TVET CERTIFICATE V in ELECTRONIC SERVICES

CCTV CAMERA SYSTEM INSTALLATION

TSVEL401

Install CCTV camera system

Competence

Credits: 7

Learning hours: 70

Sector: Technical Services

Sub-sector: Electronic Services

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Purpose statement

This core module describes the skills, knowledge and attitude required to install CCTV camera. The learner will be able to select, arrange different materials, equipment and tools used during CCTV camera installation. Moreover, he/she will be able to fix, connect and configure different devices of a CCTV camera system including; Monitor, connectors, Cables, DVR, AVR/NVR, IP cameras or analog cameras and UPS.

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Learning Unit 1 – Conduct site survey

1. Introduction

Site surveys are inspections of an area where work is proposed, to gather information for a design or an estimate to complete the initial tasks required for an outdoor activity. It can determine a precise location, access, best orientation for the **site** and the location of obstacles.

2. What does a site survey include?

A site survey includes taking pictures, examining the materials and area where the sign will be installed, and verifying all measurements. Additionally, we reexamine all sign ordinances to make sure that your sign will fall within city code, and determine when a permit is needed, as well as securing these permits when necessary.

3. Why is a site survey so important?

From what material, to visibility, to accurate measurements, a site survey can help work out any kinks before they happen; after the sign is already manufactured, it's almost impossible to fix a majority of these problems that are easily preventable with a site survey.

A site survey allows us to make sure that the sign we're about to manufacture will actually fit in the space desired, and that it will actually be possible to install it with current conditions.

Finally, a site survey allows the sign company to give a much more accurate quote. Knowing what is really going to be involved in the process, as well as how easy or hard it will be to work around obstacles, will help your sign company give an accurate quote and prevent any surprises when the installation comes around.

Site survey can help an organization even technician save valuable time, money and resources. As a result of the intelligence gathered through a site survey, you can make better decisions; reducing cost errors are made in the execution phase of your project. The information we need to know on site survey are:

- Gathering information about the design of installation
- Gathering information about the cost of the work
- Determination of precise location of installations.

LO 1.1 – Study the environmental requirements according to the work to be done.

- Content/Topic 1: Classification of CCTV camera system installation based on environmental requirements.

A **closed-circuit television camera** typically abbreviated as CCTV camera is a self-contained surveillance system comprising cameras, recorders and displays for monitoring activities in a store or company.

A **closed-circuit television camera** can produce images or recordings for surveillance or other private purposes. **Cameras** can be either video **cameras**, or digital stills **cameras**. Walter Bruch was the inventor of the **CCTV camera**. The main purpose of a **CCTV camera** is to capture light and convert it into a video signal.

Underpinning a CCTV camera is a CCD sensor (Charge Coupled Device). The CCD converts light into an electrical signal and then signals processing converts this electrical signal into a video signal that can be recorded or displayed on the screen.

Closed circuit TV camera, comprises at least one camera transmitting data to a monitor or video recorder. The data transmitted can either be video and audio, or video only. A CCTV camera must never be mistaken for an ordinary TV. An ordinary television receives publicly broadcasted contents while a CCTV doesn't. In everyday use, CCTV cameras are fitted on buildings, gates, and other structures purely for surveillance purposes. The closed circuit system can either be used to monitor live proceedings like in a supermarket or documented for later reference.

1.1 Classification of CCTV camera system based on environmental requirements

CCTV camera system is classified into the following classes:

1.1.1 Indoor

Indoor cameras can be smaller, more lightweight and are usually less intrusive than bulkier outdoor cameras. Both indoor and outdoor cameras utilize features like infrared, allowing for clear pictures in low light conditions and easy transitions when there is a sudden change in light-changing automatically from color images in bright light to black and white when it gets darker.

1.1.2 Outdoor

Outdoor cameras are also more vulnerable to being tampered with, so they are typically made of more durable materials, like metal, and may be heavier or even housed in a casing in order to discourage easy removal.

The primary distinction between indoor and outdoor security cameras is the types of external factors each camera has to be able to withstand. While both types of cameras usually come in similar styles and with comparable features, outdoor cameras need to be able to contend with all types of weather and varying light conditions.

- Content/Topic 2: Installation requirements for indoor and outdoor CCTV camera.

While installing the outdoor and indoor CCTV camera, consider the following requirements:

2.1 Coverage area

The coverage area is the geographic area served by a certain system, such as a mobile system or a broadcasting system, in which the service is available to the users.

Coverage Area means the total area, expressed as a percentage of the area of a site, that may be covered by the vision of camera.

2.2 Visual angle

The visual angle is the angle a viewed object subtends at the eye, usually stated in degrees of arc. It also is called the object's angular size.

In a simplified model, **visual angle** is formed from the light rays from two points (in height, width, or depth) of a viewed object as they enter the eye and is proportional to the **angle** projected onto the retina. The size of the subtended image is thus determined by the visual angle.

2.3 Temperature

It is a measure of the warmth or coldness of an object or substance with reference to some standard value.

Temperature is a physical property of matter that quantitatively expresses hot and cold. It is the manifestation of thermal energy, present in all matter, which is the source of the occurrence of heat, a flow of energy, when a body is in contact with another that is colder.

Temperature is measured with a thermometer.

2.4 Humidity

Humidity is the concentration of water vapor present in the air. Water vapor, the gaseous state of water, is generally invisible to the human eye. Humidity indicates the likelihood for precipitation, dew, or fog to be present. The amount of water vapor needed to achieve saturation increases as the temperature increases. As the temperature of a parcel of air decreases it will eventually reach the saturation point without adding or losing water mass. The amount of water vapor contained within a parcel of air can vary significantly.

2.5 Technology

The technology of CCTV Camera system includes:

i) Analogue CCTV cameras

Analogue CCTV cameras record images to a digital recorder which converts the video to a digital format. To view the video, the DVR needs to be connected to a monitor or router to be broadcast through an internal network for remote access. However, there are government regulations for the strength of **analogue** signals.

An analogue security system begins with a CCD image sensor and then converts the images into a digital form for processing. But before it can transmit the videos, it needs to convert back in an analogue form, so analogue devices such as video recorder and monitor, can receive the videos.

Advantages Analogue CCTV cameras

- **Cost**: Analog cameras tend to cost less, sometimes even a lot less, than their digital counterparts on a per camera basis.
- **Simplicity:** DVR is easier to set up and understand for most. It is one unit with one cost, and the installation is a bit more straightforward.
- **Lower Bandwidth Requirements**: Analog recorded video files tend to be smaller, and they are transmitted to the DVR over coax instead of LAN, so transmitting them doesn't take as much bandwidth and doesn't tax your network as much. Plus, DVRs also usually

only transmit the information and use bandwidth when someone is viewing the video, rather than on a more constant basis.

- **More Design Options:** With a wider variety of analog camera designs, you may have an easier time finding a camera model with all of the features you need at a lower cost.

Disadvantages Analogue CCTV cameras

- **Cabling:** Because the cameras need to be connected to both the power supply and the DVR via cables, you tend to have a lot of wiring to handle, even if you use cables that bundle video and power. Furthermore, coax cables are usually more expensive on their own than the Cat 5 or 6 counterparts used for digital systems.
- **Image Quality:** The image quality on analog cameras is pretty low. Most smartphones today have higher resolution. As a result, details at a distance may be grainy, making it difficult to identify potential suspects in an incident with a high degree of confidence. Moreover, there's no digital zoom. If you try to zoom in on something on analog video, you'll likely get an image that is even more blurred and grainy.
- **Coverage Area:** Typically, analog surveillance cameras have a much narrower field of view than their digital counterparts, so you may need more of them to cover the area you need.
- **Positioning Limitations:** Because analog cameras need to be connected to the DVR, you have to keep these cameras within a reasonable range of the device, or you risk diminishing the reliability of the connection. As a result, you become more limited on where you can place your cameras.
- **Port Limitations:** DVRs have only so many ports on them, so you can only connect a limited number of cameras to them. If you want to exceed this number, you'll probably have to get a second DVR.
- **Wireless Capability (or Lack Thereof):** The reality is that analog wireless systems don't work very well due to government regulations regarding analog frequencies and signal strength. As a result, other wireless devices and even fluorescent lighting can interfere with and distort the video signal.
- **Encryption:** Analog signals can't be encrypted, typically speaking, meaning that it could be easier to for unwanted eyes to view the signal.

ii) (Internet Protocol) camera

An Internet Protocol camera, or **IP** camera, is a type of digital video camera that receives control data and sends image data via an **IP** network. They are commonly used for surveillance but unlike analog closed-circuit television (**CCTV**) cameras, they require no local recording device, only a local area network.

An IP security system broadcasts their video as a digital stream over an IP network such as a WAN, LAN, Internet or Intranet. IP cameras combine the capabilities of cameras and some PC functionalities so that they don't require a direct connection to a PC to operate. This means that an IP Camera can be placed anywhere within a network.

An Internet Protocol Camera, commonly referred to as an IP camera, is a digital video camera much like a webcam, which transmits and receives data over a network or the internet. Unlike an ordinary webcam it is a standalone unit with its own IP address that requires nothing more than a network connection in order to transfer images. The IP camera connects to a network in exactly the same way as any other standard network device such as a laptop, tablet or printer.

How does an IP Camera Work?

IP cameras capture images in much the same way as a digital camera, and compress the files to transmit over the network. IP cameras may be used with a wired network connected via ethernet cable to a broadband modem or router, or wirelessly via a WiFi router.

Advantages of (Internet Protocol) camera

- **Image Quality:** The image quality from digital security cameras is significantly higher than analog, with many cameras capable of recording and transmitting high-definition video. Plus, digital cameras are more likely to have digital zoom features, which can have zoom distances over 100ft.
- **Coverage Area:** A single digital camera can cover an area that would require three or even four of its analog counterparts. As a result, you may require fewer cameras and be able to maintain security surveillance over a wider area.
- **Fewer Cables Needed:** Instead of individually wiring each camera with power and then cabling each camera to the DVR, digital systems can have multiple cameras connected

to a switch, and then all of those cameras on the switch can be connected to the NVR with a single cable.

- **Positioning or Port Limitations:** Because cameras merely need to be connected to your LAN network in order to connect to your NVR, you are no longer limited by the distance between cameras and the video recorder. As the NVR is software-based and does not have ports, you also eliminate that limitation as well.
- **Power over Ethernet (PoE):** Power over Ethernet switches enable your signal cables to provide power to the cameras as well, reducing the need for those additional cables.
- **Wireless Capability:** Digital security camera systems are very good at operating within a wireless network. They are not susceptible to the same kinds of interference that affect their analog counterparts, so you can easily view a live feed from more remote locations if desired.
- **Encryption:** A lot of digital security cameras have encryption built in, so your data is safer from the beginning of its journey to its end.

Disadvantages of (Internet Protocol) camera

- **Setup Complications:** If you don't have the network set up already and the switches in place, these can increase the cost and labor involved in your CCTV installation, regardless of the fact that you'd need fewer cables overall.
- **Higher Initial Cost:** The cameras and equipment (aside from cables) tend to cost more on an individual basis compared to their analog counterparts (though you might need fewer of them, so the costs may balance out).
- **High Bandwidth Requirements:** IP security camera systems usually require a lot more bandwidth than analog ones. Between the higher resolution and higher frame rate, even with compression, you're looking at around 720Kbps, and that's before considering the newer cameras that have megapixel resolution. As a result, this could drive your costs up.
- **Storage Requirements:** Higher resolution and higher frame rates mean larger files, so you'll need a lot more storage space on your hard drive to accommodate them.

- **Comparison of analog and IP camera**

An analogue camera is a traditional camera used in CCTV systems. It sends video over cable to VCRs or DVRs. IP cameras are all digital cameras that can send signals over cable to be stored in the network. Many security camera systems today are hybrid systems incorporating both analogue and digital components.

1. Video quality

IP cameras provide overall higher video quality than analogue cameras. They offer more video site ranges, such as a wide or narrow field of view, and better zoom-in capabilities. And because they transmit truly digital signals, they offer far greater video detail, which makes them much better for facial recognition or detecting license plate numbers.

Analogue cameras have overall lower quality than IP cameras, but perform better in low light conditions. Analogue cameras have more limited site ranges and don't offer the zoom-in clarity of IP cameras. If you zoom in on the analogue images, you're going to get a grainier, degraded picture. It's not like what you see on TV cop shows. If you're using an analogue camera, you're not going to recognize the perpetrators face by zooming in.

2. Resolution

Generally, digital cameras provide resolutions 6 to 20 times higher than analogue cameras.Analogue cameras are limited to resolutions of the NTSC/PAL standard of 720 x 480 pixels (NTSC)/575 (PAL) or 0.4 megapixels (4CIF). Analogue camera resolutions range from 420 to 700; which at the high end can produce sharp images.

IP cameras offer resolutions that can range from 1.3 megapixels to 5 megapixels (2560 x 1920) of compressed, encoded transmissions. This gives you the ability to cover a far wider viewing area or to get far more detailed pictures in narrow, zoom-in viewing areas.

