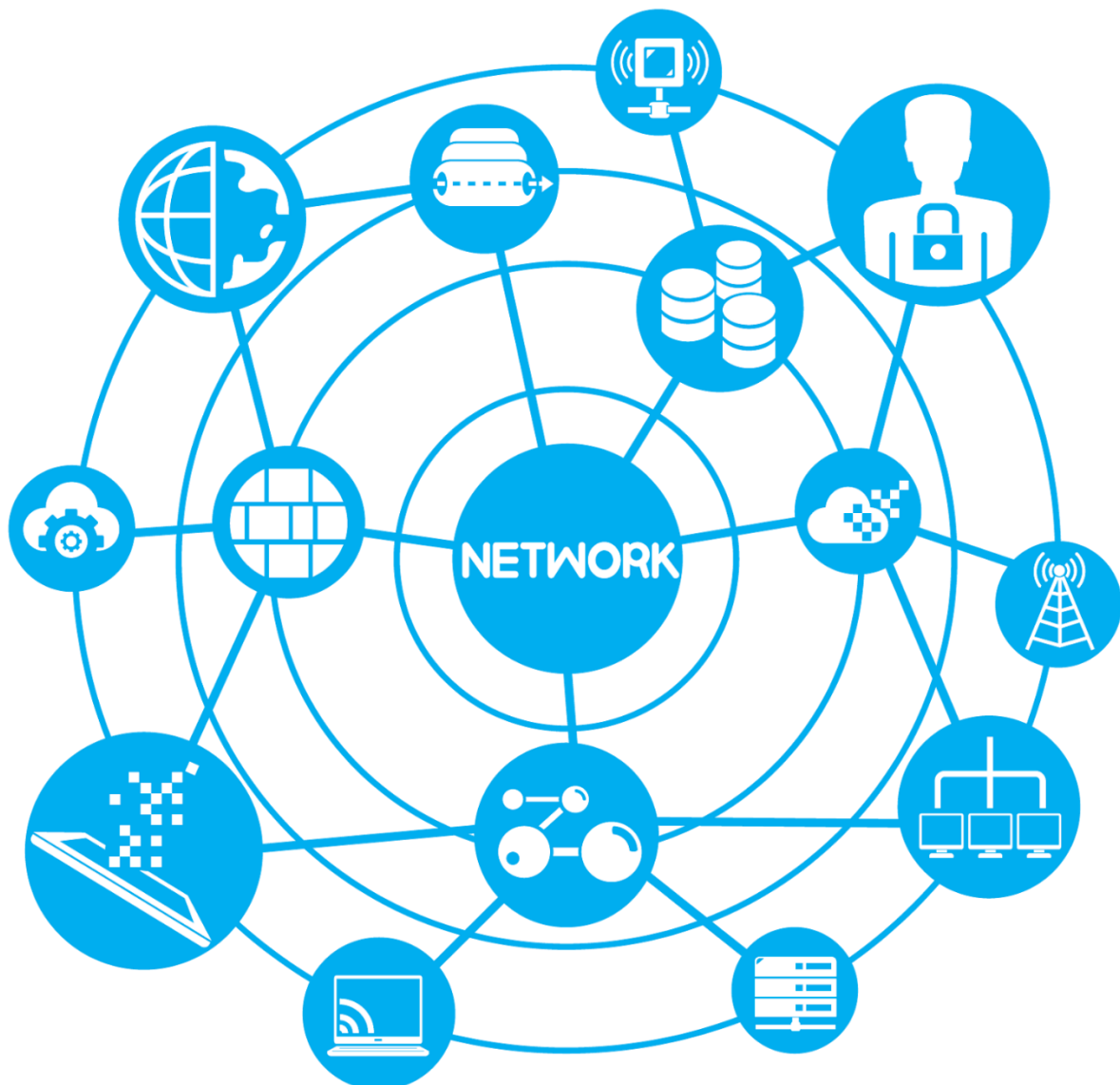


# ICA 2 – Network Design + Implementation in Packet Tracer

By Bipul Bhatta



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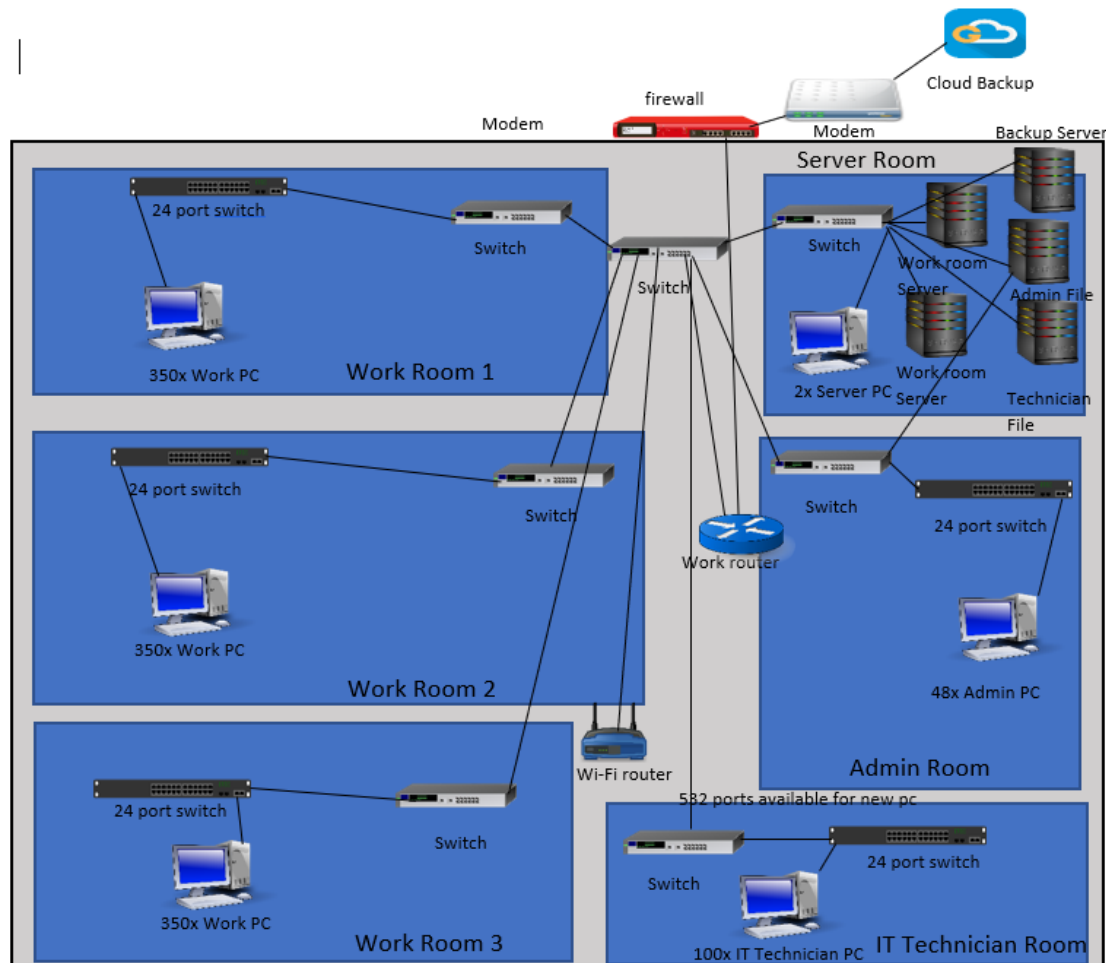
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## Intro:

In this document we are going to design and implement network for a trading floor support centre that employs 1200 staffs. They want to move into a new building, but it has no network. New network need to be designed and implemented taking care of the existing network from old building.

## Network design + Implementation

Here is my design:

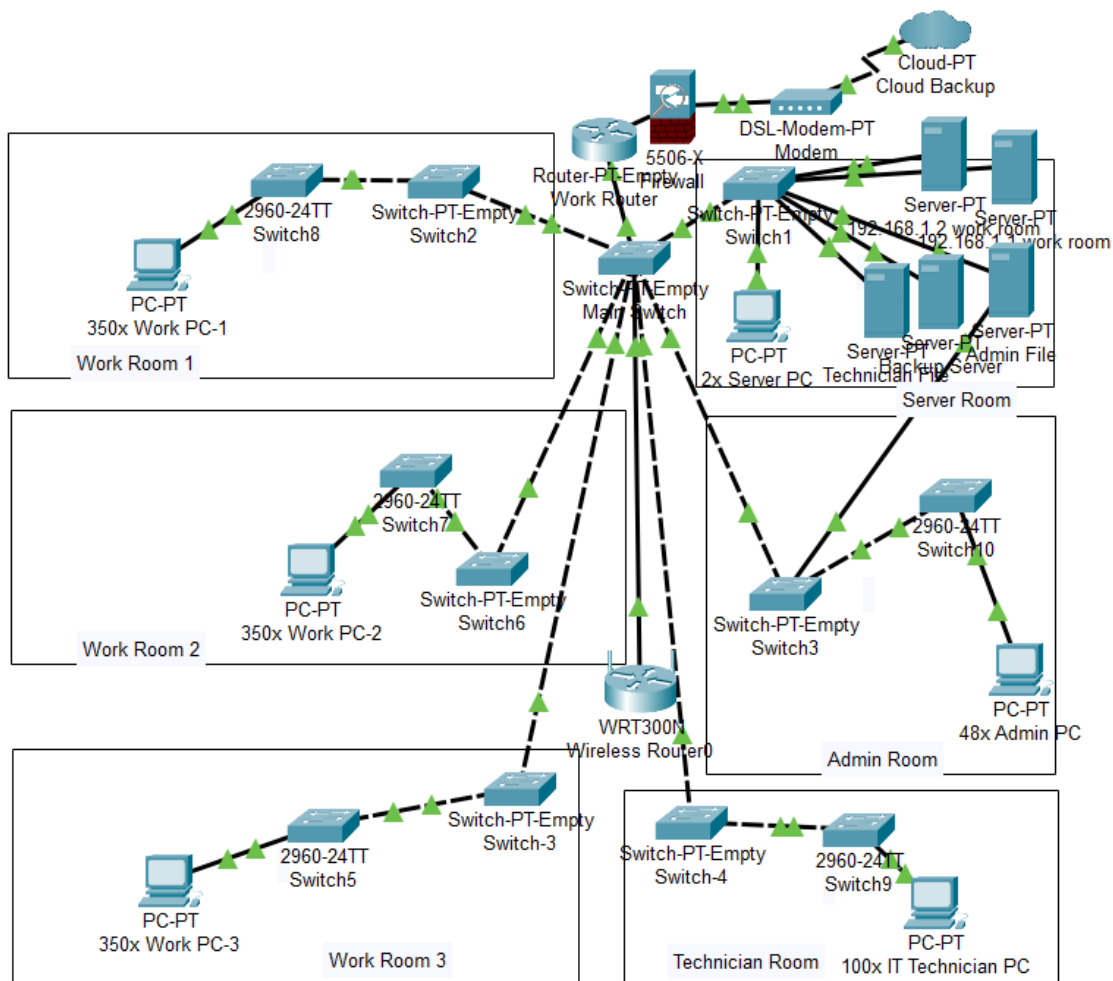


**Fig: Network Design of Trading Floor Support Centre**

In my design I tried not to make too much of mess with wire but used gigabit ethernet cable from firewall to 24 port switch and fast ethernet cable from 24 port switch to pcs. There are 3 room for employees to work on which consists of where there are 1050 pc. There is also manager/technician room where there are 100 pcs. There is also admin room where there are 48 pc. And in server room there are 5 servers of which 1 is backup server and 4 are active server and there are two pcs in server room. All pcs are connected by newest

available 24 port switch which is connected to switch which is connected to switch which I call main switch and main switch is connected to router which goes to firewall and modem and to cloud Backup. For making it futureproof there are extra port available from main switch where we can have 246 ports for new work pc, 116 new ports for manager/technician pc and 168 ports for admin pc and you can add couple of server pc directly from the switch too. The design is made in a way that cost is kept minimum with fast network with latest technology and it be futureproof for at least 5 years and network is available from 8 am to 6pm which is the office hour.

