDL) –This is the peak to peak variation in insertion loss as the input polarization varies over all its situation, expressed in dB.

PMD

Polarization Mode Dispersion (PMD) – This is one more representation in material dispersion. Single-mode fiber supports a single mode, which consists of two orthogonal polarization modes.

Where core of an optical fiber is perfectly circular along the length. Core may not be circular and mechanical stresses such as twisting& bending, brings out birefringence effects in the fiber.

Because of this, one of the orthogonal polarization components will be travelling faster compared to another, that's the reason for causing dispersion of the pulse waves in optical fiber. The highest difference in the mode propagation times because of dispersion is known as Differential Group Delay (DGD). DGD unit is picoseconds. This is a fluctuating and changing property of optical fiber. So PMD don't have a single, static data for a considered part of fiber, instead it has a DGD distribution values across time. Maxwellian distribution is the probability of a DGD with a certain value at any specific time. In an approximation, the maximum instantaneous DGD is about 3.2 times the average DGD of a fiber.

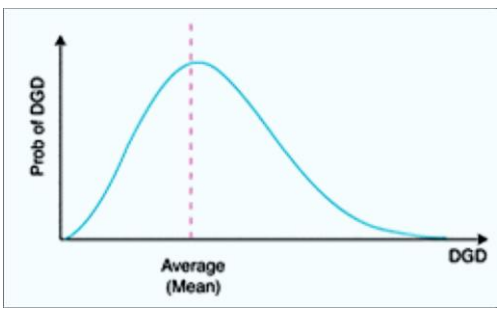


Fig. 3.2.1. Polarization Mode Dispersion (PMD)

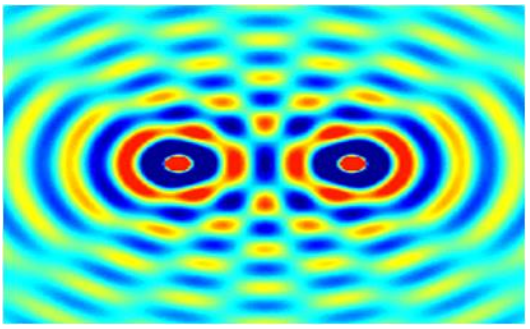


Fig. 3.2.2. Interference

3.3.2 Interference

In physics, It is a phenomenon of superposing 2 waves to create a resultant wave with great, lesser or the similar amplitude. Interference is a concept in which 2 or more waves superimpose each other and gives out a resultant wave, sometime resultant will be higher and some time it will be lower, as their sources are same or because they have nearly the same frequency. All the types of waves available in nature some of them are light waves, surface waves of water, acoustic-waves. These waves show the effect of interference. effect. Interference in metal wires occurs due to production of magnetic fields by the metals (which produce current in the metal) due to time varying electrical signals through them. The signal can also be distorted by the presence of electric/magnetic fields close to the wire. Basically anything that can induce or vary an electric/magnetic field in a metal wire would cause attenuation and interference.

In optical fibers, the signal is transmitted using light. Optical fiber consists of 3 elements: core, cladding and buffers. Transmission of light signals takes place in the core while the buffers protect the fiber from the outside environment including extraneous light signals, i.e interference. Hence no interference occurs in optical fibers.

3.3.3 Chromatic Dispersion

Chromatic dispersion

Chromatic dispersion has a great importance in fiber optics communication. In a light beam, there will be different wavelength components exist. These different colours, or wavelengths, in a light beam may come to destination on distributed time line. This is called chromatic dispersion. The chromatic dispersion is defined as concept with medium as optical and phase velocity and group velocity of light travelling in an optical fiber directly proportional on the optical frequency.

Group velocity dispersion is the related quantitative measure. The term “chromatic” is utilized for separating / distinguishing these categories of dispersion from other categories of dispersion, while these are very familiar for fiber optics. E.g.: inter modal dispersion and polarization mode dispersion.

Chromatic Dispersion Effects

1. Wavelength-dependent Refraction and Diffraction – Dispersion makes wavelength relay on refraction, E.g.: for the happening of rainbows. Same wise, at a diffraction grating on wavelength-dependent diffraction give way to the spatial separation of multiple unique frequency elements of light beam.

2. Dispersive Pulse Broadening and Chirping: Dispersion will influence the pulse propagation because a pulse will have broad frequency component or a spectral width parameter, so dispersion can make its spectral elements travel with unique velocities. Normally higher frequency component exhibits lower group velocity so called a positive (+Ve) chirp whereas abnormal dispersion creates negative (-Ve) chirps.

Note: We measure it in unit: pico seconds per nanometre*kilometer

Chromatic Dispersion Continued

Chromatic dispersion coefficient: ps/(nm km)

Single mode Different wavelengths lights are produced and transmitted by glass fibers with multiple speeds which cause Chromatic dispersion (CD). Refractive index of the material is resultant of fraction (ratio of the speed of light in a medium) /(speed of light in a vacuum). The effective index of refraction is about 1.45 for an optical fiber. Hence, the speed of light in glass/ silica is almost 2/3 the speed of light in a vacuum. In long haul applications, lasers are used as the optical light/signal generator because, it will have very minimal spectral width compared to LED and other sources.

And optical fibers are optimized for this value range of wavelengths. So, chromatic dispersion can be minimized to an extreme low value by using these two methods. Even though it cannot be avoiding completely. When Light travels along the length of optical fiber, higher wavelength components travel comparative fast, it will make spreading of pulse as shown.

Explain the reasons of Chromatic Dispersion?

2 parameters due to chromatic dispersion is,

1. Material dispersion
2. Waveguide dispersion.

Depending on the wavelength, refractive index of a material, in this case Glass, will varies and cause Material dispersion. By inspecting the graph below, refractive index variation on the complete spectrum covered by optical fiber seem small, only few percent, but it is working out on rapid -speed pulses on long distances, it can add up.

Fig. 3.2.3. Chromatic Dispersion

3.3.4 Propagation Modes

TE and TM Modes

According to Maxwell's equations electromagnetic waves having two components. 3/4 the two components are the, electric field, E(x, y, z) and the magnetic field, H(x, y, z). Electric field E and the magnetic field H, are orthogonal to each other. In an optical fiber 3/4 Modes traveling in are termed as transverse. Total length of the fiber support propagation of transverse modes. The electric field which is 3/4 in total TE modes, are perpendicular to the direction of propagation. The magnetic field, which is 3/4 in TM modes, perpendicular to the direction of propagation. The electric field is in the direction of propagation.

Two types of propagation mode

Multi-mode and single-mode are the two types of propagation mode in fiber optics cables. So, both attenuation and time dispersion gives multiple outputs with respect to Multimode and single mode. Multimodal fibers are cheaper than single modal fiber mode but will give better performance.

Propagation Modes Continued

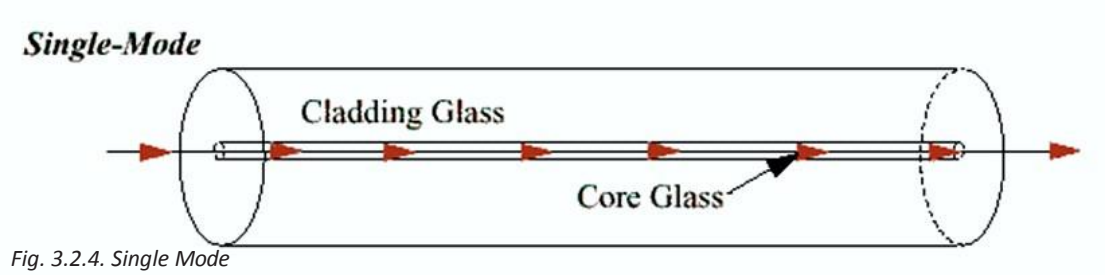


Fig. 3.2.4. Single Mode

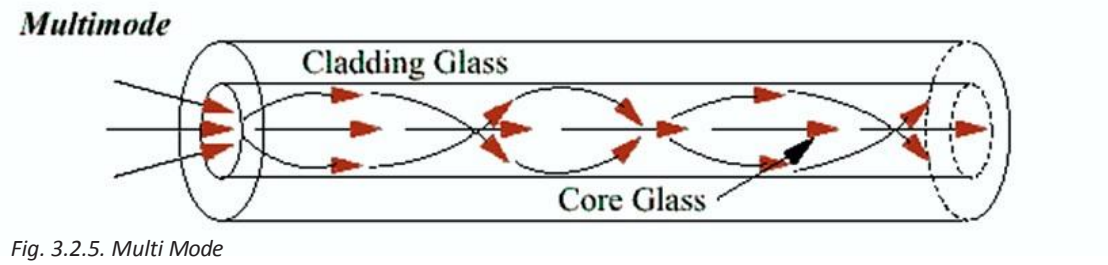


Fig. 3.2.5. Multi Mode

Multiple modes in fiber optics are based on mainly two things, which are Dimensions of the cable and the differences of the refractive indices of mutual core and cladding across the cross section.

There are three principal possibilities which are multi-mode step index, single-mode step index and multi-mode graded index.

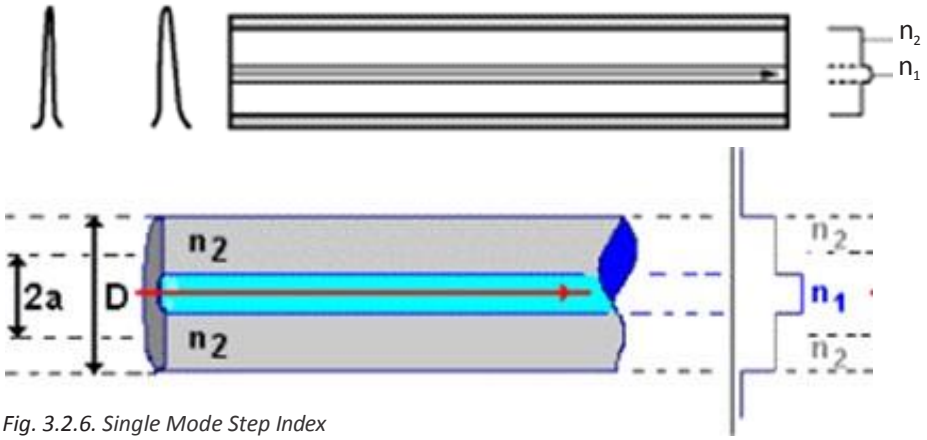


Fig. 3.2.6. Single Mode Step Index

In single mode fibers, compared to cladding size diameter of the core is slightly small. Normally the cladding is 10 times thicker compare to core in size. When look into both output pulse and input pulse results into little attenuation with dispersion in time.

The availability of Single mode propagation is only above a threshold value of wavelength called the cut off wavelength. Glass is used for manufacturing Single- mode fiber optic cable.

Because of the thickness requirement of the core, plastic cannot be used to make single-mode fiber optic cable. Plastic thickness is much higher than the requirement for manufacturing When comparing with other types of optical fiber, Single mode optical fibers are very costlier in the premise environment. Because of this high cost, single mode fibers are using for Wide area Network Applications than the Local area applications. It is more suitable for the links with distance coverage more than 100 km. Even though, Single mode fiber applications are extending to local area networks that covers moderately large distance over corporate campuses.

Propagation Modes Continued

Multi-mode Step Index

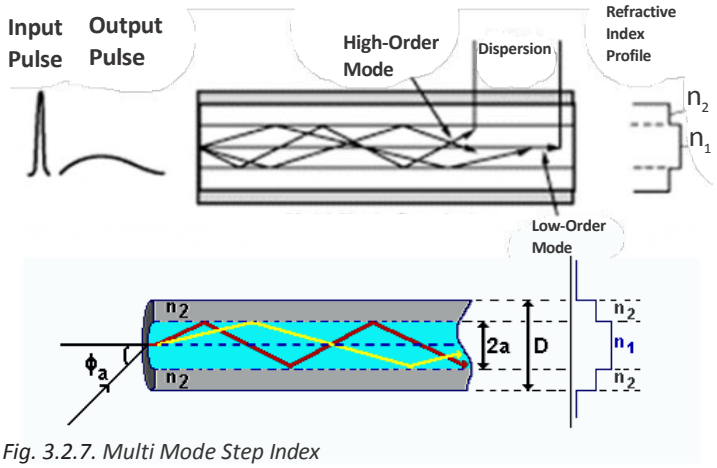


Fig. 3.2.7. Multi Mode Step Index

In this profile sharp discontinuity is not available in the refractive index sandwiching core and cladding. Core here will be comparatively large than in the single-mode step index optical fiber. For every optical fibers there should be attenuation and time dispersion when comparing input and output pulses. Note that not exactly as scope full as multi-mode step index fiber optic cable.

Optical fibers which are multi-mode propagation with a graded index profile is characterized as having attenuation and time dispersion properties in between two.

Single mode step index and Multimode Step index optical fibers. Likewise Cost of graded index multimode fiber is lays in between these two categories. So, this type of optical fibers are widely using in premise data communication applications.

3.3.5 Snell's Law

Snell's Law

Postulates the ratio of the sines of the angles of incidence and the angle of refraction of waves are constant when it passes from one medium to another.

Snell's law (also known as the Snell–Descartes law and the law of refraction) is used to explain the relationship between the angle of incident and angle of refraction when light travelling from denser medium to rarer medium. such as water, glass, or air.

In case of light travelling from a medium to another medium, it will bend towards or away from the axis. So, this law can be used to compute Angle of incident or angle of refraction or refractive index of mediums if all other parameters are known. This is used to trace a ray to compute the angle of incident in optics. In experimental, refractive index could be found out by this.

Snell's law exhibit in meta material also, which can have bent light to awkward direction at a negative angle of refraction with negative refractive index. It postulates that the ratio of the sines of the angles of incidence and angle of refraction between two media is like the ratio of phase velocities of light in the two media, or same to the reciprocal of the ratio of the refractive indices.

$$\frac{\sin\theta_1}{\sin\theta_2} = \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2} = \frac{n_2}{n_1}$$

Here, the angles must be weighted from the normal of the boundary, v - the velocity of light in the respective medium (SI units are meters per second, or m/s), n is the refractive index (which is unitless) of the respective medium.

The ratio the speed of light in a vacuum to the speed of light in a medium, is called the refractive index of the medium

medium	n
vacuum	1
air	1.000293
water	1.333
CF4	1.461
diamond	2.419

Fig. 3.2.8. Refractive Index

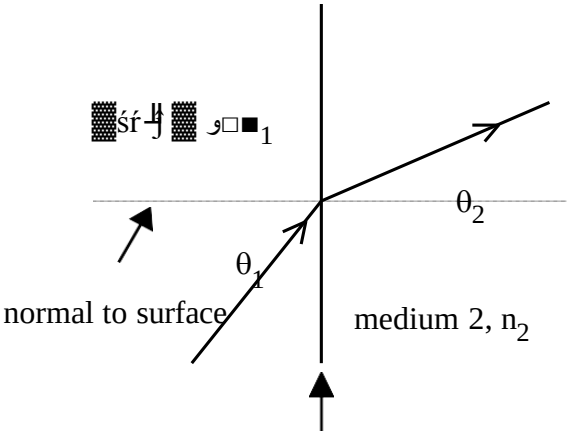
(1) $$n = \frac{c}{\bar{o}}$$

Snell's Law Continued

The refractive index of air is considered as 1 with negligible error. According to Snell's Law, light wave passing from one medium to another is bent or refracted from its original path,
which states

A ray of light passing from one medium to another (say, from air to water) is bent or refracted from its original path according to Snell's Law, which states

(2) $n_1 \sin\theta_1 = n_2 \sin\theta_2$



interface between two media

Fig. 3.2.9. Interface between two media

$n_1 \sin\theta_1 = n_2 \sin\theta_2$

Medium 1 have refractive indices of n1 and Medium 2 have n2, and the angle measured with respect to the normal (the perpendicular) to the interface between two medium. The light will be bending towards the normal when light travelling from rarer medium to the denser medium. The light is most likely bent more in direction of normal in the material with the larger n, and, in the diagram to the left, we have drawn the angles for the case $n_2 > n_1$

Note that if the ray strikes the interface perpendicularly, at an angle of 1 = 0, then it is not refracted and exits perpendicularly with 2 = 0.

Although Snell's Law can be proven from fundamental principles, we will consider it to be an experimental fact and use it to determine the index of refraction of Lucite (a transparent plastic). Lets look into a ray of light passing from air (n_{air} = 1) into secondary medium such as Lucite with an index of refraction n (n 1). In this case, the ray is incoming (incident) on the air side and outgoing (refracted) on the Lucite side of the interface, and we have

(3) $\sin\theta_i = n\sin\theta_r, \quad n = \dfrac{\sin\theta_i}{\sin\theta_n}$ (air Lucite)

Where i and r are the angles of the incident and refracted rays, respectively

Suppose now a ray of light passes from a medium (Lucite) with index of refraction n > 1 into air . We then have

Snell's Law Continued

(4) $n\sin\theta_i = \sin\theta_r$, $n = \dfrac{\sin\theta_r}{\sin\theta_{\text{Lucite}}}$ (Lucite air)

In the two cases just considered, if instead of labeling the angles as i and r, we label the angles a (in air) and p (in Lucite plastic), then both formulas (3) and (4) become

(5) $n = \dfrac{\sin\theta_a}{\sin\theta_p}$

3.3.6 Critical Angle

TOTAL INTERNAL REFLECTION.

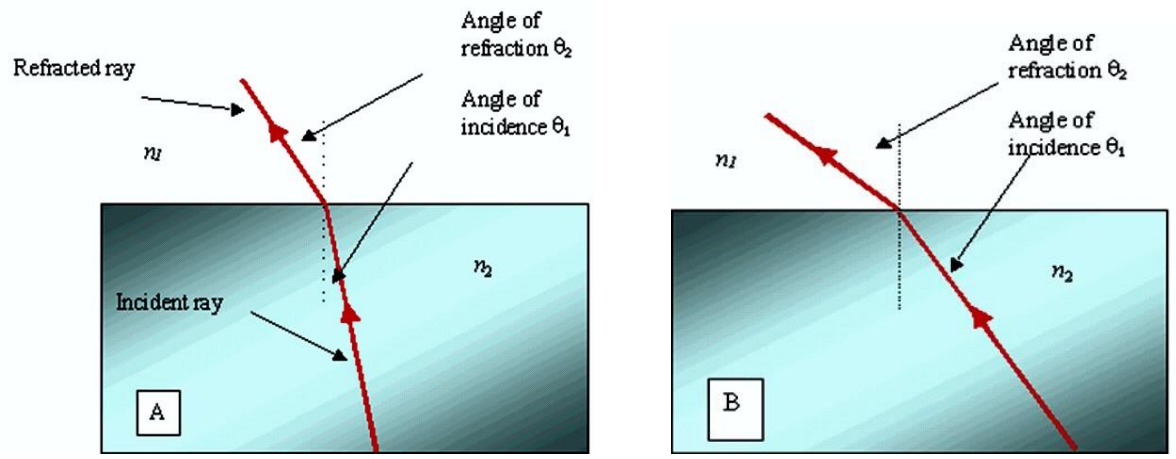
1. Ray of light will be refracted away from the normal on passing from a denser to a less optically dense-medium.

2. In case of increase in incidence angle, there will be corresponding increase of refraction angle (ray bends more to interface between the mediums). At a angle of incidence, the refracted ray angle will become 90◦.

3. When the angle refraction is 90 degrees, that angle of incidence is called the critical angle c.

Critical Angle

By snells law, it should be noted a ray of light passing from glass to air bends away from the normal. If the angle of incidence is increasing, the angle of refraction increases more (Diagrams A and B):



A & B Angle of refraction getting bigger

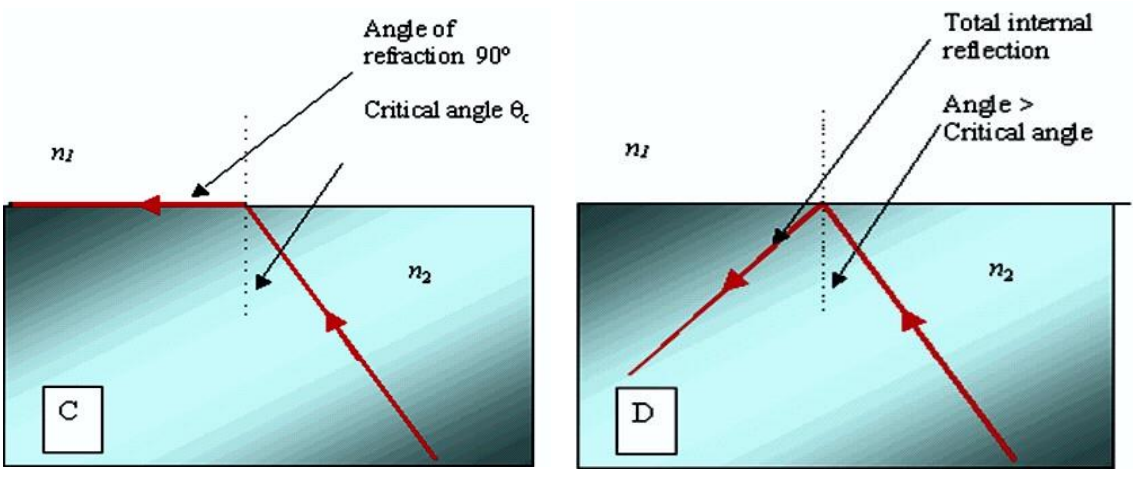


Fig. 3.3.0.(a b c d) Critical Angle

C : At a reference value of angle of incidence, the angle of refraction become 90o, as shown in Diagram C. This specific angle of incidence is called the critical angle.

D : If we are increasing the angle of incidence more than critical angle, there should not be any refraction.ie, all light component will bend back to the first medium is called Total internal reflection (TIR) See diagram D.

Critical Angle Continued

Above the critical angle total internal reflection will be happen

To be able to use the refractive index of glass in the equation the ray must be travelling from air to glass Therefore if the ray is taken as travelling from medium 1 (air) to medium 2 (glass) the equation becomes when travelling from air to glass

$$_{air}n_{glass} = \frac{\sin 90}{\sin c} = n_{glass} = n$$

$$\sin c = \frac{1}{n} \Rightarrow c = \sin^{-1}\left(\frac{1}{n}\right)$$

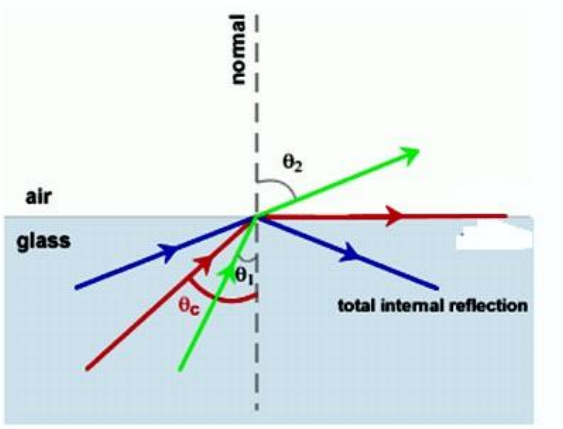


Fig. 3.3.1. Total internal reflection

Example1 . Calculate the critical angle for glass of refractive index 1.5

Example 2. Work out critical angle for the following materials

Water 1.33 perspex 1.49 diamond 2.42

Example 3. Work out critical angle for a glass water boundary.

Total internal reflection is the working principle of optical fiber. Optical fibers are long thin strands of glass which hold light from point one to another point along its length by using TIR. So, light can be guided in to the centre core by the reflection of light at the interface.

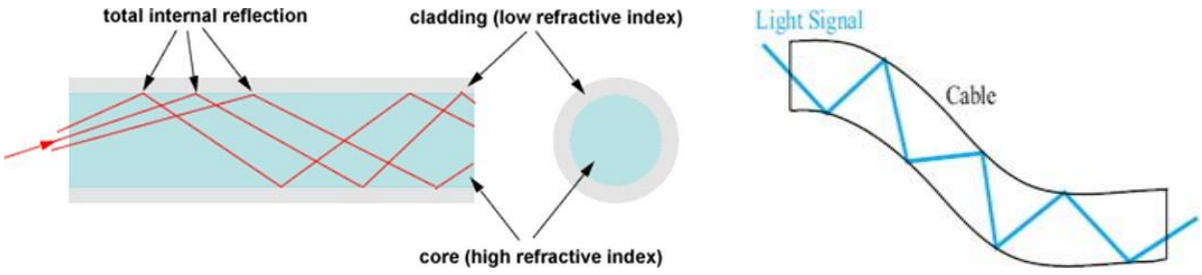


Fig. 3.3.2. Total internal reflection

3.3.7 Dispersion

In optics, dispersion is the phenomenon in which the phase velocity of a wave depends on its frequency. In optics Dispersion is the phenomenon happening because of the dependency of phase velocity on its frequency. Media that exhibits this common property termed dispersive media. Specifically, we can call it as chromatic dispersion. the term dispersion is utilised in the field of optics to explain light and electromagnetic waves, which could be applied on same meaning to any sort of wave motion for example for telecommunication signals propagating along transmission lines (such as coaxial cable), in gravity waves (ocean waves), and acoustic dispersion in the case of sound and seismic waves.

Spreading light pulses when it is travelling along the length of optical fiber is called as Dispersion. Dispersion is a performance limiting (Bandwidth) parameter in optical fiber. Greater dispersions can be tolerated by reducing the Bit error rate so separates the pulses farther apart.

There are three main types of dispersion in a fiber:

1. Modal Dispersion- Modal dispersion will be happening particularly in Multimode fibers. It comes due to multiple modes in optical fiber where, each ray will have different path to reach destination at different time.

2. Material dispersion- This occur because of different velocities of different wavelengths, in the same mode, as n = c/v. where n is index of refraction, c is the speed of light in vacuum and v is the speed of the same wavelength in the material. The value of velocity of light (v) in the equation changes with wavelength, Thus Index of refraction changes as per changes in wavelength. This phenomenon is called material dispersion, since it arises from material properties of the fiber

3. Waveguide dispersion- This is the dispersion which most significant in a single mode optical fiber, occurs because optical energy can travel through both the core and cladding, which have different refractive indices value. The light ray travels at different speeds in the core and cladding because of the difference in refractive index of the materials. Waveguide dispersion will be substantially changed by change the internal structures of the fiber, thus, changing the specified overall dispersion of the fiber.

3.3.8 Noise and Loss

Noise is the unwanted signal which combines with ideal signal, and is usually connected with random processes. It corrupts the information content and fidelity of the original signal, especially at low power levels. In communication field, we will be dealing with voltage noise, current noise, and optical intensity noise.

Noise can be categorised in many ways.

1. Intrinsic or Extrinsic
2. Random or Coherent
3. Additive or Multiplicative
4. Stationary
5. Ergodic

BER, SNR, and Noise Budget

Signal-to-Noise Ratio (SNR) of Signal-to-Noise Ratio (SNR) are of principal significance and impressive exertion will be spent endeavouring to bound the SNR prerequisite for a given arrangement of framework system necessities.

$$oSNR \equiv \frac{Average\ Signal\ Power}{Optical\ Noise\ Power} = \frac{I_{optical\ signal}}{\sigma_{optical\ signal}}$$

$$eSNR \equiv \frac{Average\ Signal\ Voltage}{RMS\ Noise\ Voltage} = \frac{V_{electrical\ signal}}{\sigma_{electrical\ signal}}$$

Fiber loss mechanisms

Optical beam propagating over the fiber, beam power reduces exponentially with distance.

There are different optical fiber losses mechanisms:

1. Rayleigh scattering,
2. Absorption,
3. Macroscopic and microscopic bends,
4. Simulated nonlinear scattering.

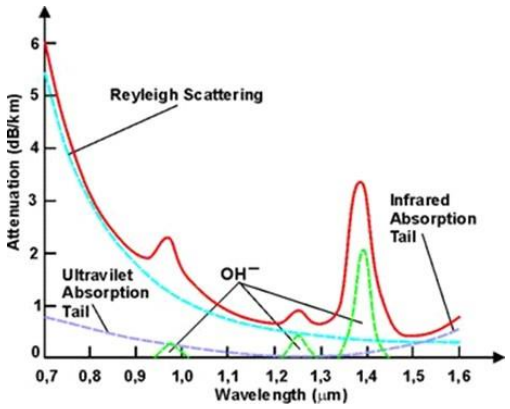


Fig. 3.3.3. Fiber loss mechanisms

Noise and Loss Continued

Rayleigh scattering is a wavelength dependent process that depends on material inhomogeneities smaller than wavelength.

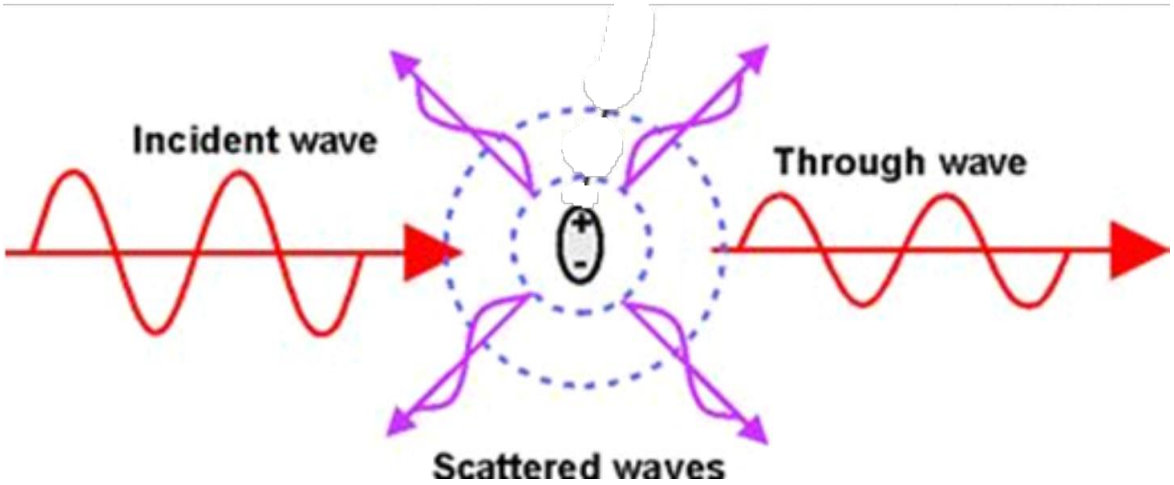


Fig. 3.3.4. Dielectric particle smaller than wavelength

Method of changing electromagnetic wave energy into another energy forms. lattice vibration is called absorption. Internal absorption is because of the energy absorption by the silica glass component itself. Internal silica glass absorption occurs in both ultraviolet and infrared frequency region. Infrared absorption tail extension gives raise to attenuation for the wavelengths longer than 1.6um.

Extrinsic or external absorption is due to the presence of external impurities in the optical fiber at the time of fiber manufacturing. These external impurities will absorb energy in larger scale. In that, water molecules in the form of hydroxyl ions (OH-) are the main causes of external absorption loss in optical fibers. The Prominent OH- losses happen at 950, 1250 and 1380 nm wavelength regions.

For silica fiber, the smallest losses of about 0,18 dB/km could be obtained in the wavelength region of 1550 nm. They are very near to the basic scattering limit. For higher wavelengths, silica attenuation increases. To obtain fiber with smaller losses than silica waveguides, need to implement different materials with very low intrinsic absorption in a more far infrared region.

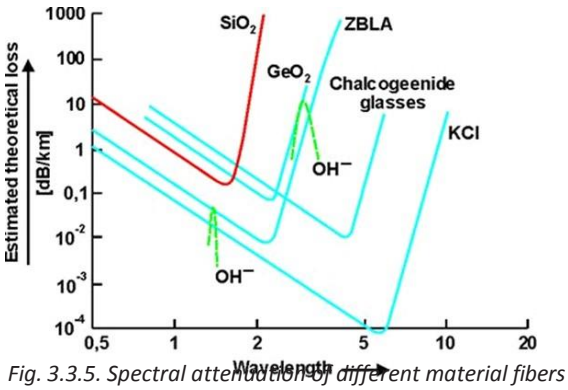


Fig. 3.3.5. Spectral attenuation of different material fibers

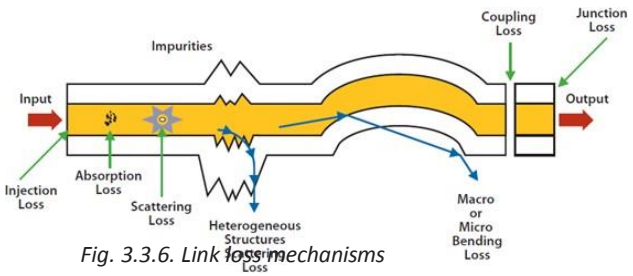


Fig. 3.3.6. Link loss mechanisms

Noise and Loss Continued

Macroscopic and microscopic bends

1. Macroscopic bends are occurring when optical fiber installation happens. If the bend diameter is less than 50 mm, then losses due to the bending will be negligible.
2. Microscopic bend losses raise because of in-homogeneity of fiber geometry, or refractive index.
3. Stimulated Brillouin back scattering (SBS) happen in times when an optical signal beam generates periodic traveling optical grating.
Stimulated Brillouin back scattering spectrum is very small and shifted to couple GHz.
4. Stimulated Raman scattering (SRS) is a nonlinear process. Where it will be accompanied with a high frequency photon generation. Stimulated Raman scattering propagates in backward and forward directions.

Exercise

1. Define Polarization & Interference.

Ans. _____

_____

_____

2. Explain Chromatic dispersion.

Ans. _____

_____

_____

3. Define Snell's law.

Ans. _____

_____

_____

4. Define Critical angle.

Ans. _____

_____

_____

5. Discuss the effect of noise and loss in prorogation.

Ans. _____

_____

_____

UNIT 3.4 Optical Sources

Unit Objectives

At the end of this module, you will be able to understand :

1. Light Production
2. LED
3. Laser
4. Fiber Optic Light Guides
5. Optical radiation

3.4.1 Light Production

In the broadest view, there is just a single way that light can be generated that is, through the quick difference in state of an electron from a condition of generally high energy state to condition of lower energy level. At the point when this happens the energy needs to go somewhere, and it is transmitted as light. Obviously, this quite often happens with regards to unique material with specific structure. Responsible electron might be bound inside a particle (though freely) or material may allow it free inside of it. Typical case would be an extreme emission spontaneously.

When an electron is moved to state of high energy, electrons will be in unstable and the electron will suddenly come back to better stable position rapidly (couple of picoseconds time).

Stimulated emission is the phenomenon in the operation of a laser. In a few circumstances when an electron enters a high energy state (energized) state it can remain there for a generally lengthy time-frame (a couple of microseconds) before it changes state immediately.

Heat

A standout amongst the most well- known methods for giving energy to support an electron into a higher energy state is to apply heat. Obviously, on majority electron promptly emits its energy as a photon and comes back to a lower energy state. This is known as traditional light radiation rule.

Electrical Discharge

In case of an electric current is gone through a gas, (for example, neon), energy from the current "ionizes" (softens the concoction bonds up) the gas. This procedure infuses energy into electrons inside the gas and when these electrons are recovered into particles energy is emitted as light.
Termed as “fluorescent" light.

Light Production Continued

Electric Current

An electric current connected to a semiconductor p-n intersection need that electrons and holes recombine at the intersection. This recombination brings about electrons going from the high vitality “conduction" band to the lower steadier "valence" band. This can bring about either unconstrained discharge or lasing relying upon how the device is developed.

Spontaneous Emission

We utilize diverse terms to portray spontaneously discharged light contingent upon how the energy was provided:

1. Radiant light is any light delivered because of warming the material.

2. Glaring light will be light created by unconstrained emanation from an energy source that isn't warm. fluorescence is utilized if the spontaneous emission stops when the outer source of energy is removed (or before long).

3. Luminous light is likewise delivered from an energy source that isn't warm however where the discharge proceeds for quite a while after the external source of energy is evacuated.

3.4.2 LED

Light Emitting Diodes (LEDs)
Semiconductors are the building blocks of most of the light sources which are using in telecommunication applications. In construction, LEDs are simpler and cheaper than LASER, but they have lot of common character in same.

Four design challenges:

Getting the Light into a Fibre
This can be done in two ways: by Utilize sources which are emitting light from surfaces (the Surface Emitting LED or SLED) or by directing the light beam out the side of the source element (the Edge Emitting LED or ELED)

Confining and Guiding the Light within the Device:
Within the device the light must be confined and directed to the end aperture, so that it can be followed to the fibre. The active layer in a hetero structure always has a higher refractive index compare to neighbour attached (higher band gap) substance. This junction makes a mirror layer and try to confine the light to the only inactive layer. Due to this factor , the external layers are normally termed as “confinement layers”.

Obtaining Power to the Active Region: To generate desired amount of light, Power in the shape of electrons and holes must reach active region in required quantity.

Escaping from Heat: Active region will be generating a considerable quantity of heat during the operation. It must be transferred farthest and distributed with some form of “heat sink”. Good devices must find a solution to all the challenges listed.

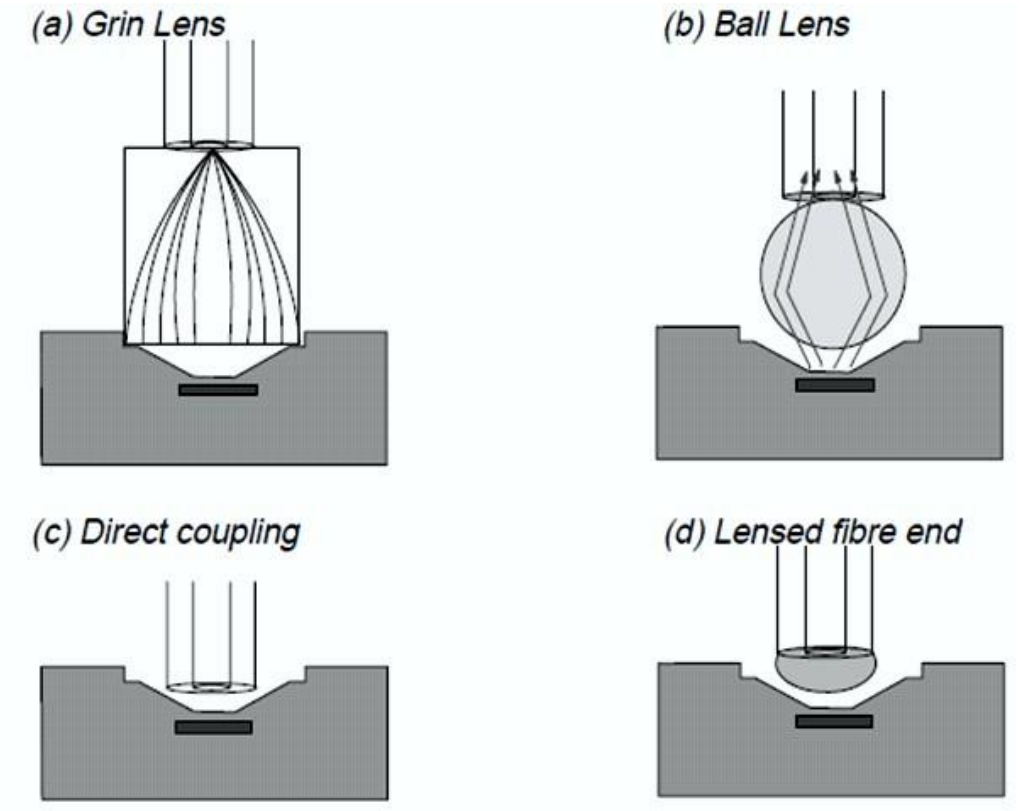


Fig. 3.3.7. Coupling to a Fibre

LED Continued

In the Manufacturing of a real LED or laser device, Coupling light output to a fibre is the most challenging and costly part. Four similar procedures are described in Figure Coupling using Graded Index Lens (GRIN lens) is common.

1. GRIN Lens is a graded index lens, or same to same as wise to just a short length of graded index fibre (though with a much larger diameter). The lens collects the light and focuses onto the end (Clean and smoothly made surface) of the fibre.
2. Coupling of light by using a Ball lens - This type of lens will be bonded to the surface of the LED with an epoxy resin that will have specific indices of refraction. Even so, the RI of the epoxy will not be corelating with fiber refractive Index and the semiconductor refractive index that works as a light source as semiconductor do have RI value approx 3.5 while fibre of has 1.45.
3. In recent times popular method is direct coupling: It is simple because Just mount the fibre end so that it directly touches the LED. Easy way to make this is to mount the LED inside a connector so that a fibre can plug inside the connector (mounted in the one half of the connector device), will get firm mounting in well position. Low cost and low complexity are the advantages direct coupling method.
4. Another way of fixing a ball lens to the end of the fibre is as shown (refer diagram).

Characteristics of LEDs

Low Cost

in cost wise LEDs are must cheaper in comparison to communication lasers. This is highly debatable. In their structures and in manufacturing cost wise these two devices are very comparable.

Low Power

Compared to laser, the highest light output of an LED is ideally being a lot lower (about 100 microwatts). However, recently with output of up to 75 milliwatt, a new class of LED has become available.

Relatively Wide Spectrum Produced

LED will produce relatively wide spectrum, it won't have One single wavelength instead of band of wavelengths. The wavelength ranges generated by a source termed as "spectral width" and is typically about .05 of the wavelength (50 to 100 nm).

Incoherent Light

Light produced is neither directional nor coherent. This means that you must use a lens to focus the light onto the surface of a fibre. Because of this, LEDs are not suitable for use with single-mode fibre where core diameter is very small in size (it is too hard to get the light into the narrow core).

Digital Modulation

In digital Modulation, LEDs cannot generate pulses short enough to be used at gigabit speed operation. More over in anyhow, systems perform quite good with speeds of up to around 300 Mbps using LEDs.

3.4.3 Laser

Abbreviation of LASER

LASER is an acronym for "Light Amplification by the Stimulated Emission of Radiation". Lasers produce far and away the best kind of light for optical communication.

Principle of the LASER

Stimulated emission and population inversion are the principle of the LASER. Figure illustrates the process involved.

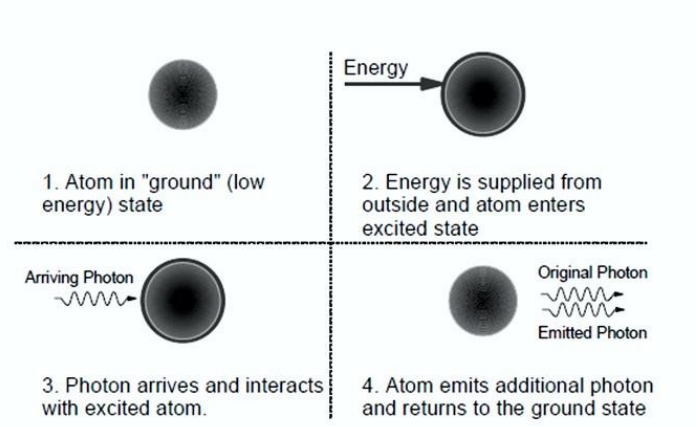


Fig. 3.3.8. Principal of Laser

1. An electron within an atom (or a molecule or an ion) lies in a low energy stable state usually known as "ground" state.

2. External energy can be provided from outside and is absorbed by the atomic structure where upon the electron enters an excited called higher energy state.

3. The wavelength of the incoming photon is very nearer to the wavelength at which the excited electron will emit its own photon, or a photon arrives with energy close to the same quantity of energy as the electron required to give up reaching a stable state

4. Incoming photon gets a resonance with the excited atom. As a result, the excited electron leaves its excited state (Higher energy state) and transitions to high stable state (fall back to ground) giving up the energy difference in the form of a photon/ Light radiation.

3.4.4 Fiber Optic Light Guides

Fiber Optic Light Guides

Fiber Optic Light Guides are used to transmit illumination provided by fiber optic illuminators for a number of imaging or microscopy applications. Fiber Optic Light Guides interface with illuminators to transfer light to one of several adapter heads that transmit light in a usable manner. Fiber Optic Light Guides are available in several varieties including back-lights or ring lights. Fiber Optic Light Guides offer the benefits of numerous illumination products with only one light source making them cheap, effective alternatives to many other illuminators.

Fiber Optic Light Guides Continued

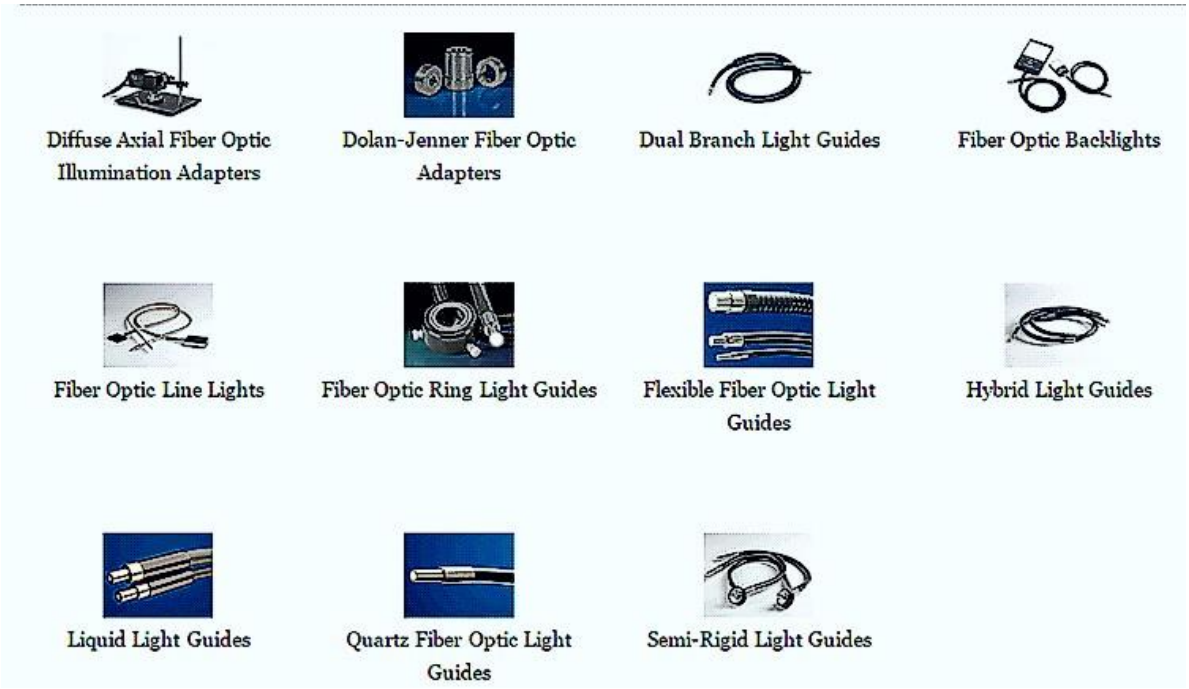


Fig. 3.3.9. Fiber optic light guides

Selecting a Fiber Optic light source

Types of light sources: General purpose illuminators: Normally, these models use a transformer device to reduce line voltage to the 21V needed for the lamp operation. By using an electronic circuit, the output level will be controlled. Most stereo microscope applications use these models.

AC Stabilized illuminators: For increased lamp life, these models use a stabilization circuit on the AC input to help reduce AC line induced fluctuations and add a 'soft-start' circuit to the illuminator. The AC stabilized models are enhancement over basic light sources for most non- critical lighting and photography applications.

AC/DC regulated illuminators: Regulated illuminators gives a very stable output voltage to the lamp by using regulation circuits with close tolerances. DC regulated models provides the lamp with DC voltage rather than AC, which will ensure longer lamp life. These categories are good options for machine vision applications and all critical light control. These models also ideally have remote control options.

Fig. 3.4.0. Fiber optic light sources

3.4.5 Optical Radiation

Optical radiation

Optical radiation is consisting in the electromagnetic spectrum. It can have categorised into ultraviolet radiation (UV), the spectrum of light visible for man (VIS) and infrared radiation (IR). It ranges between wavelengths of 100 nm to 1 mm. The laws of optics will be obeyed Electromagnetic waves in this range.

The wavelength range of optical radiation

According to DIN 5031, the term "optical radiation" refers to electromagnetic radiation in the wavelength range between 100 nm and 1 mm. The terms "light" and "visible radiation" (VIS) refer to the wavelength range between 400 nm and 800 nm, which can be perceived by the human eye. Optical radiation with wavelengths shorter than 400 nm is called ultraviolet (UV) radiation and is further subdivided in UV-A, UV-B and UV-C ranges. Similarly, infrared (IR) radiation covers the wavelength range above 800 nm and is subdivided in IR-A, IR-B and IR-C ranges

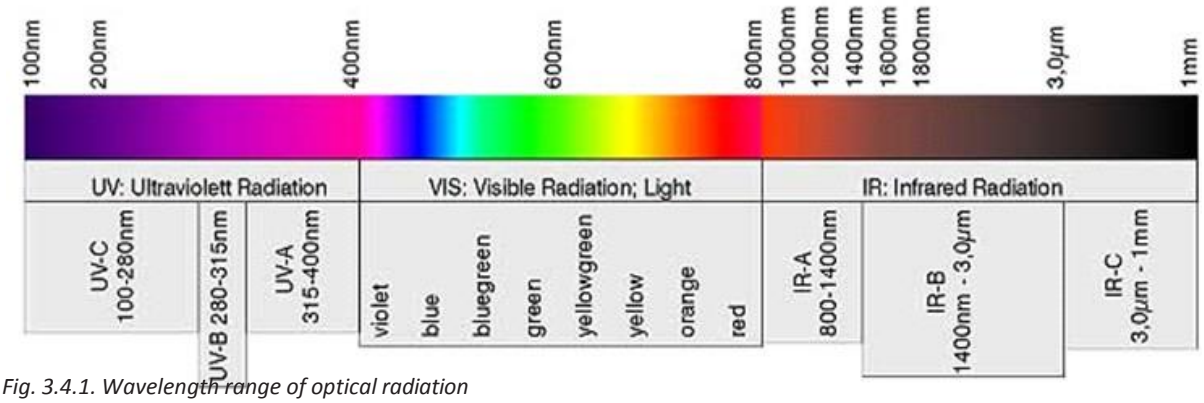


Fig. 3.4.1. Wavelength range of optical radiation

Exercise

1. Define LED.

Ans. _____

_____

_____

2. Define Laser.

Ans. _____

_____

_____

3. Discuss on fiber optic light guides.

Ans. _____

_____

_____

Click/Scan the QR Code to understand about Fibre Manufacturing

Click/Scan the QR Code to understand about Light Propagation Properties

UNIT 3.5 Gigabit Capable Passive Optical Network (GPON)

3.5.1 GPON

A point to multi point architecture can be implemented by using Passive optical telecommunication technology, where a single fiber optic cable is using to provide signals from centre point to a node in which a passive element like splitter will provide services to multiple terminals or customers.

Gigabit Capable Passive Optical Network (GPON) technology node is the access necessary to deliver multimedia services (voice, data, video and other content-content) for residential and business customers.

GPON-based FTTx technology below:

1. FTTH (Fiber to the Home)
2. FTTB (Fiber to the Building)
3. FTTZ (Fiber to the Zone)
4. FTTT (Fiber to the Tower)
5. FTTC (Fiber to the Curb)

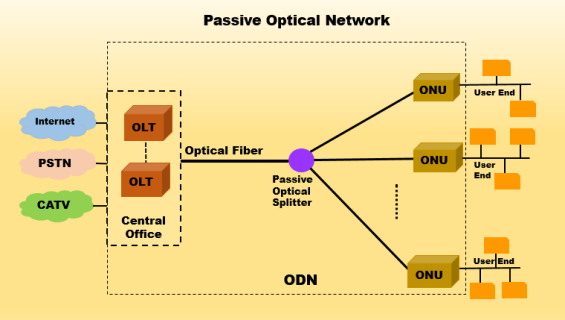


Fig. 3.1.1. PON Technology Architecture

GPON Continued

By introducing new PON architecture, we can reduce the amount of optical fiber used and central office infra equipments compared with point-to-point(P-to-P) architecture. A passive optical network is same as of fiber-optic access network. There could be one or multiple telecom vendors provide the input service lines for OLT (Optical line terminal)

Refer Fig 3.5.1 & 3.5.2 GPON system role out in the access technology market to provide triple-play services to the home\business customers. Triple play services include Voice, Video and Data. The First deployed system was based on ATM-PON(A -PON), then Broadband PON (B-PON) and Ethernet- based PON (E-PON), but the BPON can only deliver a speed up to 1244.16 Mbps in downlink stream while EPON systems could deliver 1.25 Gbps. Emerging high bandwidth applications such as HDTV service are rolling out, and those PON networks only can provide required bandwidth. To make out this, G.984 specifications introduced by ITU-T, this defined GPON operations.

GPON consists of OLT, ONT, and Splitters & CCU- SPV. It was the next-generation of PON network. GPON supports much more data rates and bandwidth than that of previous PON technologies. Also GPON exhibits symmetric and asymmetric architecture. GPON supports up stream and downstream data rates of 2.5 Gbps each and it can be reach out a distance of 60km radius with supporting 32, 64 or maximum 128 users per a single interface. GPON is the technology of option to deploying FTTx by the telecom firms; GPON could deliver much better Quality of Service (QoS), higher bandwidth and enhanced scalability when its compared to previous Passive Optical networks.

OLT is worked as a central office of service provider and it switch & Route the connection to end users by optical network units (ONUs) / Optical Network Terminals (ONTs) at (Gram Panchayats). In OLT signals transmitted combined to single fiber using WDM {Wavelength-division multiplexing} techniques. Transmission signals will consist of Voice and data parts, which use a wavelength of 1490 nm for downstream {towards users in Gram panchayaths} signals and the wavelength of 1310 nm for upstream signal {from User end to OLT}. From a satellite feed or from a cable television head end, Video services entered to the system. A wavelength of 1550nm is using to distribute (Downstream only). Video signals. OLT consists of SNI (Service Node Interface) - 10G & 1G Ethernet & UNI (User Node Interface) - E1, 10/100/1000 Base T, Telephony, analog video, USB etc. OLT and ONT use TDM/TDMA protocol. Single OLT communicate with Multiple ONT. OLT can be configured with Single Fiber or Dual Fiber for upstream & downstream. GPON OLT has the provision to taking care of card failure and fiber cuts etc.