3. Transmission media

Traditional analogue cameras operate over coax cable. They can also work over, twisted-pair cable or with wireless connections, but that produces less resolution.

IP cameras also work over twisted-pair, coax cable, and with wireless connections.

4. PoE capabilities

One of the advantages of IP cameras is that they can be powered over the twisted-pair Ethernet cable, thus eliminating worries over running electrical wire.

Older analogue cameras cannot be PoE powered.

5. Wireless

Wireless IP camera network connections can be a very practical solution in areas where it's too difficult or expensive to run cable. Wireless can also be used in buildings where it's impractical or impossible to run cable, such as in historical buildings.

6. Distance

Analogue cameras can send video over twisted-pair cable up to 1.5 kilometres away and up to 300 metres away over coax cable. But analogue transmissions lose clarity with increased distance and when the signal is converted from one format to another.

IP cameras can send digital video 100 metres over twisted-pair Ethernet cable and unlimited distances over IP networks. Because the images are digital, they maintain 100% of their clarity over long distances and when the signal is converted between different formats.

7. Intelligence and manageability

IP cameras offer network intelligence and remote manageability. They can stream images, and different parts of images, to different recipients simultaneously. They can perform additional tasks such as sending a message when they detect motion.

8. Ease of installation

Analogue cameras require more cabling than IP cameras. For instance, they require a separate cable to control the pan, tilt, and zoom functions. If there is audio, another cable is required. One analogue camera may require three separate cables: power, audio, video.

IP cameras can accept power, video, audio, PTZ control, and control signals over a single cable.

9. Security

Analogue cameras are far more vulnerable to security breaches because the feeds can be physically intercepted and tapes and recording devices can be stolen. Analogue video feeds are also not encrypted.

IP cameras make data difficult to intercept. They encrypt and compress data before transporting it over the Internet to your server and they have VPN support.

10. Reliability

Analogue security cameras have been around for more than half a century and have a long history of reliability.

IP systems have built-in reliability due to the data encryption and compression. They are as reliable as the network is, although backup systems can be put in place to minimise outages.

11. Expandability

IP cameras offer more expandability and scalability than analogue cameras because their cabling requirements are less complex. But it is still possible to leverage your existing cabling infrastructure when migrating to IP cameras with the use of converters and extenders.

12. Costs

IP camera systems are thought to be more expensive because the cost of the cameras is higher than for analogue cameras, although the price of IP cameras continues to drop. But the overall cost may be less than anticipated due to lower costs for cabling, recording equipment, and labor.

Costs can also be mitigated by installing IP cameras with the existing cabling infrastructure through the use of extenders and media converters.

LO 1.2 – Identify the network structure and devices according to their types and specifications.

- Content/Topic 1: Definition of network structure and network device.

a) Network structure definition

Computer Network Architecture is defined as the physical and logical design of the software, hardware, protocols, and media of the transmission of data. Simply we can say that how computers are organized and how tasks are allocated to the computer.

b) Network device

Computer network components are the *major parts* which are needed to *install the software*. Some important network components are **NIC**, **switch**, **cable**, **hub**, **router**, and **modem**. Depending on the type of network that we need to install, some network components can also be removed. For example, the wireless network does not require a cable.

- Content/Topic 2: Types of network structure /topology.

2.1 What is Topology?

Network topologies describe the methods in which all the elements of a network are mapped. The topology term refers to both the physical and logical layout of a network.

2.2 Types of Networking Topologies

Two main types of networking topologies are:

1) Physical topology

2) Logical topology

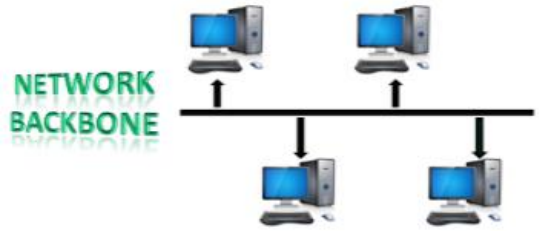
i) Physical Topology: This type of network is an actual layout of the computers, cables and other network devices.

Physical topology is the geometric representation of all the nodes in a network.

Different types of Physical Topologies are:

- Bus Topology
- Ring Topology
- Star Topology
- Tree Topology
- Mesh Topology
- Hybrid Topology

1) Bus Topology



The bus topology is designed in such a way that all the stations are connected through a single cable known as a backbone cable.

Each node is either connected to the backbone cable by drop cable or directly connected to the backbone cable.

When a node wants to send a message over the network, it puts a message over the network. All the stations available in the network will receive the message whether it has been addressed or not.

The bus topology is mainly used in 802.3 (ethernet) and 802.4 standard networks.

The configuration of a bus topology is quite simpler as compared to other topologies.

The backbone cable is considered as a **"single lane"** through which the message is broadcast to all the stations.

The most common access method of the bus topologies is **CSMA** (Carrier Sense Multiple Access).

CSMA: It is a media access control used to control the data flow so that data integrity is maintained, i.e., the packets do not get lost. There are two alternative ways of handling the problems that occur when two nodes send the messages simultaneously.

- **CSMA CD:** CSMA CD (**Collision detection**) is an access method used to detect the collision. Once the collision is detected, the sender will stop transmitting the data. Therefore, it works on "**recovery after the collision**".
- **CSMA CA:CSMA CA (Collision Avoidance)** is an access method used to avoid the collision by checking whether the transmission media is busy or not. If busy, then the sender waits until the media becomes idle. This technique effectively reduces the possibility of the collision. It does not work on "recovery after the collision".

Advantages of Bus topology

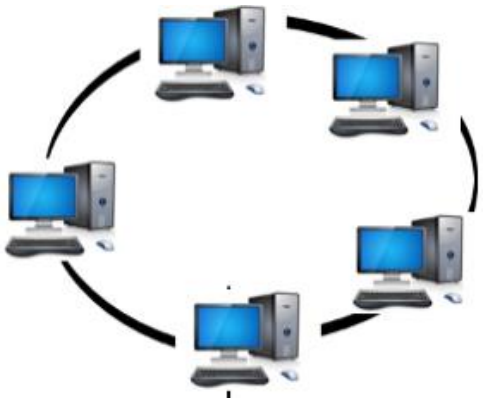
- **Low-cost cable:** In bus topology, nodes are directly connected to the cable without passing through a hub. Therefore, the initial cost of installation is low.
- **Moderate data speeds:** Coaxial or twisted pair cables are mainly used in bus-based networks that support upto 10 Mbps.
- **Familiar technology:** Bus topology is a familiar technology as the installation and troubleshooting techniques are well known, and hardware components are easily available.
- **Limited failure:** A failure in one node will not have any effect on other nodes.

Disadvantages of Bus topology

- **Extensive cabling:** A bus topology is quite simpler, but still it requires a lot of cabling.
- **Difficult troubleshooting:** It requires specialized test equipment to determine the cable faults. If any fault occurs in the cable, then it would disrupt the communication for all the nodes.
- **Signal interference:** If two nodes send the messages simultaneously, then the signals of both the nodes collide with each other.
- **Reconfiguration difficult:** Adding new devices to the network would slow down the network.

- **Attenuation:** Attenuation is a loss of signal leads to communication issues. Repeaters are used to regenerate the signal.

2) Ring Topology



Ring topology is like a bus topology, but with connected ends. The node that receives the message from the previous computer will retransmit to the next node. The data flows in one direction, i.e., it is unidirectional.

The data flows in a single loop continuously known as an endless loop. It has no terminated ends, i.e., each node is connected to other node and having no termination point. The data in a ring topology flow in a clockwise direction.

The most common access method of the ring topology is **token passing**.

- **Token passing:** It is a network access method in which token is passed from one node to another node.
- **Token:** It is a frame that circulates around the network.

Advantages of Ring topology:

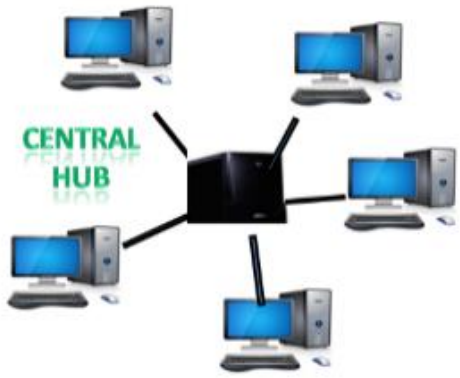
- **Network Management:** Faulty devices can be removed from the network without bringing the network down.
- **Product availability:** Many hardware and software tools for network operation and monitoring are available.
- **Cost:** Twisted pair cabling is inexpensive and easily available. Therefore, the installation cost is very low.

- **Reliable:** It is a more reliable network because the communication system is not dependent on the single host computer.

Disadvantages of Ring topology:

- **Difficult troubleshooting:** It requires specialized test equipment to determine the cable faults. If any fault occurs in the cable, then it would disrupt the communication for all the nodes.
- **Failure:** The breakdown in one station leads to the failure of the overall network.
- **Reconfiguration difficult:** Adding new devices to the network would slow down the network.
- **Delay:** Communication delay is directly proportional to the number of nodes. Adding new devices increases the communication delay.

3) Star Topology



Star topology is an arrangement of the network in which every node is connected to the central hub, switch or a central computer.

The central computer is known as a **server**, and the peripheral devices attached to the server are known as **clients**.

Coaxial cable or RJ-45 cables are used to connect the computers.

Hubs or Switches are mainly used as connection devices in a **physical star topology**. Star topology is the most popular topology in network implementation.

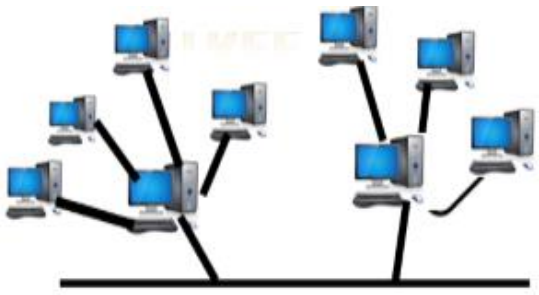
Advantages of Star topology

- **Efficient troubleshooting:** Troubleshooting is quite efficient in a star topology as compared to bus topology. In a bus topology, the manager has to inspect the kilometers of cable. In a star topology, all the stations are connected to the centralized network. Therefore, the network administrator has to go to the single station to troubleshoot the problem.
- **Network control:** Complex network control features can be easily implemented in the star topology. Any changes made in the star topology are automatically accommodated.
- **Limited failure:** As each station is connected to the central hub with its own cable, therefore failure in one cable will not affect the entire network.
- **Familiar technology:** Star topology is a familiar technology as its tools are cost-effective.
- **Easily expandable:** It is easily expandable as new stations can be added to the open ports on the hub.
- **Cost effective:** Star topology networks are cost-effective as it uses inexpensive coaxial cable.
- **High data speeds:** It supports a bandwidth of approx 100Mbps. Ethernet 100BaseT is one of the most popular Star topology networks.

Disadvantages of Star topology

- **A Central point of failure:** If the central hub or switch goes down, then all the connected nodes will not be able to communicate with each other.
- **Cable:** Sometimes cable routing becomes difficult when a significant amount of routing is required.

4) Tree topology



Tree topology combines the characteristics of bus topology and star topology.

A tree topology is a type of structure in which all the computers are connected with each other in hierarchical fashion.

The top-most node in tree topology is known as a root node, and all other nodes are the descendants of the root node. There is only one path exists between two nodes for the data transmission. Thus, it forms a parent-child hierarchy.

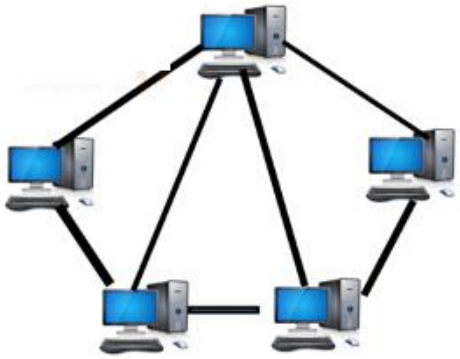
Advantages of Tree topology

- **Support for broadband transmission:** Tree topology is mainly used to provide broadband transmission, i.e., signals are sent over long distances without being attenuated.
- **Easily expandable:** We can add the new device to the existing network. Therefore, we can say that tree topology is easily expandable.
- **Easily manageable:** In tree topology, the whole network is divided into segments known as star networks which can be easily managed and maintained.
- **Error detection:** Error detection and error correction are very easy in a tree topology.
- **Limited failure:** The breakdown in one station does not affect the entire network.
- **Point-to-point wiring:** It has point-to-point wiring for individual segments.

Disadvantages of Tree topology

- **Difficult troubleshooting:** If any fault occurs in the node, then it becomes difficult to troubleshoot the problem.
- **High cost:** Devices required for broadband transmission are very costly.
- **Failure:** A tree topology mainly relies on main bus cable and failure in main bus cable will damage the overall network.
- **Reconfiguration difficult:** If new devices are added, then it becomes difficult to reconfigure.

