



Awareness Session about Computer Networks and Operating Systems

1ST 1ST.

We will make a Deal



How is this course?

❖ Goals:

- Foster Computer Networks and Operating Systems and its types...
- Learn using Gns3 and VMware Workstation
- Explore possible researches and study projects

❖ Audience:

- Beginners: provide a guide to start working/researching in Computer Networks and Operating Systems.
- Advanced: solidify concepts and go deep in Some networking projects

Agenda:

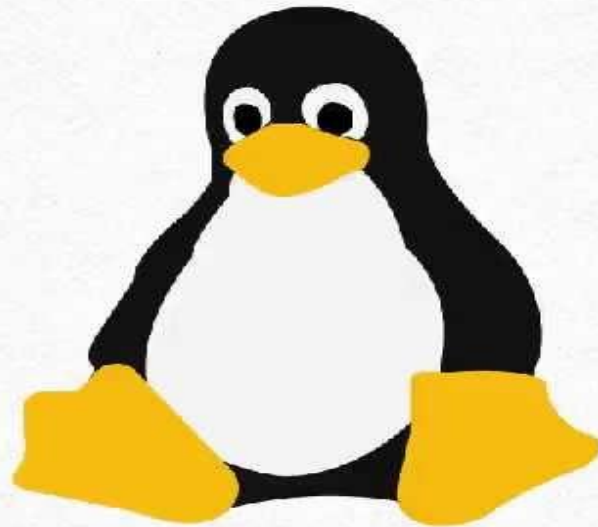
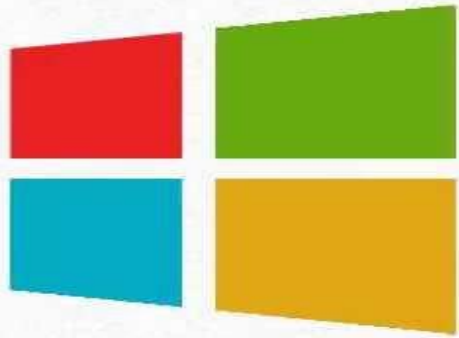
- ❖ What is Operating System
- ❖ Operating Systems types
- ❖ What is computer Networks
- ❖ Types of Networks
- ❖ Network Interface Card
- ❖ IPv4 Address Scalability
- ❖ Packet Tracer simulator
- ❖ GNS3 Emulator
- ❖ VMware Workstation