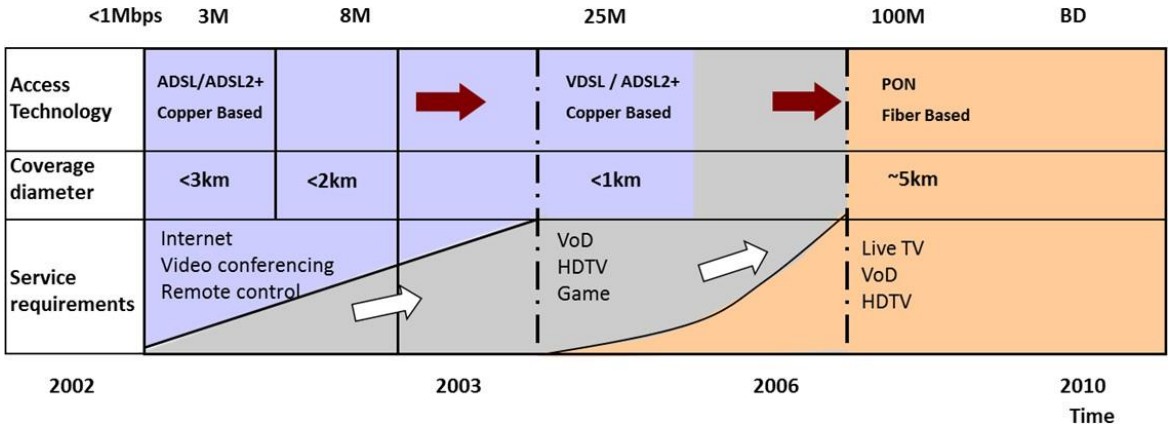
Passive optical splitter, requires no maintenance and no power activation on ideal conditions. Splitters receive single input and split it to multiple users via different ports. Higher insertion loss is the primary drawback of splitters. Insertion loss can be illustrated as 10log (1/n), where value of n can be 2 to128 (n: number of ports). This insertion loss impacted highly on the transmission range of FTTH (fiber to Home), essentially limiting the achievable span length to a distance of approx 20 Kms (maximum insertion loss of approximately 30dB). OLT transmitting power and ONT receiver sensitivity is defined keeping the splitter loss in considerations. Depending on the number of ports available, insertion loss of splitters will be varies.

Splitter insertion loss corresponds to the number of port shown in the table given below.

Number of Ports	Insertion loss
2	3 dB
4	6 dB
8	9 dB
16	12 dB
32	15 dB
64	18 dB
128	21 dB

GPON Continued

The Below Table shows comparative reasons for choosing PON technology in Network.



PON - Key Elements

ODN (Optical Distribution Network): An ODN enables the distribution system to reach signals towards costumer premises from OLT and vice versa. This distribution system uses only passive optical devices.

OLT (Optical Line Termination): OLT devices are endpoint node on the service provider side of PON system, and will be located in the central office.

ONT (Optical Network Termination): ONT have multiple native ports and which terminates the PON network in customer side.

ONU (Optical Network Unit): An ONU working same as ONT device, which terminate Passive Optical Network, and may consist multiple converged ports, such as XDSL or Ethernet, toward consumers. An ONU need a separate consumer hardware device to support native services such as telephony, video etc...

GPON Services:

1. GPON can support Triple−play services. It can be good replacement of all the previous bandwidth limiting technologies.
2. So it can be supports high- bandwidth transmission to so as to satisfy the requirements of IPTV and live TV broadcasts and all other high bandwidth services. One of the main feature of GPON is its Long coverage is almost up to 20km.
3. GPON uses Twisted pair cables in the access technology to reduce the complexity and the number of nodes.
4. GPON can be support integrated high bandwidth services by fully standardized and highly bandwidth supporting components

GPON Continued

GPON Principle

Data Multiplexing

GPON uses Wavelength division multiplexing (WDM) which facilitate communication in bi- direction through a single mode optical fiber. GPON has two multiplexing mechanism to distinguish upstream and downstream signals of individual user connections:

1. Broadcasting method in down-stream.
2. TDMA transmission technology in upstream.

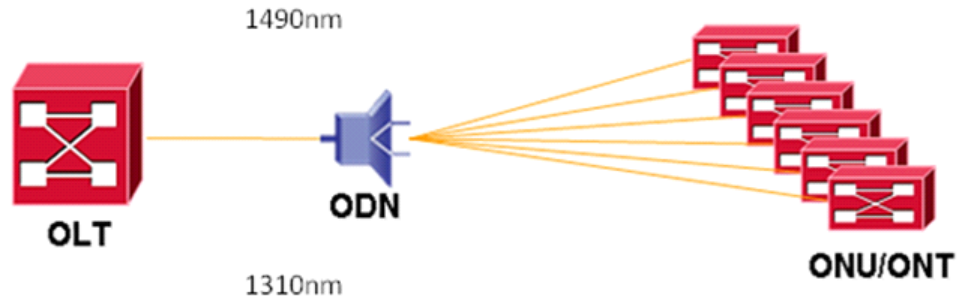


Fig. 3.5.3. GPON - Data Multiplexing

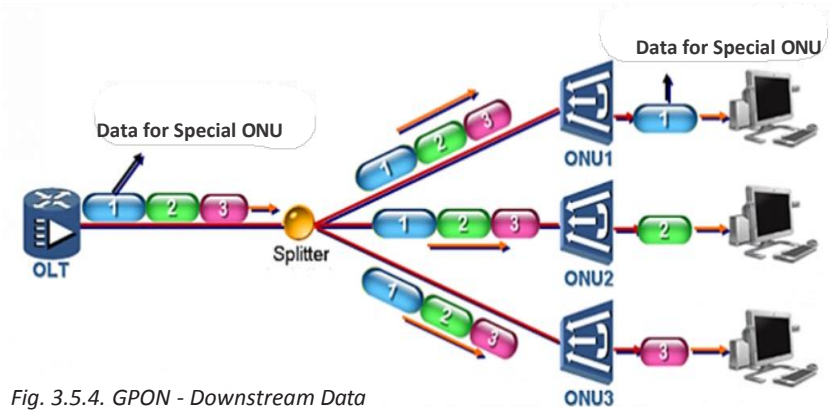


Fig. 3.5.4. GPON - Downstream Data

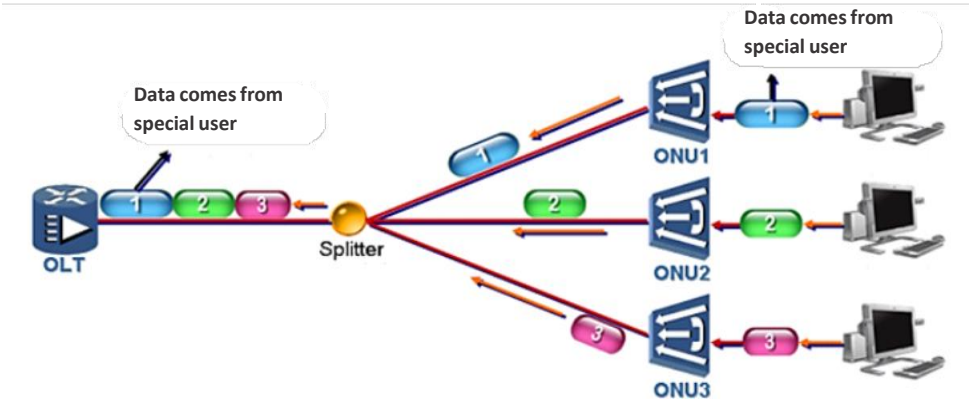


Fig. 3.5.5. GPON - TDMA Mode

GPON Continued

GPON Standards

ITU-T G.984.1

1. Parameter description of GPON network
2. Requirements of protection switch-over networking

ITU-T G.984.3

1. Specifications of TC layer in the GPON system
2. GTC multiplexing architecture and protocol stack
3. GTC frame
4. ONU registration and activation
5. DBA specifications
6. Alarms and performance

ITU-T G.984.2

1. Specifications of ODN parameters
2. Specifications of 2.488Gbps downstream optical port
3. Specifications of 1.244Gbps upstream optical port
4. Overhead allocation at physical layer

ITU-T G.984.4

1. OMCI message format
2. OMCI device management frame
3. OMCI working principle

GPON identifies 7 transmission speed combination as follows:

1. 0.15552 Gbit/s up, 1.24416 Gbit/s down
2. 0.62208 Gbit/s up, 1.24416 Gbit/s down
3. 1.24416 Gbit/s up, 1.24416 Gbit/s down
4. 0.15552 Gbit/s up, 2.48832 Gbit/s down
5. 0.62208 Gbit/s up, 2.48832 Gbit/s down
6. 1.24416 Gbit/s up, 2.48832 Gbit/s down
7. 2.48832 Gbit/s up, 2.48832 Gbit/s down

Among them, 1.24416 Gbit/s up, 2.48832 Gbit/s down is the mainstream speed combination supported at current time.

1. Maximum logical reach: 60 km
2. Maximum physical reach: 20 km
3. Maximum differential fibre distance: 20 km
4. Split ratio: 1： 64, it can be up to1： 128

GPON Continued

GPON Device & Features

GPON OLT & ONT consists elements as follows

1. OLT (Optical Line Terminal Equipment)
2. ONT (Optical network terminal Equipment)
3. SPL (Splitters Equipment)
4. CCU (Charge Coupler Unit) & SPV (Solar Photo Voltaic Equipment)

OLT

OLT receives the service input from BBNL /BBNL vendor .OLT downstream the data through splitters and reach to multiple ONT. ONT provides services to the end Users. ONT is powered up by CCU & SPV.

GPON OLT (UTL) Consist of below functional elements

1. PON Interface Card
2. SCM
3. PDU
4. MOTHER BOARD

Fig. 3.5.6. UTL OLT

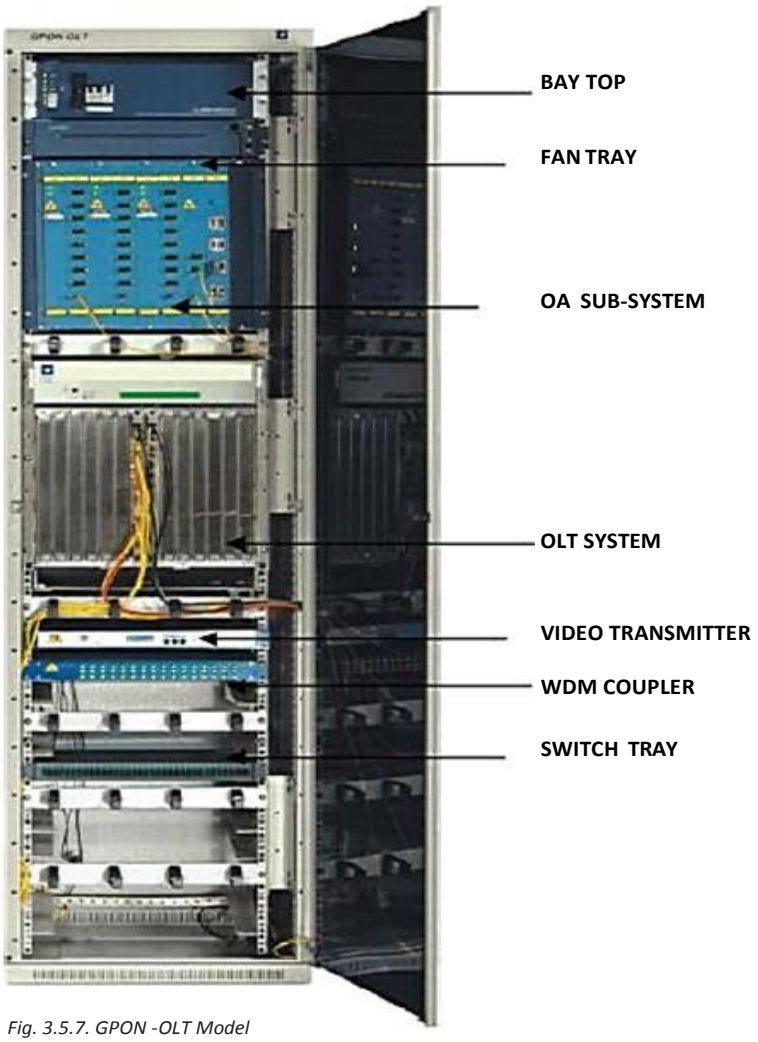


Fig. 3.5.7. GPON -OLT Model

GPON Continued

PON Interface Card (SCM) :

1. PIC acts as line card towards PON
2. It provides a total of 4 PON interface
3. In the upstream direction this card extracts 2.5G
4. Ethernet data of each PON from GEM frame and sends two 10G Ethernet links, one each towards the two 10G SCM through back plane.
5. Each SCM can have 1:1 protection on active stand by basis

Switch and Control Module (SCM):

1. Main function of this module is to provide SNI (Service Node Interface) functions and to control GPON system.
2. It provides 4 10G and 4 1G Ethernet uplinks at SNI.
3. This module provides EMS & LCT interfaces of the OLT system. – B1 port for EMS & b2 port for LCT
4. This module receives PON side Ethernet data through 10G Ethernet link via back plane - Single Pic card have 4 PON port - each PON port goes to 4 ONT via 1: 4 splitter and hence a PON card support till 32 ONT
5. It has one 100mbps Ethernet link with all PIC for management purposes.

Features of OLT

1. Complaint with ITU-T G.984 & TEC-GR
2. 2.5 Gbps downstream at 1490nm
3. 1.25 Gbps upstream at 1310nm
4. RF video transmission at 1550nm(optional)
5. 48 unprotected PON ports supported per shelf
6. Can support 1:1 protection towards ODN (SCM card active stand By operation)
7. Can support up to 32 ONTs per PON port
8. Typical coverage distance supported is 20 km (could be extended by another Splitter)
9. Upto 1536 ONTs supported per shelf (considering 1:32 splitter , Single Pic Card support 128 ONT with considering all 12 PIC card result to 1536 ONT)
10. Provide 10Gb & 1Gb Ethernet uplinks for SNI
11. Maintain Synchronization of the GPON system through network clock

GPON OLT is standard telecom grade equipment. So all routine checks which are done on any other telecom equipment are also applicable for GPON system.

GPON Continued

Application Modules

1. Configuration Management (CM)
2. Connection Management (CN)
3. Fault Management (FM)
4. Performance Management (PM)
5. Security Management (SM)
6. Software Download (SD)

Configuration Management

1. Configuration of ONT equipments
2. Configuration of the UNIs
3. Configuration of the OAM flows
4. Configuration of the physical ports
5. Configuration of the traffic descriptors
6. Configuration of Priority queues
7. ONT activation when it is new to OLT

Connection Management (CM)

1. Configuration of the GEM Port Network CTPs
2. Configuration of Inter working Termination points
3. Configuration of service profiles
4. Configuration of GAL profiles
5. MAC bridge service connection set-up
6. MAC bridge service connection tear-down
7. Addition of entries to MAC Filter Table
8. Removal of Entries from MAC Filter Table
9. It supports IPTV filtering

Fault Management (FM)

1. FM module resides in PIC card, ONT/ONU and SCM cards and it supports FM functions
2. All the alarms occurring in the GPON system are reported to the LCT/EMS with their date and time of occurrence, severity and likely cause
3. This module also maintains history alarms for the last 30 days.
4. This module is also responsible for generating alarm on loss of physical layer notification and laser shutdown.

GPON Continued

Performance Management (PM)

1. PM module is responsible to collect and report performance monitoring data associated with a Monitored managed entity for the last completed 15 minute interval.
2. It collects Ethernet Performance Monitoring History data, TC Adaptor Protocol Monitoring Data, GEM Port Protocol Monitoring History Data, GAL Ethernet Protocol Monitoring History Data.
3. This module is also responsible for threshold crossing alert (TCA) notification

Security Management (SM)

1. SM module is provided to ensure authorized access. It resides in the SCM card of the OLT System. There are 3 levels of Security
2. **Super:** SM ensure that there is only super user. He will provide all the configuration data and will be able to modify and monitor the system completely. He has the privilege of adding and deleting the users and modify the privileges of users
3. Privileged: This user has access to certain privileged commands. He will not have access to critical features of the system. He can view all the information related to any NE for remote supervision from any other NE or through internet
4. Ordinary: This user is able to view only system reports and status of specific NE from its local management I/f.

System Management Interfaces

1. System management has been provided through two standardized interfaces:
   - Local Management Interface: The local manager is able to install, monitor, control and configure the GPON system.
   - EMS Interface: A GUI based Element Management System is provided to control and monitor the GPON system. This EMS interacts with the GPON system using standard SNMP V3 protocol.
   - The EMS is able to support all the functions like Operation, Administration, Maintenance.

GPON Continued

Following should be taken up for routine maintenance :

1. Equipment Room Temperature Check 2
2. Power Voltage (-48V DC power supply) Check
3. PDU (Power Distribution Unit) Status Check
4. Fan Tray Status Check
5. Dust-Filter Check
6. SCM Card Status Check
7. PIC Card Status
8. Backplane Status Check
9. ONT Status Check
10. CCU- SPV Status Check

Transmitter module- OLT

1. It is a externally modulated CATV fiber optic high performance 1550 nm transmitter
2. It is capable of coupling high optical powers with low optical line width.
3. It has in built adjustable SBS control and electronic dispersion compensation
4. This module has a built in DC power supply, front panel, optical splitter, network card and Necessary connectors

OLT Power Supply Specifications

1. Nominal Input Power Supply: -48V DC
2. Input Voltage Range: -40V DC to –60V DC

GPON ONT

Optical Network Termination (ONT) on the GPON side has fiber to interface with OLT and on other side it has supports various user interface like Gigabit Ethernet, POTS and RF video.

Fiber optic transmission technology is using to reach the signal to customer premise. Optical fiber technology is not providing electrical power for customer side equipments, nor it apt for direct connection to premise equipment. A converter device is used to terminate the fiber line. This device which is using in FTTx is called as Optical Network Terminal (ONT).This device will separate the original signal into its sub components like voice signal television and data signal. This device will de-multiplex. For the telephone operation this device will provide the power also. As the ONT have to take electrical power for the operation by the customer end power line, multi power backup option is available with ONTs, which helps to provide service during multi power failure.

GPON Continued

ONT11 (UTL-ONT-72)- A UTL product System Overview

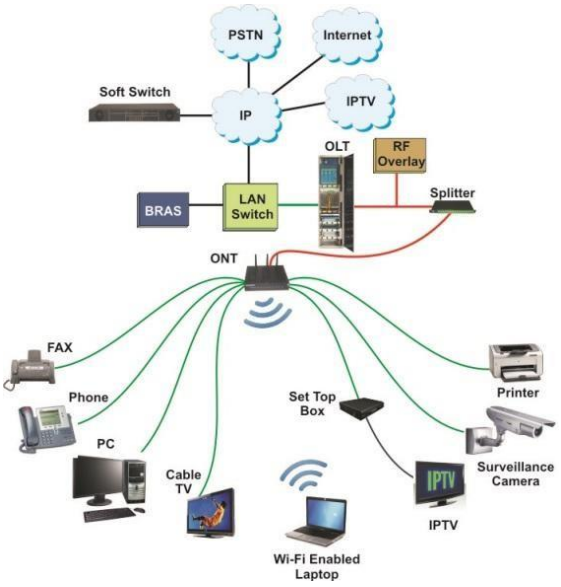


Fig. 3.5.8. ONT Location of the Network

Fig. 3.5.9. UTL-ONT Device by UTL

ONT11 is single card system, which is designed to serve an individual residential unit. ONT consumes 17 was (Approx.) power and operates on 12v DC power supply through AC/DC adaptor. ONT houses in a small metal box of size "220 x 188.9 x 48.6 (mm)" and can be placed on table top or mounted on wall.

The system provides access to users for voice, video and data services over single optical fiber. Small Family Unit (SFU) ONT is a single card system. - On the GPON side it has fibre to interface with OLT and on other side it has supports various user interfaces like Gigabit Ethernet, POTS and RF video. GPON I/f is 1.244 Gbps US at 1310 nm and 2.448 Gbps DS at 1490 nm for data and 1550 nm for Video. At user side there is one Gigabit Ethernet I/f, two POTS port and one analog video port.

ONT-Interfaces - ONT intefaces varies with ONT version and release. MDU-ONT is similar to SFU-ONT but has more number of user I/f. On the GPON side it has fiber to interface with OLT and on other side it has supports various user interfaces like Gigabit Ethernet, POTS and RF video. GPON I/f is 1.244 Gbps US at 1310 nm and 2.448 Gbps DS at 1490 nm for data and 1550 nm for Video.

At user side ONT provides

1. 1 Gigabit Ethernet I/f
2. 4 100 Base-T Ethernet
3. 4 E1 ports
4. 4 POTS port
5. One analog video port

GPON Continued

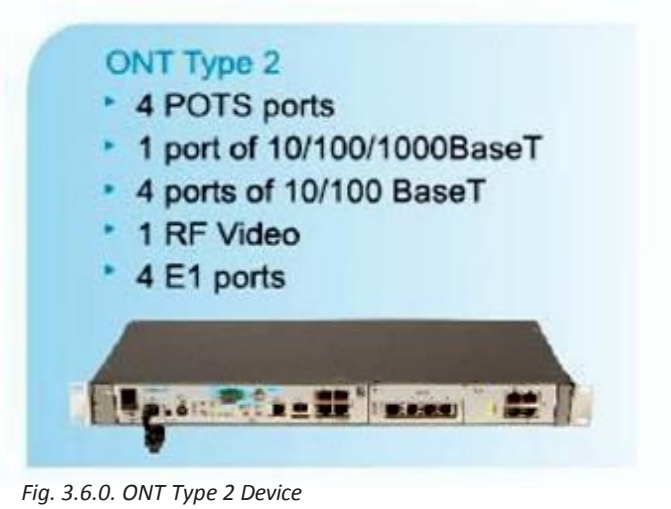


Fig. 3.6.0. ONT Type 2 Device

ONT type 11 Consist as follows

1. 2 POTS Ports
2. 4port 1000 Base T
3. 2 USB

Functions and Features of ONT

1. In Upstream direction

- ONT11 connects to OLT in the network through a passive optical network
- (PON) port to provide integrated access service.

2. In Downstream direction

- ONT11 connects with LAN Switches, PC, and STB etc. through Ethernet ports, to access data and video services.
- RJ11 ports are provided on ONT to connect phone or fax through POTS
- Interfaces for extending Voice and FAX services.

ONT11 is single card system, which is designed to serve an individual residential unit. ONT consumes 17 watts (Approx.) power and operates on 12V DC power supply through AC/DC adaptor. ONT houses in a small metal box of size “220 x 188.9 x 48.6 (mm)” and can be placed on table top or mounted on wall. The system provides access to users for voice, video and data services over single optical fiber.

ONT Serves as a GPON network termination at users end to support broadband connection and access to triple play services. It Supports GPON access and network connectivity up to 2.488 Gbit/s data rates in downstream and 1.244 Gbit/s data rate in upstream. ONT have four Ethernet ports (Tri rate 10/100/1000 Base-TX full-duplex) with RJ45 interface are provided on the ONT to extend all data and IP related services like Internet, IPTV, and VOD etc.

Two POTS ports are provided on ONT for Voice and FAX services through RJ-11connectors. One virtual interface is provided on the ONT to support VEIP services. Through VEIP ONT can be configured in RGW mode to support Wi-Fi access for multiple users. ONT provides web-based configuration through IE browser. ONT Software up-gradation is supported online remotely either through LCT or EMS.

GPON Continued

PON Splitters

Fig. 3.6.1. UTL - PON Splitter

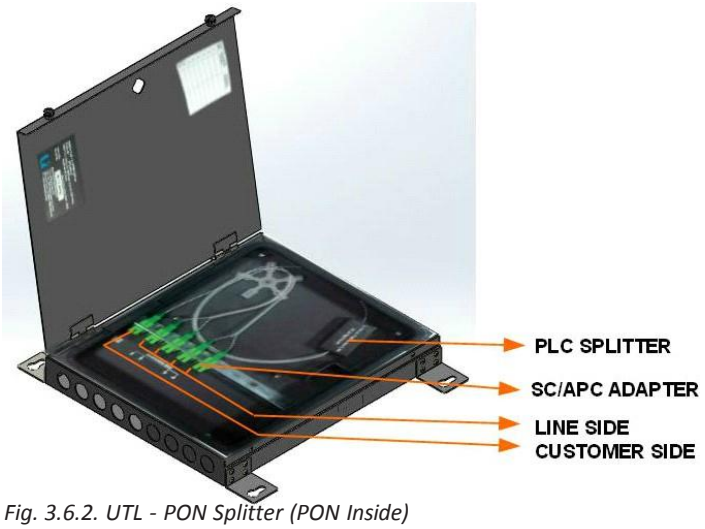


Fig. 3.6.2. UTL - PON Splitter (PON Inside)

Parameter	Unit		
Type	-	1 X 4	1 X 8
Operating wavelength	Nm	1260-1360 / 1480-1580	
Insertion Loss	dB	≤ 7.1	≤ 10.5
Uniformity	dB	0.5	0.8
PDL (max)	dB	<0.2	<0.2
Return Loss / Directivity	dB	>55	>55
Fiber Type	Single mode fibre, G.652/G.657A		
Working Temperature	^{0}C	-40 to +85	

Fig. 3.6.3. UTL GPON Splitters Specification

Planar Light-wave Circuit (PLC) Splitters

Fiber optic splitters enable an optical signal to be distributed among multiple fibers outputs. Since splitters contain active electronic parts and do not require power. They are an integral component of the optical networks and widely used.

The diagram above refer to fig 6.2.1 & 6.2.2 shows how light from a single input fiber can split between four individual output fibers (1x4). A PLC splitter is made with techniques much similar to manufacture semiconductors. These optical splitters are very compact, efficient, and reliable.

Fiber optic terminal box helps to distribute and avoid mechanical damages of fiber optic links in FTTX generally refer to the box shape optical management product. Normally the fiber optic tool box consists of optical terminal box optical patch panels. Optical termination box is small in size and fiber patch panel is bigger.

GPON Continued

Cable Management

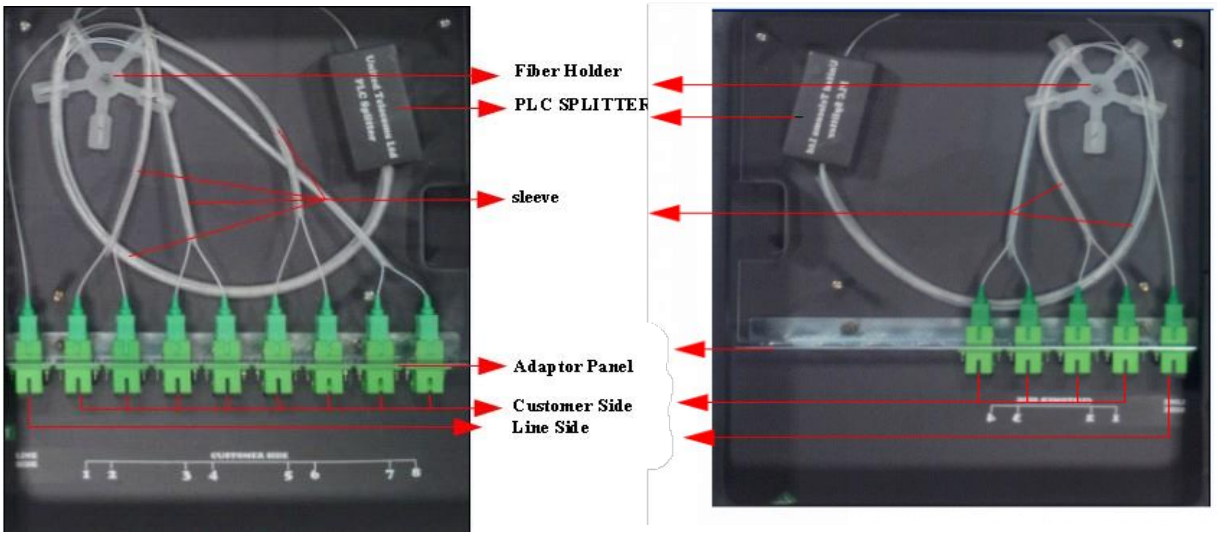


Fig. 3.6.3. Cable Management

Adapter Panel

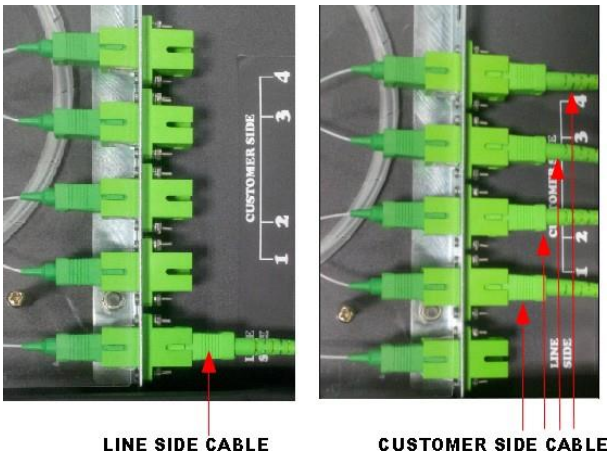


Fig. 3.6.4. - 1:4 splitter

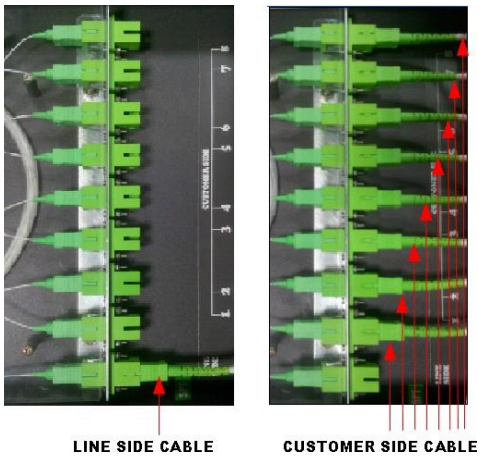


Fig. 3.6.5. - 1:8 splitter

CCU & SPV

ONT in Gram panchayats location keep the service alive with the help of multiple Power source. Power to ONT is derived from Ac mains, Solar Panel & battery bank. CCU- charge coupler unit consists of controller board, battery and serge boards for AC mains and Solar panel. UTL-SPV-018 “HYBRID SPV POWER SYSTEM FOR ONT”, is one single Integrated switched mode power supply unit that is capable of working on both Single phase AC Mains Input (90 – 300 VAC, 50Hz) as well as on 12V/60W Solar Photovoltaic (SPV) Panel output. A 12V/17Ah SMF VRLA Battery is fit inside the CCU cabinet itself. 12V/60W SPV Panel is Mounted on a Mounting structure either on Rooftop, Wall or on a Self supporting Mast. The SPV panel is DC Power Generating System – the non- conventional source of power – that converts Solar Energy (Sun Light) directly into DC Power. The unit is protected against reverse polarity connection of SPV Panel to CCU. An LED indication is provided for this purpose on the front side of the unitThe CCU is designed and certified to confirm to EMI and RFI suppression as per IEC-CISPR 22 and IEC 61000-4 standards. When Both SPV Panel Power and Mains AC I/P is available, The ONT Load and the Battery charging Current are derived from SPV Panel Power. In case the SPV Panel Power is not sufficient to cater to ONT Load and Battery Charging , Mains AC I/P delivers the output

GPON Continued

Solar Panel & CCU Connectivity

Fig. 3.6.6 Solar Panel

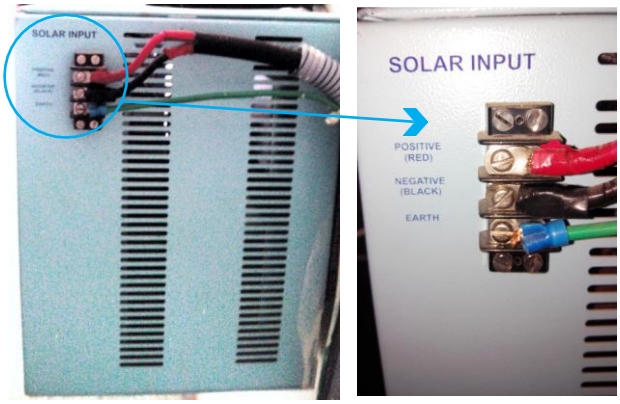


Fig. 3.6.7 Solar Panel CCU Connectivity

Solar Panel

The SPV Panel is mounted & fixed onto the specially designed module mounting structure. The orientation of SPV Panel mounted on a structure can be adjusted in 2 axis – The Horizontal Tilt angle can be varied from 0 to 60 degrees (angles are marked) continuously as per the latitude of the site. The angle of orientation can be varied continuously, from 0 to 360 degrees The SPV Panel on mounting structure can be fixed either on Rooftop. The power cable from Solar panel terminated in CCU as input as Refer fig

GPON Physical

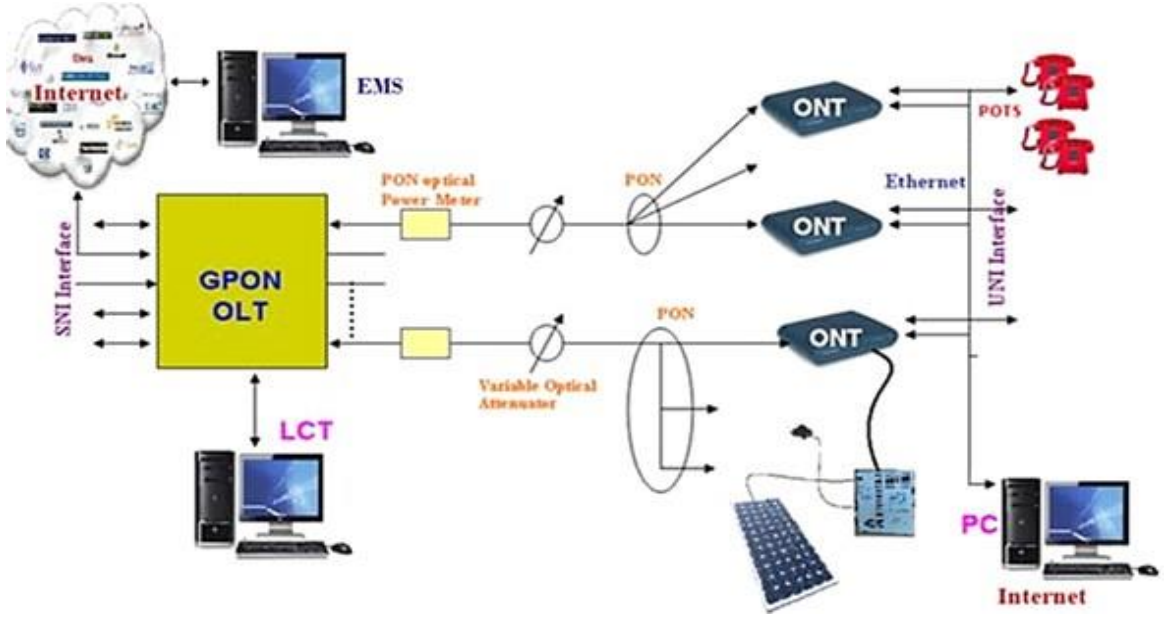


Fig. 3.6.8 Physical Conncetivity of GPON System

Physical installtion is followed up by site survey and the input received from Planning entity . refer Fig 6.2.8

GPON Continued

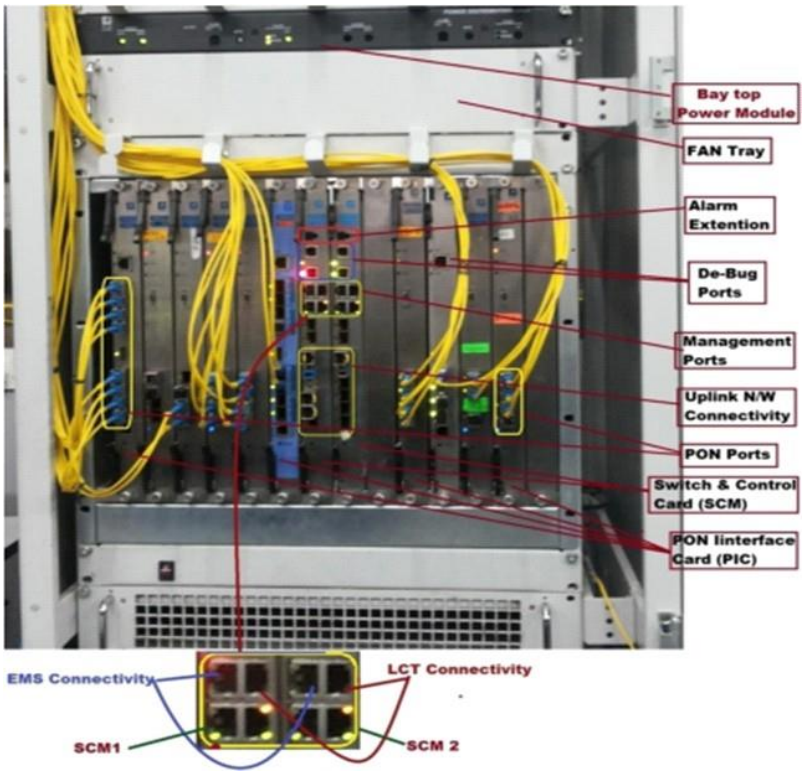


Fig. 3.6.9 OLT Connectivity at block level

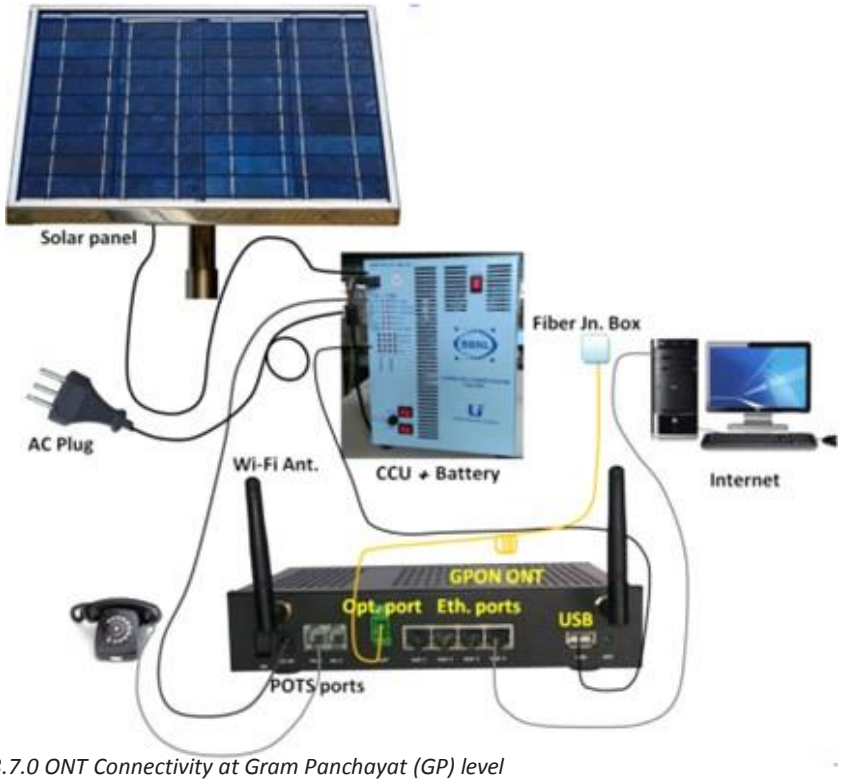


Fig. 3.7.0 ONT Connectivity at Gram Panchayat (GP) level

GPON Continued

Infrastructure Check list at OLT location:

Test description	Observations	Remarks
Layout drawing	As per engineering drawing document (EDD)	OK / Not OK
Check of Earthing (in Ohms)	Measured Value:	If earthing is available then earth measurement is to be done. If not feasible, a certificate from planning along with last reading (within six months) to be taken.
Check of Air conditioning (if available at OLT location)	Available / Not available	If existing, required temperature and humidity conditions are to be ensured as per node requirement.
Check of Documentation	Available / Not available	Technical Manuals in CD
Check of Power plant/Battery including inverter.	Available / Not available	
*Engine Alternator	Available in working condition / Non- working Condition / Not available	
Check of Firefighting Equipment / Fire Detection system.	Available / Not available	
Sign. Writing on the equipment	Done / Pending	
Network daigram in the form of OLT port daigram. (To be arranged by BBNL PMUs)	Available / Not available	

OLT Installation Engineer will perform above site verification before installation. He/She will be having below data for the installation reference

OLT Equipment Details

Sl.No	Details
1	OLT Location
2	Block & Dist. Name
3	OLT Location ID/IP address
4	OLT Model No
5	OLT Sl. No.
6	OLT Capacity (4/8/16 Port)
7	QA Reference

Software Details

Sl.No	Description	S/W Ver
1	GPON OLT	
	a) SCM	GPON_COM_2.17
	b) PIC-4	GPON PIC 2.33
2	ONT (UTL-ONT-72)	GPN OTB L4 1 7
3	EMS	V3.6.3
4	LCT	2.17

GPON Continued

OLT Installation Engineer configure parameters as below (Receive the details from service provider).

Sl.No	Item
1	OLT Management IP (in Band)
2	OLT Management Gateway (In Band)
3	OLT Management IP (Out of Band)
4	LCT/EMS Server IP (In Band)
5	LCT/EMS Server Gateway
6	OLT MGMT VLAN
7	High Speed Internet VLAN/s
8	VoIP Outbound Proxy Server
9	VoIP VLAN
10	User 1 & telephone number
11	Password
12	User 2 & Telephone Number
13	Password
14	DHCP Server IP address

Some of the Test conducted before commissioning

Test id	Test description
Test -001	Physical Verification of the Equipment at OLT site
Test -002	Verification of Power supply requirement of OLT
Test -003	Verification of Power supply redundancy at OLT
Test -004	Verification of Hot Swapping functionality of OLT
Test -005	Verification of Optical Power Measurement of OLT Uplink Ports
Test -006	Verification of Optical Power Measurement of OLT GPON Ports
Test -007	Verification of Service Restoration on OLT Reboot
Test -008	Verification of LOS on PON port due to fiber cut between OLT & 1st Splitter
Test -009	Verification of OLT Switch Card (SCM) /uplink Redundancy at OLT
Test -010	Verification of Earth Connectivity
Test -011	Verification of mechanical specifications
Test -012	ONT Node Tests with OLT

GPON Continued

ONT Installation

ONT installation engineer follow the below steps

1. Site Survey
2. Installation
3. Electrical Wiring
4. Site Security, Hygine
5. Earthing
6. Grounding

ONT Site Survey

Site survey form inform the engineer referring Village panchayat, Block/taluk, District, State, & Tools/Materials Required.

Tools and material for Site survey

1. Measuring tape
2. Compass
3. Book/Pen/Pencil
4. Chalk piece/marker pen

Building is facing .....Direction

Surroundings… .....Dense/open field/any other information

General power availability any known pattern of power unavailable hours.

Upload front elevation picture.

Roof Survey

a. Access to roof…..... stairs or ladder
b. How many floors
c. Selected place for SPV and Mark it. Upload picture d. Any shade on roof
e. Hardness of roof(suitable for drilling 3inches (12.5mm dia) holes f. Identify Route for DC/earth cable from Solar panel
g. Is the route straight in to ONT room

Earthing Pit

1. Near to DC cable entry point to the ONT room. Atleast 1mtr from foundation and no obstruction with in 2 mtr radius.
2. Type of Soil soft/hard/rocky
3. Mark earth location
4. Upload a picture

GPON Continued

ONT ROOM

1. Place for Splitter on wall should be near to BBNL FDF and computer table(about 1.5 mtrs from floor level).
2. CCU location near to ONT and near to AC power point. You need to tell VGP that exclusive earth point is required for CCU
3. CCU location should be such that DC cable length is a maximum of 10 to 12 mtrs from solar panel.
4. Wall around CCU should be clear, It can be wall mount also.
   - ESTIMATED DC cable length, Earth cable length from CCU to earth pit and FO length from Splitter to ONT

Contact Details to Collect

1. Head of Panchayat appointed by State govt
2. Computer operator
3. If possible Peons Contact number
4. Name of Panchayat
5. Distance from OLT location
6. Nearest District and distance from State capital
7. How is the transport facility like public/private

ONT Installation Procedure

1. Location/space Identification of equipment installation.
2. In between CCU to SPV the standardize cable length is 12m only. More than that voltage loss will come. So try to install the SPV below 12m cable length.
3. Fix Splitter near to BBNL termination box, if its already fixed in GP.
4. Splitter of 1:4 or 1:8 installed based on planning.
5. Then ONT and CCU should be wall mounted as per site condition. Use nails for fixing ONT's at wall instead of screws.
6. Route SC/PC to SC/APC (one end blue and other green) optical patch cord splitter to BBNL termination. Blue end should come at BBNL termination box side.
7. Route SC/APC to SC/APC (both end green) optical patch cord splitter to ONT.
8. Connect all connectors and switch on all equipments. Connect CCU unit to power if it is available in site. It should connect power main instead of UPS power.
9. Optical patch cord also need to be connect before leaving the site, in BBNL termination box it should be connect 1st port. In BBNL termination box 4 connectors are there, 1st one is blue 2nd is orange, 3rd is brown and 4th is green, some place it has miss alined so you have to identify with color code. BSNL will terminate either 1st or 2nd port. Most of the site 1st port only they used.
10. Note all serial numbers in installation form and get it sign from GP official. Also collect SPV document which is coming with SPV box.

GPON Continued

Note : Optical patch cord should be put inside the flexible conduit and need to do it carefully. It should not bend while handling.

Fig. 3.7.1 ONT Connectivity with Splitter and CCU- Wall Mount 1

Fig. 3.7.2 ONT Connectivity with Splitter and CCU - Wall mount 2

GPON Continued

Earth cable from SPV stand and the CCU unit will be routed to earth pit/earth rod terminal using 4sq mm green multi-strand wire. Part of conduit which is exposed on ground needs to be buried. All Flexible conduits inside building, while taking bend should take smooth curve. If sharp it will become V shaped after some time.

Fig. 3.7.3 Earthing

GPON Test conducted at ONT:

Test id	Test description
Test -012	ONT Node Tests with OLT
Test -013	Physical Verification of the ONT site
Test -014	Verification of Power supply requirement of ONT
Test -015	Verification of LOSi on Fiber Cut for an individual ONT:
Test -016	Verification of LOSi on Fiber Cut & DGi on Power off for the last working ONT on the PON
Test -017	Verification of Receiver sensitivity at -27dBm
Test -018	Verification of High Speed Internet Service & Wi-Fi
Test -019	Verification of DS/US & Bandwidth Assignment
Test -020	Verification of VoIP Service within OLT
Test -021	Verification of Incoming call to ONT
Test -022	Verification of Outgoing call from ONT
Test -023	Verification of Service Restoration on ONT Reboot
Test -024	Testing and Verification ONT Earthing
Test -025	Verification of RFC 2544 (QoS check for throughput, latency and frame loss)

GPON Continued

GPON Test conducted at SPV:

Test id	Test description
SPV-Test-01	Physical Verification of SPV, CCU with Battery
SPV-Test-02	Verification of charging from solar panel
SPV-Test-03	Verification of charging from A.C MAINS
SPV-Test-04	Verification of AC Power Supply & SPV Output FAIL
SPV-Test-05	Verification of SOLAR PANEL
SPV-Test-06	Battery Health check test
SPV-Test-07	Verification of FUSE

GPON Test conducted for Splitter:

Physical Verification & Insertion Loss Measurements of the Optical Splitter Purpose	**Physical Verification of the splitter at ONT site. & measurement of insertion loss.**
Procedure	Physically verify the type of splitter installed. ONTs connected to the splitter may be recorded. Calculate the Insertion loss of the splitter as per the procedure explained above.
Expected results	1. Insertion Loss of 1:4 splitter : < or = 7.1 dB 2. Insertion Loss of 1:8 splitter: ,< or = 10.5 dB

GPON Continued

OLT to DCN and EMS

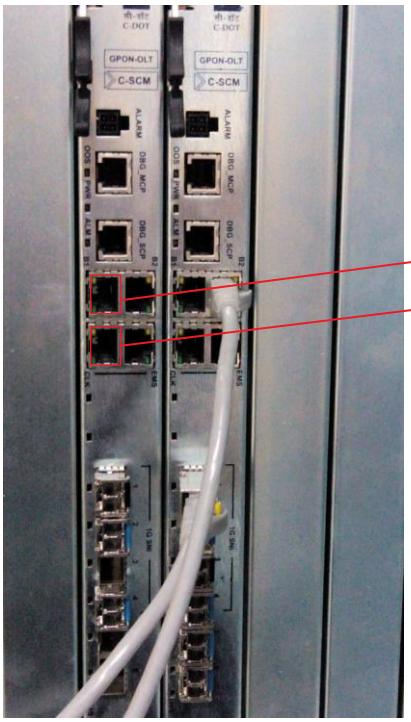


Fig. 3.7.4 OLT to DCN and EMS

NMS

Network Management System will monitor the entire system on bird view and notify the issue in remote to remote considerations.

NOFN NMS provide information on

1. EMS status
2. OLT Status
3. ONT status

Using NMS : OLT and ONT Type report could be generated and analysed on the issues if any.

- NMS shows whether ONT & OLT are active or not.
- NMS Have Features to restart and Reset Both Ont & OLT.
- NMS Could Update the OLT Via EMS. ONT s MAC and serial number will be observed carefully at NMS and incase of any replacement of ONT have to updated To NMS Engineers.
- NMS Classifies the Operations into Zonal level, state level, district level and Block level.
- NMS could be used to manage OLT – PIC and SCM cards

NMS have feature of Trouble Ticket handling. NMS engineer monitor and take relevant actions and l close the ticket once the issue get rectified. Power failure and power fluctuation auto restart will create tickets at NMS and get auto cleared as soon the system comes back to system.

Manual Ticket Creation and solvation : Issues and concerned raised from the field could also be manually counted and trouble ticket could be raised.

NMS - Fiber Management System : Fiber connectivity is one of the critical parameter in the GPON system and hence the end to end fiber connectivity is tested and evaluated.

GPON Continued

To assure the link effectiveness and consistency the fiber system is monitored by NMS in terms of

1. Zone
2. State
3. District
4. Block
5. BNL- block location
6. Panchayats
7. GPL- Gram Panchayats

Any device discontinuity or not reachability, fiber cuts could be tested by checking in nodal elements as listed above. To ease the process, the connections are named under segments and originating and terminating fiber is listed and named.

At NMS Segment ID used to monitor the end device connected length of the cable effectiveness, capacity and status of the segment. In NMS Fiber connection end to end could be monitored. Any error or issue at the fiber system create Alarms at NMS and there by the NMS will trigger the solvation.

EMS

EMS system is OAM which maintain and monitor the activities on OLT and ONT. EMS displays basic information of switch control board. Users could modify the networking configurations. Major networking configurations include IP address, network mask and gateway, etc. Before configuring VLAN, administrator should be maintain and verify the status of protocol pool base.

Port-Protocol -Vlan Trunk can be verified only in the protocol pool. Business circulation will be started only after the authorization procedures finished. All the ONUs which are connected with PON interfaces will be authorised except those are belonging in illegal ONU list. Optical Network Unit authorization is carried out through database of black and white ONU list. By means of MAC address ONU will be authorized by the switch control board legally. Illegal ONUs are the devices which its MAC address will be listed in black list ,while those MAC address listed in white list are called legal ONU.

GPON Continued

Ethernet and GPON Design

GPON can support Triple–play services. There is a bandwidth scarcity in access network where they are using twisted pair cables. GPON provides high- bandwidth for transmission, so high data rate. So we are using GPON to achieve High bandwidth requirements for services like live TV broadcasts and IPTV. So GPON will support much more coverage (up to 20 km) to provide service in maximum geographic area and to overcome limitations of twisted pair cables in access network and also avoid number intermediate network nodes. The latest available standards says that, GPON supports integrated services in a good way. GPON is the choice of large carriers in the international market.

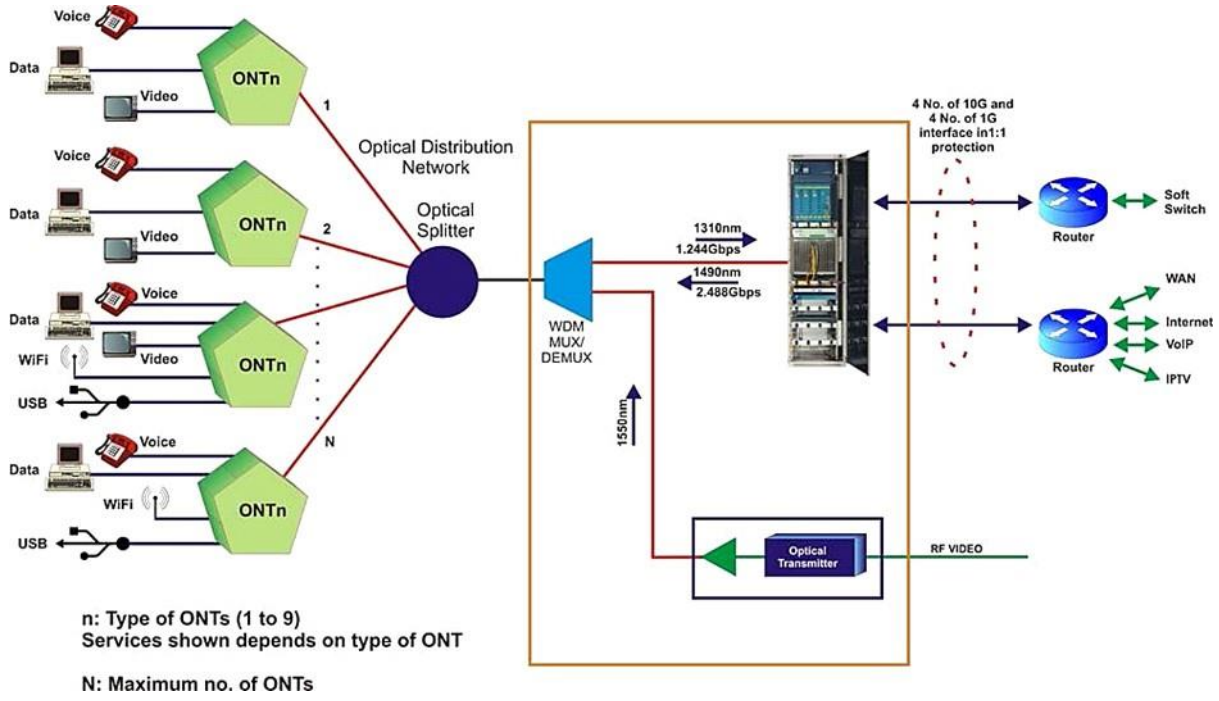


Fig. 3.7.5. ONT- GPON Design Architecture

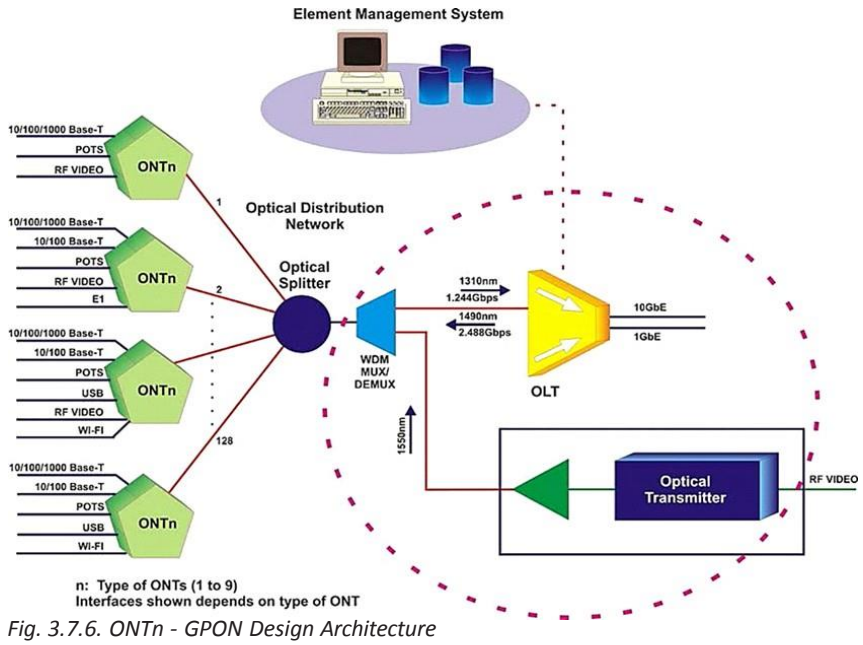


Fig. 3.7.6. ONTn - GPON Design Architecture

GPON Continued

Optical Power measurement of OLT

In OLT, ONT is identified by the MAC ID connected to the PON and activated by LCT .the services @ ONT must be defined and configured in OLT.