5) Mesh topology



Mesh technology is an arrangement of the network in which computers are interconnected with each other through various redundant connections. There are multiple paths from one computer to another computer.

It does not contain the switch, hub or any central computer which acts as a central point of communication.

The Internet is an example of the mesh topology. Mesh topology is mainly used for WAN implementations where communication failures are a critical concern. Mesh topology is mainly used for wireless networks.

Mesh topology can be formed by using the formula:
Number of cables = (n*(n-1))/2;

Where n is the number of nodes that represents the network.

b) Advantages of Mesh topology:

Reliable: The mesh topology networks are very reliable as if any link breakdown will not affect the communication between connected computers.

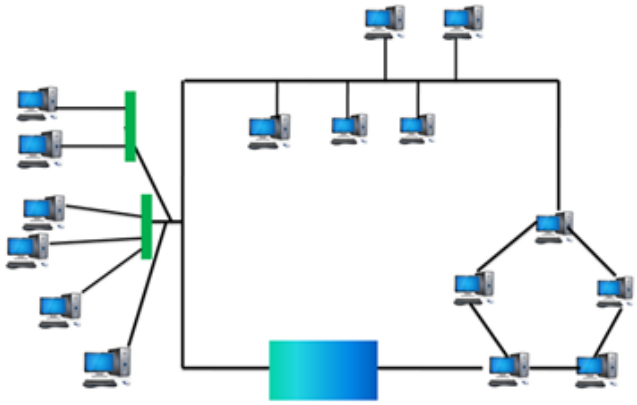
Fast Communication: Communication is very fast between the nodes.

Easier Reconfiguration: Adding new devices would not disrupt the communication between other devices.

c) Disadvantages of Mesh topology

- **Cost:** A mesh topology contains a large number of connected devices such as a router and more transmission media than other topologies.
- **Management:** Mesh topology networks are very large and very difficult to maintain and manage. If the network is not monitored carefully, then the communication link failure goes undetected.
- **Efficiency:** In this topology, redundant connections are high that reduces the efficiency of the network.

6) Hybrid Topology



The combination of various different topologies is known as **Hybrid topology**. A Hybrid topology is a connection between different links and nodes to transfer the data.

When two or more different topologies are combined together is termed as Hybrid topology and if similar topologies are connected with each other will not result in Hybrid topology. For example, if there exist a ring topology in one branch of ICICI bank and bus topology in another branch of ICICI bank, connecting these two topologies will result in Hybrid topology.

Advantages of Hybrid Topology

- **Reliable:** If a fault occurs in any part of the network will not affect the functioning of the rest of the network.
- **Scalable:** Size of the network can be easily expanded by adding new devices without affecting the functionality of the existing network.

- **Flexible:** This topology is very flexible as it can be designed according to the requirements of the organization.
- **Effective:** Hybrid topology is very effective as it can be designed in such a way that the strength of the network is maximized and weakness of the network is minimized.

Disadvantages of Hybrid topology

- **Complex design:** The major drawback of the Hybrid topology is the design of the Hybrid network. It is very difficult to design the architecture of the Hybrid network.
- **Costly Hub:** The Hubs used in the Hybrid topology are very expensive as these hubs are different from usual Hubs used in other topologies.
- **Costly infrastructure:** The infrastructure cost is very high as a hybrid network requires a lot of cabling, network devices, etc.

ii) Logical topology

1. Definition

Logical topology is the arrangement of devices on a computer network and how they communicate with one another. Logical topologies describe how signals act on the network.

In contrast, a physical topology defines how nodes in a network are physically linked and includes aspects such as geographic location of nodes and physical distances between nodes. The logical topology defines how nodes in a network communicate across its physical topology. The logical topology can be considered isomorphic to the physical topology, as vice versa.

Logical topology gives insight's about network's physical design.

A logical topology is a concept in networking that defines the architecture of the communication mechanism for all nodes in a network. Using network equipment such as routers and switches, the logical topology of a network can be dynamically maintained and reconfigured.

2. Types of logical topology

Two of the most common logical topologies are:

- **Bus topology:** Ethernet uses the logical bus topology to transfer data. Under a bus topology a node broadcasts the data to the entire network. All other nodes on the network hear the data and check if the data is intended for them.
- **Ring topology:** In this topology, only one node can be allowed to transfer the data in a network at a given time. This mechanism is achieved by token (the node having token only can transmit the data in a network) and hence the collision can be avoided in a network.

3. Communication in logical topology

Successful communication requires that a sender and a receiver know how to get messages to each other. Postal systems use geography to deliver mail to physical addresses, but getting messages between computers is a more complicated matter. With the Internet, computers can communicate regardless of physical location.

Instead of using a geographical addressing scheme for computers, engineers devised a logical addressing scheme using numeric network addresses. The following sections introduce the addressing process.

3.1 Addressing in the Network

There are millions of computers in use on the web and billions of messages traversing networks at any given time, so proper addressing is essential to make sure that the sent message arrives intact at the proper destination. Addressing of data happens in three different layers of the OSI model. The PDU at each layer adds address information for use by the peer layer at the destination.

1) IP address classes

An IP (Internet Protocol) address is a unique identifier for a node or host connection on an IP network. An IP address is a 32 bit binary number usually represented as 4 decimal values, each representing 8 bits, in the range 0 to 255 (known as octets) separated by decimal points. This is known as "dotted decimal" notation.

Example: 140.179.220.200

It is sometimes useful to view the values in their binary form.

140 .179 .220 .200

10001100.10110011.11011100.11001000

Every IP address consists of two parts, one identifying the network and one identifying the node. The Class of the address and the subnet mask determine which part belongs to the network address and which part belongs to the node address.

Address Classes:

There are 5 different address classes. You can determine which class any IP address is in by examining the first 4 bits of the IP address.

Class A addresses begin with 0xxx, or 1 to 126 decimal.

Class B addresses begin with 10xx, or 128 to 191 decimal.

Class C addresses begin with 110x, or 192 to 223 decimal.

Class D addresses begin with 1110, or 224 to 239 decimal.

Class E addresses begin with 1111, or 240 to 254 decimal.

Addresses beginning with 01111111, or 127 decimal, are reserved for loopback and for internal testing on a local machine. [You can test this: you should always be able to ping 127.0.0.1, which points to yourself] Class D addresses are reserved for multicasting. Class E addresses are reserved for future use. They should not be used for host addresses.

Now we can see how the Class determines, by default, which part of the IP address belongs to the network (N) and which part belongs to the node (n).

Class A -- NNNNNNNN.nnnnnnnn.nnnnnnn.nnnnnnn

Class B -- NNNNNNNN.NNNNNNNN.nnnnnnnn.nnnnnnnn

Class C -- NNNNNNNN.NNNNNNNN.NNNNNNNN.nnnnnnnn

In the example, 140.179.220.200 is a Class B address so by default the Network part of the address (also known as the Network Address) is defined by the first two octets (140.179.x.x) and the node part is defined by the last 2 octets (x.x.220.200).

In order to specify the network address for a given IP address, the node section is set to all "0"s. In our example, 140.179.0.0 specifies the network address for 140.179.220.200. When the node section is set to all "1"s, it specifies a broadcast that is sent to all hosts on the network. 140.179.255.255 specifies the example broadcast address. Note that this is true regardless of the length of the node section.

Private Subnets:

There are three IP network addresses reserved for private networks. The addresses are 10.0.0.0/8, 172.16.0.0/12, and 192.168.0.0/16. They can be used by anyone setting up internal IP networks, such as a lab or home LAN behind a NAT or proxy server or a router. It is always safe to use these because routers on the Internet will never forward packets coming from these addresses

Subnetting an IP Network can be done for a variety of reasons, including organization, use of different physical media (such as Ethernet, FDDI, WAN, etc.), preservation of address space, and security. The most common reason is to control network traffic. In an Ethernet network, all nodes on a segment see all the packets transmitted by all the other nodes on that segment. Performance can be adversely affected under heavy traffic loads, due to collisions and the resulting retransmissions. A router is used to connect IP networks to minimize the amount of traffic each segment must receive.

Subnet Masking

Applying a subnet mask to an IP address allows you to identify the network and node parts of the address. The network bits are represented by the 1s in the mask, and the node bits are represented by the 0s. Performing a bitwise logical AND operation between the IP address and the subnet mask results in the Network Address or Number.

For example, using our test IP address and the default Class B subnet mask, we get:

10001100.10110011.11110000.11001000 140.179.240.200 Class B IP Address

11111111.11111111.00000000.00000000 255.255.000.000 Default Class B Subnet Mask

10001100.10110011.00000000.00000000 140.179.000.000 Network Address

- Content /Topic3: Commonly used network devices

Computer network components are the *major parts* which are needed to *install the software*. Some important network components are **NIC**, **switch**, **cable**, **hub**, **router**, and **modem**. Depending on the type of network that we need to install, some network components can also be removed. For example, the wireless network does not require a cable.

3.1 Switch

A network switch (also called switching hub, bridging hub, and by the IEEE MAC bridge) is networking hardware that connects devices on a computer network by using packet switching to receive and forward data to the destination device.

A network switch is a multiport network bridge that uses MAC addresses to forward data at the data link layer (layer 2) of the OSI model. Some switches can also forward data at the network layer (layer 3) by additionally incorporating routing functionality. Such switches are commonly known as layer-3 switches or multilayer switches.

Switches for Ethernet are the most common form of network switch. The first Ethernet switch was introduced by Kalpana in 1990. Switches also exist for other types of networks including Fibre Channel, Asynchronous Transfer Mode, and InfiniBand.

Unlike less advanced repeater hubs, which broadcast the same data out of each of its ports and let the devices decide what data they need, a network switch forwards data only to the devices that need to receive it.

A network switch connects devices (such as computers, printers, wireless access points) in a network to each other, and allows them to 'talk' by exchanging data packets. Switches can be hardware devices that manage physical networks, as well as software-based virtual devices.

Switches form the vast majority of network devices in modern data networks. They provide the wired connections to desktop computers, wireless access points, industrial machinery and some

internet of things (IoT) devices such as card entry systems. They connect the computers that host virtual machines (VMs) in data centers, as well as the physical servers, and much of the storage infrastructure. They carry vast amounts of traffic in telecommunications provider networks.

A network switch operates on the network layer 2 of the OSI model. In a local area network (LAN) using Ethernet, a network switch determines where to send each incoming message frame by looking at the physical device address (or MAC address). Switches maintain tables that match each MAC address, to the port which the MAC address is received.

How a network switch works

A network switch can be deployed in the following ways:

- **Edge, or access switches**: These switches manage traffic either coming into or exiting the network. Devices like computers and access points connect to edge switches.
- **Aggregation, or distribution switches:** These switches are placed within an optional middle layer. Edge switches connect into these and they can send traffic from switch to switch or send it up to core switches.
- **Core switches:** These network switches form the backbone of the network. Core switches connect either aggregation or edge switches, user or device edge networks to data center networks and enterprise LANs to routers.

If a frame is forwarded to a MAC address unknown to the switch infrastructure, it is flooded to all ports in the switching domain. Broadcast and multicast frames are also flooded. This is known as BUM flooding -- broadcast, unknown unicast, and multicast flooding. This capability makes a switch a Layer 2 or data-link layer device in the Open Systems Interconnection (OSI) communications model.

3.2 Access point

In computer networking, a wireless access point (WAP), or more generally just access point (AP), is a networking hardware device that allows other Wi-Fi devices to connect to a wired network. The AP usually connects to a router (via a wired network) as a standalone device, but it can also

be an integral component of the router itself. An AP is differentiated from a hotspot which is a physical location where Wi-Fi access is available.

An access point is a device that creates a wireless local area network, or WLAN, usually in an office or large building. An access point connects to a wired router, switch, or hub via an Ethernet cable, and projects a Wi-Fi signal to a designated area. For example, if you want to enable Wi-Fi access in your company's reception area but don't have a router within range, you can install an access point near the front desk and run an Ethernet cable through the ceiling back to the server room.

- Content /Topic4:Types of network media:

Network Medium: A medium is a means of interconnecting these devices, that is, a medium can transport the messages from one device to another.

Network media refers to the communication channels used to interconnect nodes on a computer network. Typical examples of network media include copper coaxial cable, copper twisted pair cables and optical fiber cables used in wired networks, and radio waves used in wireless data communications networks.

The medium that physically carries the message can change several times between the sender and the receiver.

a) Types of network media

Network connections can be wired or wireless.

1. Wireless media

Definition

In wireless connections, the medium is the Earth's atmosphere, or space, and the signals are microwaves. Wireless media can include the home wireless connection between a wireless router and a computer with a wireless network card, the terrestrial wireless connection between two ground stations, or the communication between devices on Earth and satellites. In a typical journey across the Internet, a message can travel across a variety of media.

2 Wired media (Ethernet cable, fibers)

Definition

Wired communication refers to the transmission of data over a wire-based communication technology. **Wired** communication is also known as wireline communication. Examples include telephone networks, cable television or internet access, and fiber-optic communication.