Here is given the implementation of network in cisco packet tracer:



**Fig Network Implementation on Cisco Packet Tracer**

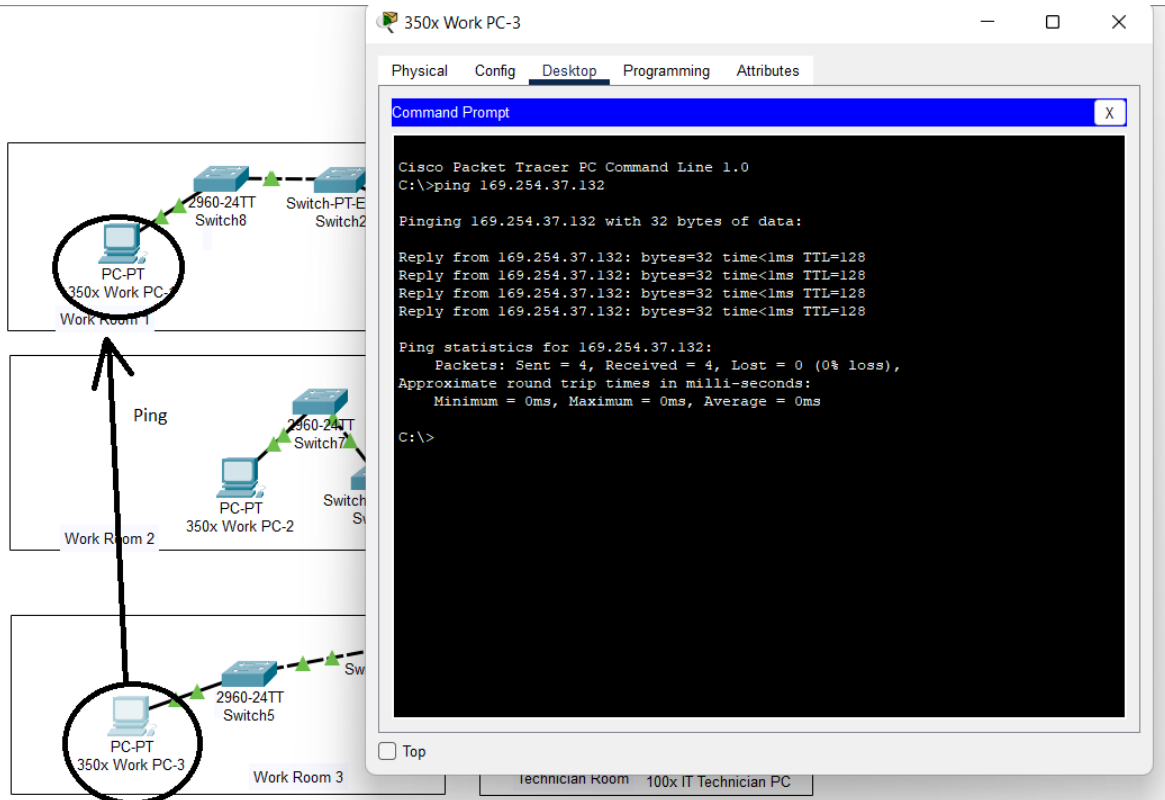
#### Description:

In the first figure network is designed on word document. It is a rough estimate of how our network will be for the trading floor support centre. Then, on second figure the design is implemented on cisco packet tracer.

#### Screenshot of Ping:

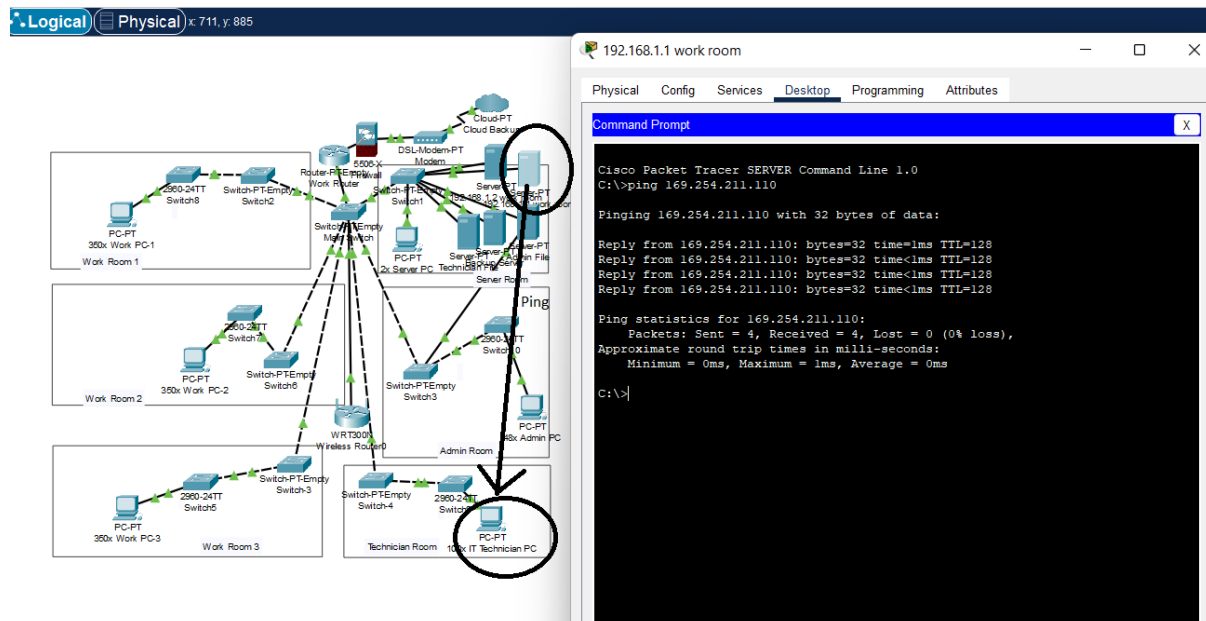
In this part we will be pinging some computer and server with each other to see if the network works:

Screenshot 1:



This is the result we got by pinging 350x work pc 1 from 350x work pc3.

Screenshot 2:



This is the result we got by pinging 100x technician/manager pc from 192.168.1.1 server.

Screenshot 3:

The screenshot shows a network diagram on the left and a command prompt window on the right. The network diagram includes various devices like switches, routers, and PCs connected in a hierarchical structure. A red circle highlights 350x Work PC-2, and a red arrow points from it to the command prompt. The command prompt window shows the output of a ping command from 350x Work PC-2 to 169.254.16.114.

```

Cisco Packet Tracer PC Command Line 1.0
C:\>ping 169.254.16.114

Pinging 169.254.16.114 with 32 bytes of data:

Reply from 169.254.16.114: bytes=32 time=1ms TTL=128
Reply from 169.254.16.114: bytes=32 time=1ms TTL=128
Reply from 169.254.16.114: bytes=32 time=1ms TTL=128
Reply from 169.254.16.114: bytes=32 time=1ms TTL=128

Ping statistics for 169.254.16.114:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\>
  
```

This is the result we got by pinging Admin file from 350x pc 2.

Screenshot 4:

The screenshot shows the same network diagram as Screenshot 3, but with a red circle highlighting 48x Admin PC and a red arrow pointing from it to the command prompt. The command prompt window shows the output of a ping command from 48x Admin PC to 169.254.37.132.

```

Cisco Packet Tracer PC Command Line 1.0
C:\>ping 169.254.37.132

Pinging 169.254.37.132 with 32 bytes of data:

Reply from 169.254.37.132: bytes=32 time=1ms TTL=128
Reply from 169.254.37.132: bytes=32 time=1ms TTL=128
Reply from 169.254.37.132: bytes=32 time=1ms TTL=128
Reply from 169.254.37.132: bytes=32 time=1ms TTL=128

Ping statistics for 169.254.37.132:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\>
  
```

This is the result we got by ping 350x pc 1 from 48x Admin pc.

Screenshot 5:

The screenshot shows a network diagram on the left and a command prompt window on the right. The network diagram includes various devices like switches, routers, and servers. A red circle highlights a 'Server-PT Backup Serv' in the 'Server Room'. The command prompt window shows the following output:

```

Cisco Packet Tracer SERVER Command Line 1.0
C:\>ping 169.254.220.6

Pinging 169.254.220.6 with 32 bytes of data:

Reply from 169.254.220.6: bytes=32 time<1ms TTL=128
Reply from 169.254.220.6: bytes=32 time<1ms TTL=128
Reply from 169.254.220.6: bytes=32 time<1ms TTL=128
Reply from 169.254.220.6: bytes=32 time<1ms TTL=128

Ping statistics for 169.254.220.6:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\>

```

This is the result we got by pinging backup server from technician/manager file.