IN GPON OLT- the connected SFP optical Parameter values should be in the following range

1. **RX Power: -8 to -27 dBm**
2. **TX Power: -1.0 to +5 dBm**

RX and TX value differs for varying SFP, few expected results are as follows

1. For 850 nm (1G SFP) the optical Parameter values should be in the following range
   a. RX Power (Min to Max): -17 to -3dBm
   b. TX Power (Min to Max): -9.5 to -4.5 dBm
2. For 1310 nm (1G SFP) the optical Parameter values should be in the following range
   a. RX Power (Min to Max): -18 to - 3 dBm
   b. TX Power (Min to Max): -9.5 to -3 dBm
3. For 1550 nm (1G SFP) the optical Parameter values should be in the following range
   a. RX Power (Min to Max): -18 to - 3 dBm
   b. TX Power (Min to Max): -9 to -3 dBm

ONT- tested for end to end connection

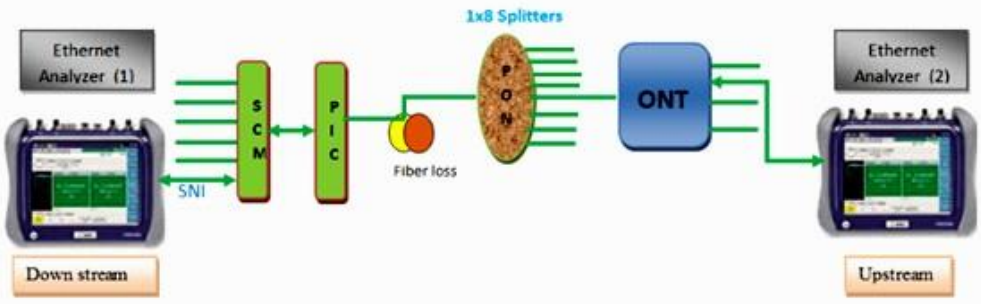


Fig. 3.7.7. ONT- Test for End to end Connection

As shown in the figure fig 6.3.7, Ethernet analyzer is connected to SCM card at OLT and to ONT port at GP location. Verify the connectivity ad status by LCT and vary the transmit rate and verify the end to connection and its stability.

GPON Continued

OLT engineer receives group of IP 's and VLAN Id's from the planning team for commissioning. Every OLT will take several IP's and ONT is represented by its MAC ID looped with VLAN Id's. Below shown the snap shots assigning OLT IP and OLT VLAN Id using LCT at OLT block level

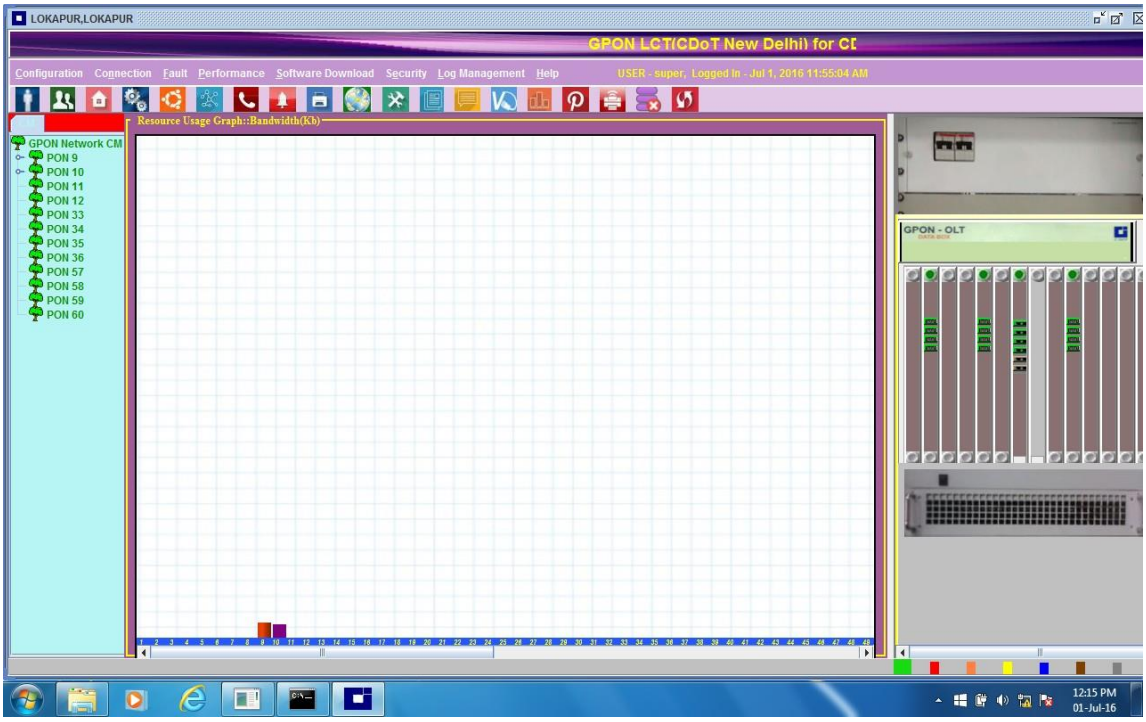


Fig. 3.7.8. EMS LCT Snapshot

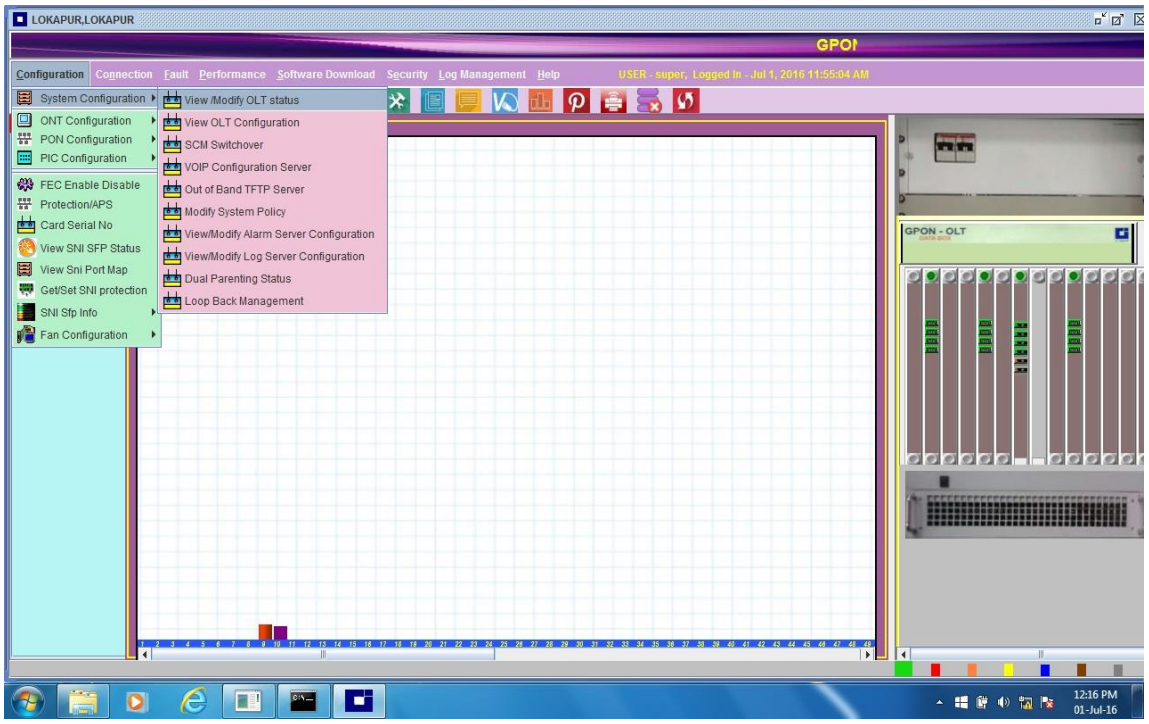


Fig. 3.7.9. View / Modified OLT Status Snapshot

GPON Continued

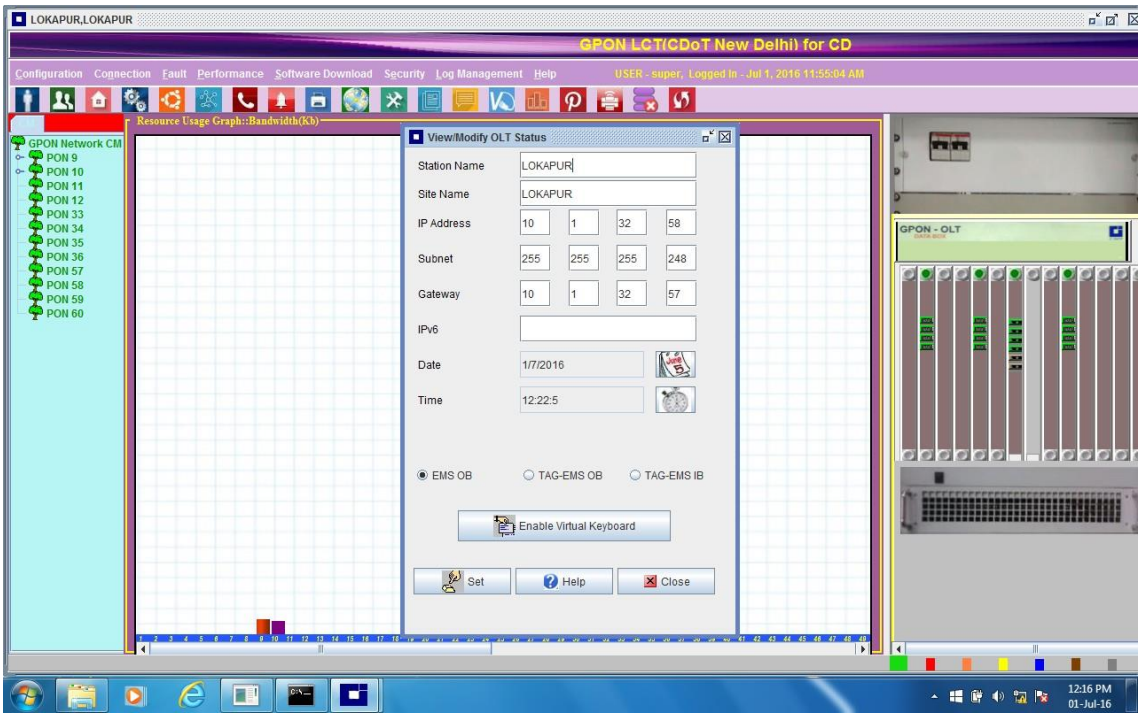


Fig. 3.8.0 Assign IP address Snapshot

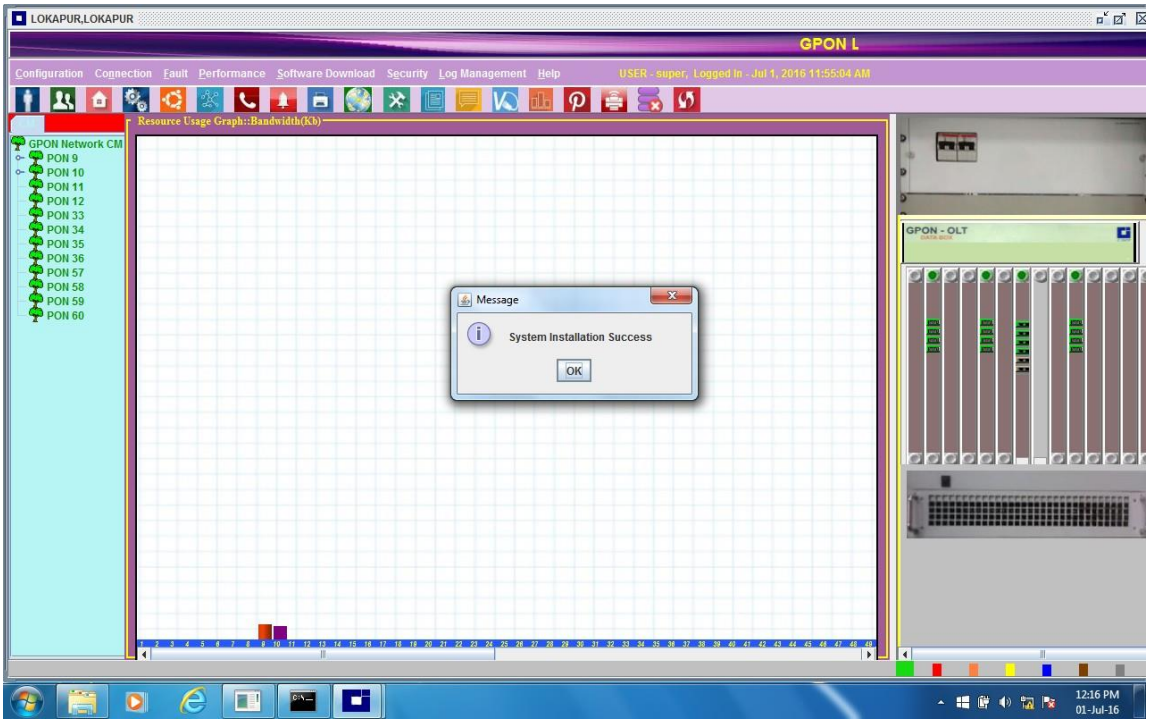


Fig. 3.8.1. System Installation success Snapshot

GPON Continued

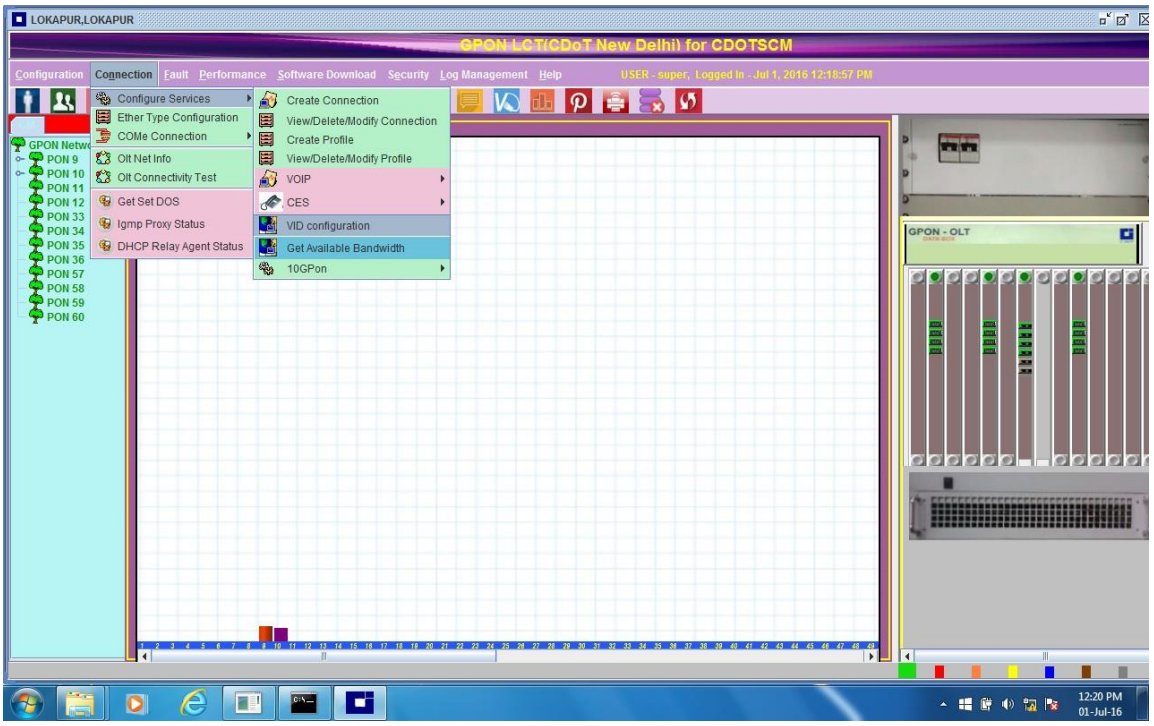


Fig. 3.8.2. Under connection tab Enter VID Configuration - Snapshot

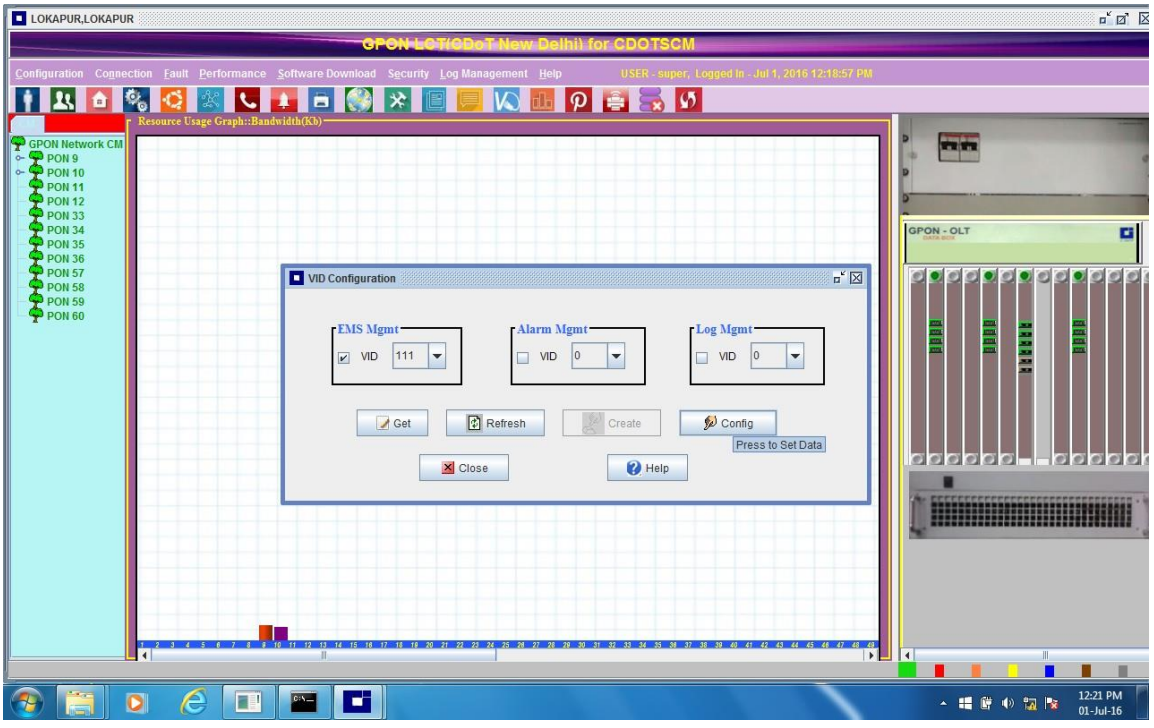


Fig. 3.8.3. Verify / Edit VID - Snapshot

GPON Continued

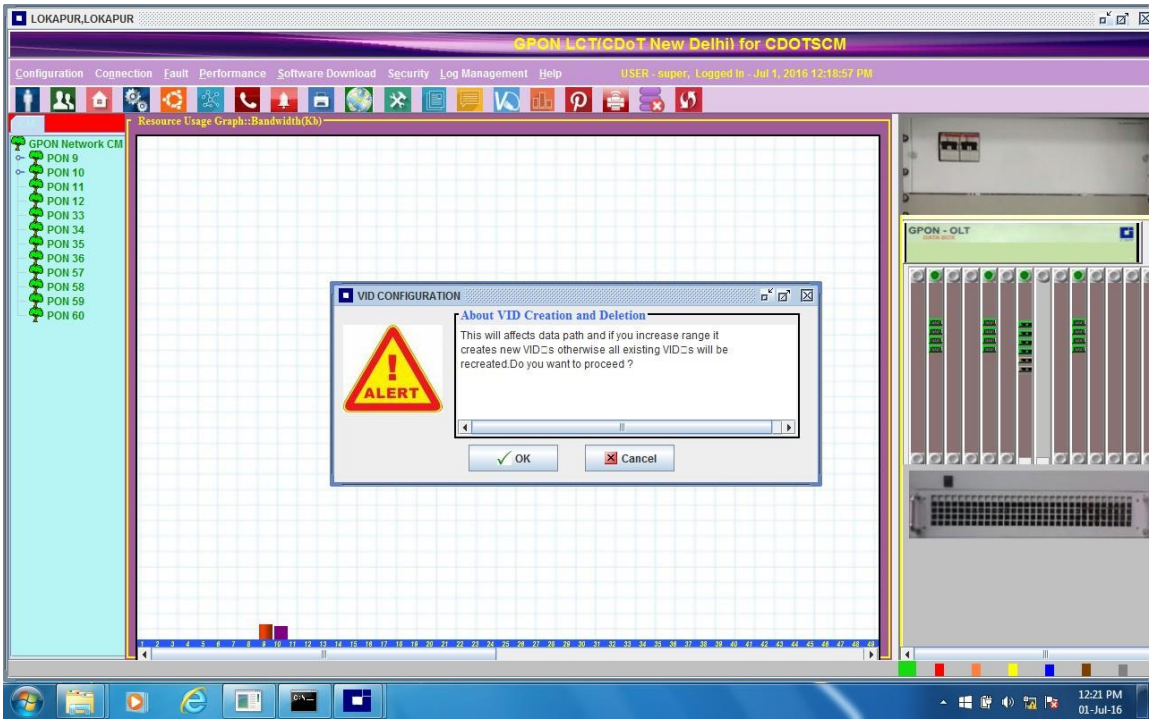


Fig. 3.8.4. Click Ok to Proceed with VID Configuration - Snapshot

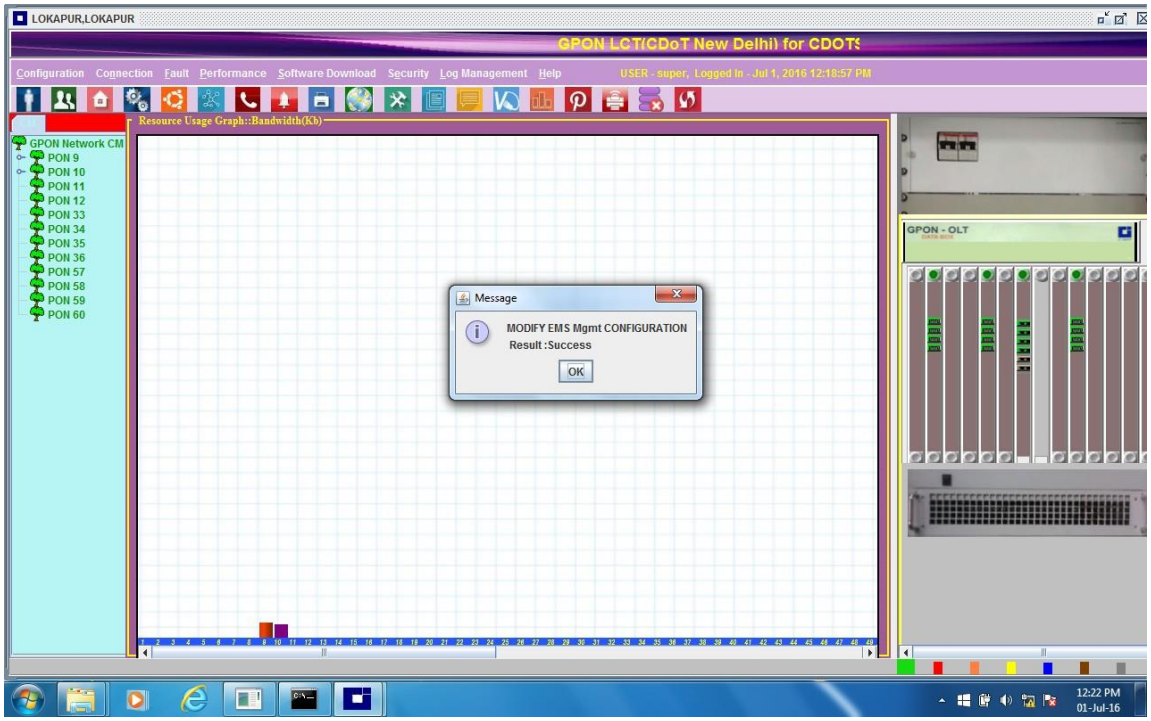


Fig. 3.8.5. VID Modification Success - Snapshot

GPON Continued

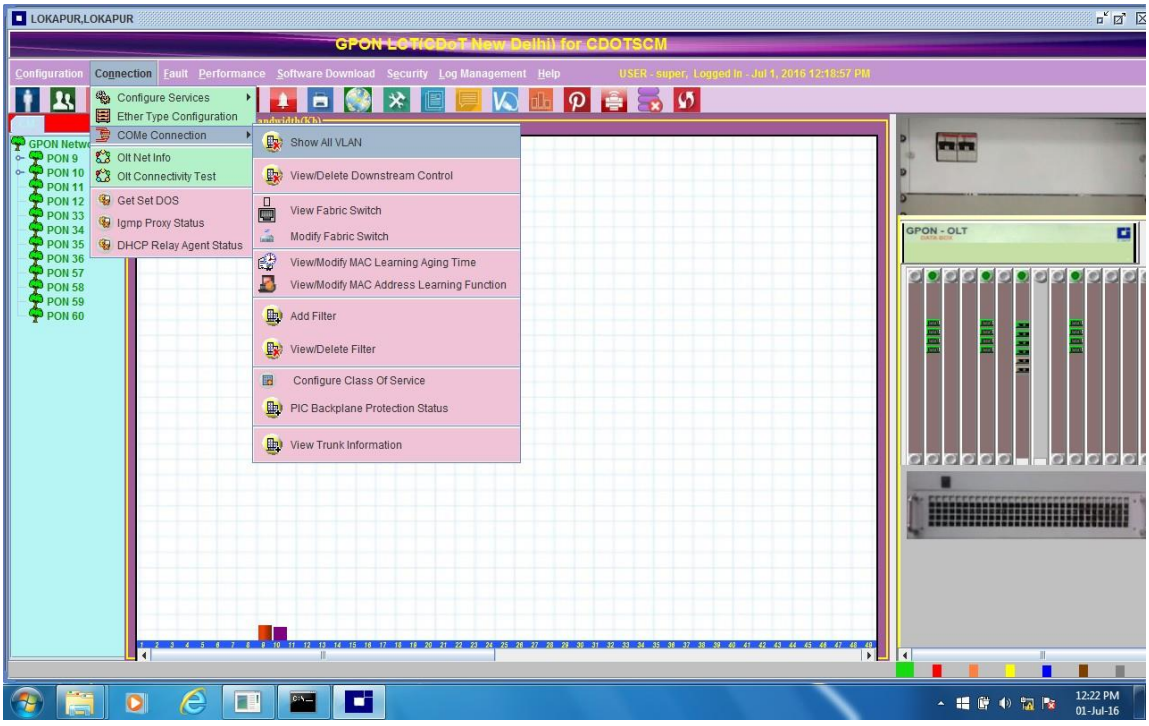


Fig. 3.8.6. Verify VID assigned by entering show all VLAN Tab under COM e connection - Snapshot

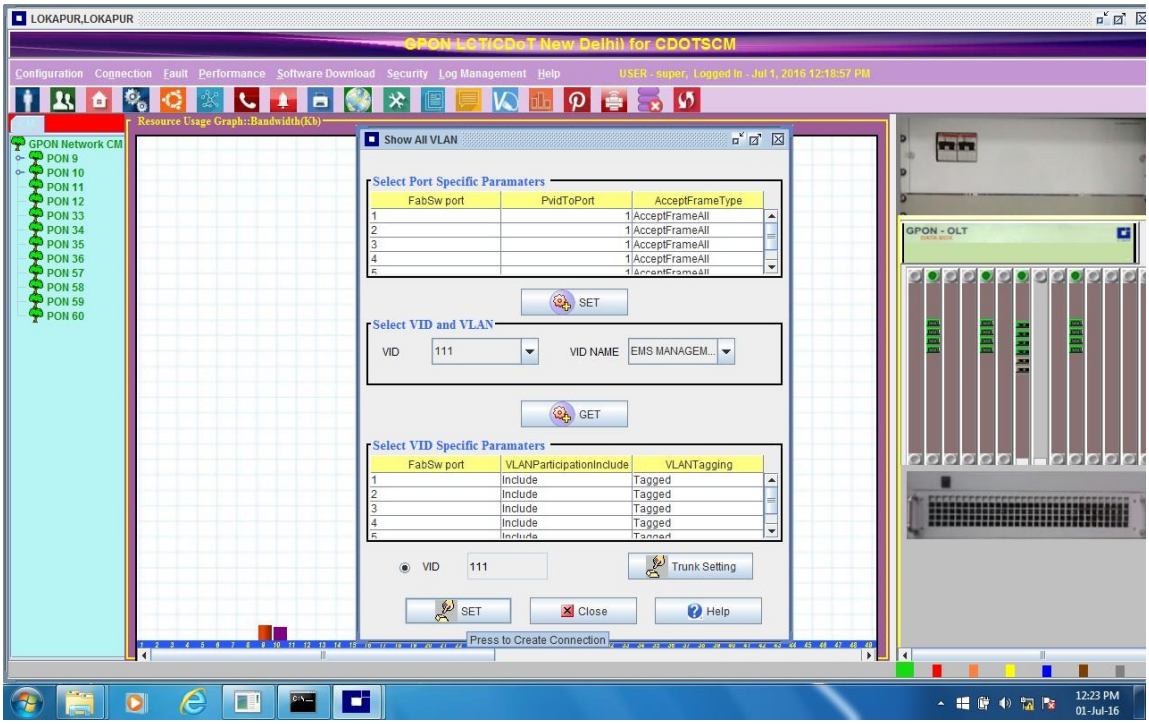


Fig. 3.8.7. Confirm the VID Name and Number and Press Set for Successful entry - Snapshot

GPON Continued

GPON Service (Internet) Connectivity Diagram

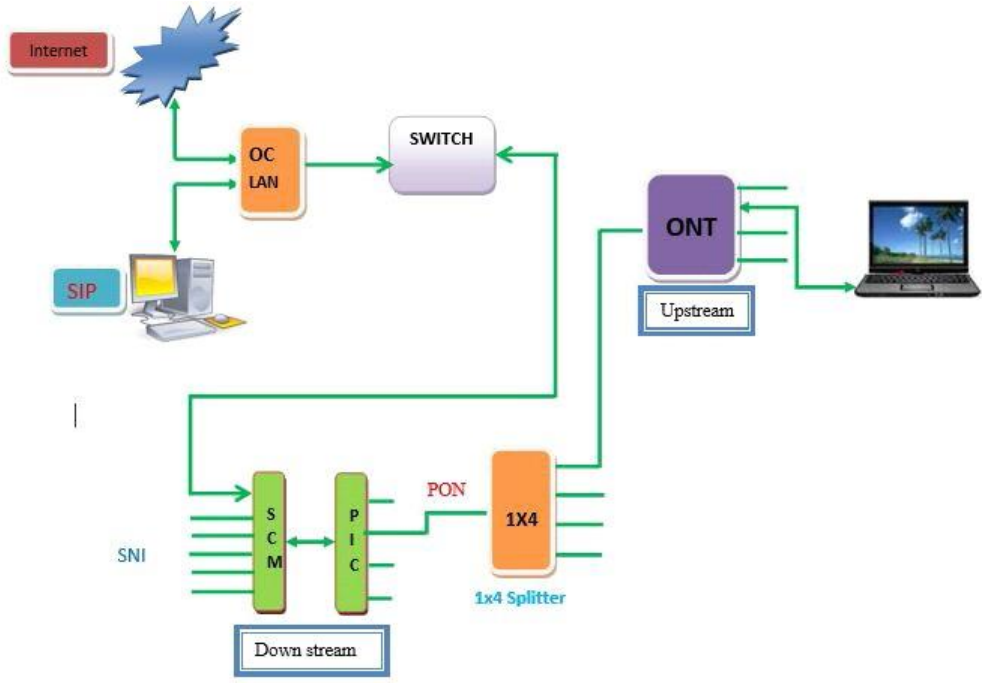


Fig. 3.8.8. GPON - Internet Connectivity Diagram

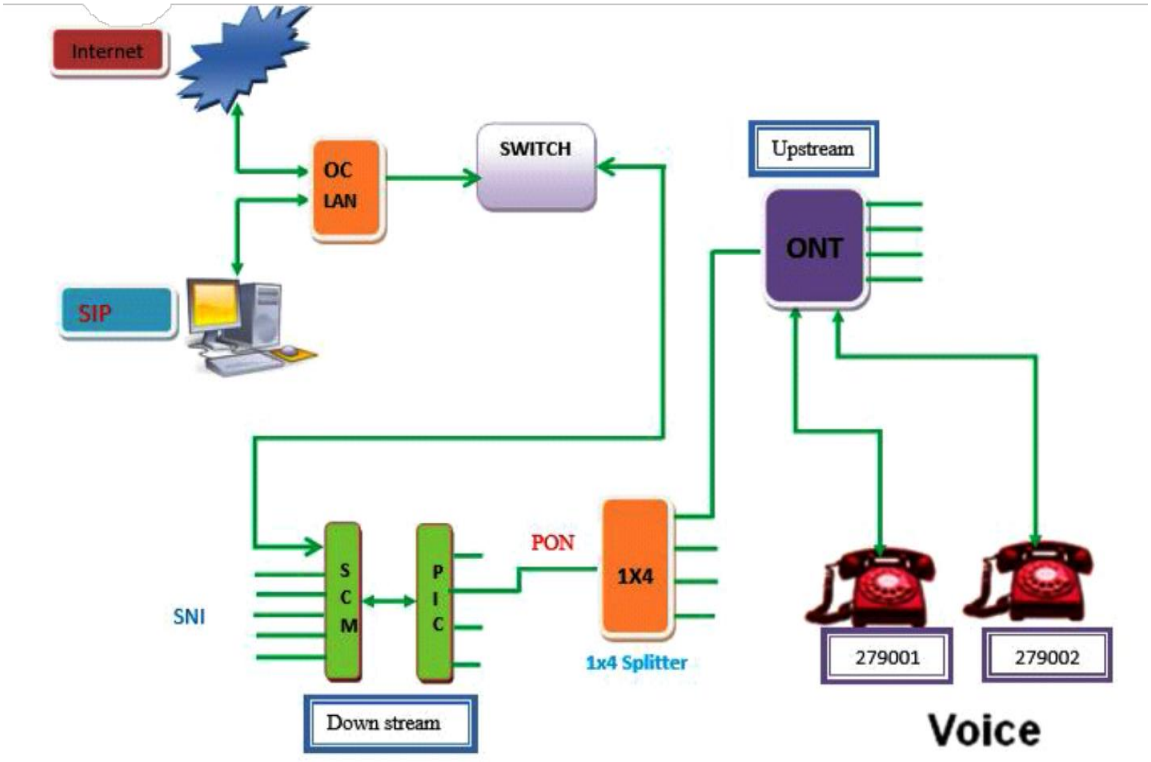


Fig. 3.8.9. GPON - VoIP Connection Diagram

GPON Continued

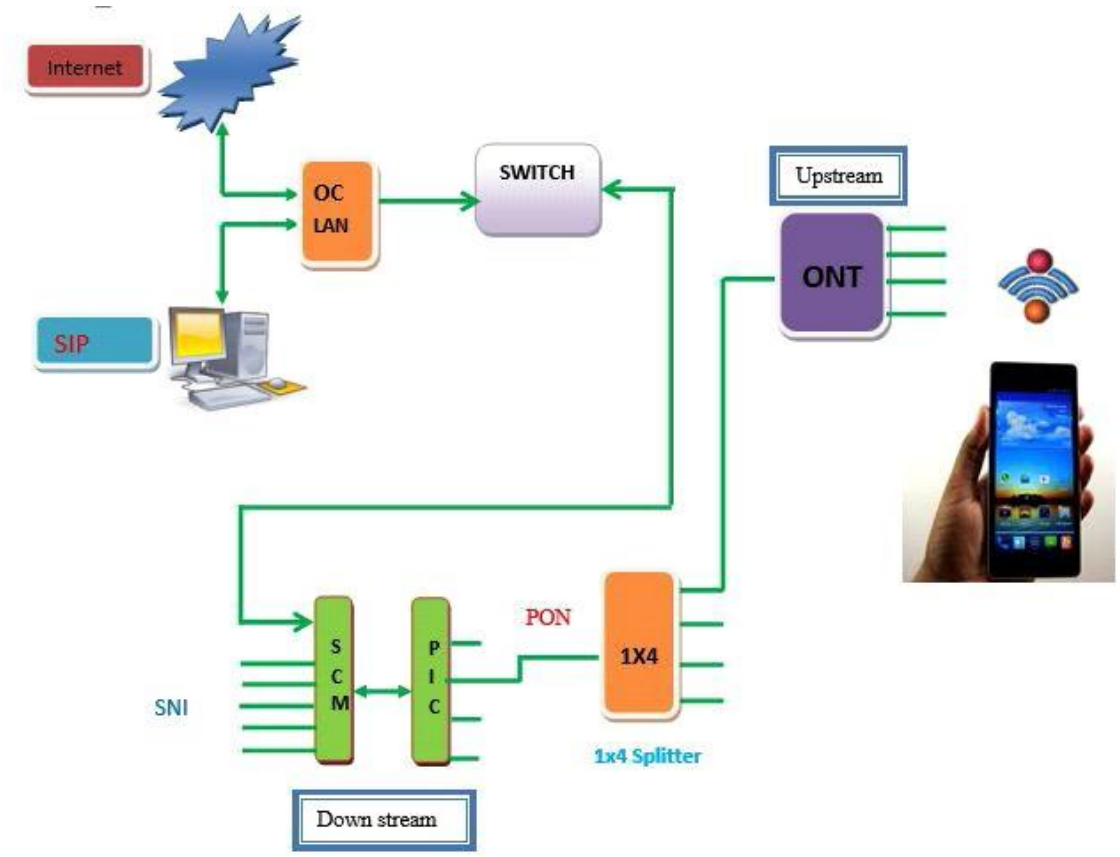


Fig. 3.9.0. GPON - Wi-Fi Connection Diagram

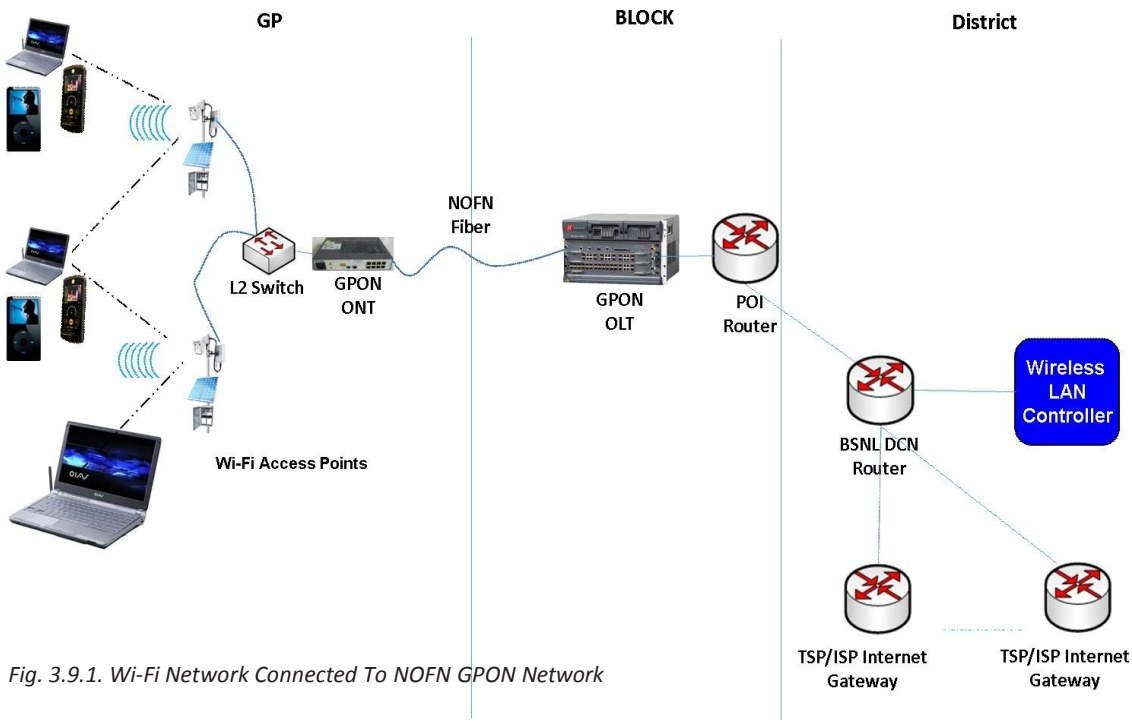


Fig. 3.9.1. Wi-Fi Network Connected To NOFN GPON Network

Exercise

1. Describe the NOFN Vision.

Ans. _____

_____

_____

2. Describe GPON Architecture and Operation with Neat block diagram.

Ans. _____

_____

_____

_____

_____

_____

3. List GPON Services.

Ans. _____

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Exercise

4. Explain the role of EMS.

Ans. _____

_____

_____

5. Explain Reporting & Resolving issues of ONT.

Ans. _____

_____

_____

6. Explain the role of NMS in Maintenance of ONT.

Ans. _____

_____

_____

7. List the services provided by ONT at GP.

Ans. _____

_____

_____

8. Discuss the do's and don't's of ONT and CCU.

Ans. _____

_____

_____

9. Discuss the alarms at ONT and suggest the solution.

Ans. _____

_____

_____

10. Disscuss on CCU and SPV Preventive maintenance.

Ans. _____

_____

_____

UNIT 3.6 : Global Position System (GPS)

Unit Objectives

At the end of this module, you will be able to understand:

1. Global Position System (GPS)
2. Global Position System (GPS) - Utility and Application

3.6.1 Global Position System (GPS)

The Global Positioning System (GPS) is a space-based navigation system. GPS provides time information and location /Position on or near earth in any environmental conditions. There should be an unobstructed line of sight to at least four GPS satellites. GPS is utilizing from around the world for various applications and services, gives critical capabilities to military, civil, and commercial users.

For utilizing its service, pre-requirements are a GPS receiver, compass altimeter and good or basic navigation skills!

Parts of a GPS System

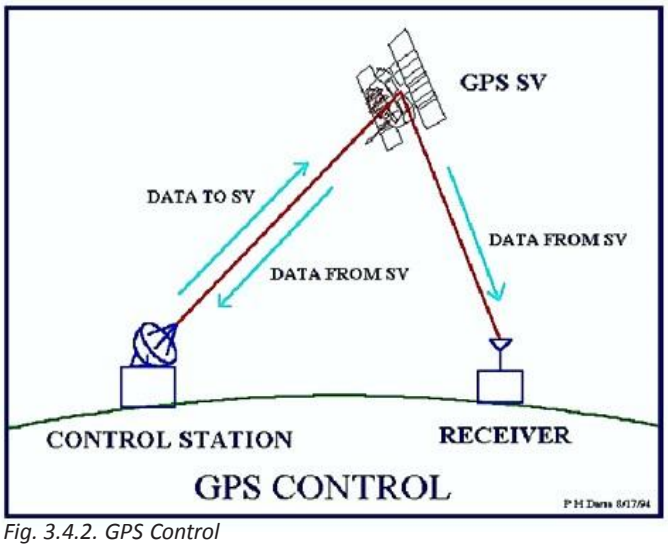

Fig. 3.4.2. GPS Control

The GPS is working based on time and the known position of special satellites. Satellites have stable and synchronized atomic clock which provides the accuracy. They will correct any drift happened from the true true time on the ground daily. So, the satellite locations are known with great precision. Even GPS receivers have clocks as well, but they are not synchronized with true time, and so they are less stable. GPS satellites transmit their current time and position continuously. Also a GPS receiver monitors multiple satellites and solves equations to find the precise position of the receiver and its deviation from true/ original time. So a minimum of four satellites must be in synch of the receiver for it to calculate four unknown quantities (three position coordinates and clock deviation from satellite time).

Global Position System (GPS) Continued

GPS Receiver- features are

1. 10+ meter accuracy
2. Computer cable
   A. Download and upload maps, routes and way point.
   B. Upgrade over the internet

Fig. 3.9.3. GPS Receiver Control

Computer Mapping Software

1. Can map out tracks and way points
2. Can plan and upload routes, tracks and way points

Receivers may also have

1. Digital compasses
2. Barometric Altimeters
3. FRS Radio
4. Other features.

Satellite positions (geometry)

1. Weather
2. Multipath
3. Timing errors
4. Typical error is 10+ meters.

All GPS are 12 channel: can receive up to 12 satellites. Some of the newer satellites & receivers can receive through thinner solid objects like cars, building walls and forest canopy. Terrain and larger buildings are still too big.

Receivers Record

Track Logs

1. Collected any time receiver is on.
2. Should be cleared before each mission
3. Overwrites previous positions, if track memory is full

Tracks

1. Track logs can be saved for reuse
2. Not as much detail as log
3. Can be drawn on computer map and uploaded

Waypoints : Stored or entered locations

Routes: Set series of way points & Less detail than a track

GPS Continued

Navigation

1. Need to have stored way points.
2. Travel is in a straight line from way point to way point (route). Can also be a track you uploaded and follow.
3. Feedback is distance and direction compass and pace may be more efficient.
4. Can use to check progress and whether you are still on track.
5. Can save way points along the way and follow back (reverse route).
6. Straight line may not be safest - use a map when planning or to double check!

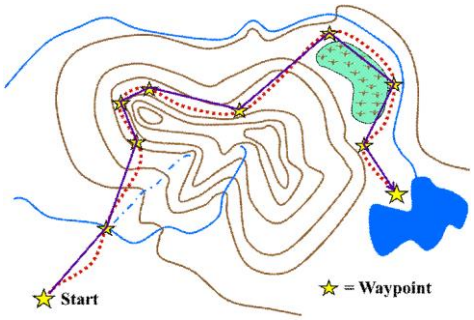

Fig. 3.9.4. GPS Navigation waypoints

GPS Navigation Strategies

1. Receiver downloads new position every 5 to 30 seconds.
2. "Compass" may jump
3. Best to follow hand compass or electronic compass rather than GPS compass.
4. If receiver has electronic compass, set it so it will kick in at under 2 mph.
5. As long as distance is decreasing, you are going the right direction.
6. Can select easier terrain to increase travel speed.

Use Basic Navigation Techniques!

Better: Follow road (or handrail it) until distance starts to increase. Now follow GPS the shorter distance into the target. If curve is easy to identify, can use GPS to navigate road to this checkpoint and then use compass and pace into target from here.

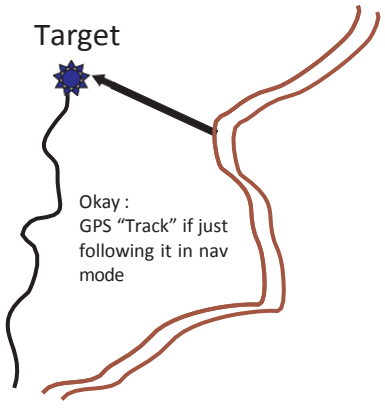

Fig. 3.9.5. GPS Track tragets

Garmin Basics

1. There are differences between models as well as between brands.
2. Basics are the same.
3. Should sit down with instruction booklet and learn all the functions.

GPS Continued

Fig. 3.9.6. GPS Devices

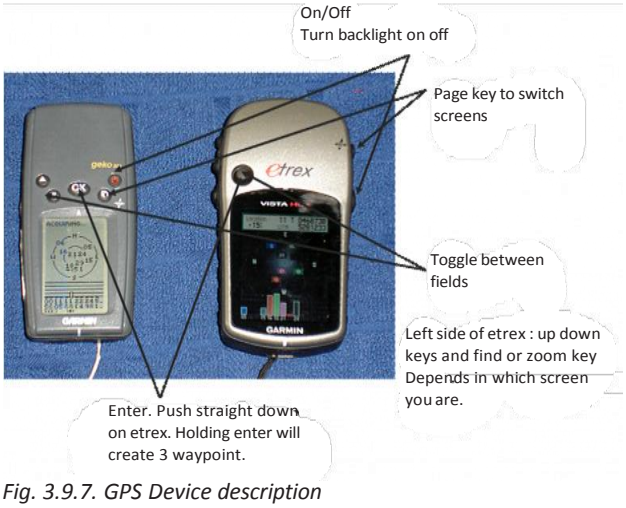

Fig. 3.9.7. GPS Device description

1. Shows map of current location.

2. If navigating, some will show purple line to follow.
3. Can zoom & pan on in some models.

Fig. 3.9.8. GPS Trip View

Trip View

1. Gives overview of current trip stats.
2. Can set up what you see
3. This may have multiple sub screens.
4. Clear out old data from this view.
5. Keeps a track log. Stores position every 5 to 30 seconds. Can be saved. Can be downloaded and mapped
6. Should at least clear track log before every trip.

Fig. 3.9.9. GPS Main Menu

Main menu

1. Most functions found here
2. Setup
3. Waypoints
   A. Create, Edit, Delete
4. Tracks
   A. Setup, Clear, Save, Turn on and off.
5. Calibration
6. Other

GPS Continued

System: Basic look and feel, turn WAAS on and off.
Set compass to kick in when speed = 2mph.

Display: Set backlight.
Set backlight to stay on.
Set for lowest level to do night work.

Units: Coordinate system, Datum, Units for distance and elevation, etc. Waypoints on most Garmins, hold enter key to mark a waypoint or go to main Menu to mark. Can then edit Name, Symbol, Location. Have a naming convention so way-points show up in the list together. Group important points with the same symbol. like a folder can bulk delete everything with the same symbol and not others. Select named waypoint, then GOTO to start navigation.

Fig. 3.10.0. GPS Elevation

Fig. 3.10.1. Way points - Marking

Fig. 3.10.2. Way points - Editing

Fig. 3.10.3. Way points - Find

Navigation

1. Main Menu - waypoints or Find
2. Select desired waypoint
3. Go To
4. Map Screen or compass screen comes up

GPS Continued

GPS Navigation

Navigation is a process of monitoring and controlling the movement of a vehicle or object from one location to another. There are generally four navigation categories that are land navigation, marine navigation, aeronautic navigation and space navigation.

Fig. 3.10.4. Navigation Direction

1. Once map or compass screen comes up:
2. Start walking
3. You must be moving for navigation mode to work.
4. Turn so compass points to top of unit or the arrow points down the map track.
5. When you get close
6. Switch to coordinate screen to find final coordinates.
7. GPS usually has a 5 to 10 meter error, more in poor conditions.
8. Mark where the GPS takes you and search a 10 meter full circle around the point

Calibrate

Calibration is the process of finding out a relationship between any two measures that are unknown (when the measurable quantities are not given a particular value for the amount considered or found a standard for the quantity). When one of quantity is known, which is made or set with one measuring device, estimation is made as comparative way as conceivable with the calibrating device utilizing a second device. The quantifiable measure may vary in two devices which are proportional. The device with the known or doled out rightness is known as the standard. The second device is the unit under test, test instrument, or any of a few different names for the device being adjusted.

1. Only if your GPS has an altimeter and/or compass.
2. Calibrate will not show in menu, if you do not have it.
3. Calibrate, altimeter, known elevation.
4. Must be at that actual elevation to calibrate.
5. Should re-calibrate daily or when weather has changed.
6. Calibrate, compass
7. Hold GPS level and slowly turn 2 rotations receiver will tell you when it is complete.
8. Must re-calibrate after changing datum and coordinates.
9. Navigation will not work right if compass not calibrated.