In wired connections, the medium is either copper, which carries electrical signals, or optical fiber, which carries light signals. The copper medium includes cables, such as twistedpair telephone wire, coaxial cable, or most commonly, what is known as Category 5 unshielded twisted-pair (UTP) cable. Optical fibers, thin strands of glass or plastic that carry light signals, are another form of networking media.

The differences in the media make each one ideal for different roles in networking situations. When choosing network media, administrators must consider the following:

■The distance the media can carry the signal,

■The environment in which the media works,

■The bandwidth requirements for users,

■The cost of installation,

■The cost of connectors and compatible equipment.

2. Advantage of wired media

- More **secure**

- Provides **high speed**
- Used for **shorter distances**

3. Disadvantage of wired media

- Need Physical link
- Time Consuming

4. Types of wired Media

There are two **types of wired media** which are Ethernet cables classified in **Twisted-Pair Cable**, **Coaxial Cable** and **Fiber-Optic Cable**.

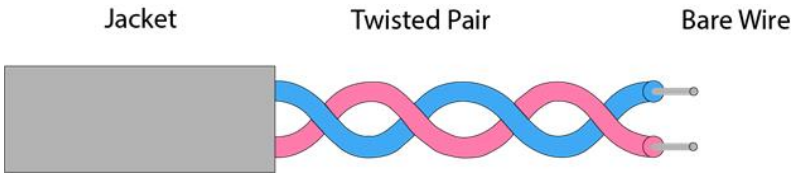
1) Twisted-Pair Cable

Twisted-Pair Cable consists of **two insulated conductors wire wound** (normally copper), twisted together. In which one wire is to carry the signal to destination and other is used as a ground reference. **Twisting is done** so that the **noise will equally affect the wire from the external environment**.

Twisted pair is a physical media made up of a pair of cables twisted with each other. A twisted pair cable is cheap as compared to other transmission media. Installation of the twisted pair cable is easy, and it is a lightweight cable. The frequency range for twisted pair cable is from 0 to 3.5KHz.

A twisted pair consists of two insulated copper wires arranged in a regular spiral pattern.

The degree of reduction in noise interference is determined by the number of turns per foot. Increasing the number of turns per foot decreases noise interference.



Types of Twisted pair

Types of twisted pair cable are:

1) Unshielded Twisted-Pair Cable
2) Shielded Twisted-Pair Cable

1. Unshielded Twisted Pair

Unshielded Twisted-Pair Cable is the widely used twisted-pair cable used in telecommunications as **Ethernet cables and telephone wires**.

UTP cables consist of 2 pairs of twisted cable use RJ-11 connector and cables consist of 4 pairs use an RJ-45 connector.

An unshielded twisted pair is widely used in telecommunication. Following are the categories of the unshielded twisted pair cable:

- **Category 1:** Category 1 is used for telephone lines that have low-speed data.
- **Category 2:** It can support upto 4Mbps.
- **Category 3:** It can support upto 16Mbps.
- **Category 4:** It can support upto 20Mbps. Therefore, it can be used for long-distance communication.
- **Category 5:** It can support upto 200Mbps.

Advantages of Unshielded Twisted Pair:

- It is cheap.
- Installation of the unshielded twisted pair is easy.
- It can be used for high-speed LAN.
- The frequency range is 0 to 3.5 kHz
- Repeater spacing is 2 KM

Disadvantage:

- This cable can only be used for shorter distances because of attenuation.
- No capacity to carrying a signal over long distances without the use of repeaters.

- Not suitable for broadband applications because of low bandwidth capacity.
- Poor security and easy to tap.

Applications of Twisted Pair Cables

1. It is used in telephone lines.
2. Also used in the DSL line (ADSL)
3. ISDN (Integrated Services Digital Network).

2. Shielded Twisted Pair

A shielded twisted pair is a cable that contains the mesh surrounding the wire that allows the higher transmission rate.

Characteristics of Shielded Twisted Pair:

- The cost of the shielded twisted pair cable is not very high and not very low.
- An installation of STP is easy.
- It has higher capacity as compared to unshielded twisted pair cable.
- It has a higher attenuation.
- It is shielded that provides the higher data transmission rate.

Advantages of Shielded Twisted-Pair Cable

1. Better performance at a higher data rate
2. Eliminates cross talk
3. Comparatively faster

Disadvantages of Shielded Twisted-Pair Cable

1. Difficult to manufacture and install
2. Bulky and expensive as compared to UTP and coaxial cable
3. It has a higher attenuation rate.

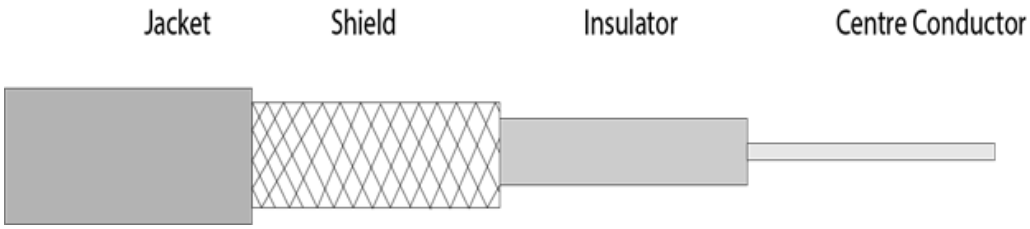
Applications

- It is used in telephone lines to provide data and voice channels.

2. Coaxial Cable

Coaxial cable has a **central core conductor of stranded or solid wire** (usually copper) enclosed in an insulating protection cover, which is, in turn, encased in an outer conductor of metal foil or a combination of the two. The outer metallic work as a shield against noise and as a conductor, which complete the circuit. The whole cable is covered by a plastic cover.

- Coaxial cable is very commonly used transmission media, for example, TV wire is usually a coaxial cable.
- The name of the cable is coaxial as it contains two conductors parallel to each other.
- It has a higher frequency as compared to Twisted pair cable.
- The inner conductor of the coaxial cable is made up of copper, and the outer conductor is made up of copper mesh. The middle core is made up of non-conductive cover that separates the inner conductor from the outer conductor.
- The middle core is responsible for the data transferring whereas the copper mesh prevents from the **EMI** (Electromagnetic interference).



a) Two types of Coaxial Cable

Coaxial cable is of two types:

1. **Baseband transmission:** It is defined as the process of transmitting a single signal at high speed. And is of 50 ohms used for digital transmission.
2. **Broadband transmission:** It is defined as the process of transmitting multiple signals simultaneously. And is used for analog transmission on standard TV cable.

Advantages of Coaxial cable:

- The data can be transmitted at high speed.
- It has better shielding as compared to twisted pair cable.
- It provides higher bandwidth.
- Carries signals of higher data rate and bandwidth.
- Used in analog telephone networks and traditional Cable TV networks.

Disadvantages of Coaxial cable:

- It is more expensive as compared to twisted pair cable.
- If any fault occurs in the cable causes the failure in the entire network
- The network depends on a single cable.
- Expensive and difficult to install when compared with twisted pair.

Applications of Coaxial cable

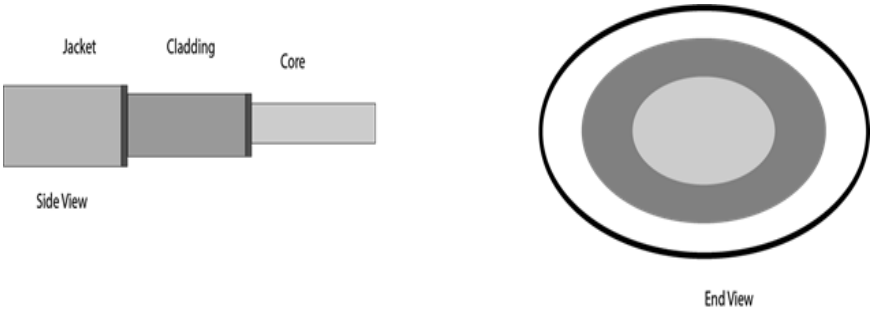
- Used in **analog telephone networks**, could carry 10,000 voice signals.

3. Fiber-Optic Cable

Fiber-Optic Cable is made of glass and transmits of data is based on the concept of **reflection of light through glass**. A glass core is surrounded by less dense glass called **cladding**.

- Fibre optic cable is a cable that uses electrical signals for communication.
- Fibre optic is a cable that holds the optical fibres coated in plastic that are used to send the data by pulses of light.
- The plastic coating protects the optical fibres from heat, cold, electromagnetic interference from other types of wiring.
- Fibre optics provide faster data transmission than copper wires.

a) **Diagrammatic representation of fiber optic cable:**



b) **Basic elements of fiber optic cable:**

- **Core:** The optical fibre consists of a narrow strand of glass or plastic known as a core. A core is a light transmission area of the fibre. The more the area of the core, the more light will be transmitted into the fibre.
- **Cladding:** The concentric layer of glass is known as cladding. The main functionality of the cladding is to provide the lower refractive index at the core interface as to cause the reflection within the core so that the light waves are transmitted through the fibre.
- **Jacket:** The protective coating consisting of plastic is known as a jacket. The main purpose of a jacket is to preserve the fibre strength, absorb shock and extra fibre protection.

c) **Advantages of fiber optic cable**

Following are the advantages of fiber optic cable over copper:

- **Greater Bandwidth:** The fibre optic cable provides more bandwidth as compared copper. Therefore, the fibre optic carries more data as compared to copper cable.
- **Faster speed:** Fibre optic cable carries the data in the form of light. This allows the fibre optic cable to carry the signals at a higher speed.
- **Longer distances:** The fibre optic cable carries the data at a longer distance as compared to copper cable.
- **Better reliability:** The fibre optic cable is more reliable than the copper cable as it is immune to any temperature changes while it can cause obstruct in the connectivity of copper cable.
- **Thinner and Sturdier:** Fibre optic cable is thinner and lighter in weight so it can withstand more pull pressure than copper cable.

d) Types of fiber optic cable

There are two types of fiber optic based on Propagation Modes

d.1Multimode mode

Multiple light beams from a light source move through the core in different paths.

It is implemented in two forms: step-index and graded-index.
(a) **Step-index**: density of the core remains constant from the centre to the edges.
(b) **Graded-index**: decreases this distortion of the signal through the cable

d.2Single mode

Single-mode uses step-index fiber and a focused source of light which limits beams to a small range of angles, all close to the horizontal.

LO 1.3 – Select tools, materials and equipment according to the work to be done.

- Content/Topic 1: Definition of tools, materials and equipment.

Tool: a device or implement, especially one held in the hand, used to carry out a particular function.

A *tool* is any instrument or simple piece of equipment that you hold in your hands and use to do a particular kind of work. For example, spades, hammers, and knives are all tools.

Material:the matter from which a thing is or can be made.

A **material** is a chemical substance or mixture of substances that constitute an object.

Equipment: the necessary items for a particular purpose.

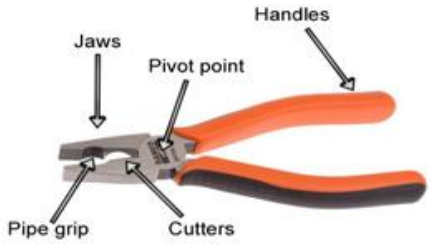
Equipment consists of the things which are used for a particular purpose.

- Content/Topic 2: Types of tools and their use

2.1 Screw drivers

A **screwdriver** is a tool, manual or powered, for screwing and unscrewing (inserting and removing) screws.

2.2 Pliers



Pliers (plyers) are handheld, manually-powered hand tools, often employing serrated jaws, designed for holding, cutting, bending, or manipulation of tough or difficult materials such as wire, sheet metal, or fine machine components. Pliers typically vary in length from 4” to 20” and consist of three basic components: a pair of handles, a pivot where the handles join, and the head section that contains the gripping jaws or cutting edges.

2.3 Hammer

An hammer is an essential tool, for hitting works. In CCTV it is majorly used for cable clipping work.

2.4 Allen keys

A **hex key**, Allen wrench or Allen key, is a simple tool used to drive bolts and screws with hexagonal sockets in their heads.

The tool is usually formed of a single piece of hexagonal rod of hard steel, with blunt ends that are meant to fit snugly into the screw's socket, bent in an "L" shape with unequal arms. The tool is usually held and twisted by the long arm, creating a large torque at the tip of the short arm. Reversing the tool lets the long arm reach screws in hard-to-reach places.

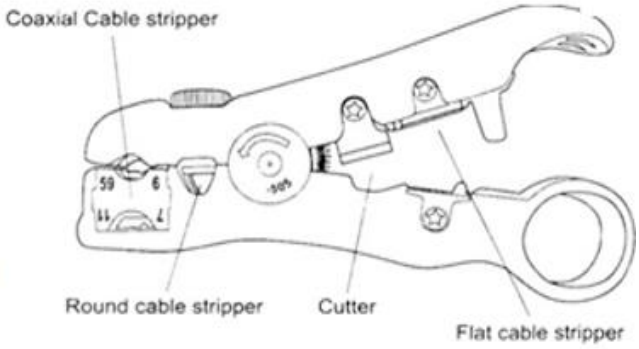
2.5 **Soldering iron**

A **soldering iron** is a hand tool used in soldering. It supplies heat to melt solder so that it can flow into the joint between two workpieces.