START

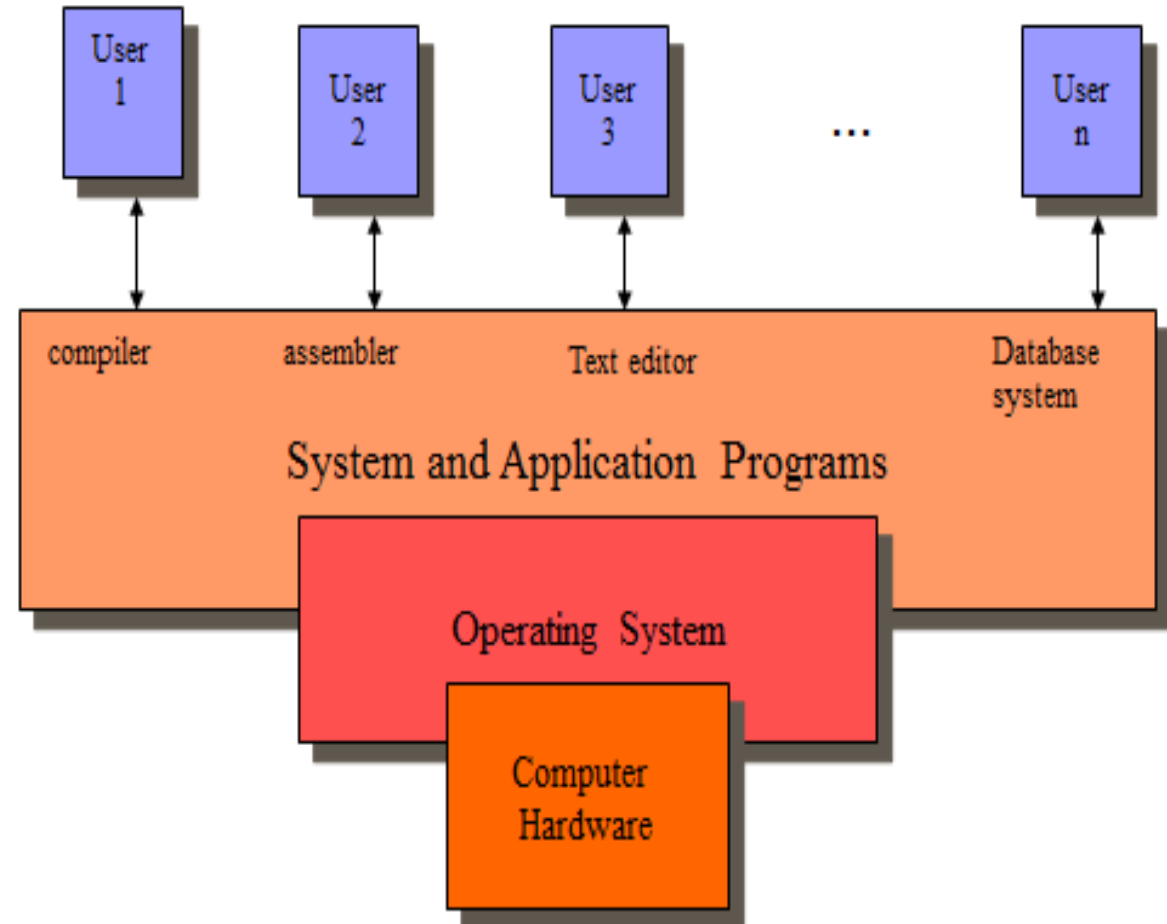
Let's start.....

What is an operating system?

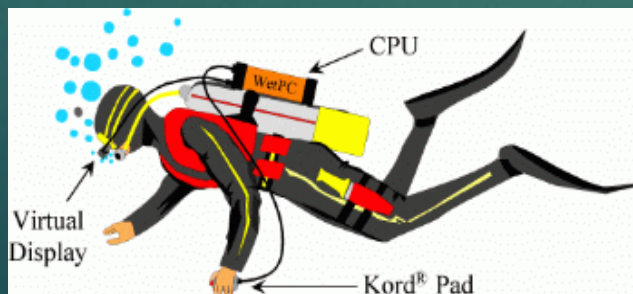


Abstract View of System Components

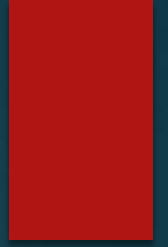
- ❖ An **OS** is a group of **programs** which acts as an **interface** between computer system users and the computer **hardware**.
- ❖ It provides a user-friendly **environment** in which a User may easily develop and **execute** programs.



Systems Today and The Future



Distributed Systems



- ❖ Distribute computation among many processors.
- ❖ Loosely coupled -
 - ❖ no shared memory, various communication lines
- ❖ Client/server architectures
- ❖ Advantages:
 - ❖ Resource sharing
 - ❖ Computation speed-up
 - ❖ Reliability
- ❖ Applications - digital libraries, digital multimedia

Real-time systems

- ❖ Correct system function depends on timeline
- ❖ Feedback/control loops
- ❖ Hard real-time systems –
 - ❖ Failure if response time too long
- ❖ Soft real-time systems –
 - ❖ Less accurate if response time is too long
 - ❖ Useful in applications such as multimedia, virtual re





What is the Network?

Networking Today The Global Community



Instant Messaging



Weblog



Online
Entertainment



Business applications can be accessed remotely as if employees were on site.