Fig. 3.10.5. GPS Calibration

Exercise

1. Define GPS.

Ans. _____

_____

_____

2. Explain GPS Operations.

Ans. _____

_____

_____

3. List and Explain GPS applications.

Ans. _____

_____

_____

_____

_____

_____

Tips

Visit to OLT and ONT Site

Discuss: The queries forwarded by VLE to OLT engineers
Discuss: Day to Day issue and its solution - refer to ONT

UNIT 3.7: PON Maintenance & ONT - CCU Indicators

Unit Objectives

At the end of this module, you will be able to understand:

1. PON Maintenance & Troubleshooting
2. Features of ONT Hardware
3. ONT - LED Identity
4. CCU Monitoring Panel Indicators

3.7.1PON Maintenance & Troubleshooting

Complete network

Fails to operate when there is issue in end to end link of FTTX. Corresponding Fiber should be replaced - repaired to bring the network up. OTDR is used for troubleshooting and Maintainace aspects of FTTx network, OTDR (optical time domain reflectometry) test could be executed by using test frequencies (wavelengths) (Example: 1310 or 1550 nm)

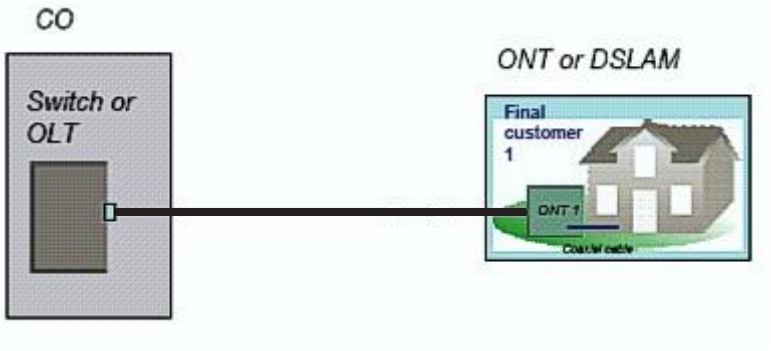

Fig. 3.11.1. FTTx Study Case=Point to Point FTTH Network

Point-to-Multipoint FTTH Network (PON) Topology

Error correction & Maintainace a point-to-multipoint fiber-to- the-home (FTTH) network (also defined as a PON net- work) vary drastically. Institute of Electrical and Electronic Engineers (IEEE) & The International Telecommunications Union (ITU-T) did created multiple policies for PON -optical access systems referring to (G.982, G.983 or G.984 for ITU and 802.3ah or 802.3av for IEEE).

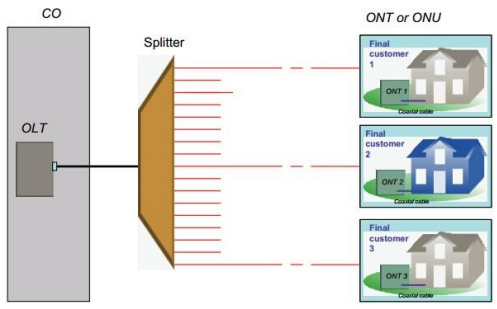

Fig. 3.11.2. Simple PON Network Topology

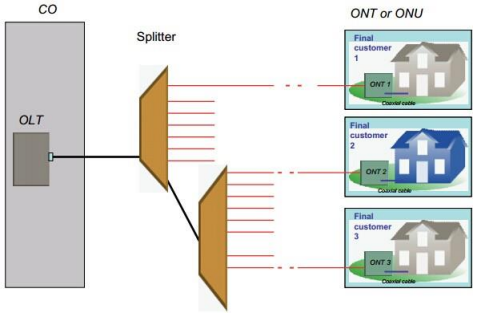

Fig. 3.11.3. Cascaded PON Topology

PON Maintenance & Troubleshooting Continued

Refer Figure---gives, a PON network holds single Optical Line Terminal (OLT) interface is connecting to a splitter and then to a customer end device called ONT with native interfaces to support subscribed services. End device will be available at every premise (one for each subscriber, up to maximum of 64 subscriber for one interface of an OLT). Occasionally, one more splitter device could also be part of in cascaded connection (as Figure 3 shows) to provide system services to nearby locations.
By accessing OAM (Operation & Management) & NOC (Network Operation Centre), operators can easily estimate total subscribers count who got are affected.it is possible that operators could find out the issues and issue related elements for example: number of customers are affected and understanding PON structure like cascaded or not.

Few scenarios of PON which could be realized are as below:

PON **Case 1:** Simple PON - Only One Customer is affected

When only one subscriber cannot receive service, three potential faults are probable, see Figure 7.1.4:

1. Fault in the distribution fiber between the customer and the closest splitter
2. Fault in the ONT equipment
3. Fault in the customer's home wiring

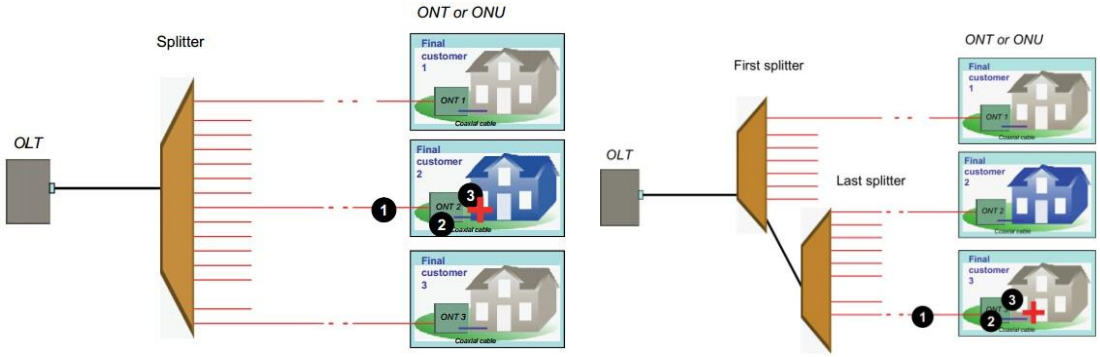

Fig. 3.11.4. PON Case 1 - Possible Faults When only one Subscriber is affected

PON Case 2: Cascaded PON - Same splitter is connected with all affected customers

A splitter failed to provide service, but other all other splitters connected to the same OLT is working fine, then cause could be because of one of the following (see Figure 7.1.5):

1. Last splitter is not working
2. Fiber link between the cascaded splitters are not working

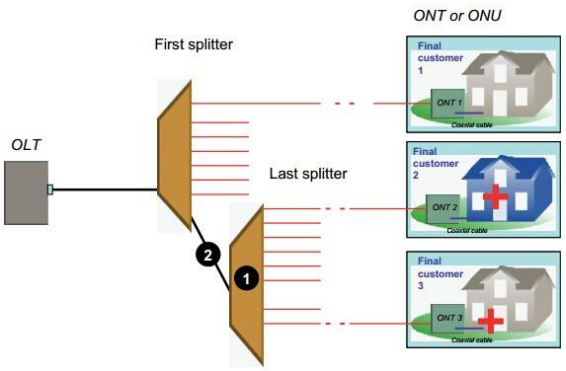

Fig. 3.11.5. PON Case 2 - Cascaded PON without getting service from last splitter.

PON Maintenance & Troubleshooting Continued

PON Case 3 : Affected to all Customers (at the OLT level)

Whether or not the PON is cascaded. If all customers are affected, the cause may be from of the following:

1. Fault could be in the OLT side Splitter
2. Fault in the feeder fiber/cable
3. Fault of the OLT equipment

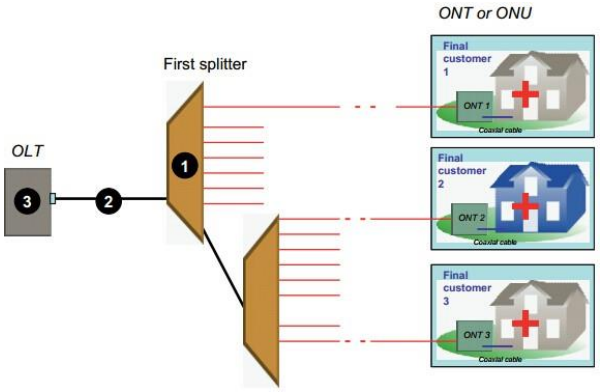

Fig. 3.11.6. PON Case 3 - All Subscribers are affected (All Connected to the first Splitter

Other Variable: Splices or Connectors at Strategic Places

If connectors are available at the splitters, terminals, or drops, isolating part of the faulty network easier. Out of service networks should be undergo connector inspection and OTDR measurements using 1310/1550 nm wavelengths.

When the entire network is spliced and some but not all customers are affected, service testing (test on a network carrying traffic) is needed.

Constraints of service Testing Measurements

Two dedicated tools are available for troubleshooting of PON networks:

- **PON power meter**
- **In-service 1625 or 1650 nm OTDR**

Traffic wavelengths are typically 1310/1490 or 1310/1490/1550 nm. The signal transmission from and towards the ONT is verified by using a PON power meter. It is possible to discriminate the faults that whether it comes from the customer's ONT or from the network by using PON meters. PON meters can measure power levels of all signal types of different wavelength independently. The wavelengths would interfere with the traffic signals and disturb the traffic by the use of a classical OTDR with 1310 or 1550 nm. Vice versa, the traffic signals disturbs the receiver of the OTDR, which will make difficult to interpret OTDR traces. So classical OTDRs should not be used and specific in-service OTDRs are required.

Recommended Steps for Locating Faults

Despite the fact that most of the firm with varieties of fiber networks have their own methods and procedures, they optimize their fault identification process to reduce the number of truck rolls.

The schematic in Figure 7.1.7 offers a complete view of:

1. All of the possible fault locations, depending on how many customers are affected
2. The best location to shoot an OTDR while minimizing truck rolls
3. Whether or not a specific in-service OTDR device should be used

PON Maintenance & Troubleshooting Continued

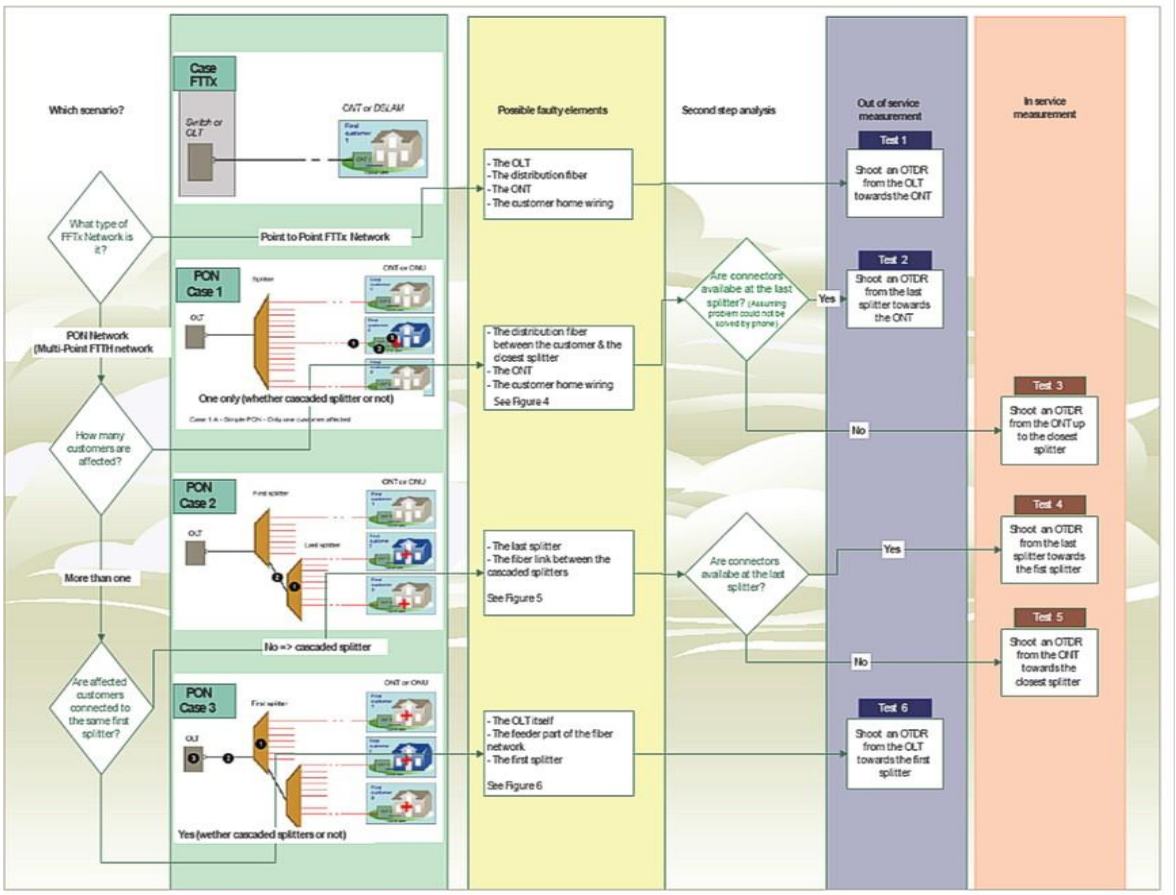

Fig. 3.11.7. Schematic Summary

Specific In-service Portable OTDR Device

Live Networks of fibers are testing specifically by OTDR which is custom made. Custom made equipment uses out of range wavelengths (test wavelength and traffic wavelength are apart) to make OTDR testing without disturbing either the transmission or the receiver of the OTDR.

In-service OTDR allows service providers to perform dark fibers in-service monitoring on metropolitan and long- distance networks. a wavelength dense multiplexer (WDM) is needed to connect the OTDR to the network while the traffic remains ON.

On a PON network, no need to use WDM except for monitoring purposes (using a remote fiber test system). The PON network is point-to-multipoint configuration. PON troubleshooting and testing can be performed directly from an accessible element (ONT or splitter). The operator can able to disconnect the element because service is already off for downstream toward the customer.

In-service OTDR should not disturb customers while operating the OTDR because wave-length for testing in upstream toward the OLT, as OLTs reject signals above 1625 nm, based on ITU-T recommendations.

The traffic signals which OTDR receives will be rejected to create accurate OTDR traces. Low -pass filter used as a jumper between the OTDR and the network to protect the OTDR. Or It can be built into the OTDR.

PON Maintenance & Troubleshooting Continued

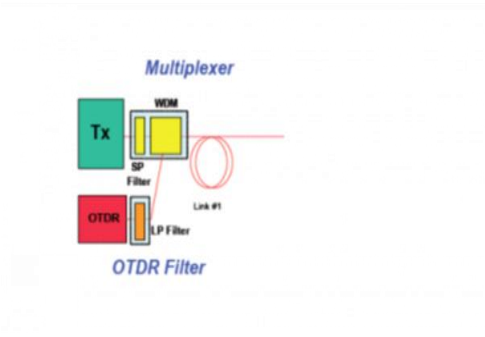

Fig. 3.11.8. OTDR Insertion for In Service Monitoring

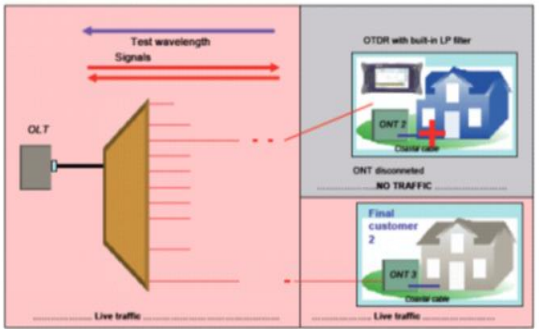

Fig. 3.11.9. OTDR Insertion for FTTH Troubleshooting at a Customer Location (ONT is Disconnected)

Most of the manufactures enable the use of the 1625 nm wavelength for best testing. Some countries like Japan nevertheless pushing the 1650 nm wavelength as reflected in the ITU-T L.41 recommendation, which provides maintenance wavelengths on fiber-carrying signals. The 1650 nm wavelength is preferred based on the characteristics of the filters and it is far away from the traffic signals (current and future PON technologies).

Making the Right Testing Decisions

To reduce the total cost and time taken to up the system after failure, it is essential to select the right OTDR tool, the correct pulse width, and the best location to start troubleshooting. OTDR configuration should be based on the equipment/ network being qualified and the total distance to be measure in approximately.

Consider each case from the scenarios presented in Figure 7.1.8 and 7.1.9 To avoid complexity, we are considering the cases where connectors are only available at the ONT/ OLT devices.

Case 1: Troubleshooting of the Distribution Fiber

Simple PON—only one subscriber affected.

Consider that no connectors are available at the splitter (see Figure 7.2.0, Test 3)

Case	Test Location	OTDR Direction	What Must be Seen	Comment	Pulse Width to Use	Specific OTDR
Case 1 Onel Customer down	**Customer's Home Disconnect the ONT**	**Up**Stream	**Distribution fiber up to the closest splitter**	**Testing through the splitter is not required, as the issus is only on the distribution fiber side.**	**Short pulse 3 to 30 ns**	**In-service OTDR**

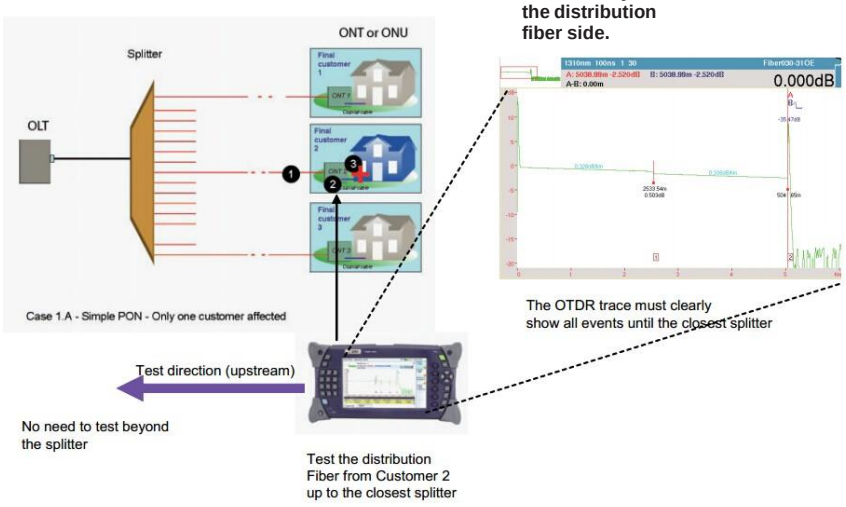

Fig. 3.12.0. OTDR is Short Upstream and Trace only matters up to the Splitter

PON Maintenance & Troubleshooting Continued

Case 2: Troubleshooting of the Distribution Fiber and the Fiber between the Two Splitters in case of a Cascaded Network

A cascaded network with 1x2, 1x4 or 1x8 splitters is used extensively in NOFN Network.

Updates received at the network operations centre (NOC) is, all customers linked to the second splitter are down. Let's consider the case where no connectors are available in the splitter (see Figure 3.11.1, Test 5).

Case	Test Location	OTDR Direction	What Must be Seen	Comment	Pulse Width to Use	Specific OTDR
Case2 All Customers are down after the second splitter	Customer's home disconnect the ONT	UpStream	Distribution fiber & fiber between the two splitters	Testing through the closest splitter is required	Medium pulse 100 to 300ns	In- Services OTDR -Short dead zone

In- Services OTDR to get the short dead zone .The OTDR used must be optimized for the better result and have the shortest possible dead zone and also the splitter typically provides 7 to 10 dB loss.

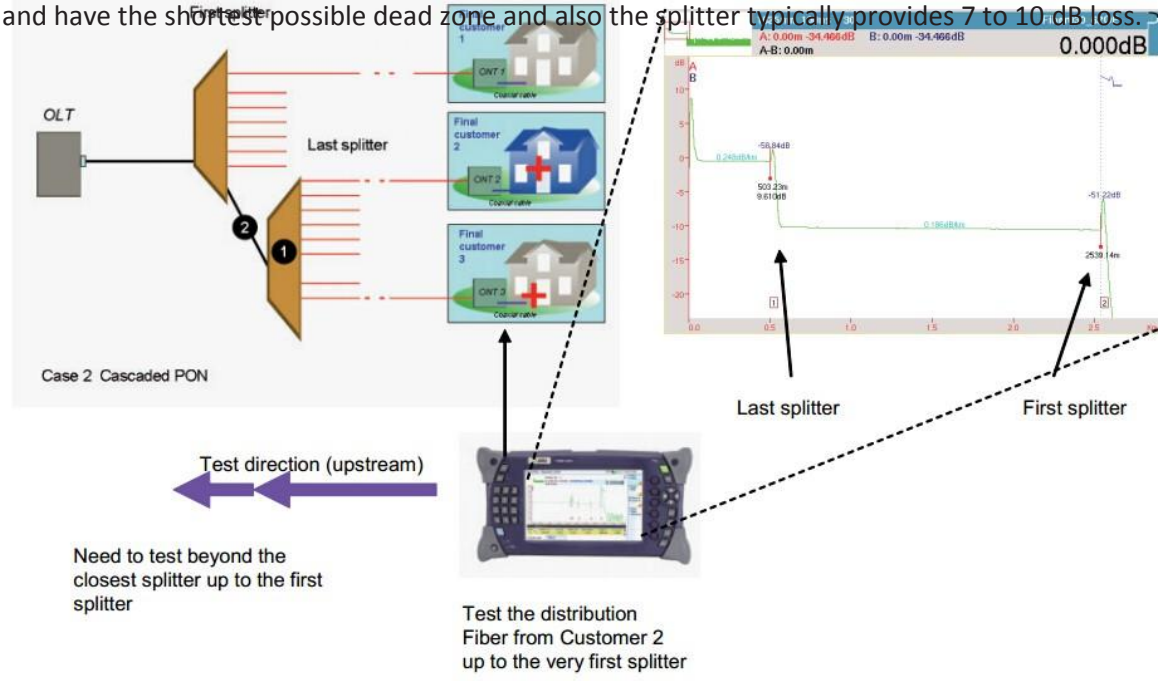

Fig. 3.12.1. OTDR is Short Upstream and Trace should Display the Traffic through the last splitter up to the First one

Case 3: Troubleshooting of the Feeder

Whether it is a non-cascaded network, information received at the NOC shows that all customers are down.As the problem likely comes from the feeder side, the most common way to test the faulty network is to shoot an OTDR downstream from the OLT (see Figure7.2.1, Test 6).

PON Maintenance & Troubleshooting Continued

Case	Test Location	OTDR Direction	What Must be Seen	Comment	Pulse Width to Use	Specific OTDR
Case3 All Customers are down	OLT	DownStream	Feeder	Testing through the splitter is unnecessary	Short pulse 3 to 30 ns	Unnecessary

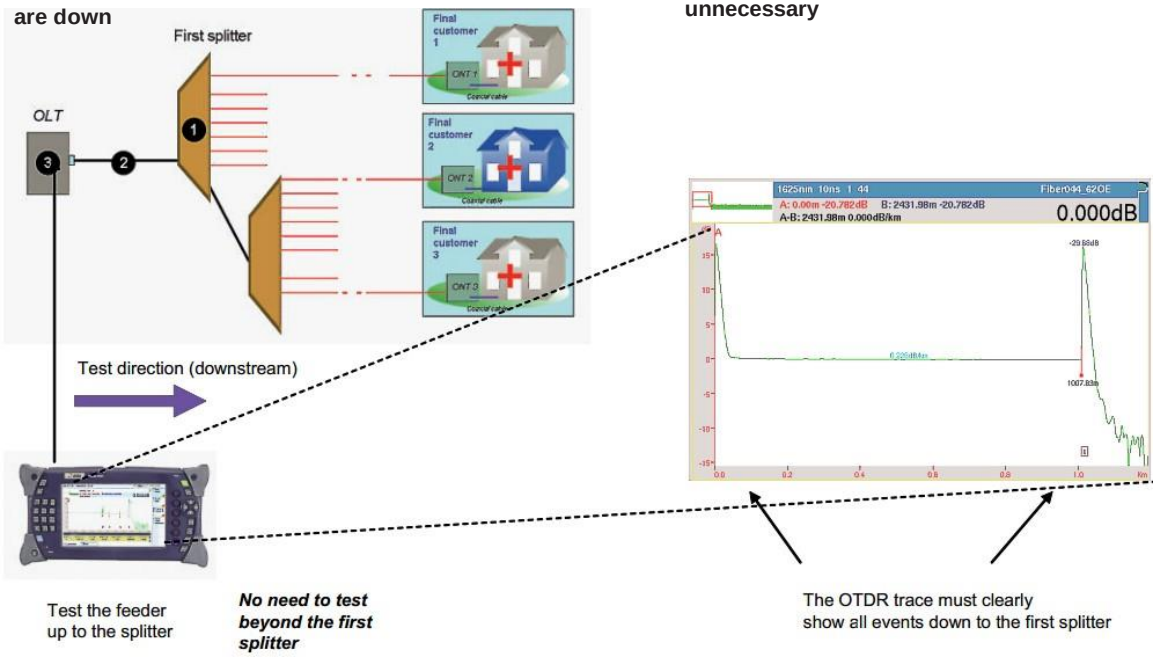

Fig. 3.12.2. OTDR is Short Upstream and Trace should Display the Traffic Down to the First Splitter

Troubleshooting the Distribution Fiber and/or the Fiber between Splitters with Alternative OTDR Testing from the OLT

when a faulty feeder is suspected OTDR testing directly from the OLT is surely the preferred choice (Case 3), but this method is not recommended for any other cases. PON OTDR instruments can run test through splitters and provide permissive traces. Analysis of the resulting trace will be completed only if linking that trace to the exact (precisely documented) network topology.

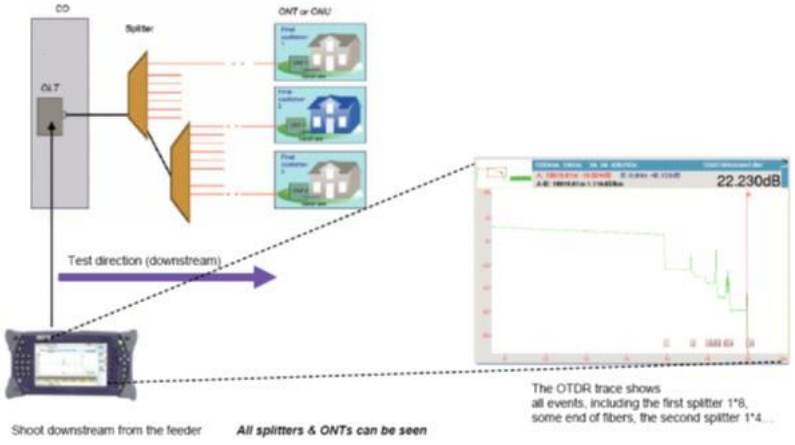

Fig. 3.12.3. OTDR is Short downstream and Trace Display Many Events that are Difficult to identify without Exact Network Topology (and corresponding distances)

PON Maintenance & Troubleshooting Continued

Complete PON Test Tools

Installation Phase

The following equipment may be used:

1. Loss test set (provides insertion loss and ORL, either unidirectionally or bi directionally)
2. OTDR

Turn-up Phase

The following equipment should be used in conjunction:

1. A PON power meter (1310/1490, 1490/1550, or 1310/1490/1550 nm)
2. IP testers (voice, data, video) and coaxial testers

Maintenance and Troubleshooting Phase

The following equipment should be used in conjunction:

1. A PON power meter (1310/1490, 1490/1550, or 1310/1490/1550 nm)
2. A loss test set or an OTDR
3. IP testers (voice, data, video) and coaxial testers

3.7.2 Features of ONT Hardware

Functions and features-ONT11

1. In Upstream direction

- ONT11 connects to OLT in the network through a passive optical network (PON) port to provide integrated access service.

2. In Downstream direction

- ONT11 connects with LAN Switches, PC, and STB etc. through Ethernet ports, to access data and video services.
- RJ11 ports are provided on ONT to connect phone or fax through POTS interfaces for extending Voice and FAX services.

Serves as a GPON network termination at users end to support broadband connection and access to triple play services.

Supports GPON access and network connectivity up to 488 Gbit/s data rates in downstream and 1.244 Gbit/s data rate in upstream

Four Ethernet ports (Tri rate 10/100/1000 Base-TX full-duplex) with RJ45 interface are provided on the ONT to extend all data and IP related services like Internet, IPTV, and VOD etc.

Two POTS ports are provided on ONT for Voice and FAX services through RJ-11connectors.

One virtual interface is provided on the ONT to support VEIP services. Through VEIP ONT can be configured in RGW mode to support Wi-Fi access for multiple users. ONT provides web-based configuration through IE browser.

ONT Software up-gradation is supported online remotely either through LCT or EMS.

ONT Rear Panel

Fig. 3.12.6. ONT Rear Panel

Fig. 3.12.7. ONT Bottom Side

System Management Interfaces

1. System management has been provided through two standardized interfaces:

2. Local Management Interface: The local manager is able to install, monitor, control and configure the GPON system.

3. EMS Interface: A GUI based Element Management System is provided to control and monitor the GPON system. This EMS interacts with the GPON system using standard SNMP V3 protocol. The EMS is able to support all the functions like Operation, Administration, maintenance.

Features of ONT Hardware Continued

UTL PON Splitter Specifications

Parameter	Unit		
Type	-	1 X 4	1 X 8
Operating wavelength	Nm	1260-1360 / 1480-1580	
Insertion Loss	dB	≤ 7.1	≤ 10.5
Uniformity	dB	0.5	0.8
PDL (max)	dB	<0.2	<0.2
Return Loss / Directivity	dB	>55	>55
Fiber Type	Single mode fibre, G.652/G.657A		
Working Temperature	^{0}C	-40 to +85	

3.7.3ONT LED and Its Identity

LED	Name	Status	Description
WIFI	WIFI service	On	WIFI function is enabled.
		Off	WIFI function is disabled.
ALM	Alarm indicator	On (red color)	Alarm indication on ONT
		On (green color)	ONT does not have any alarm
PON	ONT Ranging Status in GPON network	On	ONT is ranged with OLT
		Off	ONT is not ranged with OLT

Port	Function
Optical (OPT) port	One optical port for PON link connectivity to OLT.
GbE1 to GbE4	RJ-45 port: Ethernet interface to connect PC, Set top box or LAN switch through Ethernet cable. All ports supports 10/100/1000 Mbps in auto negotiation mode.
Ph1 & Ph2	To provide two voice telephone ports to connect to a phone or a FAX, so as to provide Voice and FAX services.
12VDC	To connect 12V DC Power supply through ONT CCU or AC/DC power adaptor
Power On/Off	ONT power ON/OFF switch to turn ON and OFF.
USB Port	To connect USB devices like printer etc.
RST	To Reset ONT (Soft reset only)

ONT LED and Its Identity Continued

LED	Name	Status	Description
PH-1	Phone	On	Voice port is enabled.
		Off	Voice port is disabled.
PH-2	Phone	On	Voice port is enabled.
		Off	Voice port is disabled.
PWR	Power	On	ONT Power supply is ON
		Off	Power supply is switched off

ONT Rear Panel GE LED Description

No.	LED status (LED Port Name)					Description
	GE-1	GE-2	GE-3	GE-4	GE-5 (VEIP)	
1	Green Glowing	Green Glowing	Green Glowing	Green Glowing	No LED	Physical Link Up
2	Amber Glowing	Amber Glowing	Amber Glowing	Amber Glowing	No LED	Logical link up with end device
3	Amber Blinking	Amber Blinking	Amber Blinking	Amber Blinking	No LED	Traffic flow @ various speed

ONT Site Line Diagram

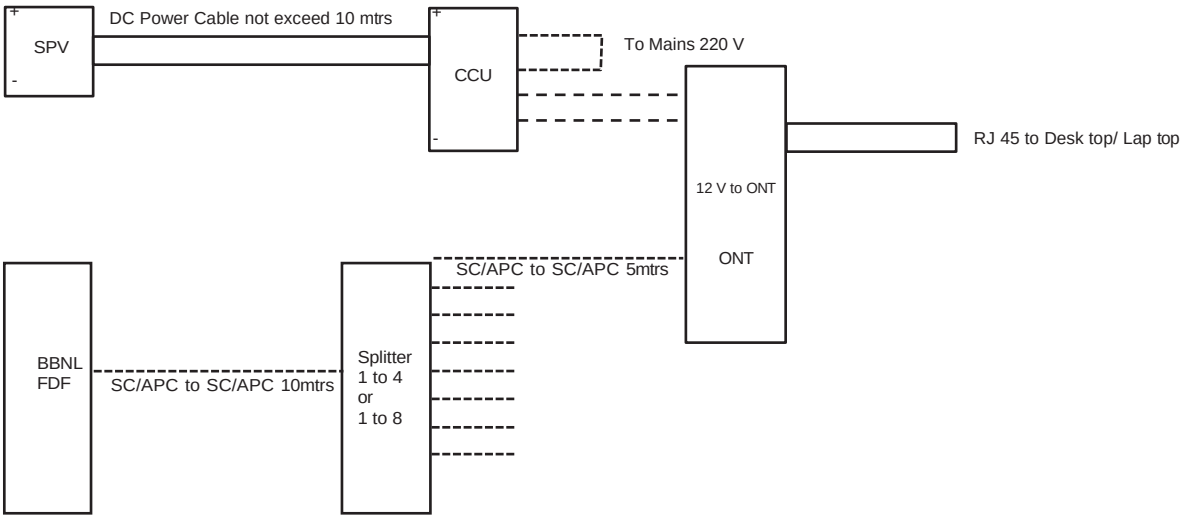

Fig. 3.12.8. ONT Site Line Daingram

CCU Monitoring Panel Indicators

Battery level

1. Various levels are displayed through LEDs as shown below:
   - 100 – 75: Battery charged level is between 75 to 100 % and the LED will be ON Green.
   - 5 – 50: Battery charged level is between 50 to 75 % and the LED will be ON Green.
   - 50 – 25: Battery charged level is between 25 to 50 % and the LED will be ON Green.
   - Low: Battery charged level is below 25 % and the LED will be RED. In this condition the ONT will be off or otherwise if ONT is on the same should be made off if both the inputs are absent.
2. Current and Voltage monitoring points are also provided on the CCU panel. These monitoring points help to measure the voltage and current for various requirements like Mains output, Solar output, CCU load (ONT Input) and Battery.

CCU Monitoring Panel Indicators Continued

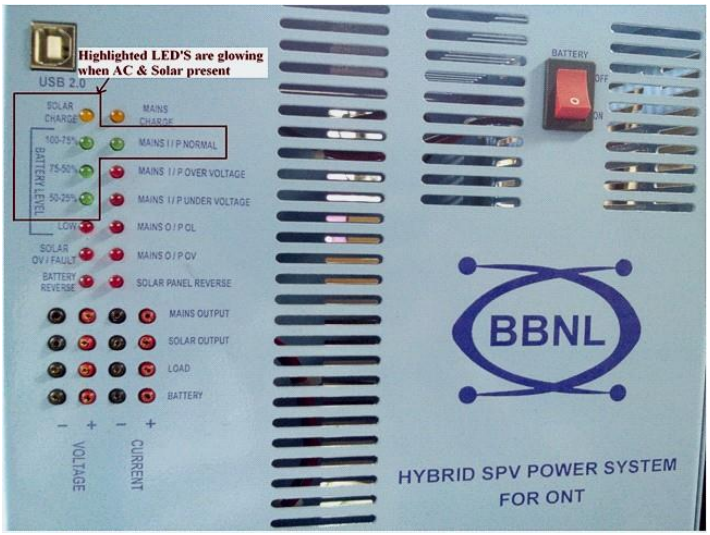

Fig. 3.12.9. Highlighted LED's are glowing when AC & Solar Present

Fig. 7.3.0. Highlighted LED's are glowing when AC only Present

Fig. 7.3.1. Highlighted LED's are glowing when Solar only Present

3.7.4CCU Monitoring Panel Indicators

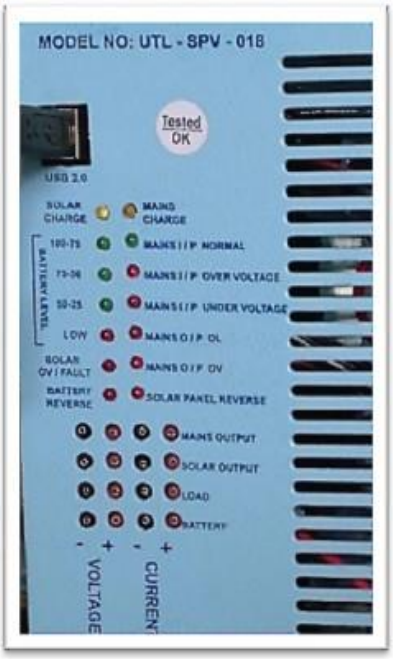

Fig. 7.3.2. CCU Monitoring Panel

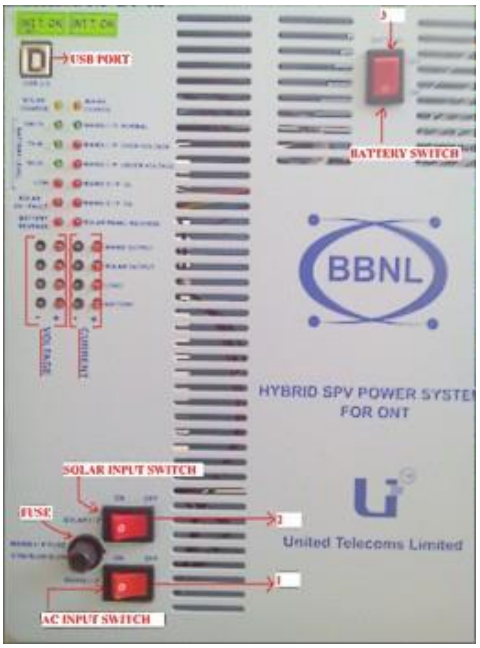

Fig. 7.3.3. Hybrid SPV Power System for ONT

1. Mains Charge: Amber LED should be ON when battery is being charged through AC.
2. Mains I/P Normal: AC mains is in operating range the LED will be ON & Green.
3. Mains I/P Over Voltage: AC voltage above the operating voltage level; LED is RED.
4. Mains I/P Under Voltage: AC voltage below the operating voltage level; LED is RED.
5. Mains O/P OL: High current is being derived on AC mains.
6. Mains O/P OV: High voltage is being delivered for battery charging; LED is RED.
7. Solar Panel Reverse: When SPV panel wires are connected with reverse polarity the LED will be RED.
8. Solar Charge: Amber LED should be ON when battery is being charged through Solar Input.
9. Solar OV / Fault: This shows the either the Solar panel voltage is high or not available. The LED will be RED in such conditions.
10. Battery Reverse: If LED is RED, this indicates that the Battery is connected in reverse polarity and action is required accordingly.

Optical specifications of optical ports on GPON ONTs

Parameter	Wavelength (nm)	Unit	Minimum	Maximum
Transmit power	1310	dBm	+0.5	+5
Received power	1490	dBm	-27	-9

Exercise

1. How do you identify ONT Status.

Ans. _____

_____

_____

2. List all the ONT Ports & LED's.

Ans. _____

_____

_____

3. List the Services offered by ONT.

Ans. _____

_____

_____

4. Explain CCU Operation.

Ans. _____

_____

_____

5. Explain ONT site survey procedure.

Ans. _____

_____

_____

Tips

Visit to ONT - GP site and discuss issues in ONT site installation.

Observe ONT hardware units , its ports type & power supply connections.

UNIT 3.8: ONT Status Check

Unit Objectives

At the end of this module, you will be able to understand:

1. ONT status check
2. LED verification
3. CCU Status Verification
4. Reporting and Corrective measurement
5. ONT configurations(services)
6. ONT preventive maintenance and troubleshoot

3.8.1 ONT Status Check

ONT in the real time will be monitored by executive at the panchayats location. The ONT performance will vary as and when the link goes down with OLT, Splitter. There are other consequences that ONT could fail in the field. So checking the ONT status is primary concern for the Village level executive. Below listed few steps to find out the status of ONT

3.8.1 ONT Status Check - LED Verification

Checking for -ONT Rear Panel correctness as per below Specification/ tables references

LED	Name	Status	Description
WIFI	WIFI service	On	WIFI function is enabled.
		Off	WIFI function is disabled.
ALM	Alarm indicator	On (red color)	Alarm indication on ONT
		On (green color)	ONT does not have any alarm
PON	ONT Ranging Status in GPON network	On	ONT is ranged with OLT
		Off	ONT is not ranged with OLT

LED	Name	Status	Description
PH-1	Phone	On	Voice port is enabled.
		Off	Voice port is disabled.
PH-2	Phone	On	Voice port is enabled.
		Off	Voice port is disabled.
PWR	Power	On	ONT Power supply is ON
		Off	Power supply is switched off

ONT Status Check - LED Verification Continued

No.	LED status (LED Port Name)					Description
	GE-1	GE-2	GE-3	GE-4	GE-5 (VEIP)	
1	Green Glowing	Green Glowing	Green Glowing	Green Glowing	No LED	Physical Link Up
2	Amber Glowing	Amber Glowing	Amber Glowing	Amber Glowing	No LED	Logical link up with end device
3	Amber Blinking	Amber Blinking	Amber Blinking	Amber Blinking	No LED	Traffic flow @ various speed

3.8.1 Charge Coupler Unit (CCU Status Verification)

Verifying the leds in CCU Monitoring panel indicators

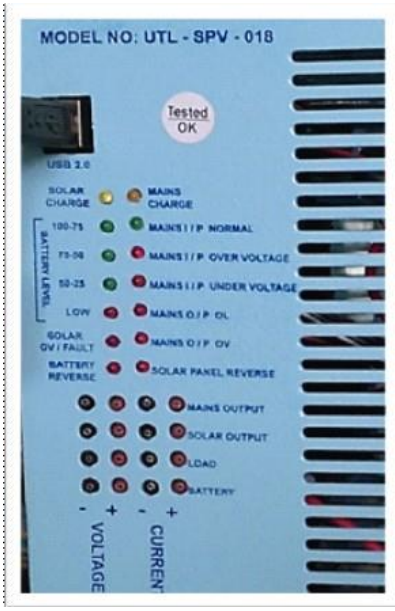

Fig. 3.13.1. Charge Coupler Unit

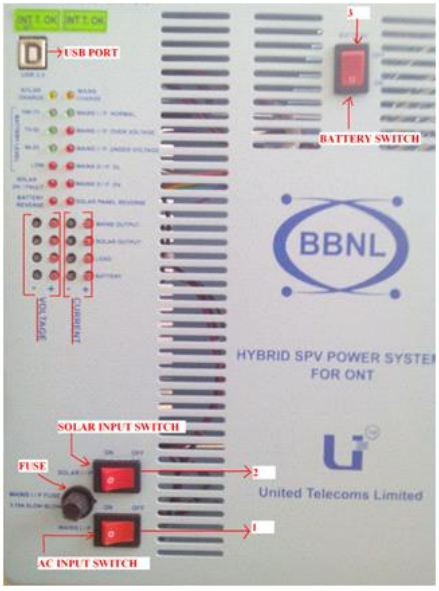

Fig. 3.13.2. Charge Coupler Unit with LED

Check for :

1. Mains Charge: Amber LED should be ON when battery is being charged through AC.
2. Mains I/P Normal: AC mains is in operating range the LED will be ON & Green.
3. Solar Charge: Amber LED should be ON when battery is being charged through Solar Input.

Issues if:

1. Mains I/P Over Voltage: AC voltage above the operating voltage level; LED is RED.
2. Mains I/P Under Voltage: AC voltage below the operating voltage level; LED is RED.
3. Mains O/P OL: High current is being derived on AC mains.
4. Mains O/P OV: High voltage is being delivered for battery charging; LED is RED.
5. Solar Panel Reverse: When SPV panel wires are connected with reverse polarity the LED will be RED.

Solar OV / Fault: This shows the either the Solar panel voltage is high or not available. The LED will be RED in such conditions.

Battery Reverse: If LED is RED, this indicates that the Battery is connected in reverse polarity and action is required accordingly.

Checking the Battery level

Battery level should be under green LED

Various levels are displayed through LEDs as shown below:

1. 100 - 75: Battery charged level is between 75 to 100 % and the LED will be ON Green.
2. 5 - 50: Battery charged level is between 50 to 75 % and the LED will be ON Green.
3. 50 - 25: Battery charged level is between 25 to 50 % and the LED will be ON Green.

- Low: Battery charged level is below 25 % and the LED will be
- RED. In this condition the ONT will be off or otherwise if ONT is on the same should be made off if

CCU Status Verification Continued

Snaps to identify the power modes

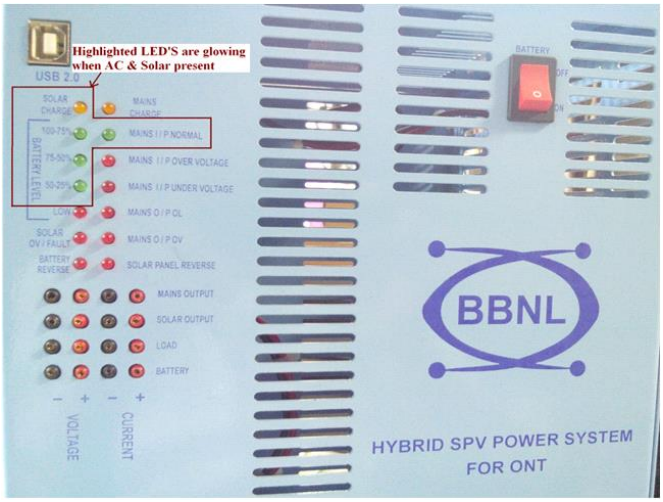

Fig. 3.13.3. Solar & AC Present

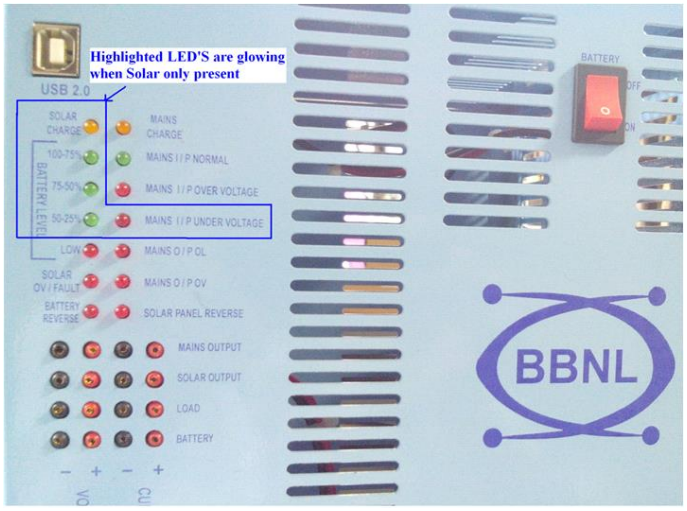

Fig. 3.13.4. Solar Present

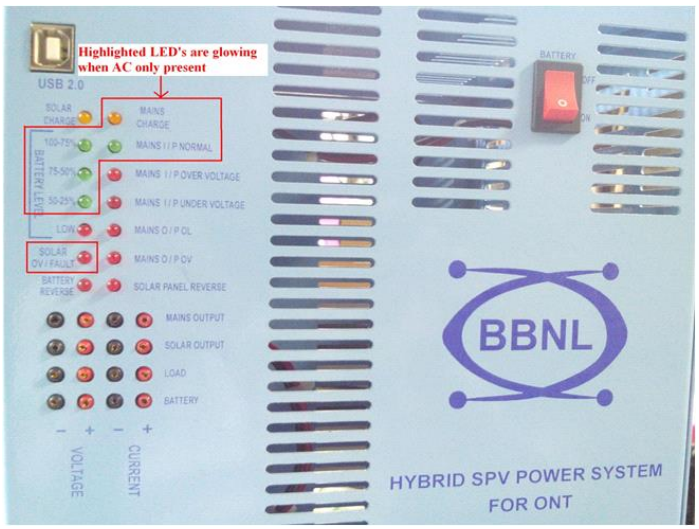

Fig. 3.13.5. AC Present

Exercise

1. Define ONT.

Ans. _____

_____

_____

2. Explain ONT Hardware.

Ans. _____

_____

_____

3. Define CCU.

Ans. _____

_____

_____

4. Explain the ONT Status check Procedure referred to ONT LED's.

Ans. _____

_____

_____

_____

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_____

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_____

_____

5. Discuss CCU Power Level LED's.

Ans. _____

_____

_____

_____

_____

_____

UNIT 3.9: ONT Service Configuration

Unit Objectives

At the end of this module, you will be able to understand :

1. ONT Service Configuration
2. ONT HSI Configuration
3. ONT WiFi Configuration
4. ONT IPTV Configuration
5. ONT VOIP Configuration

3.9.1 HSI Service Configuration

1. Verify from the central office that HSI connection is already configured through LCT/EMS in central office on the Ethernet port of ONT11.
2. Connect one end of an Ethernet (LAN) cable to the corresponding Ethernet port ofONT11 and its other end to a PC or laptop as per requirement.
3. On the PC, open Network Sharing Centre by pressing the start menu button on the left side of Desktop screen and selecting Control Panel option.

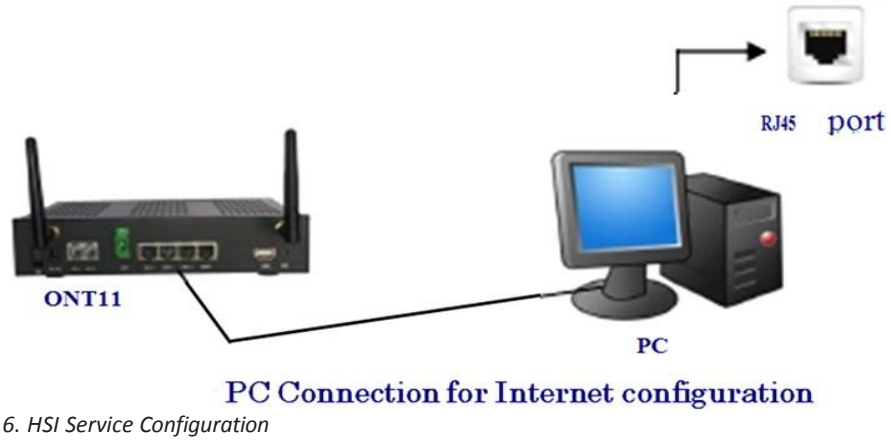
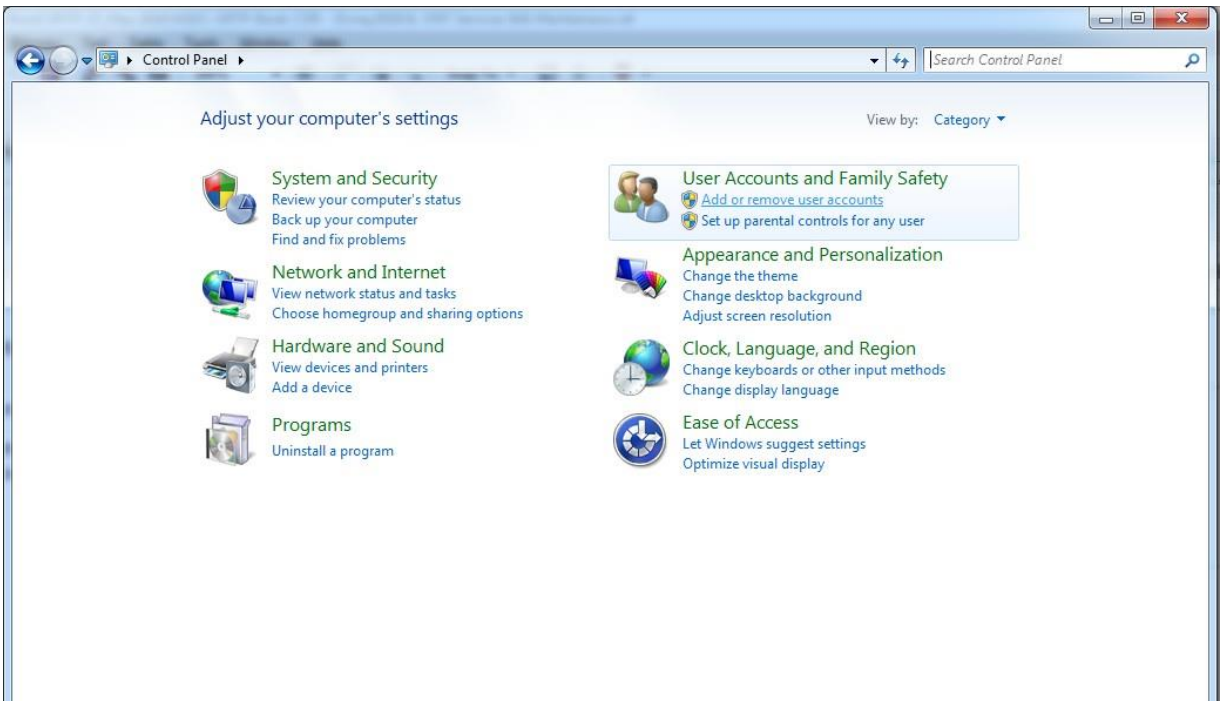


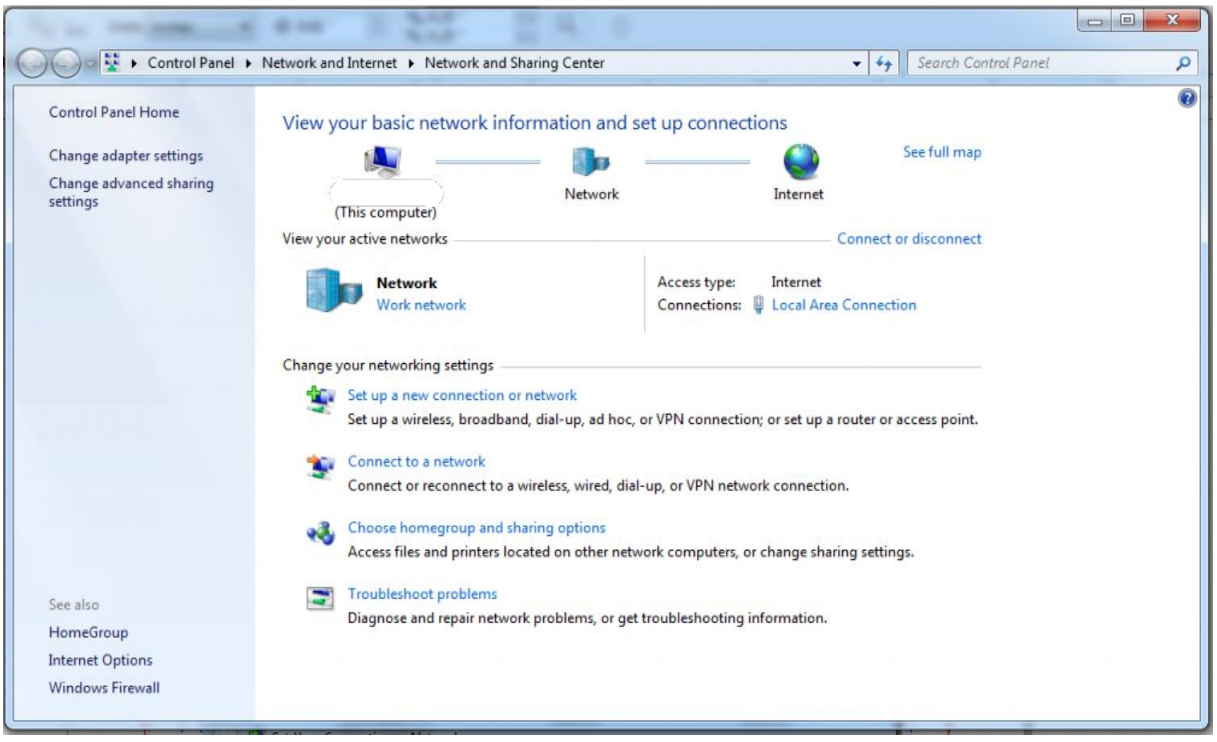
Fig. 3.13.6. HSI Service Configuration

Once you have the Control Panel window open, select the Network and Internet Option and then the Network Sharing Centre option in the subsequent window.