2.6 Di-soldering pump

Desoldering is the elimination of solder from a circuit board. Therefore, the desoldering pump is a device used in achieving the removal of solder from a printed circuit board. It is a type of device used for this purpose, and it is of two kinds, which are the plunger style and the bulb style. So, if perhaps you are interested in a quick, large job performing device, then it comes to a significant consideration.

2.7 CCTV Cable stripper



The CCTV cable stripper can be used to strip coax cables (RG-58, RG-59, RG-62, RG-6 3C, 4C, 5C, RG-174) as well as flat cables (RJ-45, RJ-11, RJ-12). In CCTV video surveillance installations, the most common type of cable that this tool is used with is RG59 Siamese cable.

The below diagram documents all of the parts of the TL-22 cable stripper as well as the locations where round and flat coaxial cable are inserted.

2.8 CCTV Cable crimping tool(for RG58,59)

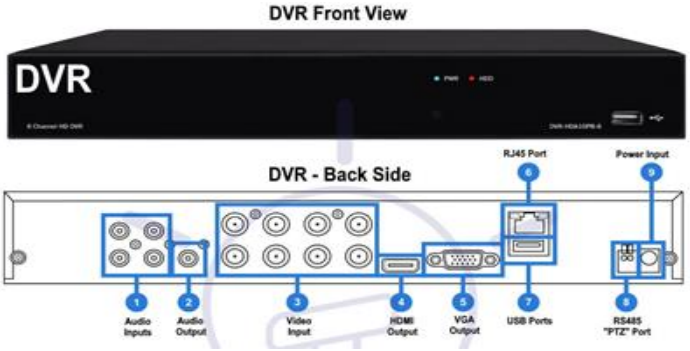
The CCTV cable crimping can be used by security system installers to crimp connectors onto the following types of coax cable: RG-58, RG-59, RG-62, RG-6. This crimping tool has built-in ratchet compression to make cable crimping easier.

2.9 Ethernet cable crimping tool

A **crimping tool** is a device used to conjoin two pieces of metal by deforming one or both of them in a way that causes them to hold each other. The result of the **tool's** work is called a **crimp**. A good example of **crimping** is the process of affixing a connector to the end of a cable.

- Content/Topic 3: Types of equipment and their use

3.1 DVR



Stands for "Digital Video Recorder." A DVR is basically a VCR that uses a hard drive instead of video tapes. It can be used to record, save, and play back television programs.

3.2 NVR

The NVR full form is network video recorder. As the name suggests, NVR recorders record videos from the network directly using Cat5 or Cat6 Ethernet cables with RJ45 plugs. NVR systems record and store video footage directly from the network it lives on. These systems work with an advanced type of camera, called **IP cameras**. IP cameras can actually capture and process video and audio data themselves. They do so using either an ethernet cable or wirelessly via an existing WiFi network.

3.3 Camera

A camera is an electronic device that captures pictures, movies or other visual images digitally or on film. Any of various devices for recording or transmitting images or sequences of images, consisting essentially of a closed case with a lens that focuses incoming light on a sensitive material, as film, or on an electronic receptor.

A **CCTV** (closed-circuit television) system allows the use of videos cameras to monitor the interior and exterior of a property, transmitting the signal to a monitor or set of monitors.

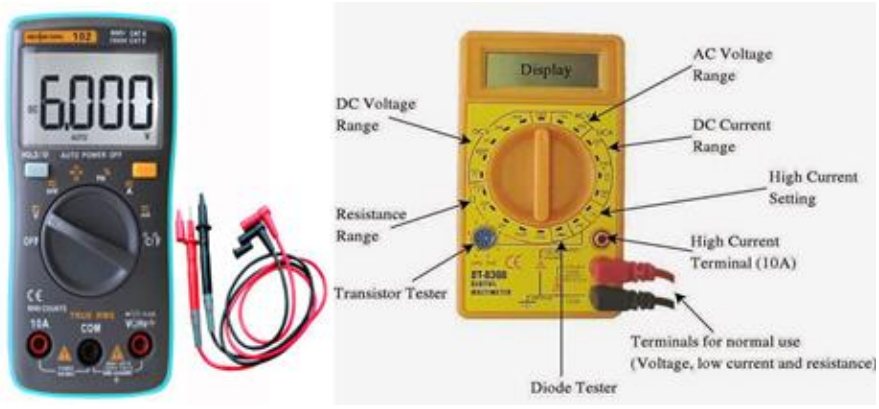
3.4 UPS

An **uninterruptible power supply** (**UPS**) is an electrical apparatus that provides emergency power to a load when the input power source or mains power fails. A UPS differs from an

auxiliary or emergency power system or standby generator in that it will provide near-instantaneous protection from input power interruptions, by supplying energy stored in batteries, supercapacitors, or flywheels. The on-battery run-time of most uninterruptible power sources is relatively short (only a few minutes) but sufficient to start a standby power source or properly shut down the protected equipment. It is a type of continual power system.

A UPS is typically used to protect hardware such as computers, data centers, telecommunication equipment or other electrical equipment where an unexpected power disruption could cause injuries, fatalities, serious business disruption or data loss.

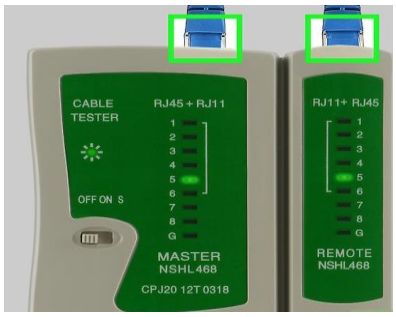
3.5 Digital multi-meter



A digital multimeter (DMM) is a test tool used to measure two or more electrical values—principally voltage (volts), current (amps) and resistance (ohms). It is a standard diagnostic tool for technicians in the electrical/electronic industries.

In CCTV field it is majorly used to check continuity & voltage.

3.6 Cable tester



A **cable tester** is an electronic device used to verify the electrical connections in a signal cable or other wired assembly. Basic cable testers are continuity testers that verify the existence of a conductive path between ends of the cable, and verify the correct wiring of connectors on the cable. More advanced cable testers can measure the signal transmission properties of the cable such as its resistance, signal attenuation, noise and interference

3.7 Handheld CCTV Monitor

It is a small monitor with required video inputs. You can any time check the camera operation in the field. In this way the camera is checked on the spot, reducing the time taken in service. It can also be used during demo sessions with new clients.

Cameras and **monitors** enable you to view events live, and recorders archive footage for later reference. Don't mistake a **CCTV monitor** for an ordinary television.

3.8 LCD service Monitor

A liquid crystal display (LCD) monitor is a computer monitor or display that uses LCD technology to show clear images, and is found mostly in laptop computers and flat panel monitors. This

technology has replaced the traditional cathode ray tube (CRT) monitors, which were the previous standard and once were considered to have better picture quality than early LCD variants. With the introduction of better LCD technology and its continuous improvement, LCD is now the clear leader over CRT, in terms of color and picture quality, not to mention capabilities for large resolutions. Also, LCD monitors may be made much more cheaply than CRT monitors.

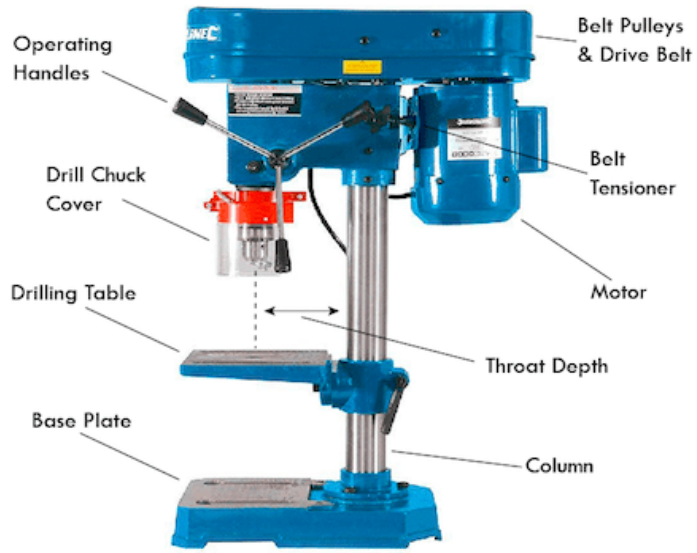
3.9 IP Camera tester

Security camera testers let you test, focus, aim, and program your cameras on-site. With no need to go back and forth between cameras, computers, or recorders, these literally handy tools are the quickest way to setup the exact surveillance system you want.

3.10 PPE

P PE is defined in the Personal Protective Equipment at Work Regulations as: ‘All equipment (including clothing affording protection against the weather) which is intended to be worn or held by a person at work which protects them against one or more risks to their health and safety’.

3.11 Drilling machine



A **drilling machine**, called a drill press, is used to cut holes into or through metal, wood, or other materials.

3.12 Screwdriver machine

Screwdriver machine is apowered equipment, for screwing (installing) and unscrewing (removing) screws.

- Content/Topic 4: Types of materials and their use

4.1 Soldering tin

Soldering is a joining process used to join different types of metals, usually made of ***tin*** and lead which is melted using a hot iron and cooled to create a bond. **Soldering tin is** a **metal** or metallic alloy used when melted to join metallic surfaces especially an alloy of lead and **tin** so used.

Solder is a fusible metal alloy used to create a permanent bond between **metal** workpieces.

4.2 Glue

Glue is a sticky substance used for joining things together, often for repairing broken things.

Adhesive, also known as **glue**, **cement**, **mucilage**, or **paste** is any non metallic substance applied to one or both surfaces of two separate items that binds them together and resists their separation.

4.3 Silicon

Silicone glue is a type of **adhesive** that contains **silicon** and oxygen atoms, making it a good water-resistant solution. It is used in many areas because of its stability, both chemically and

thermally. **Silicone glue** is also resistant to weathering and moisture, unlike many other adhesives.

4.4 Insulator tape

Electrical tape (or **insulating tape**) is a type of pressure-sensitive tape used to insulate electrical wires and other materials that conduct electricity. It can be made of many plastics, but vinyl is most popular, as it stretches well and gives an effective and long lasting insulation.

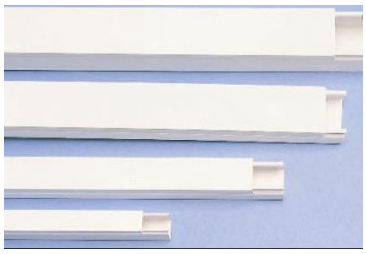
4.5 Screws

A **screw** is a type of fastener, in some ways similar to a bolt typically made of metal, and characterized by a helical ridge, known as a male thread (external thread). Screws are used to fasten materials by digging in and wedging into a material when turned, while the thread cuts grooves in the fastened material that may help pull fastened materials together and prevent pull-out. There are many screws for a variety of materials; those commonly fastened by screws include wood, sheet metal, and plastic.

4.6 Universal anchors

It is a plastic used to put in hole before you insert screw to make sure screw is very ties.

4.7 Trunking



Trunkingis used to protect cables from damage and to hide unsightly cables from view. It can be used in almost any location including homes, hotels and hospitals. Trunking is available in many materials, sizes and forms to suit the location and requirements of the installation.

Trunking is usually square or rectangular in shape, whilst providing easy access to the cable when needed via a hinge or slide system.

4.8 Cables (Coaxial, fiber optics, twisted pair)

Networking cables are networking hardware used to connect one network device to other network devices or to connect two or more computers to share printers, scanners etc. Different types of network cables, such as coaxial cable, optical fiber cable, and twisted pair cables, are used depending on the network's physical layer, topology, and size.

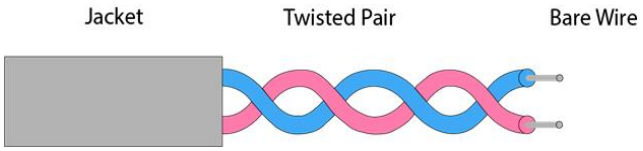
These cables are classified as follow:

a) Twisted pair:

Twisted pair is a physical media made up of a pair of cables twisted with each other. A twisted pair cable is cheap as compared to other transmission media. Installation of the twisted pair cable is easy, and it is a lightweight cable. The frequency range for twisted pair cable is from 0 to 3.5KHz.

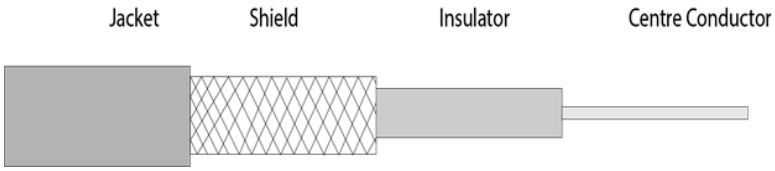
A twisted pair consists of two insulated copper wires arranged in a regular spiral pattern.