Screenshot 6:

The screenshot shows the same network diagram as in Screenshot 5, but with a red circle highlighting a 'PC-PT 350x Work PC-3' in 'Work Room 3'. The command prompt window shows the following output:

```

Cisco Packet Tracer PC Command Line 1.0
C:\>ping 169.254.221.104

Pinging 169.254.221.104 with 32 bytes of data:

Reply from 169.254.221.104: bytes=32 time<1ms TTL=128
Reply from 169.254.221.104: bytes=32 time<1ms TTL=128
Reply from 169.254.221.104: bytes=32 time<1ms TTL=128
Reply from 169.254.221.104: bytes=32 time<1ms TTL=128

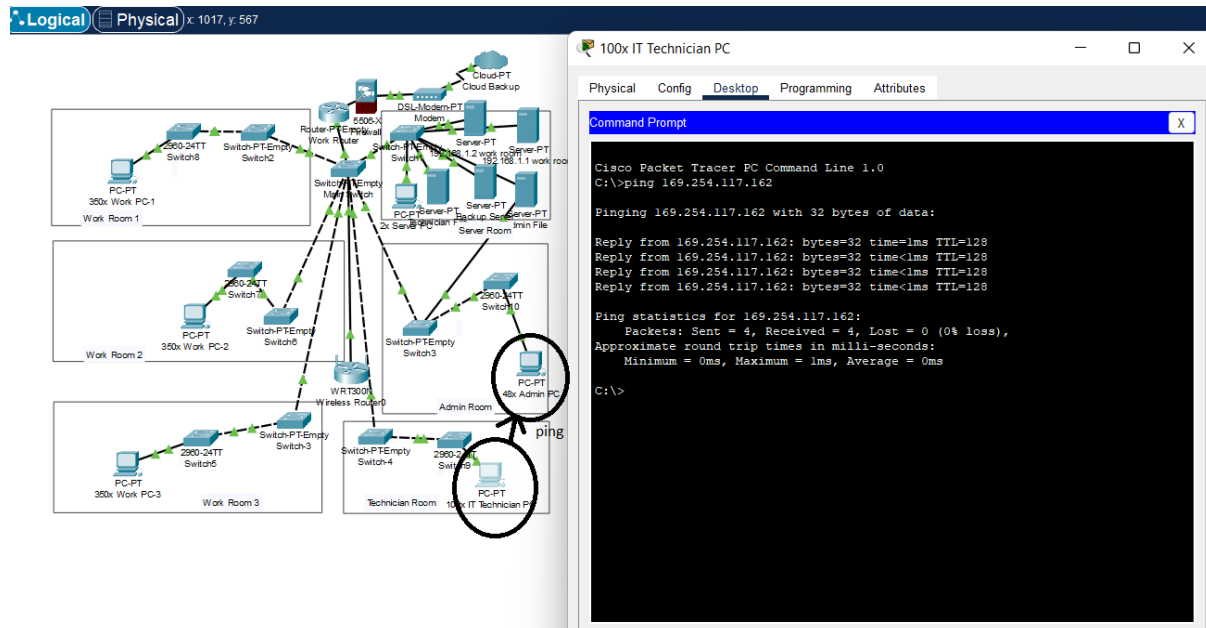
Ping statistics for 169.254.221.104:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\>

```

This is the result we got by pinging 350x work pc from 2x server pc.



Screenshot 7:



This is the result we got by pinging 48x work pc from 100x technician/manager pc.

### Subnet:

Subnetting basically means dividing computer into groups of network by identifying them by a unique code given to them known as ip address. It is classified into class A, class B and class C. Using subnet in our network can greatly reduce the network traffic and make the internet faster.

In our network we have classified our network into three subnet we are going to divide our network where Network ID is the first ip address which is unusable and broadcast ID which is last ip and also unusable and first and last host which is the range of usable ip address within the subnet. There is also subnet mask which is used to determine the size of subnet which looks like this: 255.255.255.255. In our network we have taken into consideration size of network and use for future as well so he have made subnet range a bit big so that there will be no problem in the future. Here is how we divided our network:

### Our subnet:

We have divided this network into three subnets. First is worker subnet which consists of two server and 1050 pc. Next one is technician/manager subnet which consists of 100 pc and one server and admin subnet which consists of 48 pc. However, there are two server pc and backup server which is not inside any subnet. Three work room and two work servers fall under this subnet. Here is how we divided it:

Subnet	Network ID	Broadcast ID	First Host	Las Host	Subnet Mask
Worker Subnet	192.168.0.0	192.168.7.255	192.168.0.1	192.168.0.254	255.255.248.0
Technician/Manager subnet	192.168.8.0	192.168.8.255	189.168.8.1	192.168.8.254	255.255.255.0
Admin Subnet	192.168.9.0	192.168.9.255	189.168.9.1	192.168.9.254	255.255.255.0

AS we can see in the network design and table we have used 1050 out of 2046 usable ip address in worker subnet, as well as 100 out of 254 and 48 out of 254 in technician/manager subnet respectively.