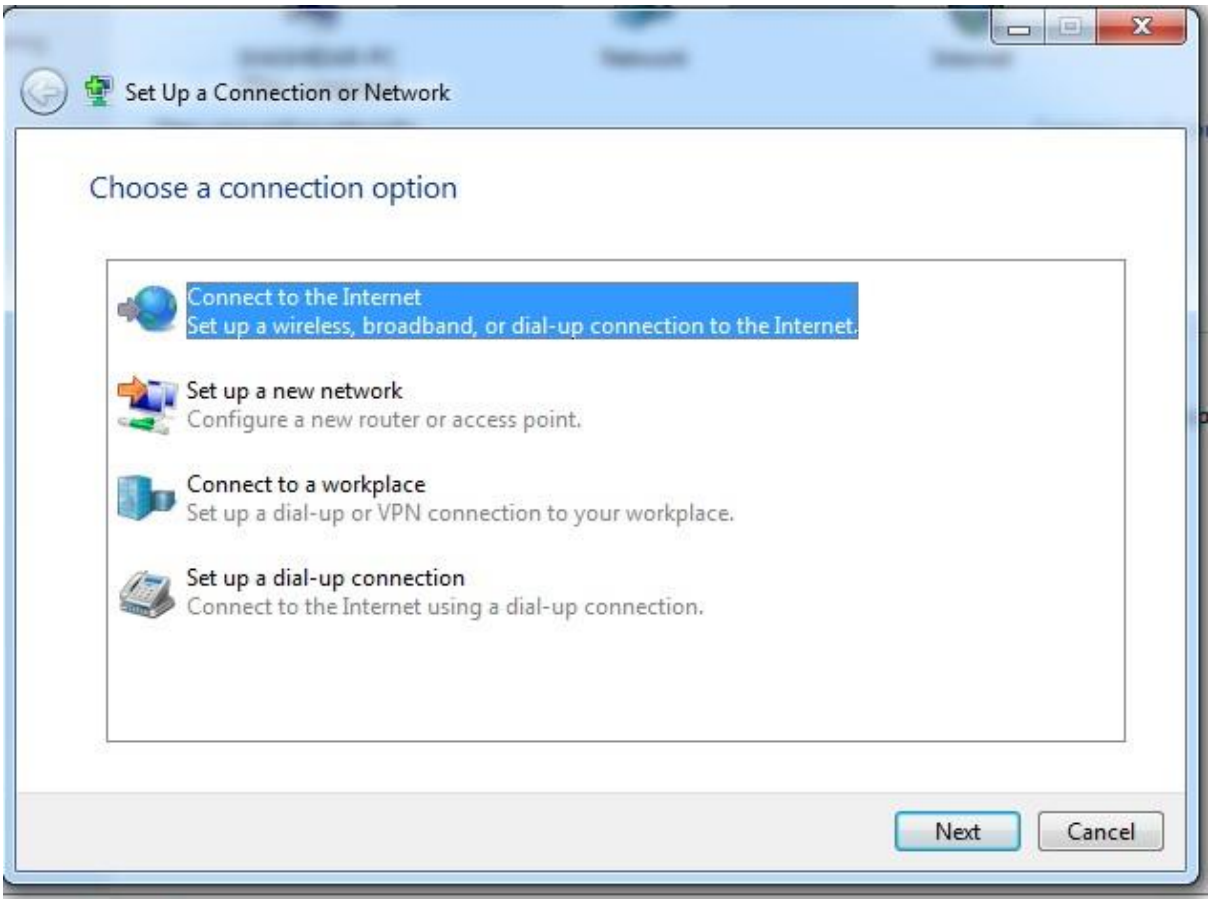
3.9.2 HSI Service Configuration



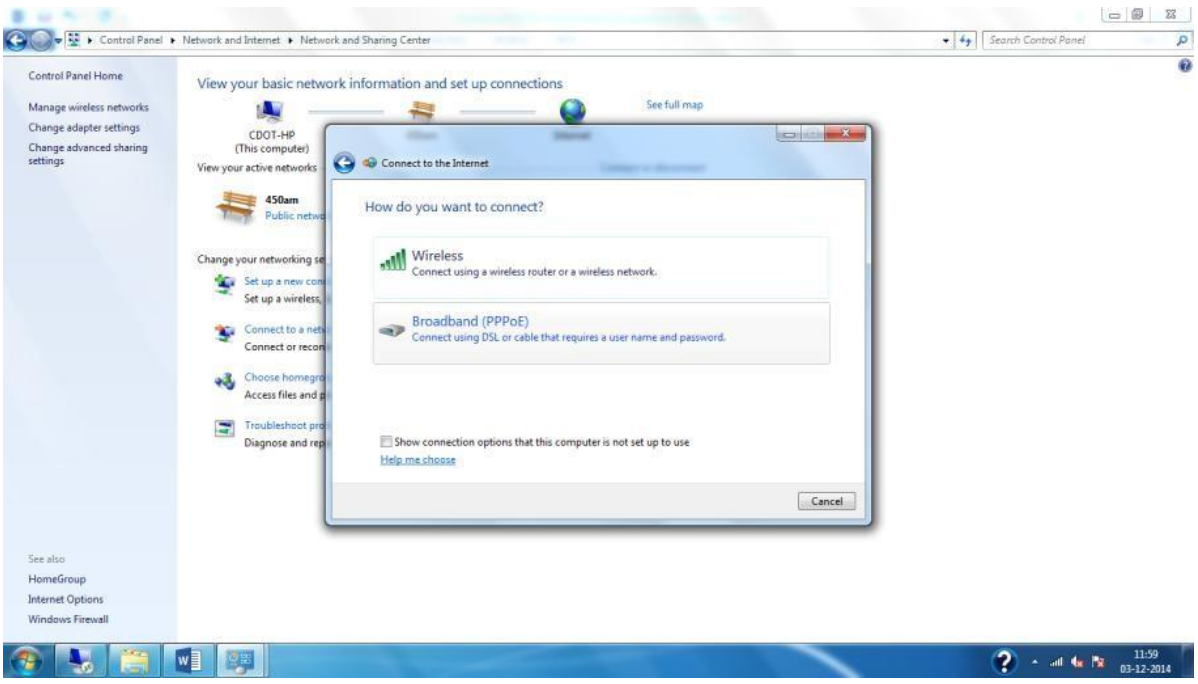
In the Network Sharing Centre window, under the 'Change your networking settings tab', select the 'Set up a new connection' option and click on 'Next' in the subsequent window.



HSI Service Configuration Continued

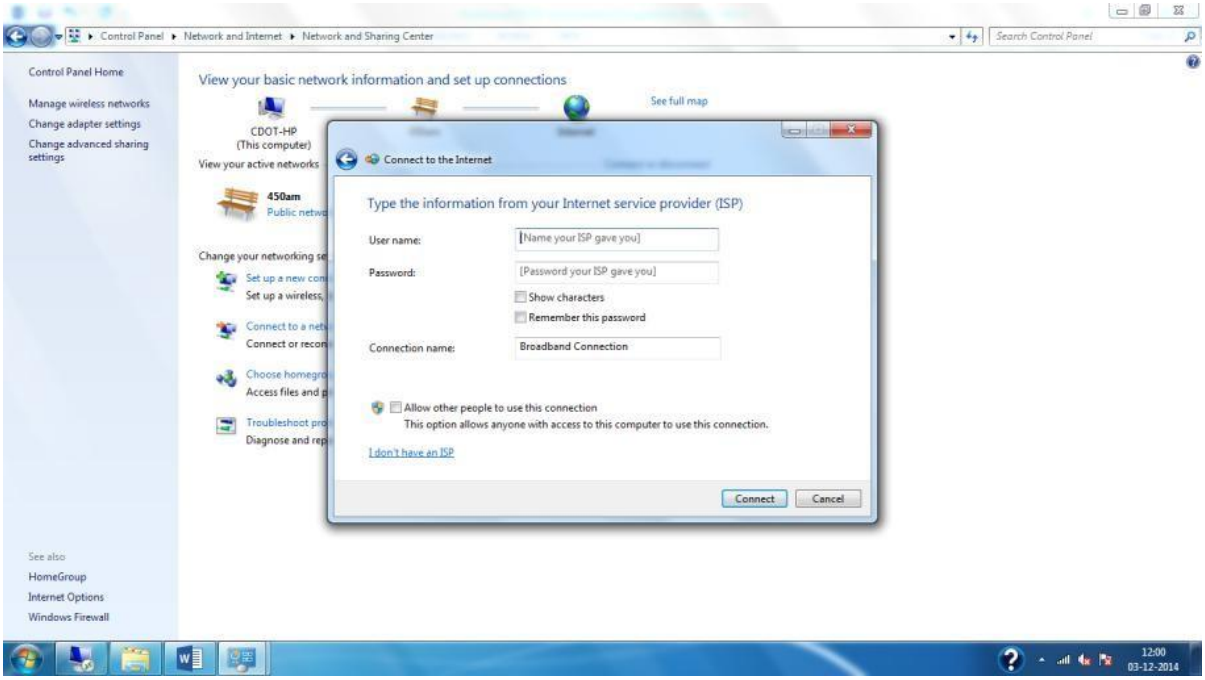


Select the Broadband (PPPoE) option from the current window as shown below.



HSI Service Configuration Continued

Now you will have a window where you need to enter the User name and password as provided by your service provider and once you have entered all the relevant details click on 'Connect' and you are ready to avail the Internet service.

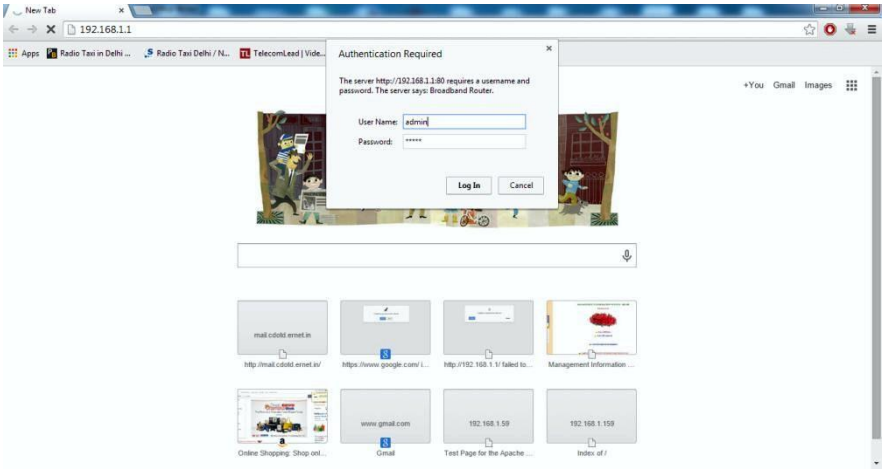


3.9.3 Configuration of PPPoE Service

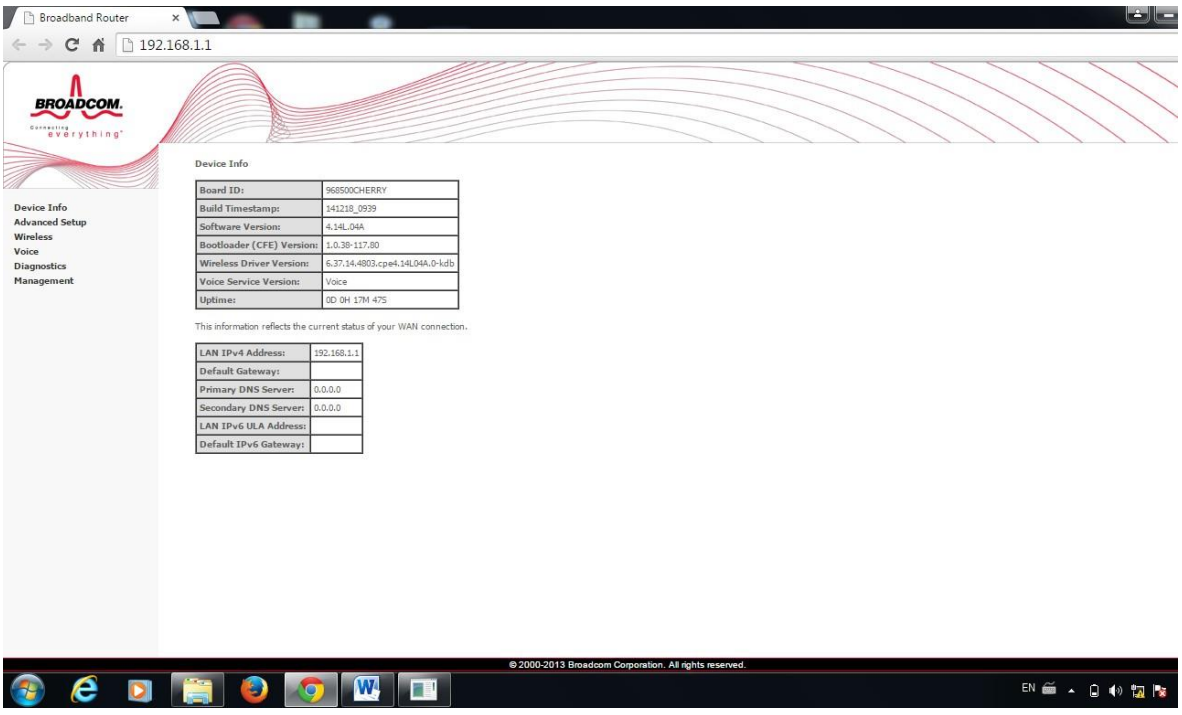
Connect PC/Laptop to any Ethernet port on ONT as shown in Fig. Further configuration to be done as per following steps: -

1. Configure a PC / Laptop in DHCP mode and connect it to one of the LAN ports of ONT on which PPPoE connection is already created, so that it gets an IP from the Residential Gateway.
2. Go to command prompt in connected laptop and check the received IP by typing "ipconfig" in Windows and "ifconfig" in Linux. It will receive an IP from the subnet with network ID 192.168.1.x.
3. Open an Internet browser in the connected laptop / PC. Browse the following site: http://192.168.1.1.
4. The ONT Gateway Config page will open and ask for user name and password. Login with Username: "admin" and Password: "admin". Enter these fields and click login button
5. Open the ONT Gateway Configuration page and further configuration is to be done in the following steps.

User name and password is required to start this configuration

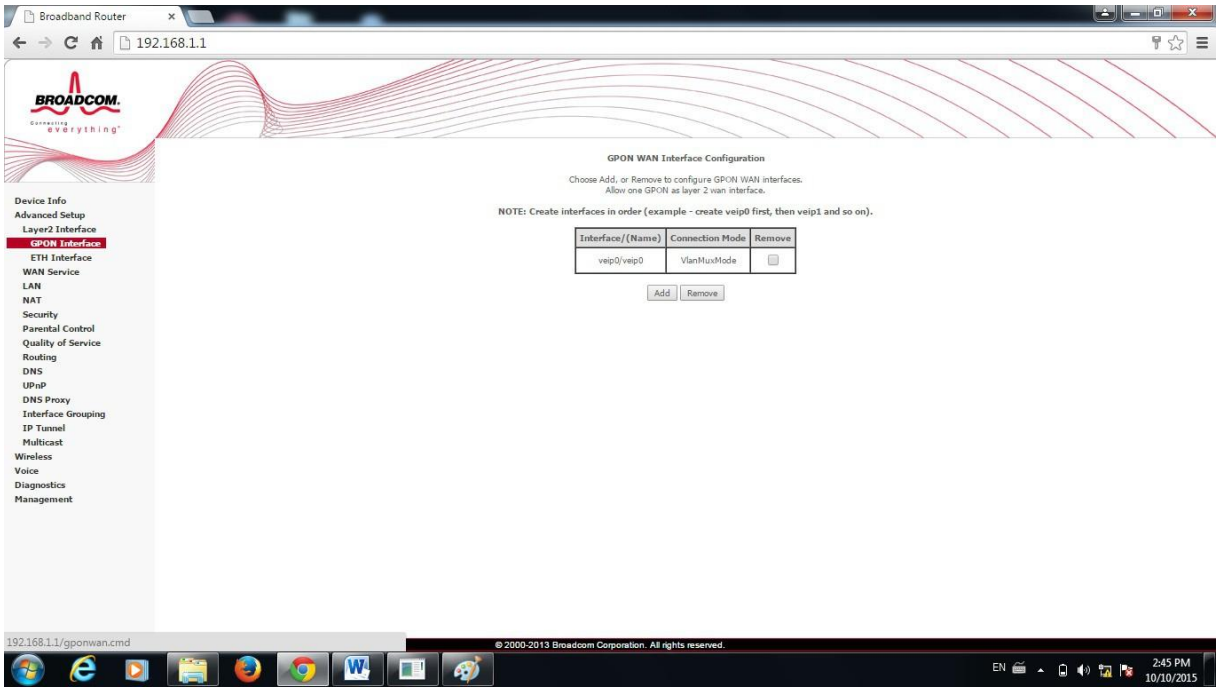


On the ONT Gateway Configuration page select 'Advance Setup' in the left side menu.

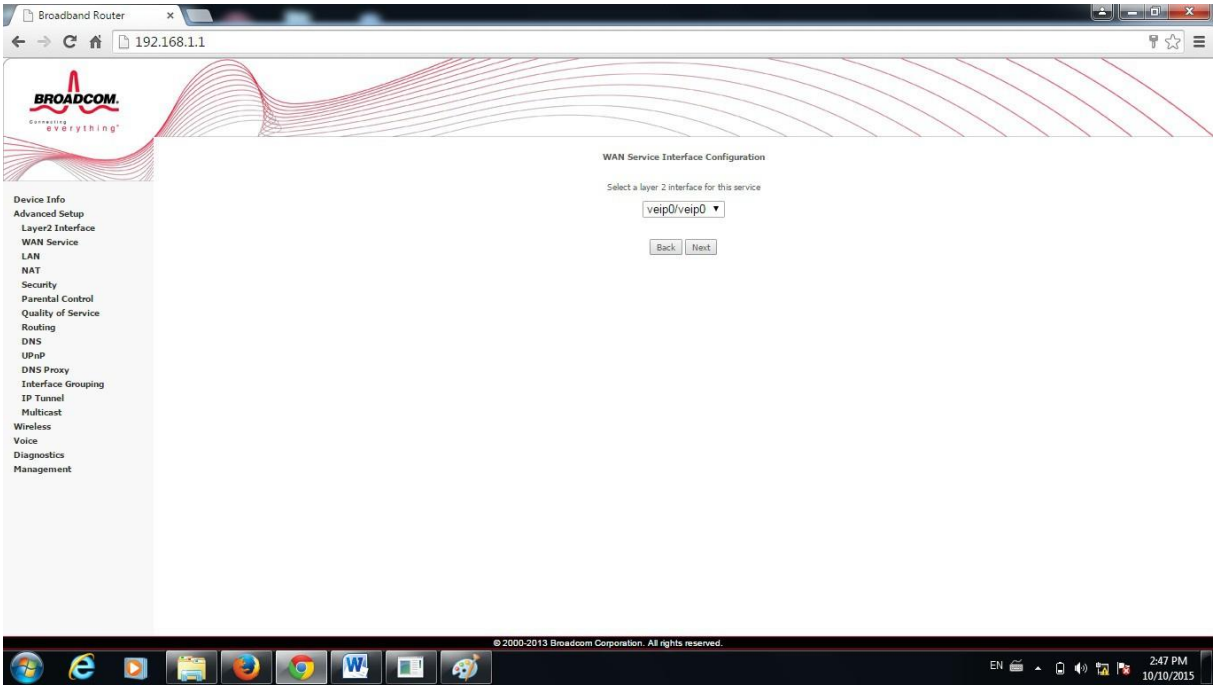


Configuration of PPPoE Service Continued

Then select Layer2 Interface and select GPON Interface in the sub-menu.



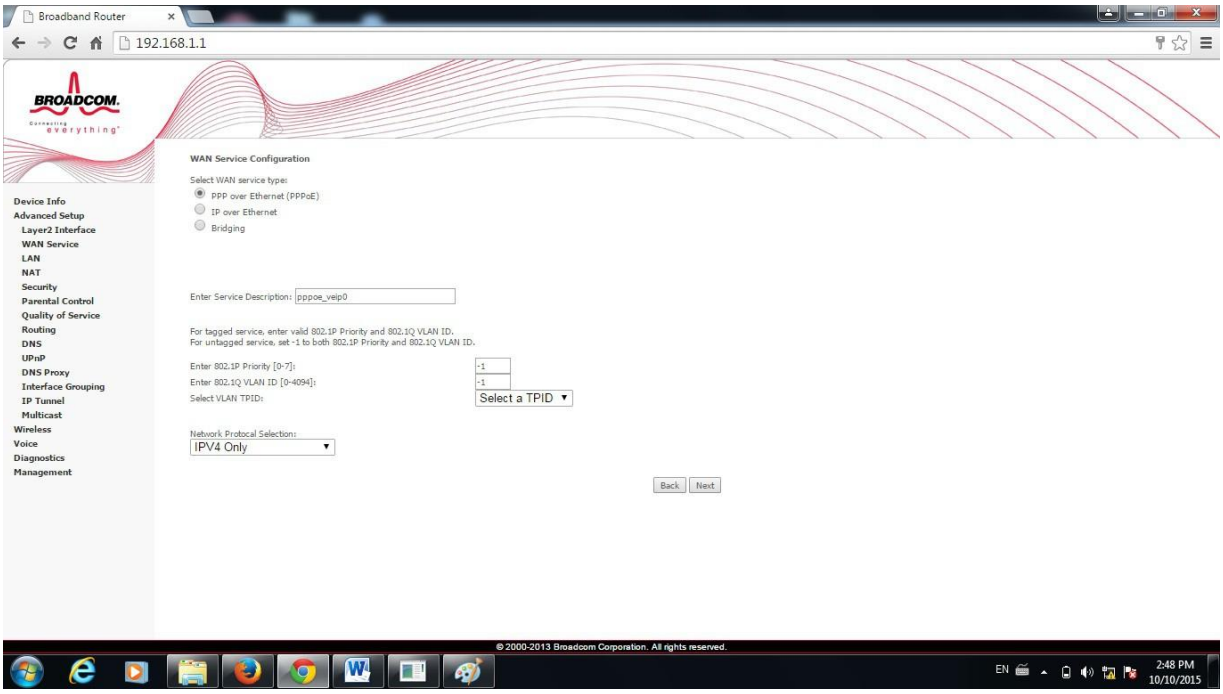
On the above page, click on Add and then Apply/Save on page mentioned below.



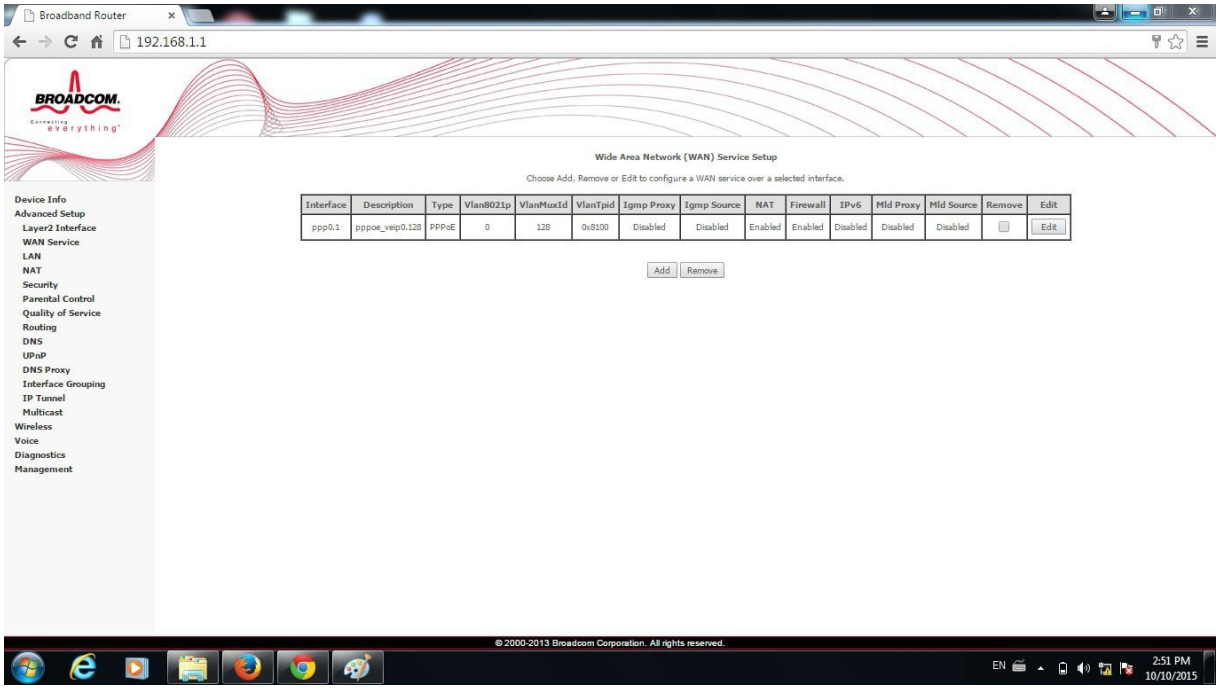
Click Next

Configuration of PPPoE Service Continued

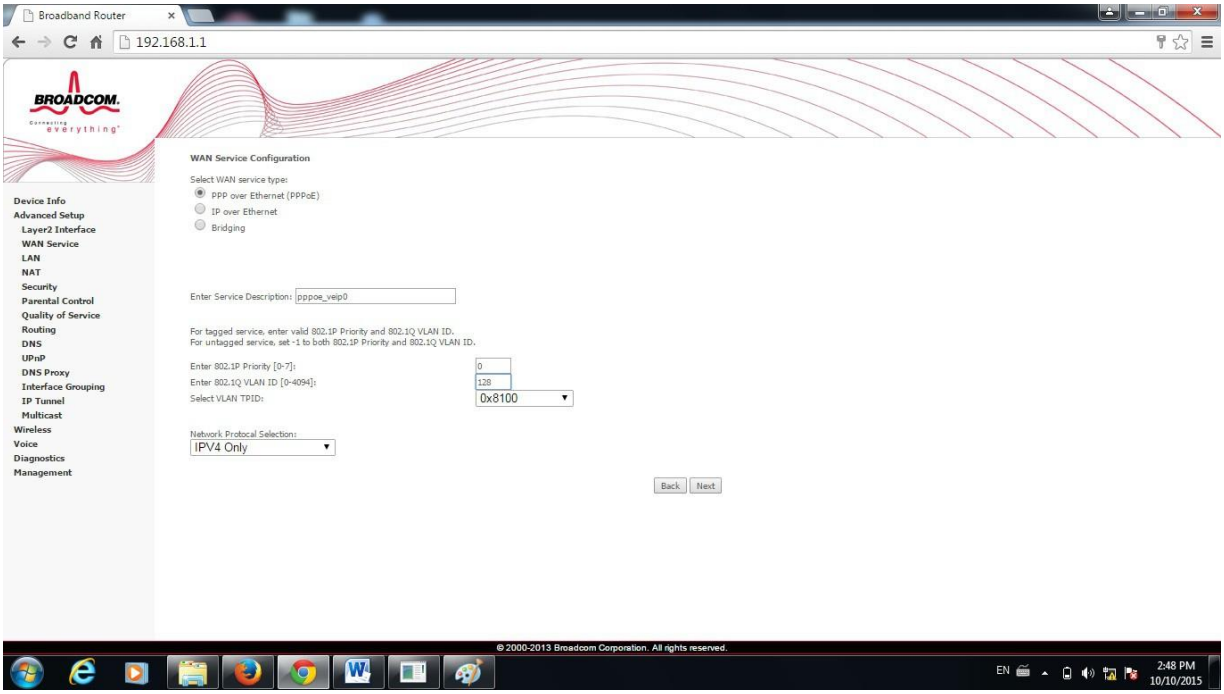
Then, go to WAN Service on the left side menu. On the right side a page titled WAN Service Setup will appear.



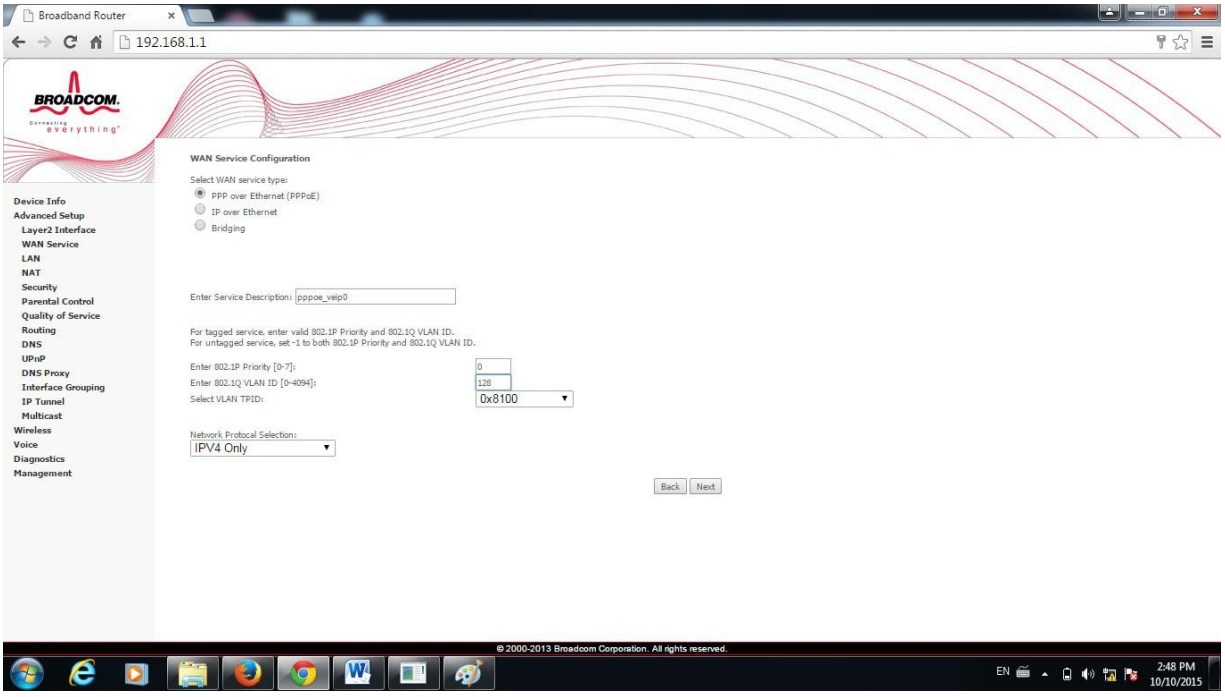
If there is a row in the service table, select remove check box in the 2 nd last column in the row and then press remove button below the table.



Configuration of PPPoE Service Continued

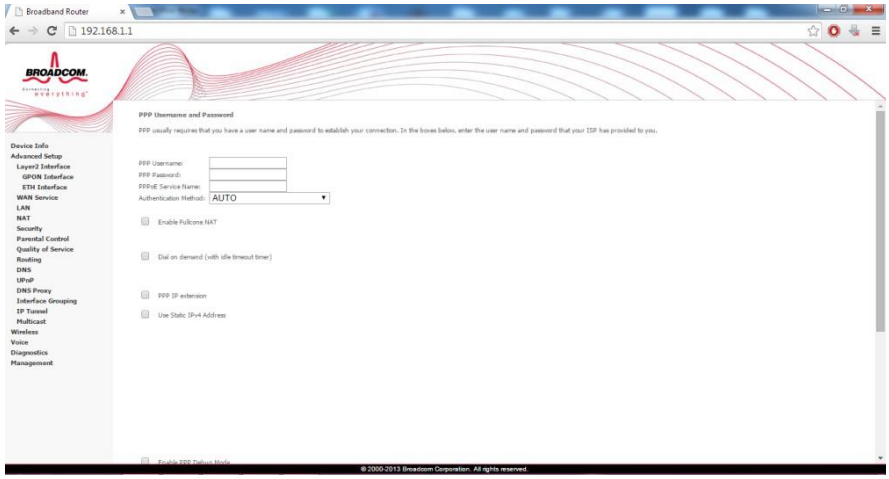


For PPPoE Service Configuration, select PPPoE radio button else select IP over Ethernet.

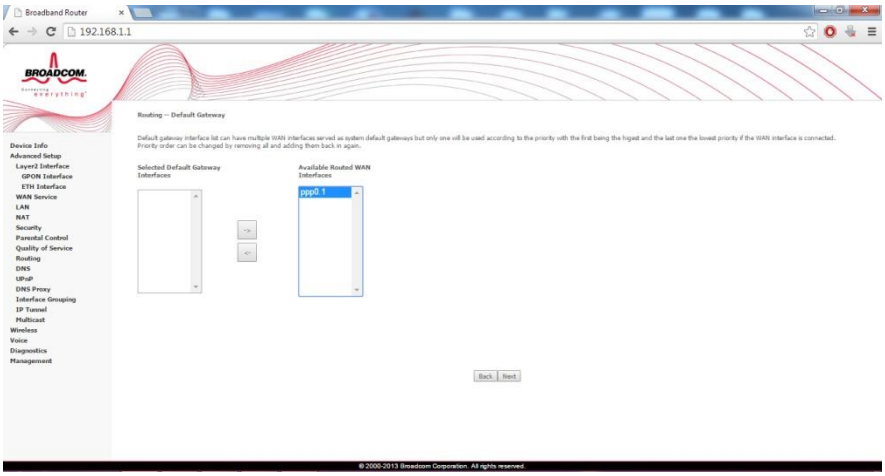


Configuration of PPPoE Service Continued

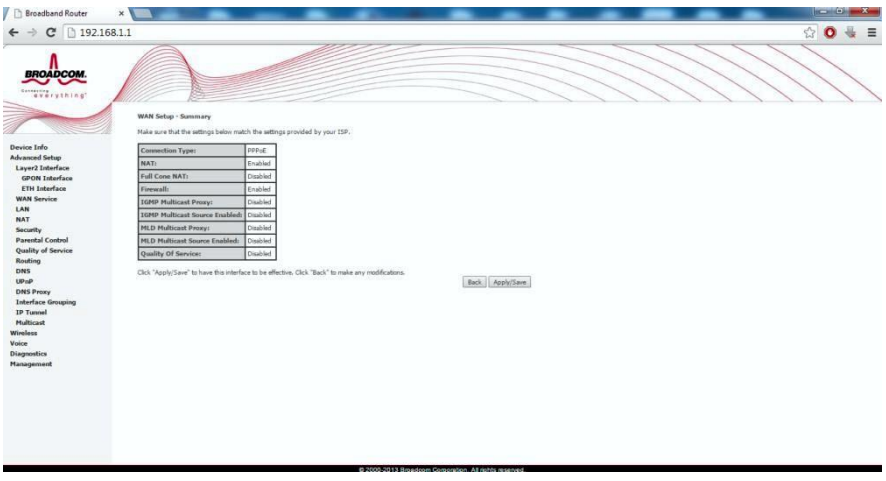
In the text boxes below, provide VLAN ID and P-bit of the connection



Press next



Provide information on the next pages as per the service preference
Finally Press Apply/Save. then close the window.
Now the ONT is ready for use with PPPoE connectivity and can be used for accessing the internet



3.9.4 Configuration of Wi-Fi Service

ONT 11

Wi-Fi enabled laptop

Fig. 3.13.7. Wi-Fi Configuration

Configuration of Wi-Fi Service

After login in to 192.168.1.1 from configuring system

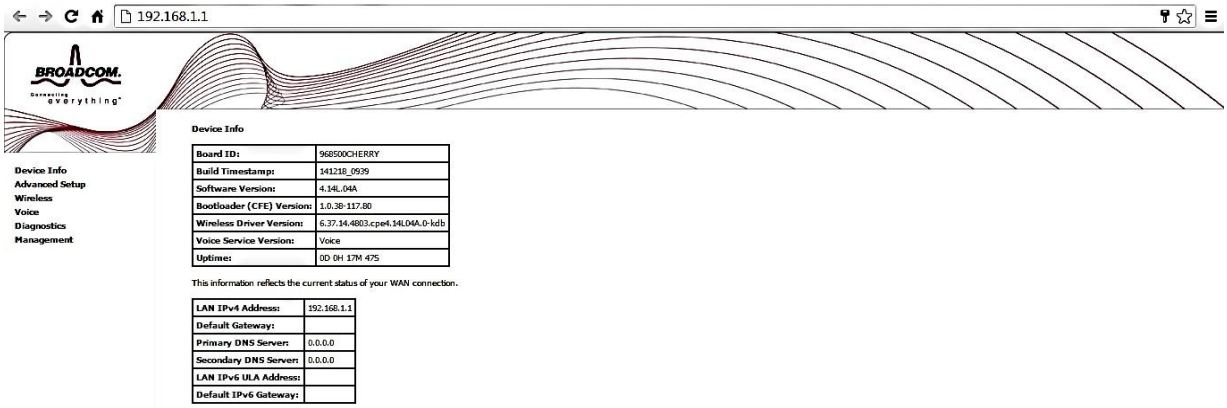
1. Select Wireless in the left side menu.
2. Then select Basic in the sub-menu.
3. On the page, select "Enable Wireless" and provide the SSID in the space provided below.
4. Select "India" in the country menu.
5. Uncheck guest access points if you desire not to configure them.
6. Press Apply/Save.
7. Now select "Security" in the Wireless sub-menu.
8. Select Network Authentication type and Encryption and click Apply/Save.
9. Now the ONT is ready for use with Wi-Fi connectivity and can be used for accessing the internet. Now enable the Wi-Fi port on Laptop to connect to the Wi-Fi network of ONT11

Wi-Fi Configuration at ONT site level on Mobile

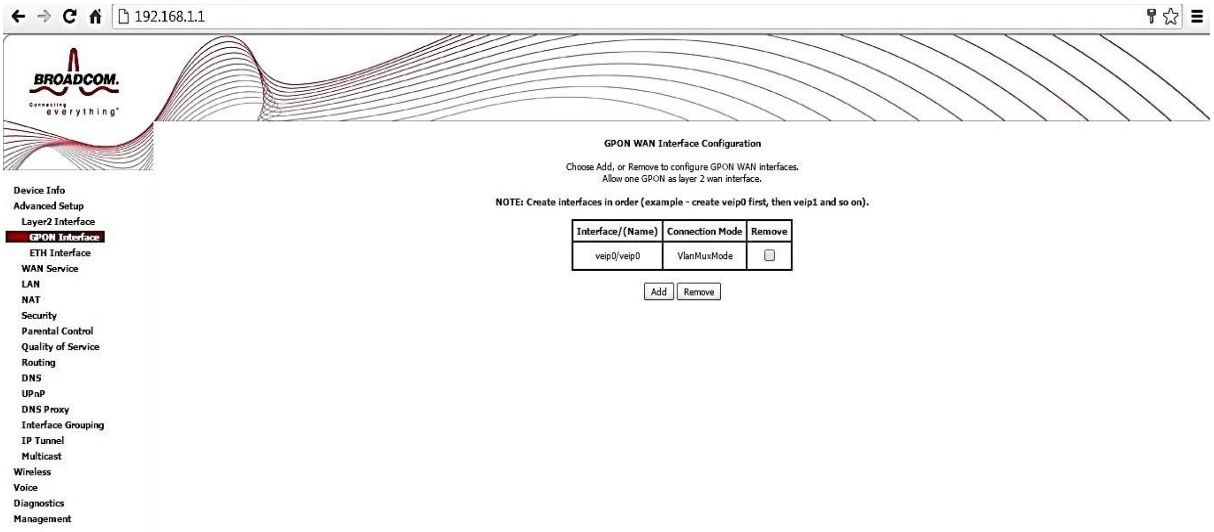
1. After configuring WIFI setup @OLT we have to do wifi setting @ ONT
2. Enable Wifi mode In Mobile
3. Detect the Wifi Name & Select the Wi-Fi {wifi name configured will be shared }
4. Open Google/Mozilla/IE browser
5. Enter 192.18.1.1. on browser tab by entering link on browser opens up Configuration page

Wi-Fi Configuration at ONT Site Level on Mobile Continued

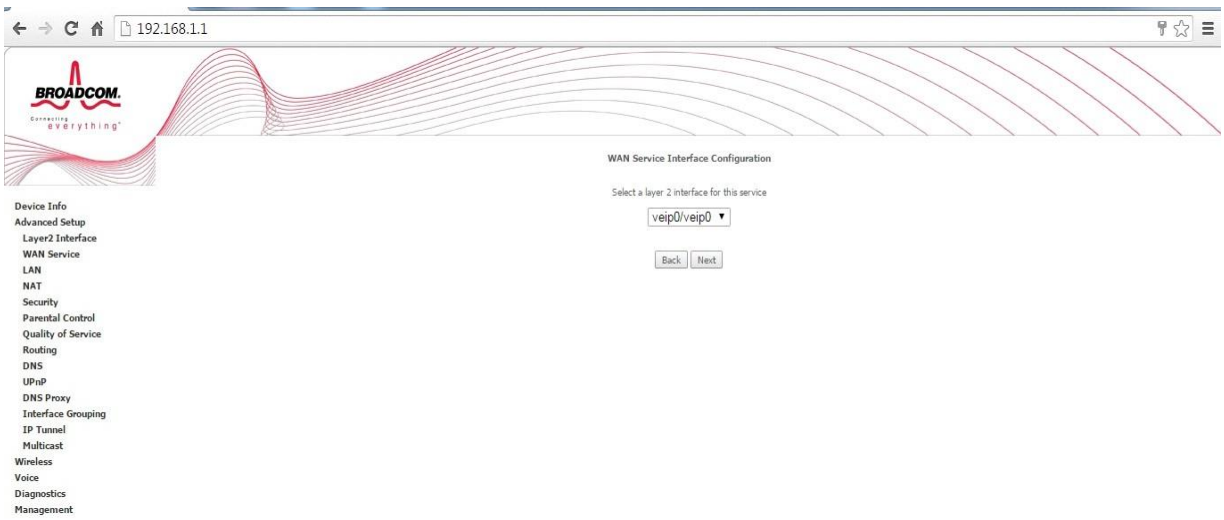
Select 'Advance Setup' in the left side menu



Then select Layer2 Interface and select GPON Interface in the sub-menu.

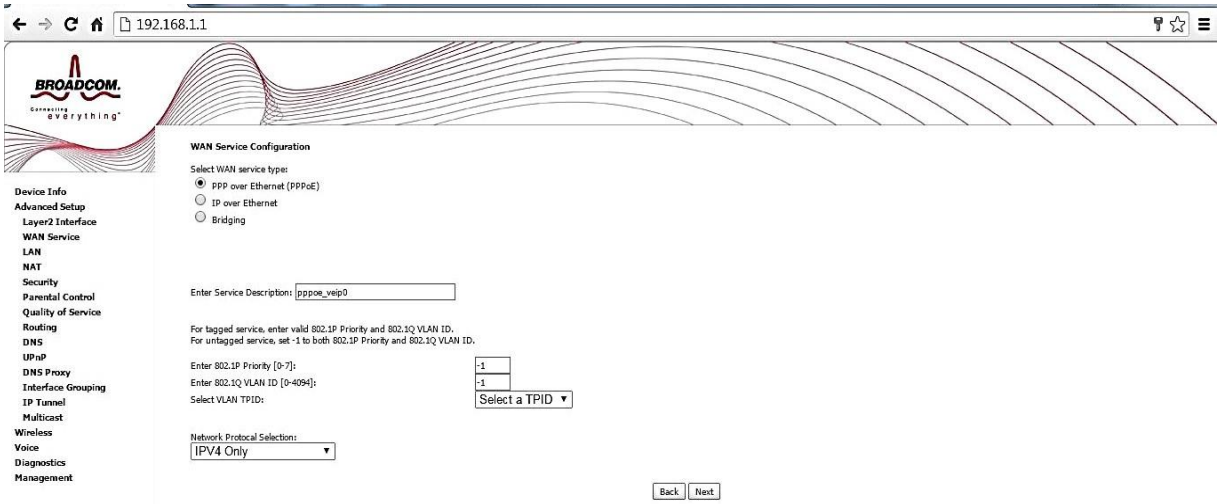


On the above page, click on Add and then Apply/Save on page mentioned below

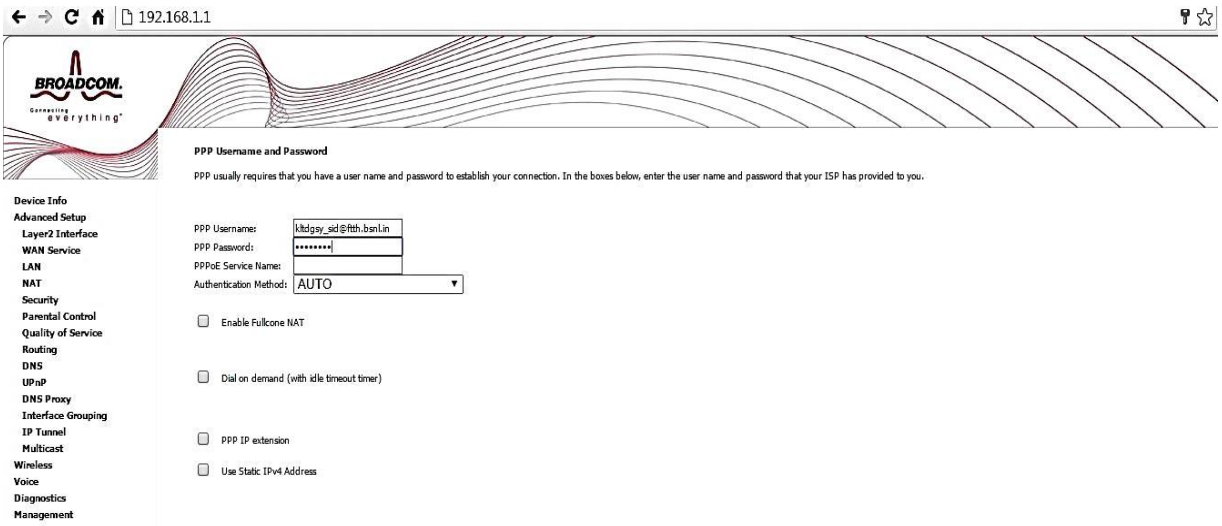


Wi-Fi Configuration at ONT Site Level on Mobile Continued

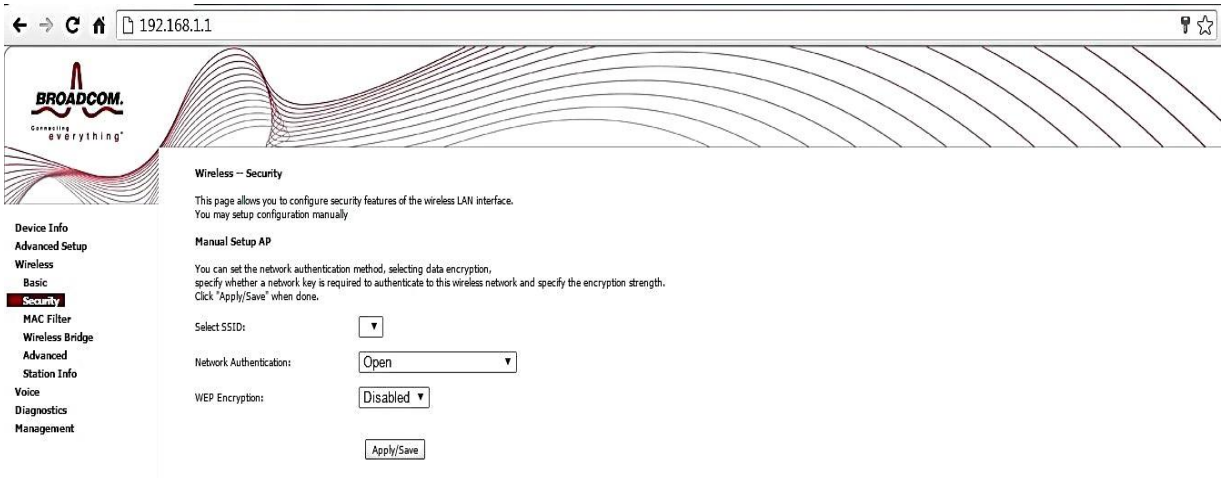
Then, go to WAN Service on the left side menu. On the right side a page titled WAN Service Setup will appear, select as shown



Enter Username and Password

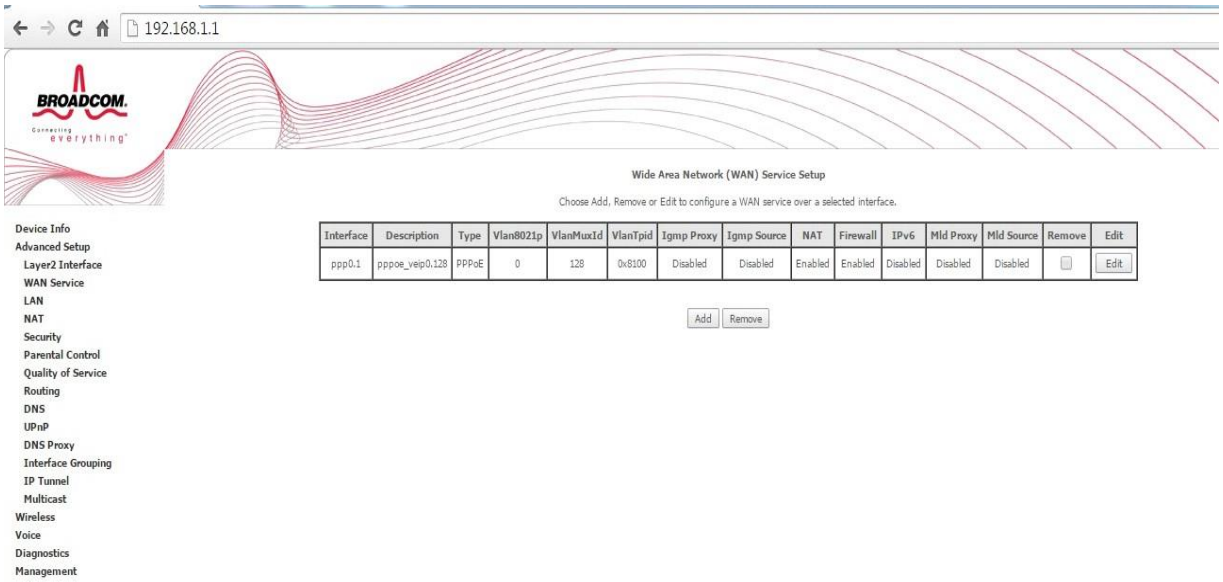


Select SSID Apply and save

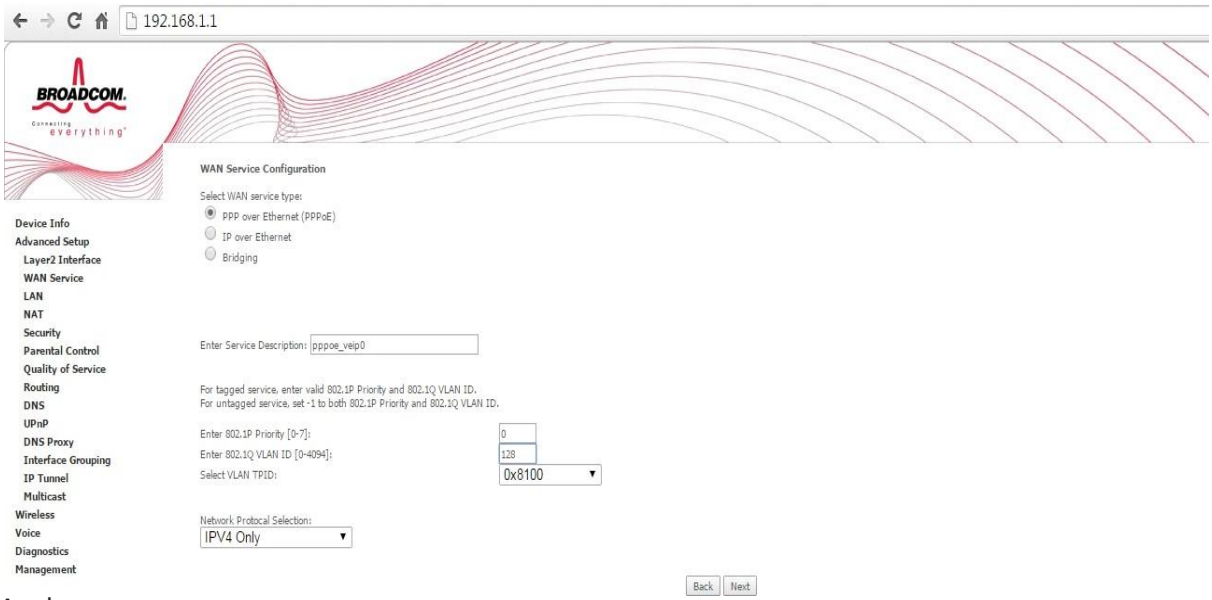


If there is a row in the service table, select remove check box in the 2nd last column in the row and then press remove button below the table.