The degree of reduction in noise interference is determined by the number of turns per foot. Increasing the number of turns per foot decreases noise interference.



b) Coaxial Cable

- Coaxial cable is very commonly used transmission media, for example, TV wire is usually a coaxial cable.
- The name of the cable is coaxial as it contains two conductors parallel to each other.
- It has a higher frequency as compared to Twisted pair cable.
- The inner conductor of the coaxial cable is made up of copper, and the outer conductor is made up of copper mesh. The middle core is made up of non-conductive cover that separates the inner conductor from the outer conductor.
- The middle core is responsible for the data transferring whereas the copper mesh prevents from the **EMI** (Electromagnetic interference).



Advantages of Coaxial cable:

- The data can be transmitted at high speed.
- It has better shielding as compared to twisted pair cable.
- It provides higher bandwidth.

Disadvantages of Coaxial cable:

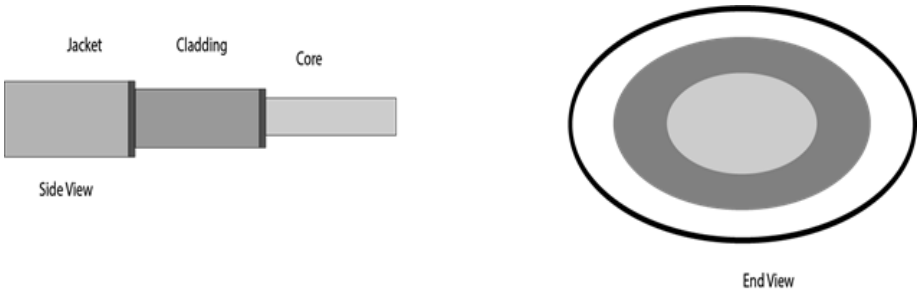
- It is more expensive as compared to twisted pair cable.
- If any fault occurs in the cable causes the failure in the entire network.

c) Fibre Optic

- Fibre optic cable is a cable that uses electrical signals for communication.

- Fibre optic is a cable that holds the optical fibres coated in plastic that are used to send the data by pulses of light.
- The plastic coating protects the optical fibres from heat, cold, electromagnetic interference from other types of wiring.
- Fibre optics provide faster data transmission than copper wires.

Diagrammatic representation of fibre optic cable:



Basic elements of fiber optic cable:

- **Core:** The optical fibre consists of a narrow strand of glass or plastic known as a core. A core is a light transmission area of the fibre. The more the area of the core, the more light will be transmitted into the fibre.
- **Cladding:** The concentric layer of glass is known as cladding. The main functionality of the cladding is to provide the lower refractive index at the core interface as to cause the reflection within the core so that the light waves are transmitted through the fibre.
- **Jacket:** The protective coating consisting of plastic is known as a jacket. The main purpose of a jacket is to preserve the fibre strength, absorb shock and extra fibre protection.

Following are the advantages of fiber optic cable over copper:

- **Greater Bandwidth:** The fiberoptic cable provides more bandwidth as compared copper. Therefore, the fiber optic carries more data as compared to copper cable.
- **Faster speed:**fiber optic cable carries the data in the form of light. This allows the fibre optic cable to carry the signals at a higher speed.
- **Longer distances:** The fiber optic cable carries the data at a longer distance as compared to copper cable.

- **Better reliability:** The fiber optic cable is more reliable than the copper cable as it is immune to any temperature changes while it can cause obstruct in the connectivity of copper cable.
- **Thinner and Sturdier:**fiber optic cable is thinner and lighter in weight so it can withstand more pull pressure than copper cable.

4.9 Flexible pipes

Flexible pipe is characterized by a composite construction of layers of different materials, which allows large amplitude deflections without adverse effects on the pipe. This product may be delivered in one continuous length or joined together with connectors.

It is mainly used in applications where there are particular requirements to accomodate large relative motions, to provide high corrosion resistance, and to reduce installation time and cost.

4.10 Ladder

it is a piece of equipment consisting of a series of bars or steps between two upright lengths of wood, metal, or rope, used for climbing up or down something.

4.11 Connectors(RJ45,BNC,Video balloon)

A connector is a device that joins two pieces of equipment, wire, or piping together.

Some of the connectors used in CCTV camera system installation are:

a) RJ45

RJ45 is a type of connector commonly used for Ethernet networking. The "RJ" in RJ45 stands for "registered jack," since it is a standardized networking interface. The "45" simply refers to the number of the interface standard. Each RJ45 connector has eight pins, which means an RJ45 cable contains eight separate wires.

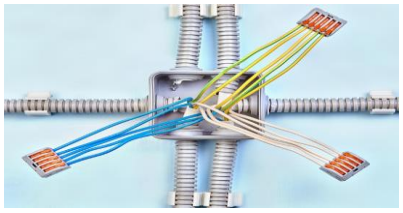
b) BNC connector

The **BNC connector** (initialism of "Bayonet Neill–Concelman") is a miniature quick connect/disconnect radio frequency connector used for coaxial cable.

c) **Video balloon**

A **video balloon** is a wire connector device that allows UTP cable (such as CAT5) to transmit the video signal from CCTV cameras instead of using coaxial cable such as RG59.

4.12 Junction box



It's a standard **electrical box** usually found mounted to the framing of a home or building that contains the connection of two or more circuit **cables** or wires. **Junction boxes** are usually metal or plastic and can range from 2 ½" to 3 ½" deep.

Junction boxes are metal or plastic enclosures used as housings for wiring connections. The connections within are called branch circuits and usually represent the end of a conduit run. Junction boxes make wire access easy, since all one must do is remove the covering to make alterations, repairs, or additions to a conduit. Junction boxes also protect wiring from the elements or environment, which can sometimes be corrosive or otherwise harmful to wiring material.

Finally, junction boxes protect wiring from unwanted tampering, whether malicious or unintentional.

- Content/Topic 5: Difference between tools, materials and equipment

a) **Tool:** a device or implement, especially one held in the hand, used to carry out a particular function.
b) **Material:** the substance or substances of which a thing is made or composed.
c) **Equipment:** the set of articles or physical resources serving to equip a person or thing.

LO 1.4 Prepare the workplace according to the work to be done.

- Content/Topic 1: Arrangement techniques of tools, materials and equipment in the workplace

Organization or arrangement of tools, materials and equipment is one of the keys to an effective workplace. It seems like such a simple thing, but the fact is that when we take the time to organize our workplace, we become more efficient.

One reason for this increase in efficiency is the decrease in "search time" that results from an organized work area.

Planning and organization makes efficient use of your time by keeping you focused from beginning to completion of a project.

Arrangement is an act of arranging; state of being **arranged**. The manner or way in which things are **arranged**.

It is achieved by the following settings:

1. Arrangement by types: the tools, materials and equipment of the same type are put on the same level, this facilitate the user to locate easily the tools, materials and equipment when servicing.

2. Arrangement by manufacturer instruction: this is the setting where the user arrange the tools, materials and equipment suit on the recommendations described by the manufacturer and most of them are written on the catalogue or datasheet.

- Content/Topic 2:Setup of workplace trespassing signs/ notice

To trespass is to illegally enter someone's property or overstep your bounds in another way.

A "No Trespassing" sign means exactly what it suggests: If to trespass is to enter without permission, no trespassing means **Do not enter without permission**.

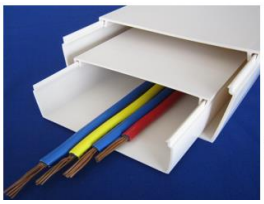
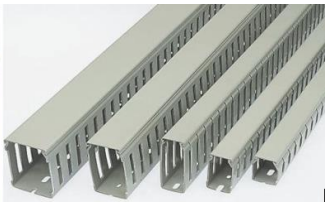
To setup the workshop trespassing signs is to warn or to notice, the customers and other persons who enter in your working place, something they should not do by writings or using signs.

Learning Unit 2 – Fix and connect the devices

LO 2.1 – Fix trunking and cable conduits according to the standards.

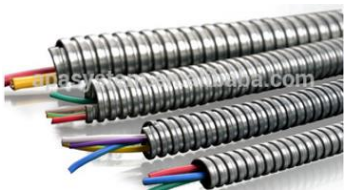
- Content/Topic 1: Definition of cable conduits and cable trunking

1.1 Cable trunking

Cable trunking is an enclosure usually with a rectangular cross section, and with one removable or hinged side, that is used to protect **cables** and provide space for other electrical equipment. They make electrical ducting and **cable trunking** for concealing and securing cabling.

1.2 cable conduit



A **cable conduit** is a tube used to protect and route electrical wiring in a building or structure. Cable conduit may be made of metal, plastic, fiber, or fired clay. Most conduit is rigid, but flexible conduit is used for some purposes.

- Content/Topic 2: Classification of cable conduits and trunking;

The classification of cable conduits and trunkings is made based on the following:

1. Based on size (section)

Size is the magnitude or dimensions of a thing. **Size** can be measured as length, width, height, diameter, perimeter, area. So classify the cable conduit and trunking based size depending on the work to be done.

2. Based on the nature of material (PVC, metallic)

PVC is a plastic material that is used for many purposes, for example to make clothing or shoes or to cover chairs. PVC is an abbreviation for 'polyvinyl chloride'.

The properties depend on the added plasticizer. The flexible forms are used in hosepipes, insulation, shoes, garments, etc. Rigid **PVC** is used for moulded articles.

Metallic materials are inorganic substances, usually combinations of **metallic** elements, such as iron, titanium, aluminum, and gold, which may also contain small amounts of non-**metallic** elements, such as carbon, nitrogen, and oxygen.

So classify the cable conduit and trunking based size depending on the work to be done.

- Content/Topic 3: Techniques for fixing and connecting cables conduits and trunking

1. Planning the route of the cables conduits and trunking

Route is the way between two places along which cable conduits and trunking travel.

Plan for a way for travel or movement, the path from point A to point B, where conduits and trunk should be fixed.

2. Measurement of trunking and cables length

A measurement is the action of measuring something, or some amount of stuff. So it is important to measure certain things like distance or length specified for trunking, conduits and cables.

3. Cutting cable conduits and trunking

Cutting is the action of *cut* off a piece from the main part of cable conduits and trunking which will fit to the length measured**.**

4. Joining cable conduits and trunking

Joining is the way of connecting two things order to produce something new. This is done to connect cable conduits and trunking to make them to have a good finishing and a good outlook.

This is performed using the following joints:

- ✓ Straight joint,
- ✓ ‘T’ joint,
- ✓ ‘L’ joint(450),
- ✓ ‘L’ joint straight,
- ✓ Through joint

5. Bending cable conduits and trunking

Bending is to force (an object, especially a long or thin one) from a straight form into a curved or angular one. This is done to facilitate the joining process of cable conduits and trunking.

6. Drilling and fixing of cable conduits and trunking

Drillingis the process of cutting holes in a solid material using a rotating cutting tool whereas fixing is the action of fastening something in place. This is done to fix the cable conduit and trunking in the planned route.

LO 2.2 – Fix and mount Camera according to manufacturer’s catalog.

- Content/Topic 1: Types of Camera and their use

The CCTV Cameras are mainly classified in the following two types:

1. Analog CCTV Camera

Analog security cameras are standard definition cameras also commonly referred to as CCTV cameras in the past. These cameras record in D1 or 960H resolution on a cctv security DVR. In case you are only looking for a camera to view on a monitor, these analog cameras produce video through the BNC video output that can also be displayed on a regular TV without the need for a DVR.

2. IP CCTV Camera

An Internet Protocol camera, or IP camera, is a type of digital video camera that receives control data and sends image data via an IP network. They are commonly used for surveillance but unlike analog closed-circuit television (CCTV) cameras, they require no local recording device, only a local area network. Most IP cameras are webcams, but the term IP camera or

netcam usually applies only to those that can be directly accessed over a network connection, usually used for surveillance.

Some IP cameras require support of a central network video recorder (NVR) to handle the recording, video and alarm management. Others are able to operate in a decentralized manner with no NVR needed, as the camera is able to record directly to any local or remote storage media.

- Content/Topic 2: Steps of fixing and mounting the camera:

To fix and mount the CCTV camera, flow the following steps:

1) **Fixing the stand**

Stand is a physical structure fixed on a wall or ceiling but may require different hardware for each application. Plan where to place the camera stand at the desired place, make guide marks for drilling, drill holes and hammer in the screw mouldings. Now, screw the camera stand in place firmly.

2) **Mounting the camera**

Place the camera unit at the desired place, make guide marks for drilling. Drill holes and hammer in the screw mouldings. Now, screw the camera in place firmly. Insert the power cable of the camera in a socket.

A camera can be mounted to a physical structure such as a wall or ceiling but may require different hardware for each application. Cameras come in many shapes and sizes and the mounting method can vary depending on the application and performance requirements.