**Protocol and design discussion**

In this part we are going to discuss about my design and protocol used in it:

**My Design Explained:**

I have already discussed about my network earlier and now we are going to talk about it more. This network is based in partial mesh topology so there should be fast connection. The network uses cat 7 cable in most of place and cat 6 from 24 port switch to pc. There is no packet loss in the network. And there is hardware firewall, software firewall and other security measures taken into account, so network is available 8am to 6pm. There might be some technical issue for hardware or end user might configure setting wrong, in these time service from specific pc might not be available. Considering hardware failure with these reason the network will be available 99.99% of the time. There is a Wi-Fi in this network connected to switch for other devices such as printer, laptop, etc. The traffic is minimized using protocols and subnet and there is no packet loss so there is quite fast internet in this network and even with these all things here there is still 246 ports available for new work pcs in all three-work room, 168 port in admin room and 116 ports in technician/ manager room. There is also 1008 ip address available for pcs and server in the work network, 154 ip address in manager/technician network and 144 ip address available in admin network. Even though we have minimized many spendings this design might be a bit expensive but this will be futureproof and well performing network.

**Topology Used:**

The topology used in this network is partial mesh because every device is not connected to each other, so it is not mesh topology and it is not bus topology because every pc and network device is not connected to a single cable that is backbone of the network because it is risky and there is chance of data loss. In partial mesh topology it is not fully mesh and it is also not bus. Here we have fast connection and less traffic with devices being connected to each other that there is always room for more data to flow. Partial mesh is also good for subnetting.

**Protocol Used:**

The protocols used in this network is as follow:

1. Transmission Control Protocol (TCP): Transmission control protocol is used by computers to communicate with each other in a network. TCP usually divides message into small packet of data and send it over to another computer and assemble it.
2. Internet Protocol (IP): This protocol can also be called addressing protocol because when used together with TCP it guides the packet of data until it reaches its destination. This protocol greatly reduces network traffic and makes internet fast.
3. Internet Control Message Protocol: it is a supporting protocol for internet protocol which is used by network device to send error message and operational message when communicating with another ip address.
4. Post Office Protocol: This protocol is used in network to receive email.
5. Simple mail transport Protocol: this protocol is used to send and distribute email from a computer.
6. File transfer protocol: The file transfer protocol is a protocol that is used to transfer file from one computer to another within certain wide area network(WAN). This protocol is used to make file transfer regulated and easy.
7. Link Control protocol (LCP): It is a protocol that is used to provide HDLC style services on LAN. It is a type of PPP protocol that is used for establishing, testing, configuring,

maintenance and ending or terminating links for transmitting data.

8. Hypertext transfer Protocol is a protocol that is used to transfer hypertext between two and more computer. In this protocol html code is used to create link which can be graphical or in text and with this protocol all type of html data can be transferred between computer inside trading floor support Centre.
9. Ethernet Protocol: For this protocol we have installed Ethernet Network Interface card (NIC) in each computer. This card actually is unique address code imbedded in a microchip which is used to identify the system. In this protocol a packet is placed on network by a computer and is sent to all the computer but only the one that matches address as Network Interface Card is able to claim it. This makes communication between computer easy as newest version of NIC provides fast connection of 100mbps.
10. Point-to-Point Protocol (PPP): It is a protocol that is used to transfer multiprotocol data between two directly connected computer. This protocol transfers data in frame.
11. Ping: It is a protocol used to check if an ip address is accessible.
12. Telnet protocol: It is a popular client server-program that provides connection to a remote computer where local terminal appears. It is very useful for company and for that reason it is also called terminal network.

#### **Layer of Protocol explanation:**

##### **Layer 1: Physical Layer**

It is the lowest layer of OSI model and deals data in form of bits or signal. Which means it is responsible for transmitting raw bit stream over physical cable. This is the layer that defines hardware items such as cables, cards, voltages, etc. This layer mainly addresses transmission at electrical and mechanical level such as signal voltage swing, voltage duration, etc. Protocol used in this layer is ethernet protocol.