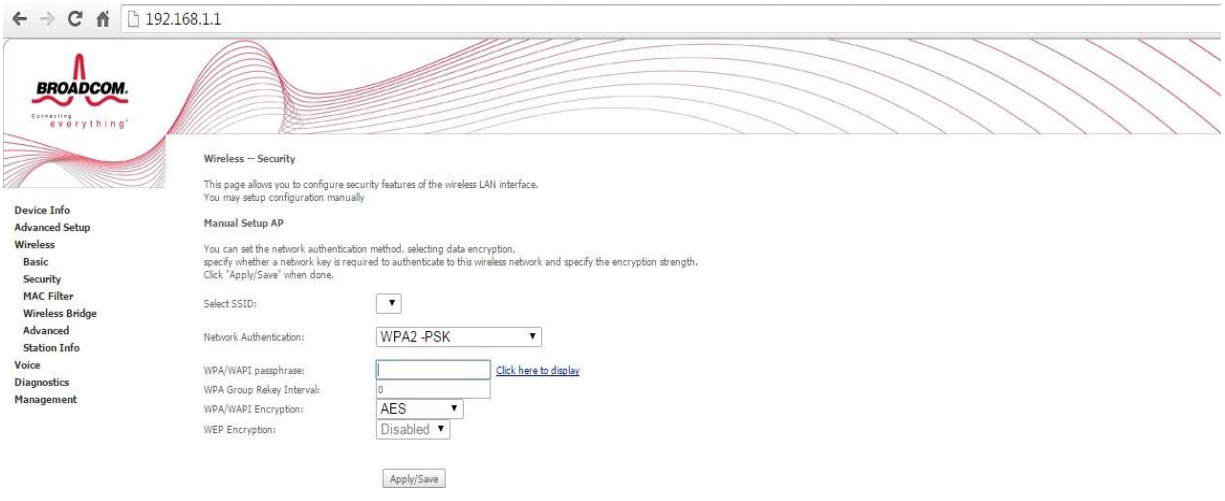
Wi-Fi Configuration at ONT Site Level on Mobile Continued



In WAN configuration enter the vlan tpid as 0x8100



Apply



3.9.5 IPTV Configuration

Do the connection as shown in the connection diagram. once the OLT engineer provide access the set up will start working.

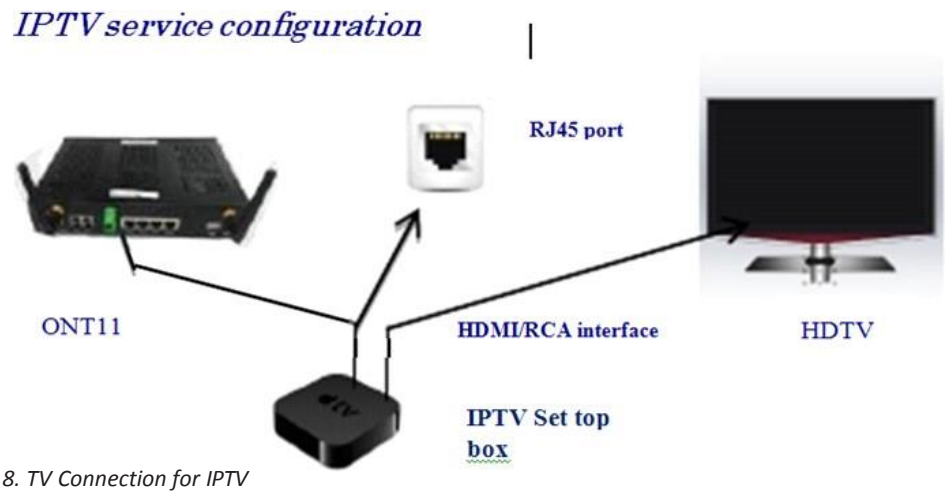


Fig. 3.13.8. TV Connection for IPTV

Procedure for IPTV configuration

Verify from the central office that IPTV connection is already configured through LCT/EMS in central office on the Ethernet port of ONT11. Connect the 'IPTV set top box 'to the Ethernet port of ONT11 through CAT-6 cable as per Fig in last slide. Connect RCA/HDMI cable between 'IPTV set top box 'and TV.

Now the ONT is ready for use with IPTV connectivity.

3.9.6 Phone(voice)/FAX Service Configuration

Fig. 3.13.9. Phone / FAX connection for Voice & FAX Service

Procedure for Phone(voice)/FAX service configuration

Verify from the central office that VOIP connection is already configured through LCT/EMS in central office on the phone port of ONT11. Connect the phone instrument/ FAX to the phone port of ONT11 RJ-11 2-wirecable. Now the phone/FAX is ready for voice and FAX service.

Exercise

1. Explain ONT HSI Configuration Procedure.

Ans. _____

2. Explain ONT WI-FIConfiguration Procedure.

Ans. _____

3. Explain ONT IPTV Configuration Procedure.

Ans. _____

4. Explain ONT VOIP Configuration Procedure.

Ans. _____

Unit 3.10: ONT Preventive Maintenance

Unit Objectives

At the end of this module, you will be able to understand:

1. Availability of required equipment
2. ONT Preventive Maintenance
3. ONT-Patrolling Practices

Availability of required equipment

Knowing what equipment you own is ultimately the goal of telecom inventory management. You can grasp the role each piece of equipment has to play by taking into account every product, even ones you may initially perceive as unnecessary. As services advance, this makes it much simpler to build upon network resources.

Operators could discover that their telecom inventory is challenging to manage since it is constantly expanding. It's critical to maintain awareness of the contents of your warehouse in order to develop an effective strategy and reduce wasteful spending.

You may avoid paying for unnecessary equipment by optimising your network inventory. It may be possible to see a quick return on your investment and clear up space in your warehouse by removing superfluous product from. As a result, you might be able to decrease the size of your current area and cut your warehouse expenses.

The fact that technology is always evolving is another factor in the significance of telecom equipment management. Every day, new services and lines are launched. Operators can end up adjusting their inventory frequently to meet demand as a result.

Additionally, it is preferable to deal with excess inventory as quickly as possible. The equipment's worth will gradually decline the older it gets. Manage your assets now to take advantage of the best pricing.

The stress of the job might be lessened with effective inventory management. Many network operators lack the time necessary to run their own equipment. This is where a service provider's inventory management system comes in.

Maintenance report form

The upkeep performed at predetermined intervals or in accordance with the established criteria has the goal of lowering the likelihood of failure on the decline in facility functionality.

Functional inspections and services carried out according to a schedule are referred to as preventive maintenance. It is predicated on the idea that if a thorough maintenance schedule is followed, a significant number of equipment failures or malfunctions can be avoided. Preventive Maintenance is carried out on a regular basis on the fans, seals, cables, connectors, batteries, towers, shelters, mounting ancillaries, and fences that support the cell sites. Even while preventative measures are taken to keep the network operational and the quality of the cell site facilities, unforeseen incidents may still happen.

Reconcilers, power distribution units, cabling, connections, grounding, and batteries are all components of the power systems. The maintenance items, condition assessment, reference standard, and servicing needed for a power system for a cell site are listed in the table below:

Item	Condition Assessment	Reference Standard	Service Required
Power cables	Check the connections of power cables carefully.	The power cables are not aging, and there is no corrosion on the connection points.	Notify to the NOC/Field Management. Renew cable connectors if possible
Voltage of Power Distribution Units or Power Supply	Measure the voltage delivered by the Power Distribution Units using a multimeter.	Voltage levels are within the operative ranges.	Notify to the NOC/Field Management if Voltage is out of allowed ranges.
GND Cables	Check whether the GND cable and grounding bar are connected properly.	The connection points are solid with no corrosion on them	Notify NOC/Field Management. Renew cable connectors and/or grounding systems if possible.
Earth resistance	Measure the earth resistance by using an electric earth resistance tester.	The grounding resistance of the cabinet is less than 5 ohms.	Notify NOC/Field Management . Renew cable connectors or cabling if possible
Batteries	Check the batteries voltage and connections.	The battery capacity is within the normal range and the batteries are correctly connected without the presence of corrosion or leaks	Notify NOC/Field Management. Replace battery/batteries

Fences, towers, ladders, and a shelter—should one exist—make up the facility's surroundings. The maintenance items, Condition Assessment, Reference Standard, and service standards needed for the facilities and room environment are listed in the table below.

Item	Condition Assessment	Reference Standard	Service Required
Environmental alarms	Check whether power supply alarms, fire alarms, or smoke alarms are reported.	No power supply alarms, fire alarms, or smoke alarms are reported.	Notify Field Management about any malfunction. Perform emergency actions if its required. In the case of sensors reporting false alarms, replace sensors.

Tower Inspection	Check overall condition of Tower	-There is no evidence of damage on the tower body, -The foundations and structural supports are solid. -In the case of a guyed tower, the cables are well secured -In the case of monopoles, the post is not inclined. -The ladders are solid and there is no presence of oxidation. -The paint is well preserved	Notify, Field Management about any degradation on the tower.

3.10.1 ONT Preventive Measurements

1. Always cover optical patch cord open end and put cap on optical port of ONT when fiber cable is not connected.
2. Connect only matching optical connector (SC/APC), generally green in colour to ONT optical port also with green color.
3. ONT should only be connected to network fiber when its optical power is received between -10dBm to

Patrolling Practices-Dealing with SFP/SFP+

SN	Do's
1.	Always handle SFP/SFP+ with clean hands
2.	Keep cover on SFP while handling/ dealing with any SFP.
3.	Always ensure the right SFP is being put in correct slot.
4.	Insert the SFP into the receptacle on the card in right position.
5.	Always check the correct position before inserting the same to slot.
6.	Slide the SFP into the receptacle until you hear a click, indicating that the SFP is securely seated in the receptacle.
7.	Always ensure the SFP is locked in to receptacle and the locking leaver is pushed to its position.
8.	Before pulling out the SFP, unlocking leaver should be pulled out.
9.	Always apply only required force while inserting the SFP or jacking out the same.
10.	Always keep all unused optical ports of SFP/SFP+ covered when not connected to a mating cable.
11.	Enable ALS (automatic laser shutdown) feature if it is disable.
12.	Any optical patch cord connected to any of the optical interface should always be capped on loose end.

ONT Preventive Measurements Continued

Patrolling Practices-Dealing with SFP/SFP+

SN	Don'ts
1.	Do not allow dust or moisture to SFP/SFP+
2.	Do not remove the SFP optical port cover before connecting to patch cord.
3.	Do not insert any SFP/SFP+ into any slot.
4.	Do not insert SFP/SFP+ into wrong slot.
5.	Don't force if SFP is not going in and check the correct position/direction
6.	Do not insert SFP/SFP+ loosely into the receptacle.
7.	Do not leave SFP in unlock position in receptacle
8.	Do not try to pull SFP without unlocking it.
9.	Do not try to insert or jack out the SFP forcefully otherwise the locking leaver will be damaged
10.	Do not leave SFP/SFP+ ports uncovered when fibre is not connected to avoid dust into SFP optical ports.
11.	Do not look into SFP/SFP+ when system is powered up. The signals coming out of SFP/SFP+ can be dangerous to eyes.
12.	Do not leave loose end of patch cord open it may cause harm to human eyes.
13.	Do not loop SFP Tx. / Rx. Ports through patch cord without using required attenuator pad.

Patrolling Practices-Handling the fiber cable

Dos	Don'ts
When handling fiber cables, take the precautions to prevent damage to the cables:	Do not allow the cables to kink.
Maintain a minimum bend radius of 1.5cm.	Do not bend fibre excessively.
When you disconnect fiber cables, always pull out by holding the connector.	Do not pull out the cable while disconnecting fiber cables.
Keep all fibre-optic connectors covered when not connected to a mating cable.	Do not look into fibre-optic connectors or cables. The signals on fibre-optic connectors and cables can be hazardous to eyesight.
Always clean fibre connector properly before connecting to optical ports.	Do not connect the fiber patch cord to optical interface without cleaning the connectors.

Exercise

1. Explain ONT Preventive / Patrolling Maintenance.

Ans.

2. Explain Patrolling Practices-Handling the fiber cable.

Ans.

UNIT 3.11: ONT Maintenance and Troubleshoot

Unit Objectives

At the end of this module, you will be able to understand:

1. ONT- Registration failures and Solutions

3.11.1 ONT- Registration Failures and Solutions

Some of the major and usual real time errors and corresponding actions are listed below
ONT- Registration failure

Fault Type	Possible Cause	Suggested Action
ONT Registration Failure	Check if the ONT power LED is ON and Green.	ONT electrical Power cable and CCU (SPV Power backup) to be verified. If power is not OK change the CCU or Power Adapter as the case may be. If power is OK, Off/ON the ONT and wait for Power LED to become ON. If power is OK and LED is off, the ONT is faulty. Replace the ONT.

Fault Type	Possible Cause	Suggested Action
ONT Registration Failure	Check if the ONT PON LED is ON and Green.	If PON LED is Off, check the ONT optical receive power is OK (-10 to -27 dBm). If power is not in the range check the fiber plant which includes cleaning of optical connectors. If optical receive power is OK, connect the fiber and restart the ONT. If still PON LED is off, check if fiber inside the ONT is connected properly at ONT PON port. Re-jack the same and cover back the ONT. Connect the fibre and restart the ONT. If it doesn't turn Green, please replace the ONT.

ONT- Registration Failures and Solutions Continued

Fault Type	Possible Cause	Suggested Action
ONT Registration Failure	The physical distance of the ONT is not as per the set window	If the physical fiber distance of ONT ≤ 20 Kms, restart the ONT and check if ONT is ranging properly, otherwise replace the ONT. If the physical fiber length of ONT ≥ 20 Kms and ≤ 40 Kms, set the logical distance of PON at OLT to 40 Km under CM in PON Physical Reach window. Restart the ONT and check if ONT ranging is OK, otherwise replace the ONT. If the physical fiber distance of ONT ≥ 40 Kms, set the logical distance of PON at OLT to 60 Km under CM in PON Physical Reach window. Restart the ONT and check if ONT ranging is OK, otherwise replace the ONT. Note that if physical reach is changed no other ONT will be ranged on the PON outside the set window.

1. Please check the system policy. If ONT discovery is directed by user, in that case ONT Serial number need to be registered at OLT first and
2. ONT will range after the ONT Sr. No. is registered.
3. Otherwise change the system policy to “Auto Discovery mode” and restart the ONT. If still the ONT is not coming up, replace the ONT.

ONT-Dos and Don't

1. Don't make direct eye contact with fiber.
2. Make sure that fiber should not bend.
3. Put the ONT11 on the place where no water and moisture present.
4. Put the ONT11 out of reach of children.
5. Don't place the ONT11 in direct sunlight.
6. Use cable stacker for cabling.

Exercise

1. Explain the ONT Maintenance & trouble shoot.
   - Refer to service failure
   - Refer to Raising service request

Ans. _____

2. List ONT Do's and Don't's.

Ans. _____

Tips

Observe and collect information on ONT - Maintenance & trouble shoot by Visiting GP & OLT Executives

UNIT 3.12 Record repairs/replacements

Unit Objectives

At the end of this unit you will be able to:

1. Record repairs/replacements undertaken during fault rectification

Successful network operations and maintenance for telecom organisations comprises not only optimising communication networks but also the staff, procedures, and systems that manage and maintain telecom networks.

The procedure used to address faults by the Key Network Services Business Unit is known as fault detection, handling, and rectification (and does not include any commercial terms, rebates, compensation or other commercial arrangement which may be offered by a Business Unit in relation to any Fault or delay). This procedure begins with the Key Network Services Business Unit recording the fault. It includes testing, fault sectionalization (when facilities of another Carrier or Carrier Service Provider's network are involved), fault rectification and clearance, and fault rectification.

Recording alone is insufficient; record storage is also necessary:

- Data documentation at the plant location is crucial.
- Databases must be stored in a variety of formats, such as paper prints or digital files, and they must have numerous copies saved in various places so that each team has access to them.

  Ensure that it is available for review by all authorities.

The following reports must be submitted on a frequent basis to ensure status updates:

- Report on the status update
- Pending issues
- Challenges
- Faults & Serviceability
- NOC for cable integration
- Final Closure of the job

The NOC engineer will assist in the first investigation of events that result from monitoring. The NOC engineer will perform the following duties:

- Keep a record of incidents and link them to the happenings.
- Use the proper workarounds.
- Coordinate resolution with other support levels, such as partners and vendors from outside sources.

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GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

4. Promote Usage of Telecom Devices & Provide Services

Telecom Sector Skill Council

Unit 4.1 Approach to Common Service Centers (CSC)
Unit 4.2 Digital Devices & Digital Approaches
Unit 4.3 Monitoring & Maintenance of Electrical Systems
Unit 4.4 Revenue Management and record maintenance

TEL/N6228

Key Learning Outcomes

At the end of this module, you will be able to understand:

1. CSC outreach programme
2. Network for information & communication technologies(NICT) for CSC
3. ISP
4. Broadband
5. Digitization in India
6. Digital devices
7. Apps & Related Devices
8. E Services
9. E Terminal & kiosk
10. Utility apps links
11. Electrical systems & its types
12. Batteries & Power Banks
13. UPS
14. Electrical Maintenance
15. Revenue Mangement & Record Maintenance

UNIT 4.1 : Approach to Common Service Centers (CSC)

Unit Objectives

At the end of this module, you will be able to understand:

1. Common Service Centers (CSC) Outreach Programme
2. Network for Information & Communication technologies(NICT) for CSC
3. Internet Service Providers (ISP)
4. Broadband

4.1.1CSC Outreach Programme

Common service centers are providing various govt. services to people like Certificates (Birth, Death, Domicile, caste, Income etc) MNREGA payments, NIELIT's CCC courses and non-government service, Bank account opening, withdrawal/ deposit, loan document, online railways, and airline ticket booking, DTH recharge, etc. It includes an exhibition van which is giving hand on experience about various public services available through these Centre. While other interesting elements of the exhibition like nukkad natak, audio visual experience and VLE assistance is educating people about convenience and transparency of services available through CSCs.

Common service centers are part of National e-governance plan which is a major initiative of the Government of India for ushering in e-Governance for improving the quality of basic governance, on a massive scale in areas of concern to the common man. The vision of NeGP is to “Make all Government services accessible to the common man in his locality, through common service delivery outlets and ensure efficiency, transparency & reliability of such services at affordable costs to realize the basic needs of the common man”. CSC e-Governance Services India Limited is a Special Purpose Vehicle (CSC SPV) incorporated under the Companies Act, 1956 by the Department of Electronics and Information Technology (DeitY), Government of India, to monitor the implementation of the Common Services Centers Scheme. It provides a centralized collaborative framework for delivery of services to citizens through CSCs, besides ensuring systemic viability and sustainability of the scheme.

Commented [YB8]: Data from government web page To present e-administration on a national scale and give taxpayer supported organizations at the doorstep of each resident, the Government of India presented the National e- Governance Plan (NeGP). To accomplish the mission of the NeGP, the Department of Information and Technology (DIT), has made arrangements for the rollout of more than 100,000 Common Services focuses (CSCs) the nation over, especially in rustic regions.

CSCs are imagined to be the front-end conveyance focuses for taxpayer supported organizations including welfare advantage applications, birth/ demise testaments, and bill instalments for utilities including power, phone, and water to every rustic subject of India. Private and non-legislative associations assume a dynamic part in working CSCs. The PPP demonstrate is involved a three- level structure comprising of the CSC administrator (Village Level Entrepreneur or VLE) the Service Center Agency (SCA), in charge of a subdivision of 500 to 1000 CSCs and a State Designated Agency (SDA) in charge of overseeing usage over the state.

CSC Outreach Programme Continued

Vision of CSC SPV

To create CSCs as a tried and true, dependable, and omnipresent IT empowered system of Citizen Service Points interfacing nearby populace with the Government offices, business foundations, banks and insurance agencies and instructive establishments, with an effect on essential, auxiliary and tertiary segments of the nation's economy.

Role of CSC SPV

Ensure pervasive nearness of resident administration focuses in all topographies, in accordance with the vision of 'Advanced India' and to operationalist CSCs crosswise over States/UTs. Bolster GOI/States/UTs to empower conveyance of G2C administrations. Encourage combination of e-Governance administrations (Central/State MMPs) gateways and NIC driven applications. Bolster State Designated Agencies (SDAs) in setting up of state CSC entries utilizing essential API coordination with instalment door, and so forth. Empower conveyance of budgetary and related administrations, for example, Aadhaar, managing an account, protection, and annuity Create a structure for empowering observing of G2C administrations. Guarantee development of e- exchanges at the CSCs. Make mindfulness and limit working among different partners inside and outside the Government. Limit working of Village Level Entrepreneurs (VLEs) and different partners

Under the Digital India program, no less than one CSC (ideally more than one) is visualized in 2.5 lakh Gram Panchayats for conveyance of different electronic administrations to residents crosswise over rustic India. This would incorporate fortifying and coordinating the current 100,000 CSCs under the CSC plan and making operational an extra 1.5 lakh CSCs in Gram Panchayats. CSC 2.0 is an administration conveyance situated business display with an expansive bundle of administrations made accessible for the subjects through ideal use of foundation as of now made as SWAN, SSDG, e-District, SDC, and NOFN/BharatNet.

Objectives of CSC 2.0

Non- prejudicial access to e-Services for country nationals by influencing CSCs to finish benefit conveyance focuses, using the foundation as of now made regarding other Mission Mode Projects. Extension of self- supporting CSC arrange till the Gram Panchayat level – 2.5 lakh CSCs, i.e. no less than one CSC per Gram Panchayat, more than one favoured. Engaging District e-Governance Society (DeGS) under the locale organization for usage. Making and fortifying the institutional structure for rollout and venture administration, along these lines, supporting the State and District regulatory hardware and hand holding of VLEs through neighbourhood dialect Help Desk bolster. Enablement and solidification of online administrations under single innovation stage, consequently making the administration conveyance at CSCs responsible, straightforward, productive, and traceable, with an innovation driven connection between all partners. Giving Centralized Technological Platform to conveyance of different administrations in a straightforward way to the natives. Expanding maintain capacity of VLEs by sharing most extreme commission earned through conveyance of e- benefits and urging ladies to join as VLEs.

4.1.1 System for Information & Communication Technologies (NICT) Cash Collection Centers

Network for Information and Communication Technology's (NICT) is an Indian non- administrative association that has been working in the field of innovation answers for better administration conveyance. The SDA of Madhya Pradesh - Madhya Pradesh State Electronics Development Corporation (MPSEDC) - delegated NICT as the Service Center Agency (SCA) for building up CSCs in 2158 areas in Indore and Ujjain, Madhya Pradesh.

To date, NICT has set up around 1800 CSCs crosswise over Madhya Pradesh. Each inside gives a range of administrations including saving money - smaller scale protection, microcredit telecom energize; Dish TV and Tata Sky deal and revive and offer of agro input materials. A large portion of The administrations gave up to this point fall under the classes of business to business (B2B) and business to purchaser (B2C) administrations.

The entire take off of government to national (G2C) administrations, for instance, arrangement of birth/passing testaments, is as yet in progress. In the interim in any case, to guarantee the maintainability and practicality of CSCs, NICT has built up the imaginative thought of power charge instalment to the Madhya Pradesh State Electricity Board (MPSEB) from the CSCs in Indore and Ujjain areas. To do as such, NICT marked a MoU with the Madhya Pradesh Paschim Kshetra Vidyut Viteran Organization ltd. (MPPKVVCL) in December 2008. Today, 350 CSCs are working as money gathering focuses to aid the smooth working of the power charge installment. Refer to Fig. 4.1.1.

VLE – NICT: ONLINE REMITTANCE SYSTEM with refer to NICT System

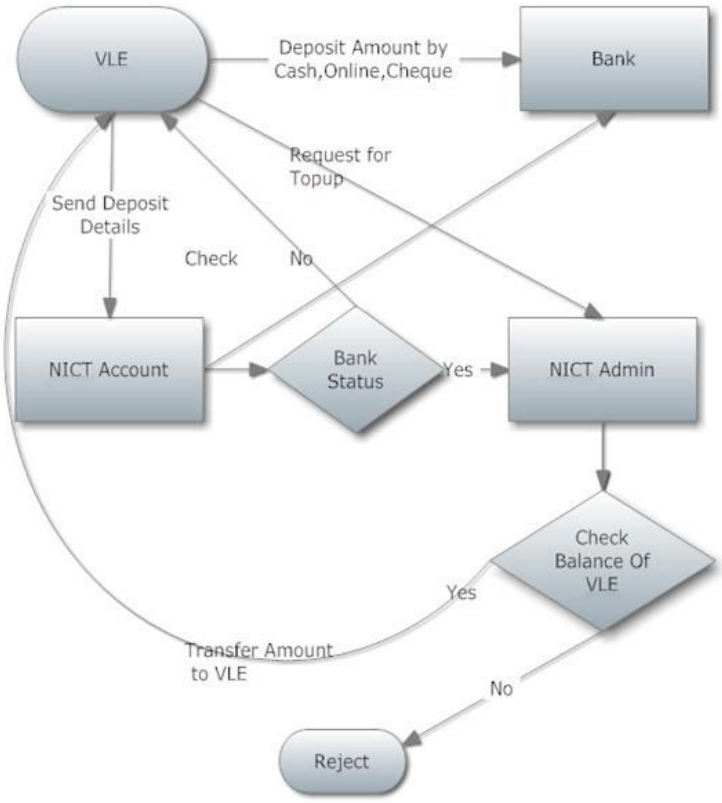


Fig. 4.1.1. VLE - NICT System Flowchart

VLE Operations Improved Efficiency, Reliability, Consistence, Convenient with Effective Monitoring Mechanism.

4.1.1Internet Service Provider

An Internet specialist co-op (ISP) is an association that gives administrations getting to and utilizing the Internet. Network access suppliers might be sorted out in different structures, for example, business, group possessed, non-benefit, or generally exclusive. Web benefits normally gave by ISPs incorporate Internet get to, Internet travel, area name enlistment, web facilitating, Usenet administration and colocation. ISPs give Internet get to, utilizing a scope of innovations to associate clients to their system. Accessible advances have run from PC latest technology couplers phone lines, to TV link (CATV), remote Ethernet (Wi-Fi) and optical fibers. For clients and private ventures, conventional alternatives incorporate copper wires to give dial-up, DSL, normally hilter kilter computerized endorser line (ADSL), link modem or Integrated Services Digital Network (ISDN) (ordinarily fundamental rate interface). Utilizing optical fibers up to client is called Fiber to The Home or comparative names.

For clients with additionally requesting prerequisites, (for example, medium-to-substantial organizations, or different ISPs) can utilize higher-speed DSL, (for example, single-combine rapid advanced supporter line), metropolitan Ethernet, gigabit Ethernet, Ethernet, Frame Relay, ISDN Primary Rate Interface, Asynchronous Transfer Mode and synchronous optical systems administration Access Remotely is another alternative, including cells and satellite Internet. Web facilitating administrations give email, web-facilitating, or online capacity administrations.

Different administrations incorporate virtual server, cloud administrations, or physical server operation. ISPs may participate in peering, where different ISPs interconnect at peering focuses or Internet trade focuses (IXs), permitting directing of information between system, no fee for each other to the information transmitted— information that would somehow have gone through a third upstream ISP, bringing about charges from the upstream ISP. ISPs requiring no upstream and having just clients (end clients as well as associate ISPs) are called Tier 1 ISPs. System equipment, programming and determinations, and additionally the aptitude of system administration staff are imperative in guaranteeing that information takes after the most productive course, and upstream associations work dependably. An exchange off amongst cost and productivity is conceivable.

4.1.1 Broadband

In media communications, broadband is wide transfer speed information transmission which transports numerous signs and movement writes. The medium can be coaxial link, optical fiber, radio, or contorted combine. With regards to Internet get to, broadband is utilized to mean any rapid Internet get to that is dependably on and speedier than conventional dial-up get to.

In broadcast communications, a broadband control networking strategy is one that handles a very wide band of frequencies. "Broadband" is a comparative term, where comprehended by its specific situation. The more extensive (or more extensive) the transfer speed of a media, the more noteworthy the data conveying limit, given a similar channel QOS. In radio, for instance, an extremely limit band will convey More code, a more extensive band will convey discourse, a still more extensive band will convey music without losing the high sound frequencies required for reasonable sound propagation.

This expansive band is frequently isolated into channels or "recurrence receptacles" utilizing pass band methods to permit recurrence dividing and combined as opposed to sending a higher-quality flag. In information interchanges, a 56k modem will send an information rate of 56 kb for every second (Kbit/s) over a 4 expansive phone line (narrowband or voiceband). In the late 1980s, the Broadband Integrated Services Digital Network (B- ISDN) utilized the term to allude to an expansive scope of bit rates, free of physical tweak points of interest.

Exercise

1. Discuss CSC program outreach programs.

Ans. _____

_____

_____

2. Explain Network for information & communication technology (NICT) for CSC.

Ans. _____

_____

_____

3. Explain ISP.

Ans. _____

_____

_____

4. What is Broadband?

Ans. _____

_____

_____

UNIT 4.2: Digital Devices & Digital Approaches

Unit Objectives

At the end of this module, you will be able to understand:

1. Digitization in India
2. Digital Devices
3. Apps & Related Devices
4. E Services
5. E terminal & Kiosk
6. Utility Apps Links

4.2.1Digitization in India

Digitization Aim is to accomplish the vision of Digital India, where each Indian is empowered digitally and each data is carefully accessible. Digitize India Platform offers an open door for government organizations to change themselves into computerized endeavours and for Digital Contributors, rewards for doing straightforward information passage employments.

Our digitizing India vision is a standout amongst the most energizing activities the nation has grasped to jump us to the 21st century. Given the gigantic gap amongst country and urban India and the advanced haves and the poor, I trust that the Digital India Program is a triumph in utilizing innovation as the considerable leveller for the natives of India. The program, as of late declared by the Prime Minister, diagrams a guide to a computerized India where a carefully exacting populace can use innovation for unlimited conceivable outcomes. What was before a visionary idea is presently the new ordinary: innovation is truly as basic as the three utilities water, gas, and power. Our administration pioneers have influenced it to clear that broadband interstates are as imperative as national thruways. Today government pioneers comprehend that while the true objective is to offer better administrations, cultivate advancement and create more employments, the basic empowering agent will be innovation and the establishment to a computerized country will lay a dish India organize.

4.2.1 Digital Devices

Digital device - Computer Definition. A physical unit of equipment that contains a computer or microcontroller. Today, myriad devices are digital including a Smartphone, tablet and smart watch. In contrast, there are numerous non-digital (analog) devices, such as a thermometer, electric fan and bicycle.

Digital Devices Continued

Desktop

A desktop computer is a personal computer that fits on or under a desk. They usually consist of a monitor, keyboard, mouse and either a horizontal or vertical (tower) form factor. Unlike a laptop, which is portable, a desktop computer is meant to stay at one location. Refer to Fig. 4.2.1.

Fig. 4.2.1. Desktop & Its Peripherals

Laptop

A laptop, often called a notebook is a small, portable personal computer with a "clamshell" form factor, an alphanumeric console on the lower some portion of the "clamshell" and a thin LCD or LED PC screen on the upper segment, which is opened up to utilize the PC. Workstations are collapsed closed for transportation, and along these lines are appropriate for portable utilize. Albeit initially there was a refinement amongst PCs and scratch pad, the previous being greater and heavier than the last mentioned, starting at 2014, there is regularly no longer any distinction. Workstations are ordinarily utilized as a part of an assortment of settings, for example, at work, in instruction, in playing recreations, Fig. 4.2.2. Laptop Web surfing, for individual interactive media and general home PC utilize Refer to Fig. 4.2.2.

Fig. 4.2.2. Laptop

Types of Laptop

Since the introduction of portable computers during late 1970s, their form has changed significantly, spawning a variety of visually and technologically differing subclasses.

1. Traditional laptop - The form factor of the traditional laptop computer is a clamshell, with a screen on one of its inner sides and a keyboard on the opposite, facing the screen. It is flexible and can be easily folded to handle easily while travelling. The keyboard and screen won't be accessible while folded. Devices of this category called as a traditional laptop or notebook.

2. Sub-notebook - A sub-notebook or an ultra portable is a laptop planned and promoted with an accentuation on portability (little size, low weight, and regularly much more battery life). Sub-scratch pad are typically littler and less weight than standard workstations, weighing in the range of 0.8 and 2 kg (2-5 lb), with a battery life of 10 hours. Since the presentation of notebooks and ultra books, the line between sub-scratch pad and either class has obscured. Notebooks are a more essential and shoddy sort of sub-note pad, and keeping in mind that some ultra books have a screen measure too expansive to qualify as sub- note pad, certain ultra books fit in the sub-note pad classification. One eminent case of a sub- scratch pad is the Apple Mac Book Air.

3. Netbook - The notebook was an economical, light- weight, vitality productive type of PC, particularly suited for remote correspondence and Internet get to. Notebooks first turned out to be financially accessible around 2008, weighing under 1 kg, with a show size of under 9". The name notebook (with net short for Internet) is utilized as "the gadget exceeds expectations in online processing execution". Notebooks were at first sold with light-weight variations of the Linux working framework, albeit later forms regularly have the Windows XP or Windows 7 working frameworks. The expression "notebook" is to a great extent old, despite the fact that machines that would have once been called notebooks - little, reasonable, the littler Chrome book models.

Digital Devices Continued

4. Convertible, Hybrid, 2-in-1- The most recent pattern of innovative merging in the compact PC industry brought forth an expansive scope of gadgets, with a consolidated component of a few already isolate gadget writes. The half and halves, Convertibles and 2-in-1s developed as hybrid gadgets, which share characteristics of the two tablets and workstations. Every single such gadget have a touch screen show intended to enable clients to work in a tablet mode, utilizing either multi-touch signals or a stylus/ computerized pen.

5. Work area substitution - A work area substitution PC is a class of expansive gadget which isn't expected basically for versatile utilize. They are bulkier and not as convenient as different workstations, and are planned for use as smaller and transportable other options to a PC. Work area substitutions are bigger and regularly heavier than different classes of workstations. They can contain all the more capable segments and have a 15- inch or bigger show. Work area substitution PCs' working Operation time on batteries is commonly shorter than different PCs; in uncommon cases, they have no battery by any means. Previously, a few PCs in this class utilized a restricted scope of work area segments to give better execution to a similar cost to the detriment of battery life, in spite of the fact that this training has to a great extent ceased to exist.

6. Tough PC - A rough workstation is intended to dependably work in cruel utilization conditions, for example, solid vibrations, extraordinary temperatures, and wet or dusty situations. Rough PCs are generally composed without any preparation, instead of adjusted from customary customer workstation models. Tough PCs are bulkier, heavier, and significantly more costly than general PCs, and consequently are rarely found in consistent shopper utilize.

7. Business PC - A business workstation is a PC intended for those in a working environment. Ordinarily, it is ruggedized, with shopper confronting highlights, similar to high determination sound evacuated to enable the gadget to be utilized for unadulterated profitability.

Workstation Operation

Overall, PC also, PCs are fundamentally the same as. They have a similar essential equipment, programming and working frameworks. The essential distinction is the manner by which their parts fit together. A personal computer incorporates a motherboard, video card, hard drive and different parts in an extensive case. The screen, console, and different peripherals associate remotely or with links. Regardless of whether the case sits vertically or on a level plane, it has heaps of room for include cards, links and air dissemination. A workstation, be that as it may, is substantially littler and lighter than even the most conservative PC tower. Its screen is an incorporated piece of the unit, just like its console. Rather than an open case with bunches of space for air course, a PC utilizes a little, level outline in which every one of the pieces fit together cozily.

Due to this key outline contrast and in view of a PC's inborn convenience, segments must:

- Fit into a smaller space
- Save control
- Deliver less warmth than work area segments Advanced cells

Digital Devices Continued

Smart phones

Definition of Mobile telephone and Smart telephones - A Mobile telephone is all the more regularly called a PDA or PDA. These specialized gadgets associate with a remote interchanges arrange through radio waves or satellite transmissions. Most cell phones give voice interchanges, Short Message Service (SMS).

The principal Smartphones were discharged path in 1994 and 1996 separately by IBM Simon and Nokia Communicator 9000, what's more, coordinated the highlights of a cell phone and an individual advanced aide (PDA) for overseeing logbooks and contacts. Both were significantly bigger than general telephones. It wasn't until 2000 that the primary genuine Smartphone, the Ericsson R380, was discharged. It wasn't any bigger than a normal telephone, and in the mid 2000s numerous others stuck to this same pattern, with telephones like the Palm and BlackBerry making enormous progress. In 2007, Apple discharged the iPhone, which shunned equipment catches for full touch screen control and has been the layout for Smartphone from that point forward.

Telephones used to be tied in with making calls, however now your portable can do as such significantly more. The scope of new touch screen advanced mobile phones enables you to get to the web, utilize online networking, get live news refreshes, play music and video, and considerably more. They generally utilize touch screens for control, be that as it may, which can be a test for individuals new to the innovation.

Before, cell phones were for the most part about making telephone calls. They had a number cushion, an advanced telephone directory and a get/hang-up catch and very little more. Presently PDAs offer quite a lot more – they're completely fledged PCs that you can fit in your pocket. They can run applications, diversions, get to the web, send email and substantially more. About all Smartphone now utilize touch screen controls. Rather than having equipment catches like some time recently, one side of the telephone is taken up for the most part by a touch screen that you control utilizing taps and motions. There aren't even any number catches; when you need to make a call, a number cushion will fly up on the touch screen. Getting comfortable with a Smartphone can take a tad of training. In any case, when you do get comfortable with it, you'll see that a Smartphone can accomplish more than you at any point thought conceivable on a cell phone.

A Smartphone can:

- Make voice calls (obviously!)
- Make video calls
- Access the web and peruse the web
- Take photographs, and transfer them to the web
- Explore with GPS if the telephone has GPS worked in
- Play back music and video put away on the telephone (and interface with a PC to duplicate media to it)
- Deal with your contacts and arrangements
- Send messages
- Play in-fabricated recreations
- Run new applications and recreations downloaded for the web.

Digital Devices Continued

Kinds of Smart Phones

There are many models of Smartphone. Each real telephone producer makes Smartphone's: Samsung, Apple, HTC, LG, Nokia, Sony Ericsson, Blackberry, Motorola and others. There are very couple of regular highlights in Smartphone, and in the event that you ace one you ought to have the capacity to move onto others. Not in a flash, maybe, but rather for the most part without an indistinguishable expectation to absorb information from your first telephone. The reason a ton of telephones have regular highlights is that they all utilization few working frameworks. Refer to Fig. 4.2.3.

Fig. 4.2.3. Smartphones

OS – (Android, Apple IOS, Windows)

A working framework on a Smartphone works a similar way especially it does on a PC: it's the fundamental programming that runs everything else. Similarly as you have Windows or Mac OS on a PC, you have a working framework on a telephone. When you get comfortable with a telephone's working framework, you ought to have the capacity to move to different telephones utilizing the same working framework effectively.

There are three major operating systems on Smartphones:

1. Android
2. Apple iOS
3. Windows

Operations

Android

Android is the most well known working framework on advanced mobile phones created by Google, and there are many telephone models from many makers that utilization it. It looks and works exceptionally like the iPhone OS (iOS) – to dispatch an application or begin a telephone include, you either tap a symbol on the screen or press an equipment catch as an afterthought Most Android telephones are modified by their producer, so a telephone from, say, Samsung isn't precisely the same as a telephone from HTC.

The telephone makers allude to this as an interface; Samsung models accompany the Touch Wiz interface, HTC accompanies Sense, et cetera. Therefore, Android telephones are like each other, however not indistinguishable. Refer to Fig. 4.2.4. Distinctive models of telephone additionally accompany diverse applications pre-introduced.

Fig. 4.2.4. Android OS

Digital Devices Continued

Apple iOS

Apple IOS goes ahead the Apple iPhone, iOS (once in the past iPhone OS) is a portable working framework made and created by Apple Inc. solely for its equipment. It is the working framework that by and by powers a significant number of the organization's cell phones, including the iPhone, iPad, and iPod Touch And is the same framework that is utilized on the Apple iPad. It's an extremely straightforward framework – you simply touch a symbol to dispatch a telephone highlight or application. Refer to Fig. 4.2.5.

Fig. 4.2.5. iOS OS

Windows

Microsoft and it influences Windows To telephone looks a ton like the new Windows 8 interface. Touching one of the onscreen obstructs distinctive applications and telephone highlights. Refer to Fig. 4.2.6.

Fig. 4.2.6. Windows Mobile OS

Because two telephones may run the same working system, doesn't mean the telephones are different:

1. There are physical contrasts: the weight and the screen estimate
2. There are execution contrasts: the speed of the processor and the measure of memory (much like on PCs)
3. There are programming contrasts, with various makers stacking extraordinary.

Other Mobile Phone Operating Systems

The three listed here may be the major phone operating systems, but they're far from the only ones. You might also encounter: Palm, BlackBerry, Symbian, Bada and Maemo. They all work a little differently from the Android, iOS and Windows Phone systems you might come across.

The below features make android more popular compared to other smart phones

1. Affordable price
2. User friendly
3. Google android got more apps which are for free
4. Android has many interfaces like Samsung, HTC, Lenovo, Sony, Miromax, Karbonn etc.
5. Has many interfaces like Samsung, HTC, Lenovo Android, Sony, Miromax, Karbonn etc

The above features made Android to achieve great market which is shown in the figure. Refer to Fig.4.2.7.

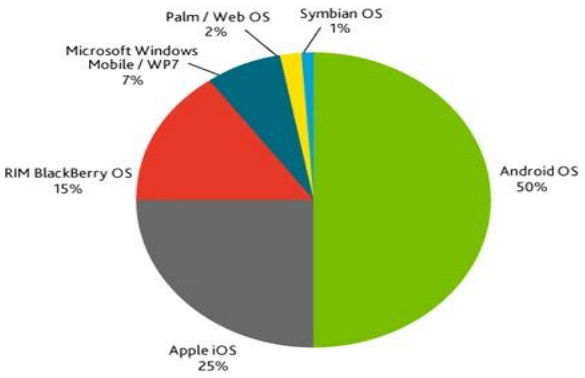


Fig. 4.2.7. Android Market

Features available in smartphone, tablets and e-terminals

The hottest electronics right now are **smartphones and tablets**. Despite having a similar appearance, there are still significant differences between tablets and smartphones. Obviously, size is the primary distinction between tablets and smartphones. Tablets are substantially larger than smartphones, and measurements are frequently made based on screen size. The most popular tablet devices have screens around 10 inches, although there are also models with even larger screens, starting at 7 inches. Smartphones have substantially smaller screens, with the majority of models having 4 inches. Since the majority of people—especially men—carry their smartphones in their pockets, it is crucial that smartphones be tiny.

Additionally, there are differences in the programmes that you can use. The majority of tablets and smartphones use the Android operating system, including the iPad and the iPhone. However, certain apps can only be used on tablets and not on smartphones. This is typically due to the impracticality of small screens with the app rather than CPU limits.

Tablets cannot compete with smartphones in terms of network connectivity. Nearly all smartphones include WiFi and 3G connectivity; the latter is essentially a certainty because devices must connect to cellular networks. Tablets include WiFi connectivity at the very least, but 3G connectivity is only available on high-end, more expensive versions.

Although cellphones serve a variety of purposes, communication is still their main application. Tablets, on the other hand, are not meant to take the role of phones. Although some tablets can make calls or send SMSes, many cannot. Tablets without 3G are immediately out because that hardware is required for this feature. Even if your tablet offers call functionality, you would probably need to get a Bluetooth headset because holding a big tablet up to your face is cumbersome.

A smartphone can perform all the functions of a tablet and more. A smartphone is a better option if you're constantly on the go because you can swiftly take it out or put it away when the situation calls for it.

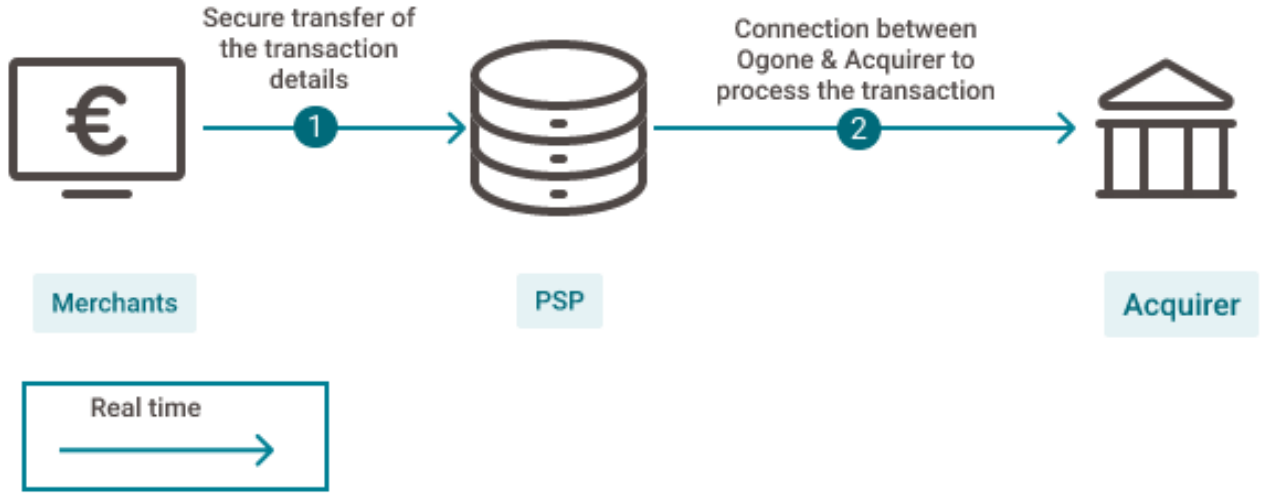
Electronic terminal refers to a consumer-operated electronic device—not a phone—through which a consumer can start an electronic payments transfer. Point-of-sale terminals, automated teller machines, and cash dispensers are all included in the term, but they are not the only ones.

A terminal is a device that terminates a telecommunications link and serves as the point where a signal enters or exits a network in the context of telecommunications. Telephones, fax machines, computer terminals, printers, and workstations are a few examples of terminal equipment.

A piece of hardware connected to the wires at the conclusion of a communications link is known as an end instrument. This is often a phone that is wired into a local loop in telephony. Printers, PCs, barcode readers, automated teller machines (ATMs), and router console ports are examples of end devices related to data terminal equipment.

Accepting payments while a card is not present is simple using e-Terminal. Simply request the card information over the phone or mail to get started.

- **It's practical:** Your clients don't even need to visit your website or see you in person! Of course, you can still use this solution if you interact with customers in person.
- **It is swift:** Use our payment form, enter the information, and get a real-time response without the need for a web store or any other technical integration on your end!
- **For both you and your clients, it is simple:** All you need is a production account, and all they require is your phone number or mailing address.



Hardware specifications typical for tablet

Hardware Component	Description
1.85-GHz ARMv8 CPU	64-bit system on a chip (SoC) Example: A9 CPU + M9 motion coprocessor Note: This is as of early 2019. Also, there are more powerful models. This is just one mid-range example.
2-GB LPDDR4 RAM	Mobile DDR—similar DDR standard to what PCs use, but a much smaller form factor, and is included in the SoC
32- or 128-GB flash memory	Similar to solid-state flash memory in a USB flash drive Used for permanent storage
Multitouch touchscreen	Capacitive touchscreen that responds to one or more fingers and proprietary stylus devices

9.7-inch display (diagonal) LED-backlit widescreen multitouch display with in-plane switching (IPS) technology	**Quad Extended Graphics Array (QXGA), 2048×1536 resolution** **4:3 aspect ratio**
Lithium-ion polymer battery (nonremovable)	Similar to lithium-ion batteries in laptops Can be made into any shape 8827 mAh (milliamp hours); 32.4 watt-hour; lasts for 10 hours on a full charge (typical usage)
High-definition cameras	Main camera: 8 megapixel, 1080p video recording Second camera: 1.2 megapixel, 720p video recording

Hardware specifications for the average smartphone

Hardware Component	Description
2.45-GHz ARM CPU	Snapdragon 835 64-bit system SoC
4-GB LPDDR4 RAM	Mobile DDR version 4
32-, 64-, 128-, or 256-GB flash memory	Similar to solid-state drives' flash memory
Multitouch touchscreen	Capacitive touchscreen
Lithium-ion polymer battery (aka li-ion or li-po)	3300 mAh (nonremovable) Typically 20 to 25 hours (talktime)
6.0-inch display	Quad HD+ (QHD+), 2880×1440 resolution 18:9 aspect ratio
Dust and water proof	IP68 compliant

4.2.1 Apps & Related Devices

The word “app” is short form of “application”. Programs (or applications, as they are better known on computers) are created by application developers to fulfil specific functions, To use any apps, you have to download and install them on the devices like mobile, tablet, laptop which ever you use, though before you buy your phone many apps are installed on it. Applications are worked to keep running on specific sorts of gadgets. For instance, you can't introduce an application made for iPhone on an Android gadget, and the other way around. we can connect with applications in a few ways, incorporating composing in content, tapping symbols and menu things, swiping our finger through them, and even speaking to them.

Applications can be just about anything:

1. Games
2. Web programs
3. Music and video players
4. Individual coordinators and logbooks
5. Web administrations like YouTube
6. Efficiency programs like word processors
7. News encourages
8. Email and long range interpersonal communication applications
9. Numerous other helpful and fun devices.

There are truly countless applications accessible for Smartphone's. Apart from pre-introduced applications, each phone accompanies a connection to an online market where you can get more applications. You'll have to make a record with that market to download applications. The most common app markets are the Google Play (on most Android devices), and iTunes App store (on the iPhone). In spite of the fact that it's known as a market, numerous applications are accessible for nothing or are altogether advertisement bolstered. In the event that an application isn't free, you'll need to add credit to your market record to download it. The market application will walk you through that procedure in the event that you endeavour to download an application that isn't free. You can likewise download music, motion pictures, and TV demonstrates specifically to your telephone from online media or play stores. Later you can use inherent media player application to play this media on your mobile.

Enabling & Disabling smart/feature phones

How to get the android app

The best place to get Android applications is the Play Store. Google offers applications here, alongside other substance like books and motion pictures. Chances are you as of now have a Google account set up which is related with your Play Store buys. Keep in mind that once you buy or download an application, you can download it again later on the off chance that you need, so don't stress over erasing it or needing to utilize it somewhere else. You'll have to give charge card or other instalment data in the event that you need to buy applications, however there are a lot of free choices out there. There are different hotspots for Android applications, for example, the Amazon App store and the Humble Bundle, yet adhere to the Play Store for the present.

In the first place, how about we open the Play Store.

1. Tap the Apps symbol in the base right of the home screen.
2. Swipe left and ideal until the point when you discover the Play Store symbol. Tap it.
3. The first occasion when you tap here, you might be provoked to sign in with your Google certifications and instalment data. It will likewise incite you to permit move down of applications to your Google account, and expect you to acknowledge the terms and conditions.

Once you're inside Google Play, you can scan for a particular application or peruse through bigger classifications.

Apps & Related Devices Continued

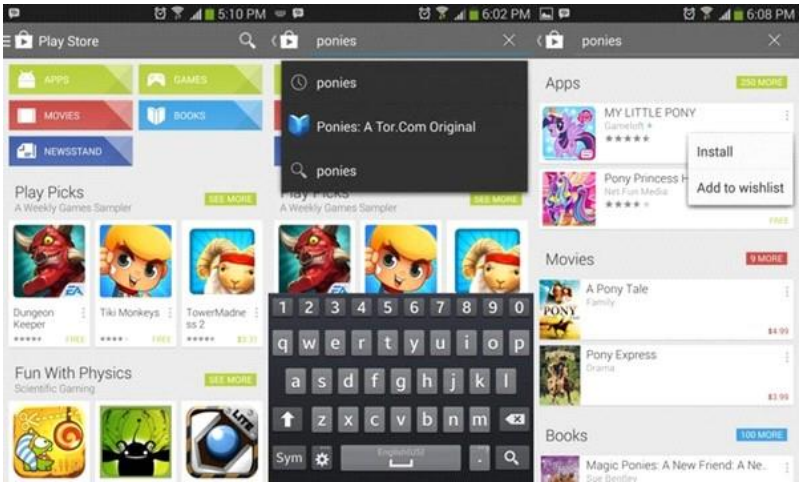


Fig. 4.2.8. Steps to Search for Android Apps

The most effective method to Search for Android applications

1. Tap the Apps symbol on the home screen. It generally resembles a heap of spots at the base of the screen.
2. Swipe left and appropriate until the point when you discover the Play Store symbol. Tap it.
3. Tap the amplifying glass in the upper right, type for the sake of the application you're searching for, and tap the amplifying glass on the console to execute the pursuit. A few proposals will fly up beneath the hunt box as you write, which you can tap to reach specifically. The pursuit term can likewise be broader to discover any applications that attention on a point or watchword.
4. Results will be displayed for applications, films, and books. To one side of the Apps subheading, tap the "___more" catch to see the full posting of results.
5. Tapping the three specks on the correct side of every section will give alternatives to introduce immediately or add the application to a Wish list for future reference.
6. Tapping the case itself will give more points of interest to that application, including screenshots, video, a portrayal, and surveys from clients like you.

Refer to Fig. 4.2.8.

How to discover Android apps

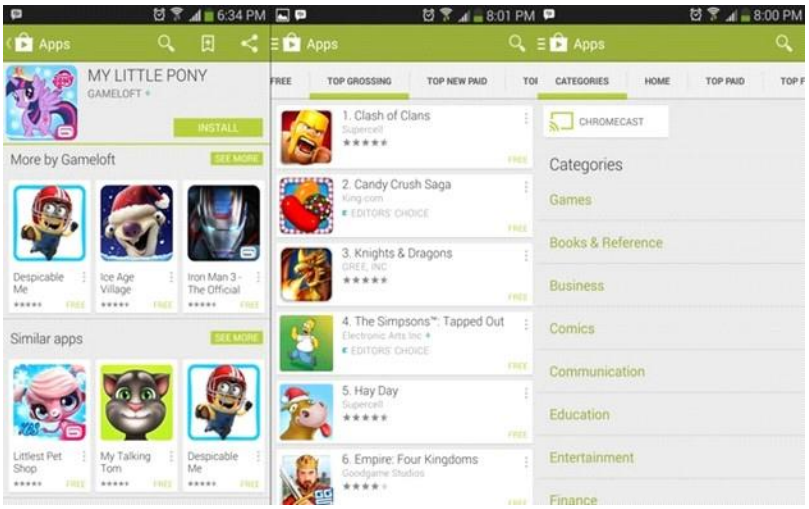


Fig. 4.2.9. Steps to Discover for Android Apps

Apps & Related Devices Continued

The most straightforward approach to find Android applications is to scrutinize the different classes and highlighted areas inside the Play Store. Obviously, you can likewise stick around Android Central to catch wind of the most recent and most prominent applications being discharged, as well.