Special mounting hardware is often required to match the styles and aesthetics of the exterior structures' existing trim elements. The mount/bracket should accommodate the weight of the camera and housing. If using the camera outside, plastic fixtures should be avoided because of their tendency to deteriorate and become brittle when exposed to sunlight. In addition, brackets should be selected that allow for easy repositioning either with knobs or adjustable arms.

The camera mounts are classified in two classes:

a) Indoor mounting which are:

- Wall Mounts
- Pendant Mounts
- Corner Mounts
- Indoor Dome Camera Mounts

b) Outdoor Camera Mounts which are:

- Pole Mounts
- Corner Mounts

3) Positioning the camera to the desired angle

You should be able to swivel the camera on the stand for surveillance, but you can always move the rig to a more convenient spot. Before you take video, look through CCTV camera tester to check that the lens is angled exactly how you want it. Make sure that the stand is level and stable when you positioning the camera.

LO 2.3 – Connect cameras and controller devices according to CCTV camera system installation standards

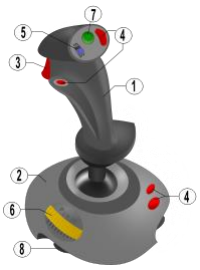
- Content/Topic 1: Types of controllers devices:

CCTV camera controller devices are:

a) 3D joystick

A joystick is an input device consisting of a stick that pivots on a base and reports its angle or direction to the device it is controlling. A joystick, also known as the control column, is the principal control device in the cockpit of many civilian and military aircraft, either as a center stick or side-stick. It often has supplementary switches to control various aspects of the aircraft's flight.

Joysticks are often used to control CCTV camera, and usually have one or more push-buttons whose state can also be read by the computer.



3D joystick elements: **1.** stick, **2.** base, **3.** trigger, **4.** extra buttons, **5.** autofire switch, **6.** throttle, **7.** hat switch (POV hat), **8.** suction cup.

b) Joystick for NVR

A **joystick** is mechanical device consisting of a handgrip mounted on a base or pedestal and typically having one or more buttons, used to control an NVR, computer or other equipment.

Joysticks consist of a base and a stick that can be moved in any direction. The stick can be moved slowly or quickly and in different amounts. Some joysticks have sticks that can also be rotated to the left or right. Because of the flexible movements a joystick allows, it can provide much greater control than the keys on a keyboard.

Joysticks typically include several buttons as well. Most joysticks have at least one button on the top of the stick and another button in the front of the stick for the trigger. Many joysticks also include other buttons on the base that can be pressed using the hand that is not guiding the stick. Joysticks typically connect to your computer using a basic USB or serial port connection and often come with software that allows you to assign the function of each button.

c) Joystick for IP Camera

CCTV Camera World has simplified the configuration and setup for controlling HDCVI and IP PTZ cameras. Using a network PTZ joystick controller, you can control PTZ cameras by simply connecting the controller to a security video recorder with a single network cable. This provides hands-on control over your PTZ camera with a setup that takes only minutes to complete.

d) NVR keyboard controller

NVR keyboard controller is hardware which connects a keyboard controller to the main to the NVR. NVR controllers and keyboards, suitable for controlling PTZ cameras. Cameras can also be controlled via compatible DVR and NVRs.

e) Precision camera controller

Designed to **control** up to seven PTZ **cameras**, the **Precision Camera Controller** can be used as a stand- alone device or in conjunction with a variety of video switchers or mixers on the market today. The **control** surface gives system users real-time knobs and buttons to **control** functions.

f) LED display 3D IP keyboard controller

Device enables quick access to the main functions, such as camera zoom and convenient 3D joystick control. Allows to control the most of camera models at direct mode (presets, routes, vectors control, etc.).

It is also possible to control many DVRs from one keyboard.

This network control keyboard is a powerful three-dimensional with multi-function, Easy to operate, no need to make any setting, plug and play; powerful hardware decoding capabilities, the first to achieve industry IP dome unlimited access for large safe City projects, support 5.0 "LED LCD HD real-time display; Support HDMI output to achieve the main console screen and control equipment screen salvo (comes matrix switching function), reducing installation costs!

LED display 3D IP keyboard controller features:

- Supports Tour, 360 Scan and A-B Scan and so on function
- To support ONVIF2.4,not limit for back-end PTZ, easy to realize PTZ tour, A-B scan, pattern, play and plug, without any set, automatically add and allocate IP address by keyboard
- Standard equipped with dimensional control, 1-64 grade speed limit, precise position, control sensitively
- To support USB,HDMI interface output, can be realize main screen picture any switch on control board
- To support 5.0”HD LED , real display image on control device
- Support network control model, unique IP address
- Supports auto-search for ONVIF devices in LAN

- Content/Topic 2: Connection steps of analog camera

The steps to connect an analogue camera are as follows:

1) Connection of analog camera and Monitor to DVR/iDVR
2) Connection of DVR/iDVR, Camera, and monitor to UPS
3) Connection of UPS to the power source.
4) Supplying power to the system

- Content /Topic3: Connection of IP camera

Flow the following steps while connecting an IP camera:

1) Connection of IP camera, Monitor and controller devices to NVR

2) Connection of NVR, Camera, and monitor to UPS
3) Connection of UPS to the power source.
4) Supplying power to the system

Learning Unit 3 – Configure, test the system and handover the work done.

LO 3.1 – Configure the CCTV camera system according to the manufacturer's instructions.

- Content/Topic 1: Configuration of DVR/NVR and Switch/Access point

A configuration of a system refers to the arrangement of each of its functional units, according to their nature, number and chief characteristics. Often, configuration pertains to the choice of hardware, software, firmware, and documentation

When you install a new device or program, you sometimes need to configure it, which means to set various switches and jumpers (for hardware) and to define values of parameters (for software).

When configuring the DVR/NVR and switch/access point, flow these steps:

1) **Connection of NVR/DVR to the network**

To connect a DVR/NVR to the internet or configure a DVR/NVR for remote viewing, first and foremost, connect your DVR/NVR to your network router either via Ethernet cable or wirelessly.
Connect the NVR and a monitor or TV via a VGA or HDMI cable. Make sure the monitor or TV is connected via the correct input (e.g. VGA, HDMI 1, HDMI 2, etc.)

Note that users must add the cameras to the NVR/DVR to view the cameras and enable recording.

2) **Assigning IP to the NVR/DVR**

Most of the NVRs from CCTV Camera World utilize plug-and-play IP camera technology by offering built-in PoE ports. This allows a user to connect an IP camera to a NVR using only a single network cable.

3) **Setting up the port to the switch/Access point**

Switch ports can be manually configured with specific duplex and speed **settings**. Use the duplex interface **configuration** mode command to manually specify the duplex mode for a **switch port**. Use the speed interface **configuration** mode command to manually specify the speed for a **switch port**.

4) **Setting up the DNS account**

DNS stands for "Domain Name System". It's a system that lets you connect to websites by matching human-readable domain names (like wpbeginner.com) with the unique ID of the server where a website is stored.

5) **Configuration by following the instructions**

Configuration refers to how its components are arranged, and how its options are set. So set how DVR/NVR and Switch will work according to the settings.

LO 3.2 – Test the CCTV camera system according to the testing techniques.

- Content/Topic 1: Testing the functionality of CCTV camera

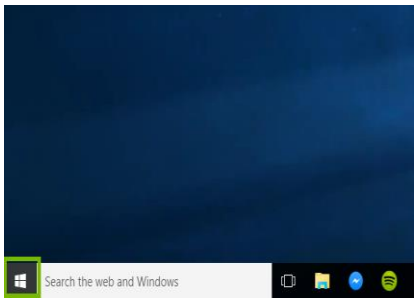
For testing the functionality of CCTV camera, check the following staffs:

1) **Checking of the network availability**

Network availability is the amount of uptime in a **network** system over a specific time interval. Uptime refers to the amount of time a **network** is fully operational. **Network availability** is measured as a percentage and is monitored to ensure the service being provided is consistently kept running for end-users.

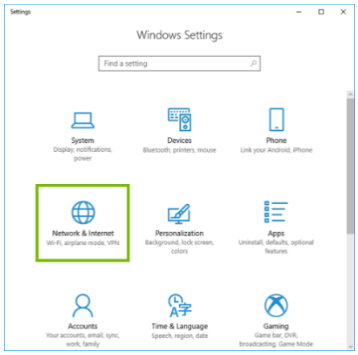
Steps to check the network availability:

1. Select the **Start** button.

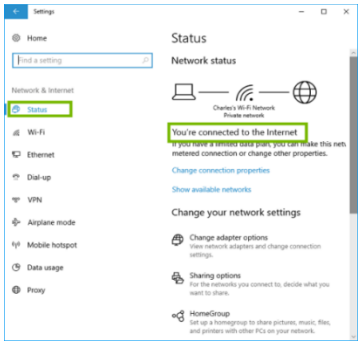


2. Select **Settings**.

3. Select **Network & Internet**.



4. Select **Status**. Your current connection status will be displayed on the right side of the screen.



2) **Scanning the available of the camera on the monitor**

Scanning is quickly looking over a vast area at all parts of something. When your eyes dart over a whole crowd in a room, this is an example of a situation where you are **scanning** the crowd.

Look the availability of camera on the screen. The screen is sprit into different parts depending on the number of camera connected into the system.

3) **Checking the quality of image**

Image quality can refer to the level of accuracy in which different imaging systems capture, process, store, and compress, transmit and display the signals that form an image.

Camera resolution is defined as the amount of detail that a **CCTV camera** can capture. **Resolution** is measured in pixels. A higher number of pixels, means more detail and larger images without blur or being grainy. **Resolutions** are measured in Megapixels, which is just over one million pixels, 1,048,576 to be precise.

To **check a photo's resolution**, flow these steps:

a) Select the file you want to use.
b) Right-click on the **image** and then select "Properties."
c) A window will appear with the **image's** details.
d) Go to the "Details" tab to see the **image's** dimensions and **resolution**.

4) **Checking the auto recording and video saving**

Automatic recording is an option that allows the host to start local **recording** or cloud **recording** automatically when the event starts.

Steps to be followed:

a) Double click the **camera** device you want to **view** into full screen and message box appear,
b) Right click on “Main Menu” and enter the password,
c) Click record control,
d) Click all or click any particular channel you want to record,
e) Click “Ok”

LO 3.3 – Clean the working area according to the cleaning techniques

- Content/Topic 1: Tools, materials and equipment used to clean the workplace

1. Vacuum cleaner

It is an electrical apparatus that by means of suction collects dust and small particles from floors and other surfaces.

2. Lags or cotton waste

These are the scraps of waste cotton yarn, used typically to clean machinery.

3. Cleaning solutions

Cleaning agents are substances used to remove dirt, including dust, stains, bad smells, and clutter on surfaces. Purposes of cleaning agents include health, beauty, removing offensive odor, and avoiding the spread of dirt and contaminants to oneself and others.

4. **Brush**

Cleaning brushes is something bristles, wire or other filaments. It generally consists of a handle or block to which filaments are affixed in either a parallel or perpendicular orientation, depending on the way the brush is to be gripped during use.

Brush (countable and uncountable, plural brushes) An implement consisting of multiple more or less flexible bristles or other filaments attached to a handle, used for any of various purposes including cleaning, painting, and arranging hair.

- Content/Topic 2: Collection and arrangement of tools and equipment

Collection is the accumulation of tools and equipment in their correct location, especially for storage or as a result of some process after work.

Arrangement of tools and equipment is to move and organize tools and equipment into a particular order or position to avoid the disorder in the working place.

- Content/Topic 3: Arrangement of non-used materials (consumables)

Consumables are products that consumers use recurrently, i.e., items which "get used up" or discarded. For example **consumable** office supplies are such products as paper, pens, file folders, Post-it notes, and toner or ink cartridges.

- Content/Topic 4: Cleaning of working area

Cleaning is the most important and primary aspect of **workshop**. It is a process of removing dirt, dust and grime by using **methods** such as dusting, shaking, sweeping, mopping, **washing** or polishing.

- **Cleaning techniques**

The following are the cleaning techniques used while cleaning the working place:

a) **Blowing:** cleaning using blower/blowing air on surface remove dirty,
b) **Brushing:** remove (dust or dirt) by sweeping or scrubbing
c) **Toweling:** wipe or dry with a towel.

Towel an absorbent cloth or paper for wiping and drying something wet, as one for the hands, face, or body after washing or bathing.

- **Tools used in cleaning**

Here are the best cleaning tools you need to have in your workplace today:

1) Broom, dustpan and mop,
2) Scrub brush,
3) Spray bottle,
4) Microfiber cleaning cloths,
5) Vacuum cleaner.

- Content/Topic 5: Waste materials management

Waste (or **wastes**) are unwanted or unusable materials. Waste is any substance which is discarded after primary use, or is worthless, defective and of no use. A by-product by contrast is a joint product of relatively minor economic value. A waste product may become a by-product, joint product or resource through an invention that raises a waste product's value above zero.