##### **Layer 2: Data Link Layer**

Data Link Layer is a layer that is divided into two sub-layers: Media Access Control Layer (MAC) and logical link control layer (LLC). It is the layer that is responsible for sending data to physical layer. It also encodes and decodes packets into bits. This layer also handles flow and synchronization of the network. PPP and LCP data link layer protocol used in this network.

##### **Layer 3: Network Layer:**

Network layer is the layer that is responsible for translating logical network address and name into their physical address. This layer is also responsible for addressing, determining routes which can be used to help manage network problem like packet switching data congestion and routing. Network layer also fragments and reassembles the packet. That is why network layer is known as the layer that establishes and maintains the network connection. IP, ICMP, Ping are the protocol used in this layer.

#### **Security & Ethics**

In this part we will talk about the security problem and solution that we have considered:

##### **1. Problem:**

Desktop machines are running a mixture Windows seven SP2, Windows 10 and Ubuntu 18 as an Operating System

##### **Solution:**

For security reason and for better communication between computer we have deleted

- all operating system and installed Windows 10 professional on all pcs.
2. Problem:  
Servers are running Windows 2008 R2 with Domain controller.  
Solution:  
New Window Server 2022 is installed with a schema version of domain controller.
  3. Problem:  
Wireless Access Point use WPA  
Solution:  
WPA is removed and WPA3 is installed which is the latest version and provides better security.
  4. Problem:  
Main Layer two Protocol is Spanning Tree.  
Solution:  
Instead of using Spanning tree protocol Link Control Protocol which is faster and can perform more operation than Spanning tree protocol.
  5. Problem:  
Physical layer cabling is CAT 5e  
Solution:  
Cat 5e is too slow for computer nowadays so we have used cat 7 which provides up to 1000mbps connection in our cables up to 24 port switches and for connection between 24 port switch and computer which can provide broadband speed of up to 100mbps. This cabling can be a bit expensive, but we won't have to worry about changing ethernet cable in near future.
  6. Problem:  
Open-source web server and anti-virus software are in use.  
Solution:  
Open-Source Software is good, but everyone should be using same browser, so we have installed Mozilla Firefox on all pc because it is one of the best and trustworthy open source browser. For antivirus we have installed Bitdefender GravityZone Business Security which is one of the best software firewalls out there in the market that provides extra security.
  7. Problem:  
Servers and key network infrastructure are located on the ground floor.  
Solution:  
In this new network, we are a bit high on building so putting server and key network will be costly and network might become slow and there is security risk so there is a server and key network dedicated room in same floor with two pc there.
  8. Problem:  
Full and incremental backups are stored on a server located on the ground floor.  
Solution:  
Instead of using physical server for backup we have used cloud backup to make our backup file more secure.
  9. Problem:  
Key network services use a single 15-character password for authentication.  
Solution:  
Two factor authentication is used where employees are required to enter password and add their login credential to access network.

**10. Problem:**

USB and external adaptors are allowed.

Solution: USB AND external adapter are disabled and if anyone needs to use them, they will need to fill out form and test their cable and take responsibility if anything happens.

**11. Problem:**

End users have basic IT knowledge

Solution:

End users are provided with 7 days of full training on how to operate computer and have good security.

**Ethics and Legal Issues:****Data Protection Act:**

In this network we have taken into consideration data protection act where we have made sure network is used fairly, lawfully and transparently for only purpose of work. Here everything in the network is up to date and latest technology for security is used. Which means this network is based in data protection act.

**Computer Misuse Act:**

Computer misuse act is also taken into consideration in this network. For this network there is a two-factor authentication in both pc and network which makes sure no unauthorized personnel have access to this network. And end user is also taught about the computer misuse act and were taught about proper use of network taking security into consideration.

**Freedom Of Information Act:**

According to the freedom of information act this network will keep client's information by them knowing and they will be able to access their information that we have about them and if they want then their information will be permanently deleted from the network.

**Opportunism:**

Opportunism is one of the factors that no one have control on, it totally relies on ethics. But there are way to avoid it. For opportunism no external ports are allowed. Also only the most reliable people should be allowed to access confidential things and only reliable people should be allowed the fix things if there is any problem in the network.

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