1. From the Play Store home screen, swipe your finger from base to the best to peruse through included substance classifications. Tap the See More catch to see the full rundown, or tap the three dabs by the application title to download immediately or add an application to your Wishlist for future reference.

2. Tap the Apps catch at the best. Once more, you can swipe through the first page for well known proposals.

3. Swipe left and appropriate to change channels along the best. These incorporate a rundown of classes, top paid downloads, top free, top earning, top new paid, top new free, and slanting. Inside individual classes, for example, Games, Business, or Communication, you can swipe between these channels also.

4. In the wake of tapping an application that you're occupied with downloading, swipe through and through and look past the surveys area. From that point forward, there are areas where you can find different applications by a similar designer, different applications in a similar classification, and different applications downloaded by those that have downloaded this one Refer to Fig. 9. 2.8.

The most effective method to introduce Android applications from Google Play

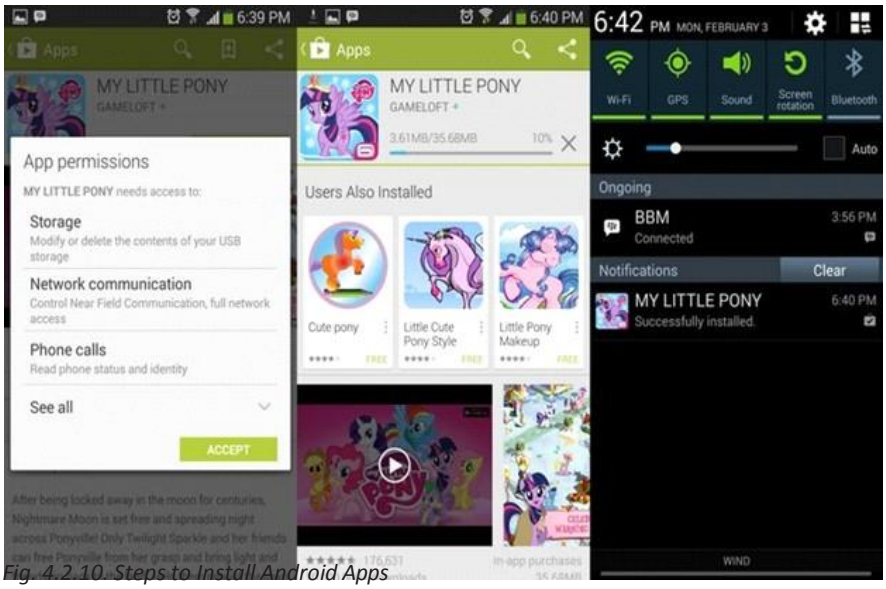


Fig. 4.2.10. Steps to Install Android Apps

1. Tap the Apps symbol in the base right of the home screen.

2. Swipe left and appropriate until the point that you discover the Play Store symbol. Tap it.

3. Tap the amplifying glass in the upper right, type for the sake of the application you're searching for, and tap the amplifying glass in the base right. A few proposals will fly up underneath the pursuit box as you compose, which you can tap to reach straightforwardly. The hunt term can likewise be more broad to discover any applications that emphasis on a point or catchphrase

4. Results will be exhibited for applications, motion pictures, and books. To one side of the Apps subheading, tap the "____more" catch to see the full posting of results.

Apps & Related Devices Continued

5. Tapping the three spots on the correct side of every passage will give choices to introduce immediately or add the application to a list of things to get for future reference.

6. Tapping the crate itself will give more points of interest to that application, including screenshots, video, a depiction, and surveys from clients like you. Tap the Install catch at the best to begin downloading. You will be provoked to give certain gadget authorizations to the establishment to proceed.

7. Progressing downloads and establishments will appear as symbols in the notice bar at the highest point of the screen. Swipe down from the best for a definite look.

8. Once the download and establishment are finished, you can tap the Open catch in the Play Store posting, or tap the symbol from the warning plate to open your application. Something else, the application will be available by tapping the Apps symbol in the base of your home screen, expecting a symbol hasn't just been put on your home screen. Refer to Fig. 4.2.10.

Examples of Apps

As we discussed earlier there are number of apps which are helpful for E-Learning, E-Commerce and E-Health, Entertainment, Game etc. Some of the apps listed below with their usage

1. BHIM – Bharath Interface for Money app is for Making India Cashless

Enrol your Bank account with BHIM, and set an UPI PIN for the ledger. Your Payment Address is your mobile number, and you can essentially begin executing. Truly! It is that basic.

Send/Receive Money: Make Cashless Payments or get cash from companions, family and clients through a portable number or instalment address. Cash can likewise be sent to an unregistered client utilizing Mobile number, Account number +IFSC and Aadhaar Number. You can likewise gather cash by sending a demand and invert instalments in a split second if required.

Check Balance: You can check your bank adjust and exchanges subtle elements in a hurry.

Custom Payment Address: You can make a custom advanced instalment deliver notwithstanding your telephone number. You can do transaction by using your Aadhaar number Used for sending money, BHIM app is different from mobile wallets such as Pay tm and MobiKwik as it also allows sending money to people who don't have the app. The government has stretched out the UPI instalments joining to USSD stage where a client can dial *99# by means of their component telephone or even cell phone and direct UPI construct exchanges without continually depending in light of the web.

2. Amazon - Online shopping app, where you can buy anything you want by your smart phone using internet

3. IRCTC - IRCTC stands for Indian Railway Catering and Tourism Corporation Ltd. (India) , it is a government app which is developed to book the railway tickets. Here you have many applications with user friendly. The app allows you to book your train ticket cancelling the ticket choking the status of the ticket PNR and payment can be done cashless which means you can use your bank details to pay for the ticket with much security.

Apps & Related Devices Continued

Standard lines Installing other outside apps

You may access applications through different channels, for example, the modest package, or from trusted associates over email. Make certain you confide in your sources previously introducing!

1. Swipe down from the highest point of the screen and tap the Settings catch. You may need to swipe from the upper right.

2. Tap the Security catch underneath the Personal subheading.

3. Look down to the Device Administration subheading, tap Unknown Sources, and OK in the accompanying cautioning fly up.

4. Close, handicap, or uninstall applications appear in the multitasking view and can be shut from that point, however more often than not you don't have to stress over it since your framework knows how to oversee framework assets insightfully. Looking through the framework settings can demonstrate the most eager for power applications on your Android gadget, and give brisk access to uninstalling them, however

Closing Android applications

1. Tap the multitasking catch at the base of the screen. It should look like two boxes, one behind the other.
2. Swipe from left to appropriate crosswise over individual applications to close them.

Refer to Fig. 4.2.11.

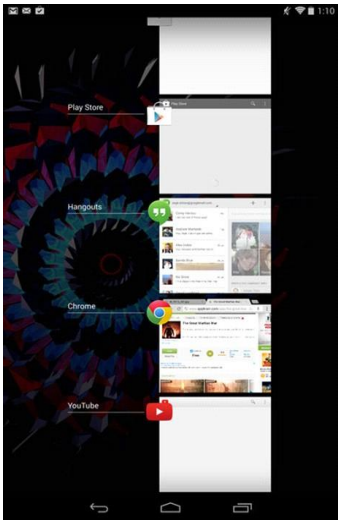


Fig. 4.2.11. Steps to Close the Apps

Uninstalling Android apps

1. Swipe down from the highest point of the home screen to raise the settings window. You may need to swipe down from the upper right half of the screen.
2. Tap the rigging symbol at the best, at that point tap Apps under the Device subheading.
3. Swipe to one side until you're on the Running Tab. Tap Show reserved procedures at the best to see foundation applications.

Fig. 4.2.12. Steps to Uninstall the Apps

4. Tap individual applications in this rundown and tap Force Stop to stop at present running procedures and applications. (Once more, you should by and large let the framework \ when to stop applications.)
5. Swipe to the All tab and tap hazardous applications to compel stop, uninstall, or stop warnings.

Tablets, e-terminals, kiosks, and similar devices

Tablets, e-terminals, kiosks, similar devices are electronic smart devices which can use to have number of services. Refer to Fig. 4.2.12.

Apps & Related Devices Continued

Tablets

Tablets e-terminals, kiosks, and similar devices Tablets, e-terminals, kiosks, similar devices are electronic smart devices which can use to have number of services. Refer to Fig. 4.2.12. Tablets Looks (and works) a great deal like super-sized Smartphone's, tablets are a progressive better approach for getting to the web, playing recreations, and imparting. Despite the fact that they perfectly fit in your grasp and are sufficiently very light to bear, they can complete a considerable measure of the extremely same things your PC can do. You can peruse the web, play recreations, send, and get messages, even sort up letters. It's altogether controlled utilizing a touch screen: to complete things, you basically touch the screen. Owning a tablet implies you truly can take your PC with you wherever you go; they're likewise helpful to utilize when sitting on a love seat. You can Refer to Fig 4.2.13 Indeed, even lay in overnight boarding house a book that you've stacked onto the tablet.

Fig. 4.2.13. Tablet

Types of Tablets

1. Slate
2. Mini tablet
3. Phablet
4. Convertible, hybrid, 2-in-1
5. Gaming tablet
6. Booklet
7. Customized business tablet.

Operation

Do you have a cell phone with a touch screen and the capacity to run applications, similar to the iPhone or Samsung Galaxy? On the off chance that you do, you have a truly decent head begin on understanding what a tablet is – you can consider it basically a big and comfort -sized variant of your Smartphone. If not, at that point the most ideal approach to think about a tablet is as a PC, yet as opposed to being controlled with a mouse and console, you control it by touching components on the screen. Touching a symbol on the screen resembles clicking that symbol with the mouse on a PC. In the event that you have to type message, an onscreen console flies up.

1. Most tablets are intended to be conveyed in a pack and utilized when you're moving. They're considerably lighter than general PCs, and on the grounds that they have no mouse or console you can utilize them anyplace.

2. Like PCs, they can do loads of things, including: Browsing the web Sending email and long range informal communication Playing Games Watching Movies Reading electronic books Listening to music Video and voice visiting Viewing photographs.

3. Additionally like PCs, you can put in new projects on them whenever. On tablets (like on telephones) they're generally called applications, short for applications.

4. Most tablets have sim card slots, cameras and they works just like Smartphone.

5. Tablets comes in various sizes, and are generally portrayed by the extent of their screen. Normally tablets come with 7-inch or 10-inch screen (the estimation speaks to the length of the askew).

6. Tablets get to the web utilizing your home remote (WiFi) organize. A few tablets likewise can get to the web utilizing a 3G or 4G mobiles information benefit, in the event that you have a portable arrangement that backings web get to.

7. Bunches of various organizations make tablets, and there are (in some cases inconspicuous) contrasts between models.

4.2.2 E-Terminal & Kiosk

In information interchanges, a terminal is any gadget that ends one end (sender or beneficiary) of an imparted flag. Practically speaking, it is typically connected just to the expanded end focuses in a system, not focal or middle of the road gadgets. In this utilization, on the off chance that you can send flags to it, it's a terminal. n communication, the term Data Terminal Equipment (DTE) is utilized to portray the PC end of the DTE-to-DCE (Data Communications Equipment) correspondence between a PC and a modem.

A state of-offer (POS) terminal is an automated substitution for a money enlist. Substantially more perplexing than the money registers of even only a couple of years back, the POS framework can incorporate the capacity to record and track client orders, process credit and check cards, associate with different frameworks in a system, and oversee stock. By and large, a POS terminal has as its center a PC, which is given application-particular projects and I/O gadgets for nature in which it will serve. A POS framework for an eatery, for instance, is probably going to have all menu things put away in a database that can be questioned for data from various perspectives. POS terminals are utilized as a part of most businesses that have a state of offer, for example, an administration work area, including eateries, hotel, amusement, and historical centers. Progressively, POS terminals are likewise Web-empowered, which makes remote preparing, and operation conceivable, and additionally stock following crosswise over geologically scattered areas.

Kiosk

In data innovation, a stand (articulated KEE-ahsk) is a little physical structure (regularly including a PC and a show screen) that showcases data for individuals strolling by. Kisoks are basic close to the passageways of shopping centers in North America where they furnish customers with headings. Booths are likewise utilized at public exhibitions and expert gatherings. More complex booths let clients interface and incorporate touch screens, sound, and movement video. Many organizations spend significant time in making mixed media stands. A basic booth can be made utilizing HTML pages and illustrations, setting the sort estimate sufficiently expansive to draw in individuals from a short separation, and evacuating the Web program's device bar with the goal that the show screen is successfully in "stand mode." The introduction can be intended to just circle through a progression of pages or to permit client communication and investigation. Having a different printed sign that welcomes individuals to your home-made booth may help. Refer to Fig. 4.2.14.

Types of Kiosks

1. Tele kiosk
2. Photo kiosk
3. Financial services kiosk
4. Instant Print Stations
5. Digital order stations

Fig. 4.2.14. Kiosk

Example

A few nations have officially executed across the country establishment of stands for different purposes. One case of such vast scale establishments can be found in the United Kingdom, where a huge number of exceptional reason booths are currently accessible to help work searchers in discovering business. The United States Department of Homeland Security has made movement booths where guests enlist when they enter the United States. There are likewise Exit booths where guests enlist when they leave the U.S. Inside the U.S. government has organizations, for example, the Postal Service which utilize HR booths for their disengaged workers to refresh their preparation and additionally screen and keep up their advantages. In India, computerized booths are utilized for different purposes, for example, instalment of bills.

4.2.3 E Services

Learning, E-Commerce, and E-Health: How Internet Connectivity Is Transforming Lives Across the Globe. The ascent of Internet network is changing lives Over the globe, with clearing benefits for development, employments, and thriving more broad by the day. More than three billion individuals are currently associated with the Internet, with numbers anticipated to ascend to more than six billion by 2020, as indicated by a current State of Broadband report. This expansion in Internet availability could add trillions of dollars to the worldwide GDP, and open financial entryways around the globe. Computerized availability gives a large number of advantages, and a one of a kind stage for development, imagination and critical thinking. In the previous 15 years, the Internet has changed everything from the way we work together and figure out how to the way we give and access human services.

eEducation

e-Education is learning by electronic means. eLearning is conveyance of data, correspondence, instruction, and preparing by means of some correspondence implies on the web. The motivation behind eLearning isn't to supplant the conventional method for formal adapting yet to give another skyline that can enhance all the customary method for learning, course book contemplate, CD- ROM, and customary PC based preparing.

Through eLearning framework, the student require not to keep pace with educator as the speed of understanding shifts from individual to person. Additionally, the student has alternative to get to the eLearning framework at the time and the place advantageous to him. This will help a student to spare valuable time and cost as well as urges the students to assume liability of their own realizing which thus upgrades the self-assurance and self-information refreshing. It isn't just the student who will be profited from eLearning framework yet additionally the educator or teacher is recipient who can speak with understudies, give directions, make refreshing from the remote areas.

eEducation by Indian Government

NPTEL – NPTEL gives E-learning through online Web and Video courses in Engineering, Science, and humanities streams. The mission of NPTEL is to improve the nature of building training in the nation by giving free online courseware.

Virtual Labs - Objectives of the Virtual Labs to give remote-access to Labs in different orders of Science and Engineering. These Virtual Labs would oblige understudies at the undergrad level, post graduate level and in addition to look into researchers.

Talk to Teacher - A-VIEW is a honour winning indigenously fabricated multi-modular, mixed media e-learning stage that gives an immersive e-learning knowledge that is nearly on a par with a genuine classroom encounter created by Amrita e-Learning Research Lab.

eCommerce

Electronic commerce is electronic business, commonly referred to as a web business, might be characterized as the use of data and correspondence advancements in help of the considerable number of exercises of business. Trade constitutes the trading of items and administrations between organizations, gatherings and people and be one of the basic exercises of any business. Electronic trade concentrates on the utilization of ICT to empower the outside exercises and connections of the business with people, gatherings, and different organizations. Web based business is exchanging for the items or administrations utilizing PC Networks. E-business includes business forms that are electronic acquiring, preparing orders electronically, dealing with client benefit, and participating with business accomplices. Unique specialized measures for e-business encourage the trading of information between organizations. E-business programming arrangements permit the mix of intra and entomb firm business forms. E-business can be directed utilizing the web, the Internet, intranets, or some blend of these.

E Services Continued

eCommerce by Indian Government

National portal of India - This area encourages subjects to benefit completely online administrations offered by the Central and State/UT Government experts. With the assistance of this area you can profit the Government benefits through the web without going to any administration office. You can profit administrations identified with Passport, Aadhaar card, PAN card, Railway Reservation and some more.

The other approach is mobile app called BHIM APP is the one which does e payment money transaction online and many more services in fingertip with your smart phone.

eHealth: How Internet Connectivity Is Transforming Lives Across the Globe

Commented [V10]: Standard lines no change required In the more extensive sense, eHealth is Information Technology and Communication Technology connected to enhance conveyance of social insurance. It is the utilization of correspondence advancements to communicate with patients for settling on the choices with help of choice emotionally supportive network. There is no concurred meaning of eHealth, however extraordinary specialists have characterized eHealth in various ways.

WHO (World Health Organization) characterizes "eHealth is the practical and secure utilization of data and correspondences advancements in help of wellbeing and wellbeing related fields, including social insurance administrations, wellbeing reconnaissance, wellbeing writing, and wellbeing instruction, learning and research". Claudia Pagliari and partners, offer a more extensive definition, "e- wellbeing is a rising field of therapeutic informatics, alluding to the association and conveyance of wellbeing administrations and data utilizing the Internet and related innovations. In a more extensive sense, the term portrays a specialized advancement, as well as another method for working, a state of mind, and a dedication for organized, worldwide reasoning, to enhance human services locally, territorially, and worldwide by utilizing data and correspondence innovation".

E- wellbeing is the way toward giving social insurance through electronic means, over the Internet. It can incorporate instructing, checking (e.g. physiologic information), and communication with medicinal services suppliers, and in addition collaboration with different patients harrowed with similar conditions.

eHealth by Indian Government

1. **Hospital Management System (HMS)**: This system is useful for patients, doctors and Administrators.
2. NeHA – National eHealth Authority
3. eHealth care foundation
4. **Gujarat Hospital Management Information System (GHMIS)** : GHMIS is best in class human services answer for give better care to patients by tending to all the major practical regions of the hospital and the whole extent of doctor's facility exercises. The main aim is to maintain electronic Health records of Patients. Like Gujarat the other states have eHealth benefits from Indian Government.

E-Services continued

Broadband and its applications

Broadband describes a number of high-capacity transmission methods that can send data, voice, and video quickly and over great distances. Coaxial cables, fibre optic cables, and radio waves are typical transmission media.

Dial-up is no longer necessary thanks to broadband, which is always connected. Its impact is wide-ranging since it enables teleconferencing, data transmission, high-quality and quick access to information, and other things in a variety of contexts like healthcare, education, and technical advancement.

Broadband Internet connection is preferred by both end users and governments due to its obvious advantages over dial-up services.

Broadband usage has grown over time. The number of people utilising the Internet is predicted to reach 4.9 billion in 2021, up from an anticipated 4.1 billion in 2019, according to estimates from the International Telecommunication Union (ITU), the United Nations' specialised organisation for information and communication technologies (ICTs).

The speed of broadband is likewise increasing. The average global broadband speed is anticipated to increase to 110.4 Mbps by 2023, which is more than twice as fast as the 45.9 Mbps average speed recorded in 2018. While mobile speeds are anticipated to increase from 13.2 Mbps in 2018 to an average of 43.9 Mbps in 2023.

Digital subscriber line (DSL), cable modem, fibre, wireless, satellite, and broadband over powerlines are the six primary types of broadband technologies (BPL):

- **Digital subscriber line (DSL):** Data is transmitted using DSL through copper cables that were formerly used for telephone lines in households and businesses. Millions of bits per second to several hundred Kbps are possible with DSL broadband (Mbps).

- **Cable modem:** The same coaxial lines used by cable companies to deliver images and sound to your television can also be used for data transmission with cable modems. External devices called cable modems offer 1.5 Mbps or more of speed. The cable modem, traffic, and the choice you chose from your cable provider all affect speed.

- **Fiber:** Using fibre optic technology, fibre broadband transforms electrical signals into visible light. Data is carried through the electrical signals. Transparent glass fibres are used to transmit the light after it has been transformed to it. In general, fibre transfers data at a rate that is tens or hundreds of times faster than DSL and cable modems. In addition to providing data, voice and video, fibre connections can also serve as an alternative to conventional cable connections. Because it requires businesses to build out fibre networks, which have been expanding over the past few years, access to fibre is now restricted.

- **Wireless:** Wireless broadband transfers' data via radio signals from the service provider's facilities to the customer's location and can be either mobile or stationary. Remote places without access to DSL, cable, or fibre can benefit from long-distance communications thanks to wireless technology. Wireless Internet speeds are comparable to those of cable and DSL.

- **Satellite:** Satellite broadband is a type of wireless broadband that transmits data using satellites in Earth's orbit. Many technological companies that want to bring Internet to every corner of the planet are focusing on satellite broadband since it is essential for bringing broadband connectivity to remote regions of the world. Generally speaking, satellite broadband speeds are 500 Kbps for downloads and 80 Kbps for uploads, depending on a variety of circumstances.

- **Broadband over powerlines (BPL):** BPL delivers speeds comparable to DSL and cable and transfers data over existing powerlines. It may be installed using an existing electrical system in a building. Only a few places have access to BPL, which is a relatively recent technology. But the reason there is so much buzz about it is that it eliminates the need to construct new, expensive infrastructure to service each broadband consumer by using powerlines, which are already established everywhere.

4.2.4 Utility Apps Links

(Agriculture, Medical, health, Education, Government Assistance, Rural Development etc)

With the aim of quickening conveyance of e- benefits as visualized under NeGP and enhancing ICT spending of the legislature, the Indian government has propelled the activity of building up the e-Gov AppStore. The e-Gov App Store is a national level basic vault of adaptable and applications which are configurable segments and web benefits that can be re- utilized by different government offices/offices at Center and States, which will incorporate the setting up of a typical stage to host and run applications (created by government offices or private players) at National Clouds.

Following are the objectives for setting up the e-Gov AppStore:

1. To accelerate the advancement and organization of e-Gov applications
2. To reproduce effortlessly fruitful applications crosswise over States
3. To keep away from duplication of exertion and cost being developed of comparable application
4. To guarantee accessibility of confirmed applications following normal models at one place.

Here you find some of the app e-Gov app links

1. **http://apps.nic.in/apps/government/government-eprocurement-system-nic-gepnic**

Government eProcurement System of NIC (GePNIC) is a generic software which can be directly used by any Government Department.

2. **http://apps.nic.in/apps/government/e-hospital**

e-Hospital@NIC -Healing center Management System is a work process based ICT answer for Hospitals particularly implied for the doctor's facilities in Government Sector. This is non specific programming which covers major utilitarian territories like patient care, research center administrations, work process based report/data trade, human.

3. **http://apps.nic.in/apps/government/e-granthalaya-digital-agenda-library-automation-and-networking**

A Library Management Software for computerization of Indian Libraries. The software provides Web based Data Entry solution to the libraries. The software generates e-Catalogs of library documents and provides various kinds of Online services to the Library members. The Application is available at NIC.

4. **https://play.google.com/store/apps/developer?id=Mobile+Seva**

Yield Insurance portable application can be utilized to figure the Insurance Premium for told crops in view of region, scope sum and advance sum in the event of loanee agriculturist. It can likewise be utilized to get points of interest of ordinary aggregate protected, broadened total guaranteed, premium subtle elements and appropriation data of any advised yield in any informed zone.

5. **https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwjR_IjMrsLUAhWJNo8KHb6XCIoQFggnMAA&url=https%3A%2F%2Fplay.google.com%2Fstore%2Fapps%2Fdetails%3Fid%3Dcom.brinvik.vksKBazar.app%26hl%3Den&usg=AFQjCNHSexz2Be5DyqP6GR8a6saIrYU7Gg&sig2=BTX4bMVfI5TW31bOETIJUg**

Simple and useful Krishi app. This app is for agriculture traders and farmers in India. See the commodity prices on your mobile anytime. App is covering most of the farm product from all over the Indian agriculture markets, market yard and mandi.

Utility Apps Links Continued

6. **http://apps.nic.in/apps/government/mother-and-child-tracking-system-mcts**

Mother and Child Tracking System (MCTS) is an activity of Ministry of Health and Family Welfare to use data innovation for guaranteeing conveyance of full range of social insurance and inoculation administrations to pregnant ladies and youngsters up to 5 years old. It is an imaginative electronic usage Apart from these apps there are many more e-Gov Apps and private apps (free and paid) available in the market which are helpful in eCommerce, eHealth and eLearning.

Exercise

1. Discuss Digitization in India.

Ans. _____

_____

2. Explain Digital Devices.

Ans. _____

_____

3. Discuss Need of Smart phone & Apps.

Ans. _____

_____

4. Explain how to install & Install apps on Smartphone.

Ans. _____

_____

5. What are E terminal & Kiosk?

Ans. _____

_____

6. Discuss eCommerce, eHealth & eEducation.

Ans. _____

_____

UNIT 4.3: Monitoring & Maintenance of Electrical Systems

Unit Objectives

At the end of this module, you will be able to understand:

1. Electrical Systems & its types
2. Batteries & Power banks
3. UPS
4. Electrical Maintenance

4.3.1 Electrical Systems & Its Types

This can be as basic as an electric lamp cell associated through two wires to a light or as included as the space shuttle. Electrical frameworks are gatherings of electrical parts associated with complete some operation. Each travel auto's electrical framework is a subsystem of the tram framework.

Types & Principles

Establishing to most specialists, experts and circuit testers is a straightforward subject and little consideration is paid to it other than realizing that something is required. To a few people there are grounds and afterward there are “Clean Grounds”. .Thirty years back when PCs were moderately new, there were many ways to deal with establishing, especially for hardware and PCs. Some of these methodologies built up what was known as a “Clean Ground” which was regularly confined from the power grounds.

A significant number of these thoughts have been ended up being incapable and some of the time unsafe to gear and faculty. As frequencies wound up plainly increasingly elevated (PC speeds speedier and quicker) explore quickened into the subject of establishing, protecting, EMI, lightning insurance and friction based electricity. The examination brought about the essential science behind establishing. This subject isn't as straightforward as once thought and one needs an unmistakable comprehension of the essential standards.

In the first place, the ground or establishing of a circuit is a misnomer. For most purposes, the term implies earthling or associating the circuit to earth, its interfacing the circuit to a typical perspective for most frameworks that is the earth.

Groundings fundamental reason for existing is to give a typical perspective between different wellsprings of electrical vitality, i.e.

Different power systems	- Public Utilities, on-site generation, battery
systems Different voltage systems	- 138,000v, 13,800v, 480v, 120v, etc.
Different energy sources	- Electrical Energy, Lightning, Static Electricity, RF Energy

Electrical Systems & Its Types Continued

Precautions & Observation

Safety - In actuality, groundings reason for existing is significantly more than giving a common point of reference. It is the way to SAFETY. That is, the assurance of

1. Individual
2. Gear
3. Offices

When thinking about insurance of staff, hardware and offices against electrical perils there is a NEED TO CONSIDER both Grounding and Over current Protection and how they relate. They go as an inseparable unit. A facility=s electrical insurance frameworks are proposed to:

1. Shield Personnel from - Electrocution, Fire
2. Shield Equipment and Facility from - Failure, Fire
3. Shield Electrical Circuit from - Cable Failures

For the assurance frameworks to do as proposed, they should first work and second they should work sufficiently quick to kill or possibly limit harm. This is the place legitimate establishing comes to play.

Electric shock - An electrical stun (electric shock) happens when two parts of a people body meet electrical conveyors of a circuit which is at various possibilities, in this manner delivering a potential contrast over the body. The human body has protection and when the body is associated between two conductors at various possibilities (voltage) a circuit is shaped through the body and current will stream.

At the point when the human body meets just a single conductor, a circuit isn't framed and nothing happens. At the point when the human body meets circuit conductors, regardless of what the voltage is, there is a potential for hurt. The higher the potential distinction the more the harm. The impact of an electrical stun is an element of what parts of the body meet every conductor, the protection of each contact point, the surface protection of the body at the contact, and in addition different components.

The Ground - The word ground, as expressed above, regularly alludes to associating a segment of an electrical circuit to earth. There are many motivations. In the first place, our offices and gear are associated with earth in some way since most materials are conductive to some degree. Additionally the earth is conductive under typical conditions.

Regardless, electrical circuits, close-by conductive materials, and the earth are associated deliberately, unintentionally or by nature through inductive as well as capacitive coupling. As the utilization of power spread after Thomas Edison developed the light, many flames and mishaps happened. It was discovered that by interfacing one point in each electrical circuit to a typical reference point, the earth, potential contrasts between electrical frameworks could be controlled and electrical frameworks could be made safe.

Lighting Protection - The harm caused by lightning can be exceptionally noteworthy. There isn't a high level of comprehension of lightning and more research is required. Lightning as we as a whole know is of high vitality. The lightning stroke has a quick ascent in present and a lot of what applies to high frequencies likewise applies to lightning because of the quick ascent times. Cloud traverse the earth surface. Because of the development of the dampness in the cloud against the air, electric energizes fabricate. The base of the cloud turns out to be contrarily charged while the working underneath the cloud turns out to be decidedly charged. The air between the cloud and the building goes about as an expansive capacitor. At the point when the voltage over this capacitor ends up plainly higher that the protection of the air, a lightning strike happens and high current starts to stream.

4.3.2 Batteries & Power banks

(Agriculture, Medical, health, Education, Government Assistance, Rural Development etc)

A battery is an electrochemical cell (or encased and secured material) that can be charged electrically to give a static potential to control or discharged electrical charge when required. A battery for the most part comprises of an anode, a cathode, and an electrolyte. Normal kinds of business batteries and some of their attributes and points of interest are condensed in the accompanying table. Battery writes not demonstrated incorporate the Zinc-Air, Flooded Lead Acid, and Alkaline batteries.

CCU & SPV

Power to ONT is derived from AC mains, Solar panel & battery bank. CCU – charge coupler unit consists of controller board, battery and serge boards for AC mains and solar panel. SPV is single integrated switch mode power supply that can work in both single-phase AC mains input as well as solar photovoltaic panel output (SPV)

Solar panel

The SPV is mounted & fixed onto the specialty designed module mounting structure. The orientation of SPV panel mounted on a structure can be adjusted in 2 axes. Refer to Fig. 9. 3 .1

Fig. 9.3.1. Solar Panel

4.3.3 UPS

The Uninterruptible power supply (UPS) is an online power insurance system that avoids loss of significant electronic data, limits equipment downtime and limits the adverse impact on hardware generation due to startling force issues.

Standard

The UPS system keep on monitors all the time and approaching electrical power and expels the surges, spikes, lists, and different irregularities that are characteristic in business utility power. Working with your building's electrical framework, the UPS system supplies perfect, predictable power that your touchy electronic gear requires for dependable operation. Amid brownouts, power outages, and other power interference, discretionary battery strings give crisis energy to protect operation. The UPS framework is housed in an unsupported bureau, isolated into three segments to encourage shipping. The bureau segments line up and coordinate in style and shading, and have safety shields behind the doors for dangerous voltage protection.

UPS Installation Plan and Unpacking

Use the accompanying essential succession of ventures to introduce the UPS:

4. Make an establishment anticipate the UPS framework
5. Set up your site for the UPS system
6. Review, unload, and empty the UPS cupboards
7. Wire the system
8. Install features, accessories, and/or options, as applicable
9. Finish the installation checklist
10. Have approved administration faculty perform preparatory operational checks and start-up

Creating an Installation Plan

Setting up Your Site :

For the UPS system to work at peak productivity, the establishment site should meet the ecological parameters sketched out in this manual. In the event that the UPS is to be worked at a height higher than 1500m (5000ft), contact your administration agent for vital data about high elevation operation. The working condition must meet the weight, clearance, and natural necessities. The UPS cabinets use forced air Cooling to control inside segment temperature. Air gulfs are in the front of the cabinet and outlets are in the top. You should permit freedom before or more every cabinet for legitimate air dissemination.

Condition Considerations

The life of the UPS framework is antagonistically influenced if the establishment does not meet the accompanying rules:

1. The framework must be introduced on a level, fixed solid cushion or floor.
2. The framework must be introduced in a temperature controlled indoor region free of conductive contaminants.

UPS Continued

Preparing for Wiring the UPS System

The power wiring associations for this gear are appraised at 90°C. On the off chance that the surrounding temperature is more prominent than 30°C, higher temperature wire as well as bigger size wire might be essential. Control wiring for remote crisis control off (REPO) and discretionary adornments, (for example, building alerts and observing interface) ought to be associated at the client interface terminal squares situated inside the UPS utilizing UL Class 1 wiring strategies.

Size up your battery capacity

The initial phase in any UPS establishment would be to first size up your necessities and distinguish the servers that you mean to interface with the UPS. While endeavouring to coordinate the right UPS model to your server isn't that confounded, it can be overpowering in the event that you are not equipment kind of individual.

For simplicity purpose, I assemble UPS into three establishment "sizes" — little, medium, and vast.

1. Little : Low-limit UPS that is regularly used to control several work areas or a solitary server. These can be effortlessly obtained off-the-rack.
2. Medium : Any UPS that is intended to serve more than a solitary server, yet still fitting and-play. These must be bought from IT gear sellers.
3. Vast : Any UPS that can't be straightforwardly controlled off an unmodified divider attachment is delegated "huge." Also, unless you have related knowledge with electrical issues, you ought to get the architect from your UPS maker to come in, or else draw in the administrations of a qualified circuit repairman. These UPSs have a tendency to be accessible just from the makers themselves, or from select sellers.

Most server rooms will likely comprise of numerous medium-measure UPSs. They may run autonomously, or are fell with battery packs to draw out runtime. I am summing up here, however a few of these is generally adequate to help a rack of equipment.

Plan for establishment

A vital point to endure as a top priority is that you ought to never endeavour to introduce an UPS without anyone else's input, unless you are taking care of a basic, little UPS.

The heaviness of most UPSs is generous. Regardless of whether you can convey your eight-year-old on your shoulder fine and dandy, you should recollect that the heaviness of an UPS is consolidated into a moderately little bundle with a to a great degree poor weight circulation — the thick battery is ordinarily situated in one end, and it has hard metal edges on most sides to boot.

Moreover, remember that you are managing electrical gear, and there is dependably the possibility of a mischance. While you may like the peace and calm of introducing it over an end of the week or late during the evening, to be protected, ensure there is another person around.

4.3.4 Electrical Maintenance

The electrical maintenance technician installs or repairs equipment that has electrical components either on site or at centralized repair facilities. Education. Associate's degree in electrical and electronic maintenance. Maintenance electricians use testing devices to discover problems with wiring, fixtures, or other electrical equipment. They replace or repair the defective elements using various types of hand or power tools.

Equipment handling - Work utilizing electrically powered equipment. You should ensure that electrical hardware utilized for work is safe. Here is a rundown of moves that ought to be made to guarantee this is so play out a hazard appraisal to recognize the dangers, the dangers emerging from those risks, and the control measures you should utilize. More specifically, regularly electrical hardware refers only to components part of some portion in the electrical appropriation system, for example, Electric switchboards. Conveyance sheets. Circuit breakers and detaches. Fig. 9.3.2. Electrical Equipment's Refer to Fig. 9.3.2.

Fig. 9.3.2. Electrical Equipments

Some examples of electrical devices include light bulbs, vacuums, toasters, and older technologies such as the electric telegraph and batteries. Electrical devices are defined as devices that use or generate electricity and transform it into another form of energy, such as motion, heat, or light.

Precautions - Electrical dangers are dangers of death, electric stun or other damage caused straightforwardly or in a roundabout way by power. It's indispensably vital to avoid potential risk when working with power. Security must not be traded off and some guidelines should be taken after first. The fundamental rules in regards to safe treatment of power archived beneath will help you while working with power.

1. Dodge water dependably when working with power. Never touch or have a go at repairing any electrical hardware or circuits with wet hands. It expands the conductivity of electric current.

2. Never utilize gear with frayed lines, harmed protection, or broken attachments.

3. On the off chance that you are taking a shot at any container at your home at that point dependably kill the mains. It is additionally a smart thought to set up a sign on the administration board with the goal that no one turns the fundamental switch ON coincidentally.

4. Continuously utilize protected instruments while working.

5. Electrical risks incorporate uncovered stimulated parts and unguarded electrical gear which may move toward becoming invigorated startlingly. Such gear dependably conveys cautioning signs like "Stun Risk". Continuously be attentive of such signs and take after the wellbeing rules set up by the electrical code took after by the nation you're in.

6. Continuously utilize suitable protected elastic gloves and goggles while taking a shot at any branch circuit or some other electrical circuit.

7. Never have a go at repairing stimulated gear. Continuously watch that it is de-empowered first by utilizing an analyser. At the point when an electric analyser touches a live or hot wire, the globule inside the analyser illuminates demonstrating that an electrical current is coursing through the particular wire. Check every one of the wires, the external metallic covering of the administration board and some other hanging wires with an electrical analyser before continuing with your work.

8. Never utilize an aluminium or steel stepping stool on the off chance that you are chipping away at any container at stature in your home. An electrical surge will ground you and the entire electric current will go through your body. Utilize a bamboo, wooden or a fiberglass stepping stool.

Electrical Maintenance Continued

Electrical safety – The general electrical risks and causes of injury are:

1. Danger implies any potential or real risk to the prosperity of individuals, hardware or condition Burns, Shocks, Falls are the injuries from electrical equipment's.
2. Electrical risk wellbeing implies playing it safe to recognize and control electrical perils
3. Electric shock or stun causing damage or death. The electric stun might be gotten by immediate or aberrant contact, following through or over a medium, or by arcing. For instance, electric stun may come about because of roundabout contact where a conductive part that isn't regularly empowered moves toward becoming invigorated because of a blame (e.g. metal toaster body, fence).
4. Arcing, blast, or fire causing consumes. The wounds are regularly endured on the grounds that arcing or blast or both happen when high blame streams are available.
5. Electric stun from 'step-and-touch' possibilities
6. Dangerous gases causing ailment or demise. Consuming and arcing related with electrical hardware may discharge different gases and contaminants.
7. Fire coming about because of an electrical blame.

The followings are the basic electrical safety terms

1. Ground-blame Circuit Interrupters (GFCIs)
2. Fundamental electrical line wellbeing
3. Resetting Breakers
4. Conductive Apparel
5. Divider Penetrations
6. Safe Work Practices for Equipment Applications
7. Just qualified electrical labourers can perform electrical work.

Safety priorities - Electrical dangers exist in relatively every work environment.
Basic reasons for electric shock are:

1. reaching overhead wires
2. Undertaking support on live hardware
3. working with harmed electrical hardware, for example, expansion leads, attachments and attachments
4. utilizing hardware influenced by rain or water entrance

On the off chance that you go over a man accepting an electric stun:

1. in the event that conceivable, detach the electrical supply (switch?)
2. survey the circumstance – never put yourself in danger
3. play it safe to ensure yourself and any other person in the region
4. apply the medical aid standards (e.g. DRSABCD)
5. evaluate the wounds and move the setback to a protected zone if required 6. oversee emergency treatment if prepared
7. look for earnest therapeutic consideration.

Electrical Maintenance Continued

Testing and Status Check –

Utilization of Specific Safety-Related Equipment and Work Practices

1. Ground Fault Circuit Interrupters (GFCIs) are required for every one of the 125-volt, single stage, 15 and 20- ampere repository outlets utilized for brief electric power, or as an augmentation to the power supply string.
2. Test before Use. Push the test catch and confirm the GFCI has closed off by connecting a protected gadget to it (i.e. convenient light or instrument). On the off chance that it doesn't close off, don't utilize it. Reset it. In the event that it turns on, it is sheltered to utilize.
3. Report a breaking down GFCI to the assigned office association.
4. Most offices will permit resetting the GFCI one time. Check with your office.
5. On the off chance that it trips a moment time, have it assessed by a qualified electrical labourer.
6. It might have stumbled to spare your life!
7. Repeated resetting isn't permitted.

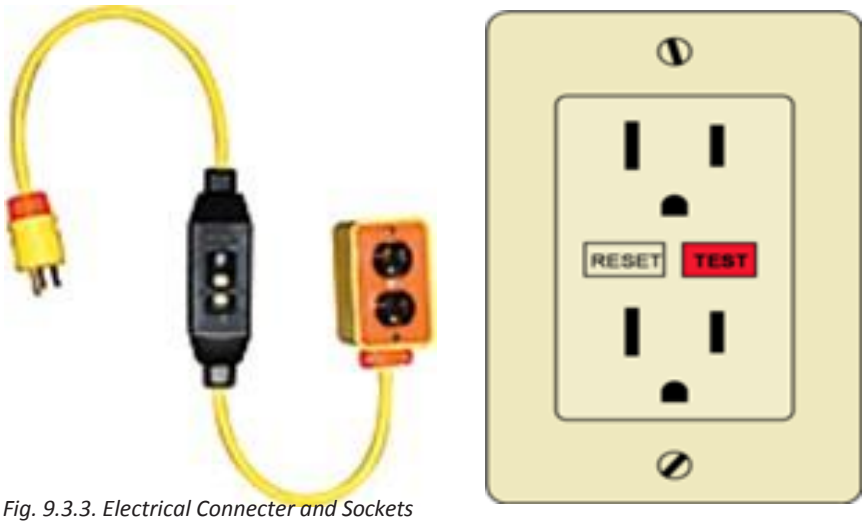


Fig. 9.3.3. Electrical Connecter and Sockets

Circuit Breaker Tripping –

Utilize the Specific Safety-Related Equipment and Work Practices

1. In the event that you can reset circuit breakers or other electrical switches, position yourself in the most secure area conceivable.
2. Never stand straightforwardly before or reach over the gadget.
3. A few offices have particular prerequisites for who can work breakers and separates. Ensure you know the necessity before playing out these activities.

Electrical Maintenance Continued

Do's & Don'ts in Electrical Operations

Do's

1. Check wiring to ensure its properly insulated, the correct decision for the activity (e.g., named for utilize outside or in work regions with risky substances)
2. Watch that electrical associations Commented [V14]: Standard line no change are tight.
3. Match attachments and outlets (three-pronged fittings go in three-pronged outlets as it were).
4. Read and take after producer's guidelines for electrical hardware.
5. Leave take a shot at empowered hardware to qualified laborers.
6. Obey notices to avoid electrical circuits and bolted out gear.
7. Wear elastic gloves and some other doled out defensive attire and hardware.
8. Keep machines and devices greased up.
9. Keep the work region clean and quickly and legitimately discard sleek clothes, paper, sawdust, or whatever else that could copy.
10. Utilize electrical strings just when approved—and of the correct limit.
11. Keep electrical gear clean.
12. Review electrical apparatuses before each utilization.
13. Report any electrical apparatus, hardware, or wire issues promptly.
14. Use per Listing and Labelling
15. Tightly coiled line that had an emergency since it couldn't cool properly when over-burden.
16. Strings must be GFCI guaranteed or under an Assured Equipment Ground Conductor program.

Don'ts

1. Over-burden motors, circuits, or outlets.
2. Run ropes along the floor.
3. Utilize impermanent wiring.
4. Put anything besides a connect to an electrical outlet.
5. Touch anything electric with wet hands.
6. Leave hardware or warming gear pursuing unattended working hours. 7. Give strings a chance to get curved or tangled.
8. Get nearer than 10 feet to an electrical cable (in case you're an unfit representative).
9. Reach indiscriminately into a space that may contain stimulated gear.
10. Wear metal adornments when working with electrical machines.
11. Utilize a power device that smokes, starts, smells, or stuns.

Health & Safety Precautions

Safety is important and its our responsibility. Unsafe working environment conditions are not allowed. The primary objective of a company is the health and safety of the Employees, and also safety of company property. The goal is to provide healthful and safe working conditions for all Company Employee

Electrical Maintenance Continued

Safety Precautions while working with electrical systems includes using of well-designed equipment's to avoid hazards and following the below steps

1. Be protected from physical damage always.
2. Inspection before the use.
3. Be routed so trip, squeeze, scraped spot, catching, and so on can't happen.
4. Not be utilized as a substitute for lasting wiring.
5. Be reasonable for nature i.e. outside, wet, daylight, and so on.
6. Might have slack – not drawn out tight.
7. Might be unplugged by getting a handle on the attachment not the string.

Refer to Fig.9.3.4

Fig. 9.3.4. Electrical Safety Precaution Materials

While working with the electrical system use the equipment's which are necessary for example, Ladders utilized around electrical working place must and should have non-conductive side rails. Steps or stepping stools with non-conductive side rails that are polluted with paint, oils or different coatings may never again be non-conductive. Look at them. Avoid uncovered empowered hardware. Continuously turn upward before you lift or move up. Refer to Fig. 9.3.5.

Fig. 9.3.5. Electrical Safety Equipment's

1. Numerous things concerning electrical security have been introduced. It isn't conceivable to cover every one of the risks electrical energy can present.
2. In the event that you recognize a hazard, ensure you and others are protected and afterward report it quickly to the best possible specialist for your work area.
3. You are likewise needed to be ALERT and AWARE of potential electrical dangers. On the off chance that you are not, you can be seriously harmed or killed

Exercise

1. Discuss Electrical Systems & its types.

Ans. _____

_____

_____

2. Explain Batteries & Power banks.

Ans. _____

_____

_____

3. Explain UPS.

Ans. _____

_____

_____

4. Explain Electrical maintenance.

Ans. _____

_____

_____

5. What are the Do's & Don'ts in Electrical Operations?

Ans. _____

_____

_____

6. Discuss Health & Safety Precautions.

Ans. _____

_____

_____

UNIT 4.4 Revenue Management and record maintenance

Unit Objectives

At the end of this module, you will be able to understand:

1. Revenue Management and record maintenance

4.4.1 Revenue Management and Record Maintenance

VLE will sell vouchers and coupons issued from the authorities. VLE is responsible for the billing co ordinations to multiple operations. He/she will be responsible to maintain the site Rental bill payment collection of receipts and act as interface in some cases. VLE perform Site management, Product & service information delivery, Marketing of E services and assistance Public private operation executions. Administration conveyance at Citizen Doorsteps in far-flung remote areas via VLE mode benefits the rural civilians on

1. Accuracy & Straightforwardness in benefit conveyance process
2. Circling a few distant Govt workplaces for benefiting administrations
3. Different outlets for every office
4. Constrained working days, bringing about long holding up time before the real conveyance of the administration
5. Manual Processes
6. Troublesome record keeping
7. Discrete procedures crosswise over areas
8. Troublesome and in-precise information investigation from physically looked after records.

Provincial Centric Services

1. PPP Model
2. Application administrations
3. Semi On-line
4. Bunch Mode

Urban Centric Services

1. Claim staff
2. Service Bills
3. On-line

Observations: Difficulties / Limitations noted

1. Manual/ Semi-online system
2. Client server based application
3. No MIS available
4. Discrete processes across districts
5. Irregularities in application/ financial related matters
6. Individual districts did service creation
7. Non-standardization of processes
8. No account keeping, resulting in financial irregularities
9. No centralized control

Revenue Management and Record Maintenance Continued

The CSC Scheme Envisaged:

1. Efficient delivery to Door step of citizens from government services
2. Entrepreneurship in rural areas must be promoted
3. Rural populations Capacity building in using IT-enabled service platforms
4. Arrangement private sectors commercial goals with social objectives of the Government

Government

CSC would be outfitted with least required IT Infrastructure and would likewise have broadband Internet availability (256 Kbps).

1. Delivery of services through kiosks
2. Preparing and determination of stand proprietors
3. Everyday administration and help to VLEs, guaranteeing network
4. Credit Limit Maintenance
5. General co- facilitator in the interest of Central and State
6. Government for fruitful execution
7. State assigned nodal office
8. Strategy plan and undertaking checking
9. Budgetary help in the interest of DoIT&C
10. Administering exercises of SCA and LSPs
11. Observing e-administration venture advance at region level

VLE/CSC will do management Support on Billing system and Revenue Management aspects in Applications, while doing integration process and in User management cases. Few are listed below.

Applications

1. Prepaid system
2. Dynamic/on-the-fly Service Creation
3. Dynamic application producing continuous substance
4. The application and servers are hearty and bolster high level of simultaneous
5. Finish digitized work process for the conveyance of digitally marked authentications

Integration

1. SMS Integration component
2. Instalment Gateway reconciliation (ICICI, Axis Bank, Bill Desk)
3. Outsider Application Integration (ICICI Prudential, DISH TV, LSP/SCA gateway, Telecom specialist organizations, and so forth)

Revenue Management and Record Maintenance Continued

User Management

1. Client Management of all Stakeholders
2. Keeping up credit farthest point of stand proprietors and LSPs/SCAs.
3. Accommodation of Online Application Form
4. enlistment for different Government offices
5. admissions to different scholastic courses
6. Accommodation of Grievances/Information Retrieval
7. Carefully Signed Copy of Land Records
8. Carefully Signed Certificates
9. Service Bill Payment-Post - paid
10. Prepaid administrations (All significant telecom TV revive specialist organizations, CSC SPV, and so on.)

Record Maintenance

Record Maintenance is an important aspect in the specification of VLE operations. Documentation of the services issued and services offered rental pay slips and customer details musts be maintained. Licence certificate should be kept copies. Maintainace manual service indications emergency contact details, civic service contact number and cases must be recorded. E governance and service activities at rural may also be kept recorded. E copies, forms, notice, formats, application forms ad missionary document will serve the need.

Exercise

1. Discuss VLE Responsibility in Revenue Management and record maintenance.

Ans. _____

_____

2. What are the Rural & Urban Centric Services?

Ans. _____

_____

3. What are the Application of Bill system & Revenue management?

Ans. _____

_____

4. Discuss Record Maintenance.

Ans. _____

_____

Skill India

GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

Telecom
Sector
Skill
Council

5. Organize Resources and Work Effectively and Safely

Unit 5.1 – Workplace Health and Safety

Unit 5.2 – Different Types of Health Hazards

Unit 5.3 – Importance of Safe working Practices

Unit 5.4 – Reporting Safety Hazards

Unit 5.5 – Waste Management

Unit 5.6 – Organizations' Focus on Greening of Jobs

TEL/N9101

Key Learning Outcomes

At the end of this module, you will be able to:

1. Explain about the work place health and safety
2. Differentiate various health hazards
3. Demonstrate various first aid techniques
4. Importance of safety at workplace
5. Understand Basic hygiene Practices and hand washing techniques
6. Explain the need for social distancing
7. Understand the reporting of hazards at workplace
8. Explain e-waste and process of disposing them
9. Explain Greening of jobs

UNIT 5.1: Workplace health & safety

Unit Objectives

At the end of this unit, you will be able to:

- Understand about workplace health and safety
- Explain tips to design a safe workplace
- Explain precautions to be taken at a workplace

5.1.1 Safety: Tips to Design a Safe Workplace

Workplace health and safety policy defines the best possible work conditions and safety for the employees. Employees have a right to feel safe in their workplace. Hence the organizations create and follow legal standards and ensure a hazard-free workplace.

Every organization is obligated to ensure that the workplace follows the highest possible safety protocol. When setting up a business some tips to remember:

- Use ergonomically designed furniture and equipment to avoid stooping and twisting
- Provide mechanical aids to avoid lifting or carrying heavy objects
- Have protective equipment on hand for hazardous jobs
- Ensure presence of emergency exits and they are easily accessible
- Set down health codes and ensure they are implemented
- Follow the practice of regular safety inspections in and around the workplace
- Get expert advice on workplace safety and follow it
- Get regular inspection of electrical wiring and also the electrical switches and gadgets
- Install fire extinguishers and fire alarms.

5.1.2 Precautions to be taken while at work

Every employee is obligated to follow all safety protocols put in place by the organization.

All employees must make it a habit to:

1. Immediately report unsafe conditions to the supervisor
2. Recognize and report safety hazards that could lead to slips, trips and falls
3. Report all injuries and accidents to the supervisor
4. Wear the correct protective equipment when required
5. Learn how to correctly use equipment provided for safety purposes
6. Be aware of and avoid actions that could endanger other people
7. Always be alert
8. Educate the employees about the first/emergency exits on the floor, and also where the fire extinguishers are kept.

Tips

1. Be aware of what emergency number to call at the time of a workplace emergency
2. Practice evacuation drills regularly to avoid chaotic evacuations

UNIT 5.2: Different types of Health hazards

Unit Objectives

At the end of this unit, you will be able to:

1. Understand the health hazards
2. Demonstrate First Aid Techniques

5.2.1 First Aid

Illness, injuries, and pain are part of human life. This can happen anyway. Every individual is prone to illness and injuries at any time and anywhere.
In case of any of these, some kind of immediate medical attention or treatment is needed to reduce the discomfort, pain, and deterioration of the condition. The medical attention that is given at the first instance before seeking professional medical help is called “First Aid”. First aid is the immediate and temporary treatment given to the victim of an accident or sudden illness while awaiting the arrival of “Medical Aid”. Firt Aid means providing the initial treatment and life support for people with an injury or illness. However, First Aid has its limitations and does not take the place of professional medical treastment. Proper early assistance given by First Aider helps in saving the life of a patient.
Illness and injuries can happen anywhere, be at home, the workplace, or in the market place. Whatever safety measures we adopt, we are all prone to illness sometime or the other.
Some common injuries and their rescue techniques:

5.2.1 First Aid Techniques

- Direct pressure must be applied to the cut or wound with a clean cloth, tissue, or piece of gauze, until bleeding stops.
- If blood soaks through the material, it is highly recommended not to remove it.
- More cloth or gauze must be put on top of it, and pressure must be continued.
- If the wound is on the arm or leg, the limb must be raised above the heart to help slow the bleeding.
- Hands must be washed again after giving first aid and before cleaning and dressing the wound.
- A tourniquet must not be applied unless the bleeding is severe and not stopped with direct pressure.