Types of waste materials

a) Recyclable waste

Recycling is the process of converting waste materials into new materials and objects. The recyclability of a material depends on its ability to reacquire the properties it had in its virgin or original state.

Recyclable rubbish includes all waste items that can be converted into products that can be used again. Solid items such as paper, metals, furniture and organic waste can all be recycled.

b) Bio-degradable waste

A biodegradable material can be defined as a material which can be decomposed by bacteria or other natural organisms and not be adding to pollution.

Biodegradable wastes are such waste materials which are and can be degraded by natural factors like microbes (e.g. bacteria, fungi and few more), abiotic elements like temperature, UV, oxygen, etc. Some examples of such wastes are food materials, kitchen wastes, and other natural wastes. Microorganisms and other abiotic factors together break down complex substances into simpler organic matters which eventually suspend and fade into the soil. The whole process is natural which can be rapid or slow. Therefore the environmental issues and risks caused by biodegradable wastes are low.

Biodegradable waste is a type of waste, typically originating from plant or animal sources, which may be degraded by other living organisms.

Biodegradable waste can be commonly found in municipal solid waste as green waste, food waste, paper waste, and biodegradable plastics. Other biodegradable wastes include human waste, manure, sewage, slaughterhouse waste.

c) Non-bio-degradable waste

Non-biodegradable substances are materials which do not degrade easily. As they are synthesized and do not occur naturally, degradation is impossible with these products. Therefore, when they stay in the ecosystem for a long period and do not decompose, they harm our environment.

For instance, plastics, chemicals, rubber, paints, batteries, metals and all fall in this category. The drawback is that in place of returning to the environment, they transform into solid waste which poses a great threat to the environment and health. This does not make it eco-friendly and we must avoid using it at all costs.

3 Treatment of waste materials

Waste treatment refers to the activities required to ensure that waste has the least practicable impact on the environment.

Whether it is biodegradable or non-biodegradable, they harm human life and ruin other organisms and their environment. Thus, a proper treatment of wastes has to be done. This is not only the responsibility of Government, and each can contribute. The three Rs- Recycle, Reuse, and Reduce are simplest steps which can take by each person. This can save energy and other resources as well. Another step is separate biodegradable from non-biodegradable at home and disposes of them separately.

Hazardous waste can be treated by chemical, thermal, biological, and physical methods. Chemical methods include ion exchange, precipitation, oxidation and reduction, and neutralization.

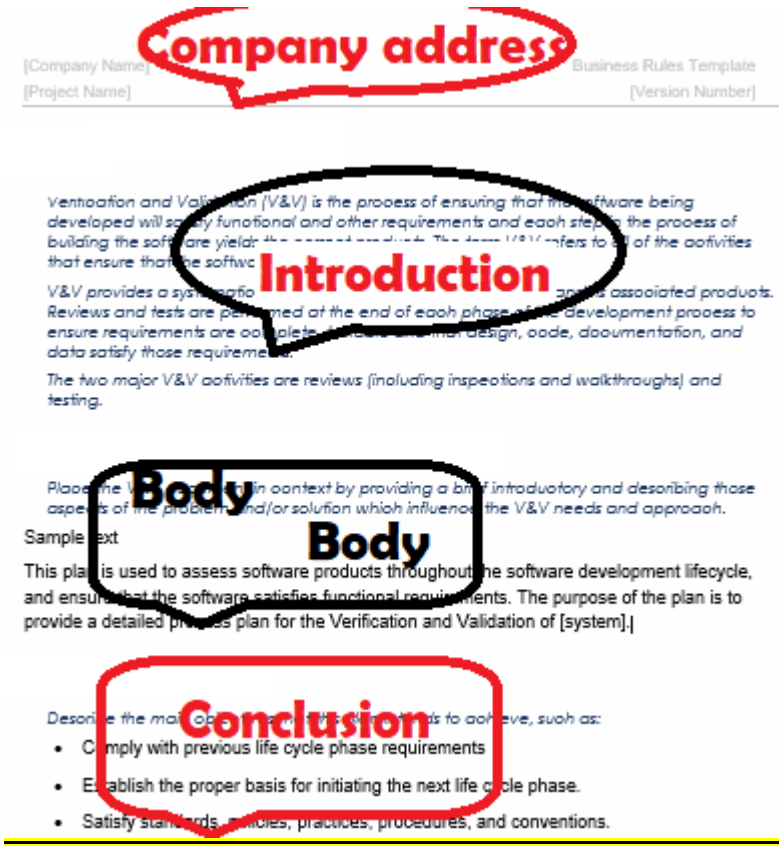
LO 3.4 – Elaborate the installation report according to reporting techniques

- Content/Topic 1: Elaboration of the installation report

Elaboration is the process of developing or presenting a theory, policy, or system in further detail.

An installation report is a document that describes in detail the correct installation procedures. This can involve a machine, a device or an appliance. When you write an installation report, it must be kept organized and detailed. While there is no proper format required for an installation report, you should include the basic installation steps, safety concerns and installation checklists sections to help the reader understand what the installation requires and why. Organize the sections in the order they are needed, so give an introduction of the device being installed and the safety precautions before the installation process.

- Content/Topic 2: Format of the installation report



The installation report should be have the following information:

a) **Business full address:** is the official location of a company's premises. It could be anything from someone's home **address** right up to a multi-million-pound campus, such as those big tech companies favour and everything in between.

b) **Introduction:** is a beginning section which states the purpose and goals of the following writing. This is generally followed by the body and conclusion. The introduction typically describes the scope of the document and gives the brief explanation or summary of the document.

c) **Body of your report:** is a detailed discussion of your work for those readers who want to know in some depth and completeness what was done. The **body** of the **report** shows what was done, how it was done, what the results were, and what conclusions and recommendations can be drawn.

d) **Conclusion/recommendation/way forward:** The conclusion enables you to reinforce the main messages of the document. A conclusion summarizes the report as a whole, drawing inferences from the entire process about what has been found, or decided, and the impact of those findings or decisions.

The Conclusions section sums up the key points of your discussion, the essential features of your design, or the significant outcomes of your investigation.

LO 3.5 – Provide the invoice according to the work done

- Content/Topic 1: Types invoices

  - **Definition of invoice**

An **invoice** is a document issued by a seller to the buyer that indicates the quantities and costs of the products or services provider by the seller. Payment terms indicate the maximum amount of time that a buyer has to pay for the goods and/or services that they have purchased from the seller.

  - **Types of invoice**

Typical types of invoice are as follow:

1) Proforma invoice
2) Invoice

- Content/Topic 2: Difference between invoice and proforma invoice.

1. Proforma invoice

A pro forma invoice is an estimated invoice that a business sends to a client before providing their services. A pro forma invoice provides the client with an estimated cost of the work to be completed. Pro forma invoices may have to be altered once a project is complete to accurately reflect the hours worked.

Pro-forma invoice can be simply termed as an invoice that gives a rough idea to the buyer about the cost of products and services.

Pro-forma invoice is basically referred as estimation or a quote.

This billing method is sometimes used as a seller's declaration stating his commitment to deliver certain goods or services at the estimated price.

It can also be an advance payment against the estimated project amount. Since it is not a true invoice format, it is neither recorded as account receivable nor account payable.

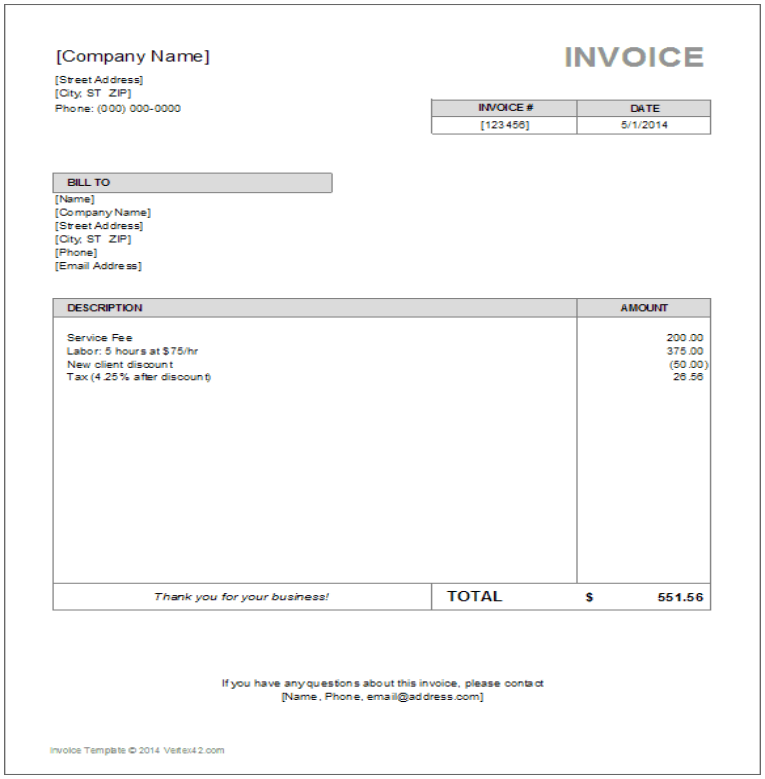
2. Invoice

A standard invoice is issued by a business and submitted to a client. This is the most common form of invoice that small businesses create and the format is flexible enough to fit most industries and billing cycles. Standard invoices include the following details about the sale:

- The business's name and contact information
- The client's name and contact information
- An invoice number
- The amount of money the client owes the business for its services

- Content/Topic 3: Elaboration of invoice /Pro-forma

3.1 Format of the invoice



[Company Name]
[Street Address]
[City, ST ZIP]
Phone: (000) 000-0000

INVOICE

INVOICE #	DATE
[123456]	5/1/2014

BILL TO
[Name]
[Company Name]
[Street Address]
[City, ST ZIP]
[Phone]
[Email Address]

DESCRIPTION	AMOUNT
Service Fee	200.00
Labor: 5 hours at $75/hr	375.00
New client discount	(50.00)
Tax (4.25% after discount)	26.56

Thank you for your business!	TOTAL	$	551.56

If you have any questions about this invoice, please contact
[Name, Phone, email@address.com]

Invoice Template © 2014 Vertex42.com

An invoice may include the following information's:

1) Business name,
2) TIN number of the company,
3) Company name and address,
4) Customer bank account,
5) Item number,
6) Item name,
7) Item specification,
8) Item quantity,
9) Item unit price,
10) Item total price and
11) Total amount due

LO 3.6 – Suggest the maintenance contract according to manufacturer instructions.

A **maintenance contract**, defined as the contract between 2 parties which creates the agreement that one party will maintain an asset owned by another party, is common across many industries/fields.

A maintenance contract, explained as an agreement which supports many service businesses, is simply an agreement to maintain something.

Contracts are legal agreements between two parties or more. Legally binding contracts must have essential elements in order to be enforced in court. Some contracts that are missing one or two of these essentials will still hold up in a court, but it's best to have them all covered.

Contract Classification

Usually, the types of contracts you'll come across in the business world are classified as simple contracts. These can be made:

- In writing
- Verbally
- With action

- Content/Topic 1: Manufacture's recommended maintenance activities for different types of CCTV camera system.

The technical **meaning** of **maintenance** involves functional checks, servicing, repairing or replacing of necessary devices, equipment, machinery, and supporting utilities in industrial, business, governmental, and residential installations.

- Content/Topic 2: Suggestion/negotiation of the maintenance contract based on manufacturer's recommendations.

A negotiation is a strategic discussion that resolves an issue in a way that both parties mentioned in the contract find acceptable. In a negotiation, each party tries to persuade the other to agree with his or her point of view. By negotiating, all involved parties try to avoid arguing but agree to reach some form of compromise.

Parties involved in negotiations can vary. They can include talks between buyers and sellers, an employer and prospective employee, or between the governments of two or more countries.

- Content/Topic 3: Elaboration of maintenance contract.

A **maintenance contract**, defined as the **contract** between 2 parties which creates the agreement that one party will maintain an asset owned by another party, is common across many industries. **Maintenance contracts** can exist for equipment, a building, landscape, computers and other information technologies, and more.

Elements of the contract

The maintenance contract should have the following information's:

1) **Obligation agreements of both parties:** are those duties that each party is legally responsible for in a **contract** agreement. In a **contract**, each party exchanges something of value, whether it be a product, services, money, etc. On both sides of the agreement, each party has various **obligations** in connected with this exchange.
2) **Job description:**a description of the goods and/or services that your business will receive or provide, including key deliverables

It is a written narrative that describes the general tasks, or other related **duties**, and **responsibilities** of a position.

3) **Job timeframe**: a period of days, weeks, months, etc. within which an activity is intended to happen.
4) **Allocation of risks**: refers to contract provisions that determine which party assumes the **risk** of certain events occurring (or failing to occur).
5) **Insurance**: required insurance and indemnity provisions
6) **Price review and adjustments when amendments is required: renegotiation** or renewal options
7) **Full contact of contracting parties**
8) **Stamps and signature of contracting parties**
9) **Termination of contract:** ending the **contract** before both parties have fulfilled their obligations under the terms of the **contract**.

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