Click / Scan the QR code for First Aid Techniques

Fig. 6.2.1a: Clean cut or wound

Clean cut or wound

- The wound must be cleaned with soap and lukewarm water.
- To prevent irritation and burning sensation, the soap solution must be rinsed out of the wound.
- Hydrogen peroxide or iodine must not be used to clean or treat the wound since they are corrosive and can damage live tissues.

Fig. 6.2.1b: apply hydrogen peroxide or iodine

Protect the wound

- Antiseptic cream or solution must be applied to the wound to reduce the risk of infection.
- Then the wound must be gently covered with a sterile bandage.
- Till the wound heals, the bandage must be changed (dressed) daily to keep the wound clean and dry.

Fig. 6.2.1c: Protect the wound

Call the Emergency Helpline if:

- The bleeding is severe and deep
- You suspect Internal Bleeding
- Abdominal or Chest wound exists
- Bleeding continues even after 10 minutes of firm and steady pressure

For Burns:

- Immediately put the burnt area under cold water for a minimum of 10 minutes
- If the burned area is covered, take clean scissors, cut and remove the fabric covering the area
- In case clothing is stuck to the burned area, leave it as it is
- Before sterile dressing application, remove jewellery (if any)
- It is better to leave the burned area open
- Do not apply any medication or ointment
- Breaking a blister – it is an absolute no-no!

Fig. 6.2.1d: Put Burnt Area under Water

For Broken Bones and Fractures

- **Protruding bone must be left alone**
- If a bone has broken through the skin, it must not be pushed back into place.
- The area must be covered with a clean bandage and immediate medical attention must be sought.
- **Bleeding must be stopped**
- Steady and direct pressure must be applied with a clean piece of cloth for 15 minutes and the wound must be elevated.
- If a blood soaks through, one must apply another cloth over the first and seek immediate medical attention.
- **Swelling must be controlled**
- The RICE (Rest, Ice, Compression and Elevation) therapy must be applied to control and reduce swelling.
- Rest the injured part by having the person stay off of it.
- Ice must be applied on the area with the help of an ice pack or by wrapping the ice in a clean cloth. Ice must not be directly placed against the skin.

For Heart Attack/Stroke

- Think FAST. Face: is there weakness on one side of the face? Arms: can they raise both arms? Speech: is their speech easily understood? Time: to call Emergency helpline
- Immediately call medical/ambulance helpline or get someone else to do it

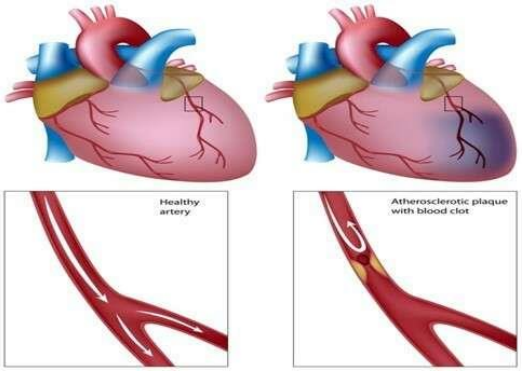


Fig 6.2.1e: Anatomy of Heart Attack

For Head Injury

- Ask the victim to rest and apply a cold compress to the injury (e.g. ice bag)
- If the victim becomes drowsy or vomits, call Medical helpline or get someone else to do it

Steps of using breathing apparatus:

Check the parts of the breathing apparatus thoroughly.

Check the bypass knob (red). Close it if you see it open. After this, press the reset button (area above bypass nob – black)

Inspect the facemask to see that it is undamaged.

Lift the cylinder ensuring that on the top the cylinder valve should be present. The back plate of the cylinder should face the wearer. Wear the breathing apparatus on the shoulder like a bag pack and by the neck strap, hang the facemask.

After wearing the breathing apparatus tighten shoulder straps and fasten the waist belt.

The cylinder valve should be opened slowly to inspect the pressure gauge.

Make sure that 80% of the cylinder is full.

Wear the mask slowly by resting your chin in the resting cusp and pull the head strap slowly over your head.

Pull the head straps for a snug but comfortable fit.

Breath in and normally to see if you can breathe normally or not.

Now insert a finger sidewise of the facemask for easy outward airflow.

Slowly close the cylinder valve without leaving the knob.

Be steady for 10 minutes and hold your breath or extremely slow to listen to any wheezing sound.

Also, check the pressure gauge for any dip in the pressure.

Normally Breathe to vent system
Listen for a whistle alarm while observing the pressure gauge
at 55 bar (+/-5 bar)

Briefing and Guidance for Fire Fighters

There are basically three methods with the help of which people can be rescued from a building engulfed in a blazing fire. To ensure on-site reception, here are two of the important steps that we will discuss now. These come under the best safe lifting and carrying practices.

Conventional Technique: This is a good method if there is an open area close by. The first rescuers will make the victim sit reach under their armpits and finally, grab their wrist. The other rescuer will cross the ankle (victim), pull up that person's legs on his shoulder. Finally, on the count of 3, both will lift the person up and move out.

Fig. 6.2.1f: Fast Strap

Fast Strap: In case the victim is completely incapable of moving out of the fire zone. The rescuers should follow this method. One of the rescuers will place their knee between victim's shoulder and head. Pin the loop of webbing to the ground with the help of the knee. This acts as an anchor. With the non- dominant hand hold the other end of the webbing and make a loop. With steady hands, pull the victim's hand in from the loop, tie it securely and finally clip the webbing loops.

Fig. 6.2.1g: Fast Strap

Essentials for Smooth Evacuation: The following are essential to have a smooth evacuation during an outbreak:

1. Clear passageways to all escape routes
2. Signage indicating escape routes should be clearly marked
3. Enough exits and routes should be present to allow a large number of people to be evacuated quickly
4. Emergency doors that open easily
5. Emergency lighting where needed
6. Training for all employees to know and use the escape routes
7. A safe meeting point or assembly area for staff
8. Instructions on not using the Elevator during a fire

Special Evacuation Requirements For Specially Abled Persons

9. **The Visually Impaired**
   - Announce the type of emergency
   - Offer your arm for help

- **With Impaired Hearing**
  - Turn lights on/off to gain the person's attention, or indicate directions with gestures, or write a note with evacuation directions

- **People with Prosthetic Limbs, Crutches, Canes, Walkers**
  - Evacuate these individuals as injured persons.
  - Assist and accompany to evacuation site if possible.
  - Use a sturdy chair, or a wheeled one, to move the person to an enclosed stairwell
  - Notify emergency crew of their location

5.2.2 Importance of Fire Safety Drills

Fire drills are indispensable in any workplace or public building for rehearsing what to do in the event of a fire. They are also a lawful obligation under the Fire Safety Order of 2005 and all workers in a company must partake. Here's how to get the most out of your fire practice.

Why have fire drills?

There are numerous reasons why fire drills are vital; first of all, fire drills are a chance to practice evacuation techniques to make sure all staff are acquainted with them. The staff will vacate the building quickly and therefore in a real life situation panic will be decreased, as everyone will know what they need to do. Fire drills are also beneficial for testing escape methods to assess their efficiency.

During fire drills, checks can also be carried out on alarm systems to make certain they are working properly and that emergency exits are passable. Overall fire drills help increase safety, so that you will be best equipped if a real fire does happen.

How often?

Ideally there should be two fire drills a year, although this may vary according to the workplace and after checking the firm's risk assessment. If there are people who work in shifts, suitable preparations should be made to ensure all staff partake in at least one fire drill per year and to educate them as to how to handle the situation.

Should you inform staff beforehand?

There are arguments for and against making people conscious of fire drills before they take place. Some people contend that not notifying staff gives an element of surprise, so that people take drills more sincerely. However, this can also have the reverse effect in a real fire, as on overhearing the alarm people may reason that it's only a drill.

The benefit of notifying all staff of fire drills in advance is that initially, they will not panic, which circumvents potential injuries that could be instigated in a rush to exit a building. Furthermore, if the alarm sounds, lacking a prior warning, there will be no uncertainty as to if it is a drill or not and people will act correctly. In public places such as shopping centres, it is prudent to make members of the public alert when a drill is about to happen.

UNIT 5.3: Importance of Safe Working Practices

Unit Objectives

At the end of this unit, you will be able to:

1. Explain Basic Hygiene Practices
2. Understand the importance of Social Distancing
3. Demonstrate the safe working practices

5.3.1 Basic Hygiene

We are living in an environment with millions of germs and viruses. And our body can be a breeding space for these microbial organisms. They grow and multiply and cause many diseases which sometimes can prove to be fatal for the human beings. These disease-causing microbial organisms kill over 17 million people every year. Some simple hacks and little changes of basic personal hygiene habits can bring amazing changes to all of us. We can prevent contracting these diseases if we follow these hygiene practices every day.

Personal Hygiene

Personal hygiene is all about managing your body hygiene, essentially caring for your well-being incorporating some physical hygiene habits. Also, there are mental health benefits as well, as they affect each other immensely.

What are good personal hygiene habits?

Good personal hygiene includes but not limited to-

- Take regular shower
- Maintain oral hygiene
- Wash your hands frequently
- Wash your genitals
- Keep your clothes and surrounding dry and clean

These habits should be practiced on a regular basis, at home, at work, basically where you are! That's the whole idea of preventing your body system collapse over a tiny microbe!

Personal Hygiene Practices at Home

Your home should be the most comfortable and convenient for you to keep up your personal hygiene level to a standard, yet, we find ourselves procrastinating over hygiene issues when we are at home. Even though some of these tasks barely take a minute.

1. **Take Regular shower**

Do not wait up to feel the dried sweat in your body to feel the urge to take shower, make it a routine, you have the choice to either take them before you head to work or after the long day or even before you head to sleep, whichever one suits your routine. Make sure to rinse your

2. **Wash your hands frequently**

We use our hands to do our most physical acts, from picking up the keys, browsing through our phones, cooking or eating to attending our pets. While we agree and accept the importance of washing hands before eating and after visiting the toilet, it is also ***important to wash our hands*** with soap or sanitizer every now and then. The pandemic covid-19 which crippled the life all over the world has taught us an important lesson that sanitizing our hands regularly is the only way we can avoid transmission of the disease. Use ***alcohol based sanitizer*** to wash hands well to prevent the spread of communicable diseases

6.3.1 7 steps for Handwashing

3. Maintain oral hygiene practices

It is very important to take care of the teeth and gum, to prevent tooth decay and bad odour. Just brushing them twice a day is not enough, but using fluoride toothpaste and brushing properly is very essential. And wash it well with water to remove any food particles that is stuck in the gap in between the teeth. It is advised to wash the teeth everyday twice to maintain healthy teeth and gum.

Click/Scan the QR Code to know more about handwash techniques

4. Nails and hairs hygiene

The cleanliness of nails and hair is also very important. They store dirt and grease. And even the microbes could be in there stuck and spreading. If the nail is not clean they can cause severe food poisoning, as we use our hands to eat food. Trim the nails once in a fortnight and wash hair at least twice a week with a shampoo to keep them healthy

5. Nose and ears hygiene

Wherever we are most likely to breathe in some pollutants, and most of the particles are bound to be stuck in the nasal hair. So, rinse the nose and ear with warm water once you return from outside.

6. Wear fresh and clean clothes

Changing into neat and clean clothes will prevent many infectious diseases. It will also give the mental effect immediately and it will boost the mind. Wash clothes with a good detergent every day and dry it in the sun. This will ward off any microbes attached to the clothes. If possible, Dettol can be used while rinsing which is an anti-disinfectant.

7. Food hygiene

You can get severely sick from food-borne diseases, as most of your foods are raw, purchased from outside, they risk being cross-contaminated with harmful microbes. Food hygiene is basically the idea of better storage, handling, and preparation of food to prevent contamination and to prevent food poisoning.

5.3.2 Importance of Social Distancing

Preventing communicable diseases:
All these above practices will help us to prevent communicable diseases. These diseases are highly infectious and contagious and spread through air, urine, feaces, saliva, skin (through touch) and using same towels and utensils.

Social Distancing and isolation, Self-Quarantine:
Ever since the spread of the pandemic covid-19, several health organisations have been insisting on following social distancing and isolation. Communicable diseases mainly spread through coming close to the infected individual and through physical touch. If a person is infected with diseases like normal flu or cold and spread it to others, the symptoms and may remain with the infected person for a day or two. The virus may be destroyed by taking an antibiotic. But in severe cases like corona virus the infection is severe and can prove fatal to the affected people. To prevent the spread of the virus, the entire world adopted lockdown, ***social distancing*** and compulsory face mask. And the infected person has to be in ***self isolation*** and ***quarantine*** till the time the symptoms are over. This was the advisory from the World Health Organisation, and the entire world followed it to prevent the rapid spread of the virus. The same can be applicable to all types of communicable diseases that are spread mainly through air and touch.

As communities reopen and people are more often in public after the pandemic, the term "physical distancing" (instead of social distancing) is being used to reinforce the need to stay at least 6 feet from others, as well as wearing face masks. Historically, social distancing was also used interchangeably to indicate physical distancing which is defined below. However, social distancing is a strategy distinct from the physical distancing behavior.

What is self-quarantine?

Self-quarantine was imposed on people who have been exposed to the new covid-19 and who are at risk for getting infected with the virus were recommended to practice ***self-quarantine***. Health experts advised the self-quarantine for 14 days or two weeks. Two weeks provides enough time for them to know whether or not they will become ill and be contagious to other people.

self-quarantine was also recommended for people who have recently returned from traveling to a part of the country or the world where COVID-19 was spreading rapidly, or if a person has knowingly been exposed to an infected person.

Self-quarantine involves:

- Using standard hygiene and washing hands frequently
- Not sharing things like towels and utensils
- Staying at home
- Not having visitors
- Staying at least 6 feet away from other people in your household

Once your quarantine period has ended, if the symptoms are not there, then the person may return to normal routine as per doctor's advice.

What is isolation?

Anybody who is infected with a contagious disease needs to practice isolation in order to prevent the spread of the germs to their near and dear ones. This became very popular and was strictly adhered to during the covid-19 pandemic. People who were confirmed to have COVID-19, **isolation** was mandatory. Isolation is a health care term that means keeping people who are infected with a contagious illness away from those who are not infected. Isolation can take place at home or at a hospital or care facility. Special personal protective equipment will be used to care for these patients in health care settings. They are attended by well trained nurses and specialised doctors. And these people have to be in the PPE kits all through their presence in the hospital.

Complete PPE Kit

Complete PPE Kit

Disposing off the PPE Kits

The PPE kits are worn by health workers and doctors who are attending to patients with highly infectious diseases and who are kept is isolation in order to arrest the spread. They have to wear it every time they go near the patient and have to remove it once their duty is over. Most of the PPE components are used for single use, however the face mask and goggles can be reused provided they are sanitised properly. The PPE kits have to be disposed off safely as they might have contaminants stuck to them and they may infect the healthy person if they are not discarded properly. The health workers may be all the more vulnerable to contact the disease.

5.3.3 Safe Workplace Practices

Every company has the provision of first aid box. As you have already read about the types of injuries that technicians can receive in their field of work, it is imperative for the companies to have appropriate first aid accessories.

The basic first aid supplies and accessories that a first aid box should have are:

Supplies and Accessories in the First Aid Box

Splint

Elastic wraps

Latex gloves

Adhesive tape

Tweezers

Blanket

Scissors

Wound cleaning agent

Triangular bandages

Gauze roller bandage

Adhesive bandages

Gauze pads

Antiseptic cleansing wipes

Burn cream or gel

Eyewash liquid

CPR Kit

Chemical hazards are caused by toxic materials, which are poisonous. And being poisonous in nature, they can either be fatal or cause serious damages in case the preventive actions are not taken on time. Now, the exposure to chemicals can be in 3 forms.

They can be:

- Inhaled (entering the body through nose)
- Directly in contact with skin
- Ingested (consumed)

The symptoms, in this case, will be:

- Seizures
- Partial or complete loss of responsiveness
- Burning sensation
- Stomach Cramping with bouts of excruciating pain
- Nausea
- Vomiting (and in times with blood-stains)

Now, where there are problem, their solutions come side by side. In such situations, the person giving first aid requires to be calm and take certain preventative actions.

Some of the essential actions are:

- Using insulated equipment
- Wearing protective clothing, goggles, masks, shoes and gloves
- Ensuring the place has enough ample ventilation

Remedial action

- The foremost thing that one should do is to provide immediate first aid. However, it is to be remembered that the victim should not be given any kind of fluid (water, milk) until doctors from Poison control unit gives a green signal.
- Aside from this, there are a few things a person can perform to the victim of toxic material exposure.
- Remove the victim from the toxic zone or vicinity
- Call for an ambulance
- Remove contaminated clothing
- Splash water in the eyes
- If ingested, do not try to make the victim puke (vomit)
- Wash their mouth with water

Fig. 3.8.2: CPR

1. In case the victim's breathing has stopped, give CPR (Cardiopulmonary resuscitation)
2. In case of burning due to toxic material, apply burn gel or water gel on that area.
3. Avoid any cream based or oil based lotion or ointment

   Even though giving first aid is the right thing to do in the first place, it is also important to report the incident to their supervisor.

Exercise

1. Burnt area should be kept under _____for a minimum of 10 minutes
2. _____exits should be easily accessible in case of fire.
3. _____ or _____ must be applied to the wound to reduce the risk of infection
4. The RICE which is_____,_____,_____ and _____ therapy must be applied to control and reduce swelling.
5. CPR is _____.

Click/Scan the QR code to know CPR better

UNIT 5.4: Reporting Safety Hazards

Unit Objectives

At the end of this unit, you will be able to:

- Discuss the process of reporting in case of emergency (safety hazards)
- Understand methods of reporting hazards

5.4.1 Methods of Reporting Safety Hazards

Every organization, from every industry, has a standard reporting protocol, comprising the details of people in the reporting hierarchy as well as the guidelines to be followed to report emergencies. However, the structure of this reporting hierarchy varies between organizations, but the basic purpose behind the reporting procedure remains same.

The general highlights of the Organizational Reporting Protocol, commonly known as the 6Cs, are:

1. Communicate First
    - The first source of information during emergency is the preferred source.
    - Crises situations are time-bound and hence it is important to communicate promptly.
2. Communicate Rightly
    - Distortion of information due to panic must be avoided.
    - Proper, accurate information must be provided to concerned authorities and this can save lives.
3. Communicate Credibly

    6.3 Integrity and truthfulness must never be forgotten during emergencies.

1. Communicate empathetically
    - One must wear the shoes of the victims while communicating emergencies.
2. Communicate to instigate appropriate action

    3. Communicating to the right authorities help in taking the necessary action.
4. Communicate to promote respect

    5. Communicating with the victims with respect help in earning their trust and thus eases the disaster management process.

While identifying and reporting a hazard / potential threat / potential risk, one must describe the following:

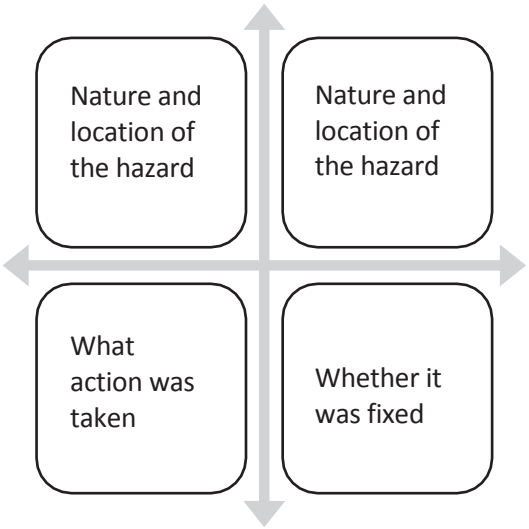


Fig. 3.8.1a: Describing hazard matrix

Part A: To be completed by the Worker Details

Required:

6. Name of Worker
7. Designation
8. Date of filling up the form
9. Time of incident / accident
10. Supervisor / Manager Name
11. Work Location / Address
12. Description of the hazard / what happened (Includes area, task, equipment, tools and people involved)
13. Possible solutions to prevent recurrence (Suggestions)

Part B: To be completed by the

Supervisor / Manager Details

Required:

- Results of Investigation (Comment on if the hazard is severe enough to cause an injury and mention the causes of the incident / accident)

Part C: To be completed by the

Action	Responsibility	Completion Date

Any job role and any occupation in this world have some hazards, in varying severity, associated with it. These are called Occupational Hazards. Occupational Hazard can be defined as "a risk accepted as a consequence of a particular occupation". According to the Collins English Dictionary, it is defined as "something unpleasant that one may suffer or experience as a result of doing his or her job". Occupational Hazards are caused by the following:

Hazard Report Form	
Name:	Date:
Location:	
Tool/Equipment:	
Description of the hazards:	
Suggested corrective action:	
Signature:	
Supercisor's remarks:	
Corrective action taken:	
Signature of Supervisor:	Date:

Fig 6.4.1b: Sample form of reporting hazards

UNIT 5.5: Waste Management

Unit Objectives

At the end of this unit, you will be able to:

- Understand what is e-waste
- Understand the concept of waste management
- Explain the process of recycling of e-waste

5.5.1 Introduction to E-Waste

Electrical and electronic products are all around us. We can't imagine a world without these gadgets. Our life is indispensable without electricity and electronic devices. Growth in the IT and communication sectors has increased the usage of electronic equipment immensely. Frequent change on the technological features of electronic products is forcing consumers to discard their old electronic products very quickly, which, in turn, adds to e-waste to the solid waste pool. What this translates to is mountainous masses of electrical and electronic waste which has a high potential to pollute the environment. This growing menace of e-waste calls for a greater focus on recycling e-waste and better e-waste management.

E-waste means electrical and electronic equipment, whole or in part discarded as waste by the consumer or bulk consumer as well as rejects from manufacturing, refurbishment, and repair processes. E-waste usually is made up of usable and non-usable material. Some of the waste if left unattended will be destructive to the environment. E-waste is made up of hazardous substances like lead, mercury, toxic material, and gases.

There are many companies these days who are engaged in the collection, handling, and disposal of this e-waste in a safer and more secure place to protect the environment.

5.5.2 What is E-Waste?

The amount of e-wastes comprising computers and computer parts, electronic devices, mobile phones, entertainment electronics, refrigerators, microwaves, TV, fridges, and industrial electronics that are obsolete or that have become unserviceable is growing. All these electronic devices contain plastics, ceramics, glass, and metals such as copper, lead, beryllium, cadmium, and mercury and all these metals are harmful to humans, animals, and the earth. Improper disposal only leads to poisoning the Earth and water and therefore all life forms. Our effort is meant to preserve the environment and prevent pollution by proper handling of e-waste. While it will take a lot of effort to educate people to dispose of such wastes in the right way, we are doing our part by providing a channel to collect e-wastes and dispose off them in a sustainably safe manner. We convert waste to usable resources.

The electronic industry is not only the world's largest industry but also a fast-growing manufacturing industry. It has been instrumental in the socio-economic and technological growth of the developing society of India.

At the same time, it poses a major threat in the form of e-waste or electronics waste which is causing harmful effects on the whole nation

e-waste is creating a new challenge to the already suffering Solid waste management, which is already a critical task in India.

5.5.3 Electronic goods/gadgets are classified under three major heads:

White goods: Household appliances,

Brown goods: TVs, camcorders, cameras etc.,

Grey goods: Computers, printers, fax machines, scanners etc.

The complete process is carried out as per the government guidelines.

5.5.4 E-waste Management Process

- Collection of e-waste from all the electronic stores, manufacturing companies, etc.
- Transport of e-waste to the disposal units
- Segregation of e-waste at the disposal unit
- Manual dismantling of e-waste to segregate components into various types such as metal, plastics and ceramics
- Convert into raw material (recycle and reuse)

5.5.5 E-waste Management Process (contd.)

Waste management is carried out to ensure that all types of waste and garbage are collected, transported, and disposed of properly. It also includes recycling waste so that it can be used again

Click/Scan the QR code to understand more about E-Waste management process

5.5.6 Recyclable and Non-Recyclable waste

Recyclable waste is **renewable or can be reused**. This means that the waste product is converted into new products or raw material, like paper, corrugated cardboard (OCC), glass, plastics containers and bags, hard plastic, metal, wood products, e-waste, textile, etc

Recycling not only conserves important areas in our landfills but also assists decrease greenhouse gas emissions.

Contrary to this, Non-recyclable waste cannot be recycled and cause a major threat to the environment.

The following items cannot be recycled:

Shredded paper, aerosol cans, paper coffee cups, milk and juice cans, used baby diapers, and bottle caps.

Recycling is one of the best ways to have a favorable influence on the world where we live.

Recycling will greatly help us to save both the environment and us from pollution. If we take immediate action, we can control this, as the quantity of waste we are accumulating is increasing all the time.

5.5.7 Colour codes of waste collecting bins

Waste collecting bins colour code

India's urban population of 429 million citizens produce a whopping 62 million tonnes of garbage every year. Out of this, 5.6 million tonnes is the plastic waste, 0.17 million tonnes is the biomedical waste, 7.90 million tonnes is hazardous waste and 15 lakh tonnes is e-waste.

According to an estimate, 40% of municipal waste in the city is 'wet' waste, which can easily be composted and used as manure. Nearly 30% of the municipal waste comprises of plastic and metal, which can be sent to an authorized dealer for recycling, and about 20% of it is e-waste, from which precious metals can be taken apart and recycled. However, out of the total municipal waste collected, 94% is dumped on land and only 5% is composted. To gather the garbage two color bin system was suggested. Green bin for wet waste and blue for dry waste. However, there is a drawback in that system. People do through the sanitary napkins and children's diaper along with wet waste causing the contamination of things. Hence the government has come up with three colored garbage collection bins.

1. Green Bin

The green coloured bin is used to dump biodegradable waste. This bin could be used to dispose off wet/organic material including cooked food/leftover food, vegetable/fruit peels, egg shell, rotten eggs, chicken/fish bones, tea bags/coffee grinds, coconut shells and garden waste including fallen leaves/twigs or the puja flowers/garlands will all go into the green bin.

2. **Blue bin**

The blue coloured bin is used for segregating dry or recyclable left over. This category includes waste like plastic covers, bottles, boxes, cups, toffee wrappers, soap or chocolate wrapper and paper waste including magazines, newspapers, tetra packs, cardboard cartons, pizza boxes or paper cups/plates will have to be thrown into the white bin. Metallic items like tins/cans foil paper and containers and even the dry waste including cosmetics, hair, rubber/thermocol (polystyrene), old mops/dusters/sponges.

3. **Black bin**

Black bin, make up for the third category, which is used for domestic hazardous waste like sanitary napkins, diapers, blades, bandages, CFL, tube light, printer cartridges, broken thermometer, batteries, button cells, expired medicine etc.

5.5.8 Waste disposal methods:

- Incineration: Combusting waste in a controlled manner to minimize incombustible matter like waste gas and ash.
- Waste Compaction: Waste materials are compacted in blocks and are further sent away for recycling.
- Landfill: Waste that can't be recycled or reused can be thinly spread out in the low-lying areas of the city.
- Composting: Decay of organic material over time by microorganisms.
- Biogas Generation: With the help of fungi, bacteria, and microbes, biodegradable waste is converted to biogas in bio-degradation plants.

5.5.9 Sources of Waste

1. **Construction waste** – waste coming from construction or demolition of buildings.
2. **Commercial waste**- waste from commercial enterprises
3. **Household waste**- garbage from households is either organic or inorganic
4. **Medical or clinical waste** -wastes from the medical facilities- like used needles and syringes, surgical wastes, blood, wound dressing
5. **Agricultural waste**- Waste generated by agricultural activities that include empty pesticide containers, old silage packages, obsolete medicines, used tires, extra milk, cocoa pods, wheat husks, chemical fertilizers, etc.
6. **Industrial waste**-The waste from manufacturing and processing industries like cement plants, chemical plants, textile, and power plants
7. **Electronic waste**-The defective, non-working electronic appliances are referred to as electronic waste. These are also called e-waste. Some e-waste (such as televisions) contains lead, mercury, and cadmium, which are harmful to humans and the environment
8. **Mining waste**- chemical gases emitted in mine blasting pollutes the environment. And the mining activity greatly alters the environment and nature.
9. **Chemical waste**-waste from the chemical substance is called chemical waste.
10. **Radioactive waste**: radioactive waste includes nuclear reactors, extraction of radioactive materials, and atomic explosions

5.5.10 Sources of Pollution

All these above-mentioned waste also adds to environmental pollution.
The contaminants that cause detrimental change to the environment are called pollution. It is one of the most serious problems faced by humanity and other life forms on our planet. The earth's physical and biological components have been affected to such an extent that normal environmental processes could not be carried out properly.

5.5.11 Types of Pollution

Types of Pollution	Detail/Pollutants involved
Air pollution	▪ Solid particles and gases mixed in the air cause air pollution ▪ Pollutants: emissions from the car, factories emitting chemical dust, and pollen
Water pollution	▪ Water gets polluted when toxic substances enter water bodies such as lakes, rivers, oceans, and so on. They get dissolved in it and cause it unfit for consumption. ▪ Pollutants that contaminate the water are discharges of untreated sewage, and chemical contaminants, release of waste and contaminants into surface
Soil pollution	▪ It is the presence of toxic chemicals (pollutants or contaminants) in soil, in high enough concentrations to pose a risk to human health and/or the ecosystem ▪ Sources of soil pollution include metals, inorganic ions, and salts (e.g. phosphates, carbonates, sulfates, nitrates),
Noise pollution	▪ Noise pollution happens when the sound coming from planes, industry or other sources reaches harmful levels ▪ Underwater noise pollution coming from ships has been shown to upset whales' navigation systems and kill other species that depend on the natural underwater world
Light pollution	▪ Light pollution is the excess amount of light in the night sky. ▪ Light pollution, also called photo pollution, is almost always found in urban areas. ▪ Light pollution can disrupt ecosystems by confusing the distinction between night and day.

UNIT 5.6: Organizations' focus on the Greening of jobs

Unit Objectives

At the end of this unit, you will be able to:

- Understand the concept of ESG
- Explain the different factors of ESG

5.6.1 What is ESG?

The ESG is the short form of environmental, social, and governance. ESG guidelines are used to evaluate businesses on how well they control emissions, governance, human rights, and other factors of their business.

Several companies audit these companies for ESG compliance. They will let the companies know how well the ESG policies are implemented in their company hat let companies know how well their ESG policy is working.

Every business enterprise is deeply intertwined with Environmental, Social, and Governance (ESG) issues. ESG has been looked at seriously by the corporate, government establishments and stakeholders.

ESG is important as it creates high value, drives long-term returns, and global stakeholders are paying attention to the topic.

ESG is said to have created high value, and focuses on long-term returns, and stakeholders are focusing more on this concept.

5.6.2 Factors of ESG

Several factors are used to determine how well a business is doing in maintaining its ESG policies. For creating the ESG Policy, thorough knowledge of these factors are critical.

The factors are divided into three categories; environmental, social, and governance. Knowing about these factors come a long way in designing the effective ESG policy.

Environmental

Environmental factors relate to a business's impact on the environment. Examples include:

- Usage of renewable energy
- Effective waste management
- Policies for protecting and preserving the environment

Social

Social factors relate to the people of the organization. How they are treated in the organization is what it focuses on. The major entities are the stakeholders, employees, and customers. Examples include:

- diversity and inclusion
- proper work conditions and labor standards
- relationships with the community

Governance

Governance factors relate to the company policies for effectively running it. They include:

- tax strategies
- structure of the company
- relationship with stakeholders
- payments to the employees and CEO

Every factor is important and matters a lot to the overall rating of the company in ESG compliance. Ignoring one aspect in favor of another can affect the rating and in turn the reputation of the company.

The companies make a clear communication about these policies to all the employees, and to the public, they should mention what their various activities are that will protect the environment, people, and the governing factors.

Exercise

1. ESG stand for _____, _____, _____.
2. Governance factors include _____, _____, _____, _____.
3. The three causes of air pollution _____, _____ and _____.
4. Mining waste includes_____.
5. Landfill is a _____.
6. _____,_____ and _____ coloured bins are used for disposing the waste.
7. The plastics cans are trashed in _____coloured bin.
8. _____,_____and _____ are considered as e-Waste
9. _____ part of e-waste is recycled and used again
10. **E-waste is made up of hazardous substances like _____,_____,_____ and _____**

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6. Communication and Interpersonal Skills

Unit 6.1 – Interaction with supervisors, peers, customers and differently-abled persons

Unit 6.2 – Explain the importance of developing sensitivity towards disabled persons

TEL/N9102

Key Learning Outcomes

At the end of this module, you would be able to

- Understand what communication and the importance of communication in the workplace is
- Understand effective communication and communicate effectively for success
- Discuss types of communication -verbal and non-verbal
- Communicate at workplace
- Communicate effectively with superiors
- Communicate effectively with colleagues and customers using different modes viz face-to face, telephonic and email communication
- Understand the hurdles for effective communication
- Conduct professionally at work place
- Respect differences in gender and ability

UNIT 6.1: Interaction with supervisor, peers and customers

Unit Objectives

At the end of this unit, you will be able to:

3. Understand the importance of communication
4. Understand types of communication

6.1.1 Why is Communication Important?

- Communication Skills are more important than ever, for all fields of endeavor.
- Whatever the role a person is holding in the organization, having a firm grasp of effective communication will undoubtedly be a key role in the individual's as well as the organization's success
- Oftentimes, people with excellent technical skills don't get promoted to higher roles because of their inability to communicate effectively
- Hence one fundamental skill everybody should be proficient along with the technical skill is ***Communication Skills***
- Effective communication helps us to build rapport with the customer both internal

6.1.2 What is Communication?

- Communication is the process of sending and receiving information among people.
- It is imparting or exchanging of information by speaking, writing, or using some other medium
- The purpose of communication is to convey your thoughts and opinions to others.
- Communication is said to be successful only when both the sender and the receiver perceive it in the same way.
- In your personal and professional life, you would be communicating with the following people-
    - Colleagues
    - Customers

6.1.3 Effective Communication

Effective communication is the process of delivering messages to a target audience in a way that guarantees satisfactory reception and understanding. If the communication is effective, both the sender and the receiver will share the same information at the end of the process. Effective communication is about more than just exchanging information. It's about understanding the emotion and intentions behind the information.

6.1.4 Effective Communication for Success

Effective Communication is critical to a business's success. From top to bottom, among colleagues, from subordinates to superiors, and from the organization to the outside, several messages are delivered daily. All the people must communicate these messages properly. Content, language, remarks, tone of voice, and non-verbal communication are elements that affect the effectiveness of messages

Clear and effective communication will

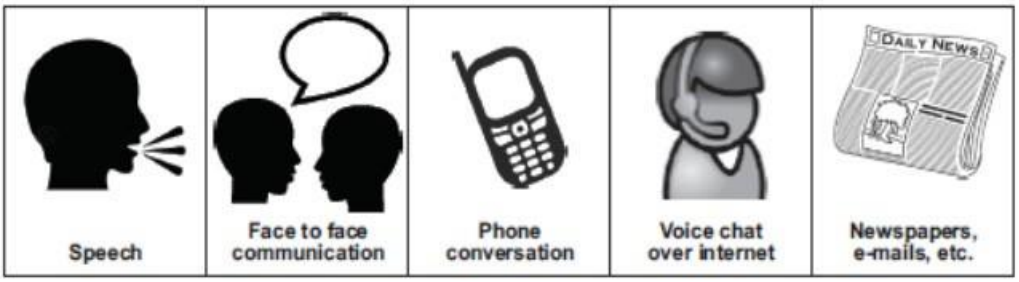
- Increase customer satisfaction
- Bring more business to the company
- Increase productivity among team members

6.1.5 Types of Communication

Communication has been divided into two types:-

- Verbal Communication
- Non-Verbal Communication

Verbal communication takes place when people exchange words with each other, either spoken or written. It includes the **choice and use of words and language to convey a message**. Examples of verbal communication are face-to-face conversation, telephonic conversation, and a speech or presentation.



Click/Scan the QR code to understand types of communication

Speech has certain characteristics which will affect the message that is being spoken:

- Volume – loud speech may sound bossy, very quiet speech cannot be heard.
- Tone – use warm tones without sounding over-friendly. Cool tones are very unwelcoming.
- Pace – fast speech is not easy to follow. Speak at a reasonable pace so that the other person has a chance to understand.

Correct body language also plays an important role in effective communication. For example, a warm smile accompanying 'Have a nice day' or looking directly at the person who is being spoken to give a positive image of the organisation.

Non –Verbal Communication

Non-verbal communication includes the overall body language of a person. There are two kinds of non-verbal communication:

1. **Signs and symbols:** for example pictures, or notices, or signboards, or even photographs, sketches and paintings. Here are some examples of different signs and symbols:

2. **Gestures and expressions:** hand signs, facial expressions, body postures or body language that can help to convey a message. You can learn to communicate better with others if you learn to recognise some of these.

   Facial expressions - A smile or a frown

   Gestures - movements of hands and body to help explain or emphasize the verbal message

   Body posture - how we stand or sit. Maintain a good posture. When you are talking to a colleague or guest, remember to stand up straight, look professional and be positive. Do not slouch, lean against something or fidget with equipment or your hands.

   Orientation - whether we face the other person or turn away

   Eye contact - whether we look at the other person and for how long

   Proximity - the distance we are from a person

   Head nods - for encouragement, indication of agreement or disagreement

   Appearance - dress and grooming

These non-verbal clues are important as they can be used to improve the quality of communication. They can be used to reinforce any verbal communication; for example, leaning forward and looking at the person you are speaking to and smiling naturally. Your expressions, posture and appearance must be appropriate and should tell the guest that you are professional, competent and willing to help.

6.1.6 Communication at workplace

In every situation, while interacting with people, we make use of both verbal and Non-Verbal Communication. It is the key to the success of any organization. Be it communication with customers, supervisors, or peers. In today's scenario having technical skills alone is not enough to get the work done, but communication skill is also equally important. Completing the task must require the support of the whole team, and without proper communication, it cannot happen. Effective Communication helps managers to perform their jobs and responsibilities and it serves as a foundation for planning.

6.1.7 Communication with supervisors

Effective and open communication within a team will build a common purpose among team members that will allow them to reach their goals. Team leaders know that group communication enhances organizational efficiency. The team members should always follow the communication guidelines. Some of the points to remember while interacting with supervisors:

1. Be aware of the communication guidelines of the organization.
2. Understand and interpret clearly, the work requirements from the supervisor.
3. Keep the supervisor informed about the progress of the task assigned.
4. Participate in all the discussions which call for decision-making, and provide facts and figures
5. Give/ accept suggestions during the discussions.
6. Accept the feedback positively and work towards rectifying errors if any. Make sure the same mistakes are not repeated.

6.1.8 Communication with colleagues & customers

- The main responsibility of a Customer Care Executive is to handle customers' concerns.
- Interaction with colleagues/peers is also equally essential and it enhances productivity in the workplace.
- Be polite in speaking to your peers at the office.
- Value other people's time as much as you value your own.
- Before you begin discussing something, ask your coworker if it is the right time to talk, and give a true picture of how much time you expect to take. Always start the conversation
- Communication with colleagues/customers can be through face-to-face, telephonic, or email.
- Keeping a few points in mind while communicating will make the interaction pleasant and fruitful.

Click/Scan the QR Code to know more about Communication with Colleagues and Customers

6.1.9 Face-to-face Communication

This is an important medium of oral communication, wherein two or more persons talk to each other and see each other physically. This form of communication is direct or straight.

Things to remember while you are communicating face to face

1. Adjust the tone of voice, don't be too loud
2. Make eye contact
3. Use appropriate language
4. Maintain adequate distance
5. Acknowledge, nod during interaction
6. Use appropriate non-verbal gestures to communicate with persons with disabilities

Benefits of face-to-face communication

1. Instant feedback
2. Information conveyed clearly
3. Build rapport

6.1.10 Telephonic Communication

Another widely adopted mode of communication is through the telephone. This is the person-to-person conversation where nobody sees others but hears each other and interacts instantly. Nowadays mobile phones are becoming more popular along with landlines as a mechanical media of oral communication.

The following suggestions are recommended to follow while making telephone calls-

1. Make the call at the appropriate time
2. Provide details about your identity like name, company, department, etc.
3. Discuss the purpose of the call
4. Think about the tone of your voice
5. Listen carefully
6. Speak clearly
7. If you don't understand something, ask
8. Use please, thank you, sorry wherever necessary
9. Follow the organization's policies and procedures while interacting on the telephone.

Click/Scan the QR Code to know more about telephone communication

6.1.12 Email Communication

Email or Electronic mail is a method of exchanging messages using electronic media. The official or business communication between colleagues or inter-department communication usually happens through email. The advantage of email is you can send communication to many people at the same time.

Points to remember in email communication

1. Be clear and concise
2. Keep the content short and to the point
3. Avoid using jargon and short forms
4. Re-read the message, before sending it for grammar and spelling mistakes
5. The subject line should describe the main mail content
6. Use readable font size (don't keep it too small)
7. Add signature at the bottom of the mail body
8. Check the attachments for viruses before sending

6.1.13 Importance of timely completion of tasks

Time is a major factor that evaluates **the success or failure of a project**. Even when the whole team has done a wonderful job and produced high-quality results, with half the cost allotted to the project, everything will be a waste if it was not delivered on time. Any deviation from the timeline will call for a penalty and sometimes may result in losing the project and eventually the customer. so adhering to the timeline is important when it comes to any organization who are into products and services.

Benefits of adhering to timelines:

1. Increased and improved customer satisfaction
2. Increased productivity and efficiency of the individual
3. Team feels motivated
4. Sense of adhering to the SLA's and Standard Operating Procedures
5. Shows the commitment toward the work and the organization
6. Good word of mouth from the customers

6.1.14 Standard Operating Procedure

A ***Standard Operating Procedure (SOP)*** is a standardized process that outlines a set of detailed instructions to help workers perform complex tasks properly and safely. The main objective of standard operating procedures is to develop an effective quality system and comply with industry-specific regulations and standards. Failure to follow SOPs can cause significant errors in operations and services.

For a mobile repairing center, the SOP defines the different process of operations, namely handling customer, repairs, sales and interaction among the staff within the repair center.

SOP also clearly defines the responsibility of each and every designated person in the organisation and what is expected from them. It further defines what the various levels of engineers will handle with respect to the handsets coming for repair.

The escalation matrix specifies how the different levels escalate the issue to the next level and adhere to the timelines for repair and communication to the customer.

SOP is created keeping in mind the customer satisfaction as a main motive.

Each and every person in the organisation is expected to read the SOP thoroughly and work accordingly. Because every customer when they go for purchasing a product, one of the main things they see is the post-sales Support. If they find the brands deliver good service support

6.1.15 Escalation Matrix

Escalation matrix is made up of several levels of contact based on the specific problem at hand. This is being followed by all who are working on that product and must adhere to the service guidelines. And the problem has to be closed at a minimum turnaround time, and for any reason the repair is taking time proper reason has to be mentioned and notified to all the people concerned including the customer.

6.1.16 Escalation Mechanism

Customer service is a very important aspect of a typical service industry. Giving committed service to customers every time and on time is very crucial for the success of the brand. In recent times, customers do research on how the after-sales support of a product is, and based on that rating they will decide which brand to buy. If the customer service is not good, they will not go for that product even though the product is very good. Hence customer service is a second important aspect of a product and services organization.

For electrical home appliances, the customer logs a complaint and the service engineer is sent to the site for looking into the problem and repairing.

For electronic devices like mobile phones and tablets, the customer is expected to take the product to their service center to get it checked and repaired.

The resolution time matters a lot, as mobile phones have become an indispensable device for people. Their business cannot function without that. Hence too much downtime is also not good.

Once at the service center, the technicians at L1 level look for the problem and try to resolve it. If it's beyond their area of resolution the same is escalated to the next level. Every organization has ***Standard Operating Procedures*** clearly state the workflow for the repair of the smart phones. Every individual working there must be aware of the same and adhere to the deadline for faster service and enriched customer satisfaction.

6.1.17 Escalation through CRM

Customer Relationship Management is a software, through which most of these companies who are into customer service, manage their customers. The customer details are entered in the system and also the services which are logged against a particular customer. This is the automated system, which takes a particular action after a period of time. For example, if a service request is assigned to an engineer for rectifying a problem of a client, and if the engineer does not update the status of the service in the system within a specified period of time, the problem is automatically escalated to the next level for resolution. Then the new engineer who is responsible for resolving pick it and try to find a solution. This system helps to maintain a track of a particular problem and the current status which will help the organization in effectively managing the customer queries. The complete escalation route is mentioned in the SOP and the same is implemented through the CRM software. This eases the manual escalation procedure which is time consuming and slow.

6.1.18 Escalation issues at work

Whether an issue arises among team members or with customers, sometimes the severity of the circumstance requires an escalation to management. Understanding how to approach an escalation can help you better find a solution when conflicts arise. We explore what it means to escalate an issue in the workplace and provide tips for how to do so successfully.

What does it mean to escalate an issue at work?

Escalating an issue in the workplace is the process of bypassing those involved by contacting upper/senior management. It involves raising awareness of the context to the right people in order to resolve a challenging situation. Typically, escalation occurs when there is an issue that the current staff working on the problem can't resolve and requires assistance from those with more authority and resources

When should you escalate an issue at work?

Deciding when to escalate an issue depends on the amount of risk it can bring to the company. Because escalating an issue can lead to difficult meetings and cause disruptions in work, you should reserve them for issues that truly require escalation. You can often avoid escalating an issue by solving the problem with the individual first.

However, some issues require support from those with higher authority. Consider escalating an issue at work when:

- You have already tried other strategies but that did not work.
- Resolving may incur additional cost to the company or the customer, while rectifying the problem.
- Because of the non-availability of certain parts the repair work is taking longer than usual.
- The engineer broke another part while repairing a part. So escalation is required to get the approval to replace the broken part by the company.

6.1.19 Hurdles for Effective Communication

Following are factors contribute to communication not being effective.

Stress and out-of-control emotion. When you are stressed or emotionally disturbed, you're more likely to misread other people and send confusing non-verbal signals. Calm down before continuing the conversation.

Lack of focus. You can't communicate effectively when you're multitasking. If you're checking your phone, planning what you're going to say next, or daydreaming, you're almost certain to miss nonverbal cues in the conversation. To communicate effectively, you need to avoid distractions and stay focused.

Inconsistent body language. Nonverbal communication should support what is being said, not contradict it. If you say one thing, but your body language says something else, your listener will likely feel that you're being dishonest. For example, you can't say "yes" while shaking your head no.

Negative body language. If you disagree with or dislike what's being said, you might use negative body language to ignore the other person's message, such as crossing your arms, avoiding eye contact, or tapping your feet. You don't have to agree with, or even like what's being said, but to communicate effectively and not put the other person on the defensive, it's important to avoid sending negative signals.

6.1.20 Professional Conduct

There are six basic rules to be followed for professional conduct:

- **Be on time:** Being late impedes a company's operations and demonstrates a lack of consideration of the time concerns of others. If you are constantly late for work, meetings, or are always late with your reports and other tasks; it demonstrates to others that you are probably not executive material because you disregard the value of time.
- **Be discreet:** Keep company secrets such as new product designs, sales figures or any other confidences to yourself.
- **Be courteous, pleasant, and positive:** No matter how demanding your clients, customers, co-workers or employees might be; always remain upbeat and positive. Projecting a positive company image has the same effect.
- **Be concerned with others, not just yourself**: Finding out a customer or client's point of view naturally helps you get ahead in any industry. Concern for others should include your superiors, co-workers and subordinates as well.
- **Dress appropriately:** Dress to be comfortable in your environment. Dressing poorly or too casually does not convey a good image, neither does overdressing, which breeds suspicion and mistrust, and will be seen as inappropriate.
- **Use proper written and spoken language:** People who can express themselves clearly are at an advantage. This goes beyond using good grammar, proper spelling, and appropriate diction in all your communications; you should also speak and write to the point.

Unit 6.2: Explain the importance of developing sensitivity towards disabled persons

Unit Objectives

At the end of the unit, you will be able to

- Respect differences in gender and ability
- Communicate effectively with person with disabilities
- Respect people with disability at work

6.2.21 Respect Gender Differences

In any business, be it a small company to a big corporate, the workforce is a mix of both genders. The ratio of men vs. women varies from 70:30 or 60:40. Studies show that business teams with an equal gender mix perform significantly better than male-dominated teams when it comes to both sales and profits. No two women or men are alike and yet at the same time there are some work-related traits that are gender specific. Both men and women approach their work in a different way and deal with many hurdles that come their way. Since they all share the same workspace every organization has devised a policy as to how they treat the opposite gender at the workplace and what are the implications of any abuses

Some of the points to remember while interacting with female colleagues

1. Treat them with respect
2. Support them in case they approach you
3. Value their opinion and suggestions
4. Involve and include the opposite gender in all the discussions

6.2.22 Communication with Disabled Person

A **disability** is any condition that makes it more difficult for a person to do certain tasks or interact with the people around them (socially or materially). These conditions, or defects, may be cognitive, developmental, intellectual, mental, physical, sensory, or a combination of multiple conditions. Defects may be present from birth or can be acquired during a person's lifetime. Often, disabled people are excluded from full participation in any activity."

But things are changing; every organization has allotted some percentage of employees from this section of the society. They are also allowed to exhibit their skills in a few jobs which they can perform without putting their life at risk

General tips for communication with disabled people

1. Speak to them as you would speak to anyone else in a soft and low tone.
2. Respect the person first, not their disability. For example, use the term 'a person with disability' rather than 'a disabled person'.
3. Do not use phrases such as 'suffers from' and 'crippled' rather the phrase should be 'people who use a wheelchair' rather than 'wheelchair bound.
4. Don't drag or push a person's wheelchair, and don't move their crutches or walking stick without their permission. It has to be in their personal space.
5. When talking to a person who is in a wheelchair, try to sit in such a way you could reach their eye level. This would not strain them much, to lift their head and talk.

6.2.23 Communicating with people with a hearing impairment

Keep these points in mind while interacting with people with a hearing problem

1. Draw the person's attention before you speak. Give a gentle tap on their shoulder, a wave of some other visual signal to the person's attention
2. Stand in front of the person and maintain eye contact
3. Don't cover the mouth while talking. They can figure out what is being said by just looking at the lip movement
4. Speak at a normal pace don't speak fast or slow
5. Choose the words wisely
6. Use short sentence
7. Be gentle while speaking don't raise the tone

6.2.24 Respect people with disability

Learn the proper way to act and speak around someone with a disability.

1. Do not use offensive or derogatory words like 'handicapped', 'crippled', and retarded etc.
2. Don't criticize or blame them. Don't shout at them or use abusive language
3. Talk slowly with a low tone. Pause while talking
4. Avoid excessive whispering, joking and laughing unnecessarily
5. Assuming things about them or their situation.
6. Don't make jokes about their condition or be sarcastic
7. Don't look down upon them because of their disability
8. Appreciate them for their efforts and work, and motivate them to perform better

6.2.25 Safety at workplace for people with disability

Disabilities of all types affect employees and can pose various mental or physical challenges. In many situations, a disability may impact the amount of time it takes for an employee to complete a task or get from one part of a facility to another. Some disabilities may be known while others remain unknown to an employer.

Health and safety legislation should not prevent disabled people from finding or staying in employment so it should not be used as an excuse to justify discrimination against them.

Disabled people and those with health conditions, including mental health conditions, should be given the opportunity to both get into and stay in work.

Responsibilities of an employer towards disabled people

The employer is responsible for the health, safety and welfare of all of their employees, whether they have a disability or not.

Disability is not always obvious so one might not realise a worker is disabled or they might choose not to tell you, particularly if their disability has no impact on their ability to do their job.

Workers do not have to tell anybody unless they have a disability that could foreseeably affect the safety of themselves or anyone else connected to their work. If they do not reveal and there are no obvious indicators of any disability, then the organization are not under any obligation to make workplace adjustments.

Periodically, consult with the employees (whether directly or through their representatives) on issues relating to health and safety. These discussions reflect good safety practice because employees have day-to-day understanding of the job, so they are likely to have good ideas on keeping themselves and others safe.

6.2.26 Workplace adaptations for people with disability

Few changes in the workplace to make it a safe place for the disable people will go a long way in the employee satisfaction for an organisation.

Workplace Adaptations

Workplace should be easily accessible for these people with special needs. One major compliance concern deals with accessibility. For example, if workplaces have been adjusted or created more accessible entrances and exits to their facilities, allowing more independence for persons in wheelchairs, would be a great idea. Other subtle changes may include the width of bathroom stalls, hand rails inside the stalls and long ramps instead of stairs. The path of travel that employees take should never be obstructed; there should be no barriers to prevent someone from getting to safety in an emergency.

Workstations easily can be adapted to follow this universal design. Many companies now use slide-out keyboard trays and monitors on swinging arms to allow employees to adjust to their needs. Desks can accommodate wheelchairs in place of regular chairs, and general work spaces can be lowered to allow easier access. The main goal is to remove all barriers and allow everyone to concentrate more on completing their tasks.

The biggest challenge with universal design is accommodating the multitude of challenges that different disabilities present. Not all disabilities are the same, and not all will present the same challenges for employees. Some employees may have issues with their right hand while others have issues with their left. For some, it may involve not being able to stand or sit. Some may need low lighting, while others need bright lighting. Designing a facility to accommodate all is always going to be a challenge.

Complying with government guidelines can be more difficult in regards to employees with disabilities. This difficulty lies with ensuring that employees are aware of all hazards in the workplace. Multiple disabilities will create multiple reasons that may keep employees from recognizing hazards. Employees with impaired vision, for example, must have other means of identifying hazards. This may be remedied with audible alarms or touch-activated devices that warn employees not to go in an area. Other employees may have difficulties reading and may benefit from shapes or colors to further identify hazardous areas. For workers who lack hearing ability, employers can utilize signs to demonstrate hazards or use flashing strobes to identify when employees need to evacuate an area and head to safety.

Exercise

1. What are the three points you will focus on when you talk to people face to face?

_____

_____

Fill in the blanks

1. Before sending the mail it's important to check the _____ and _____ of the content.

2. When you interact through phone, provide your identity details like _____,_____ and _____

3. Add your _____ at the bottom of your mail.

4. The Customer Care Executive is mainly responsible for handling _____.

Notes

Annexure

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