Interconnecting our Lives

Networking impacts in our daily lives

- ▶ Networks Support the Way We Learn
- ▶ Networks Support the Way We Communicate
- ▶ Networks Support the Way We Work
- ▶ Networks Support the Way We Play

Networks of Many Sizes



Small Home Networks



Small Office/Home Office
Networks



Medium to Large Networks



World Wide Networks



Types of Networks

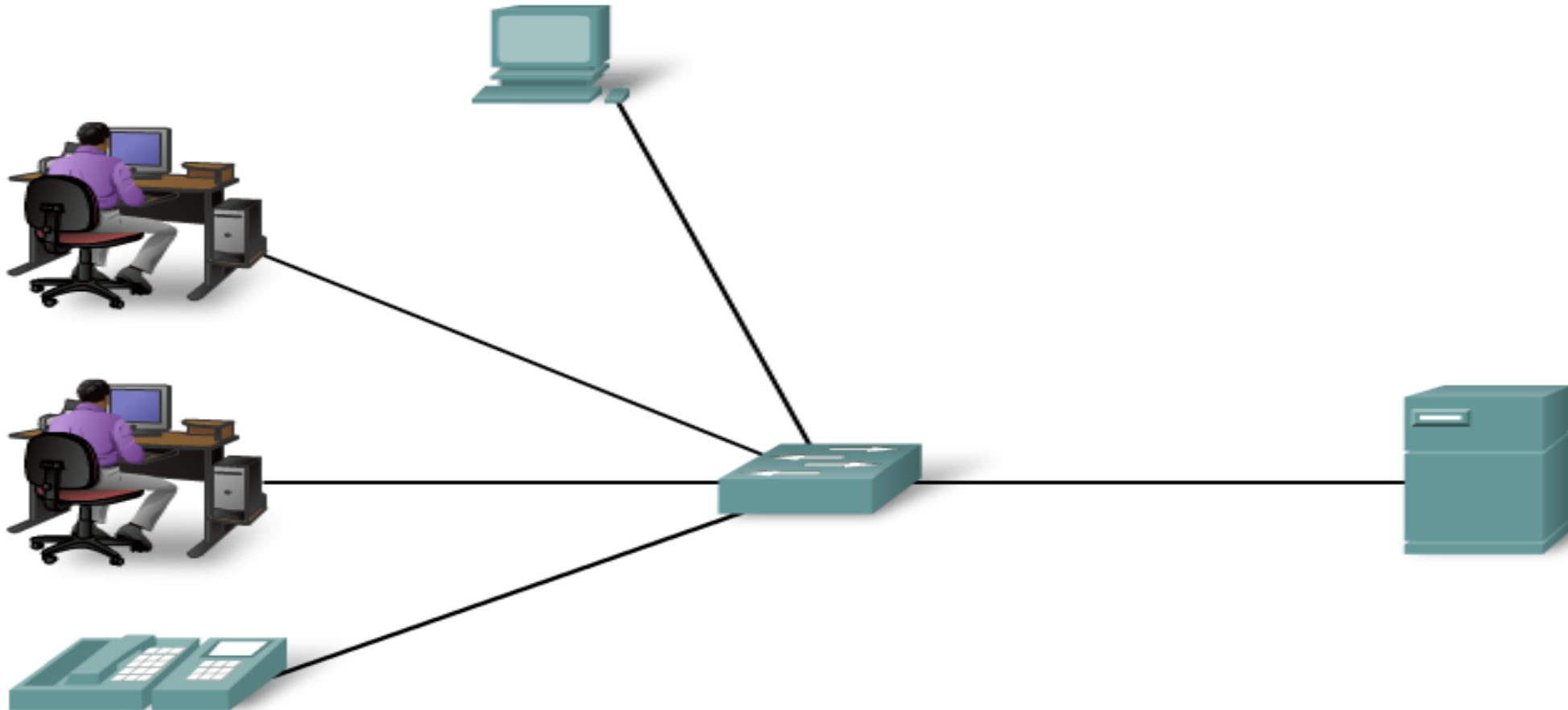
The **two** most common types of network infrastructures are:

Local Area Network (LAN)

Wide Area Network (WAN)

Local Area Networks (LAN)

A network serving a home, building or campus is considered a Local Area Network (LAN).



Switches

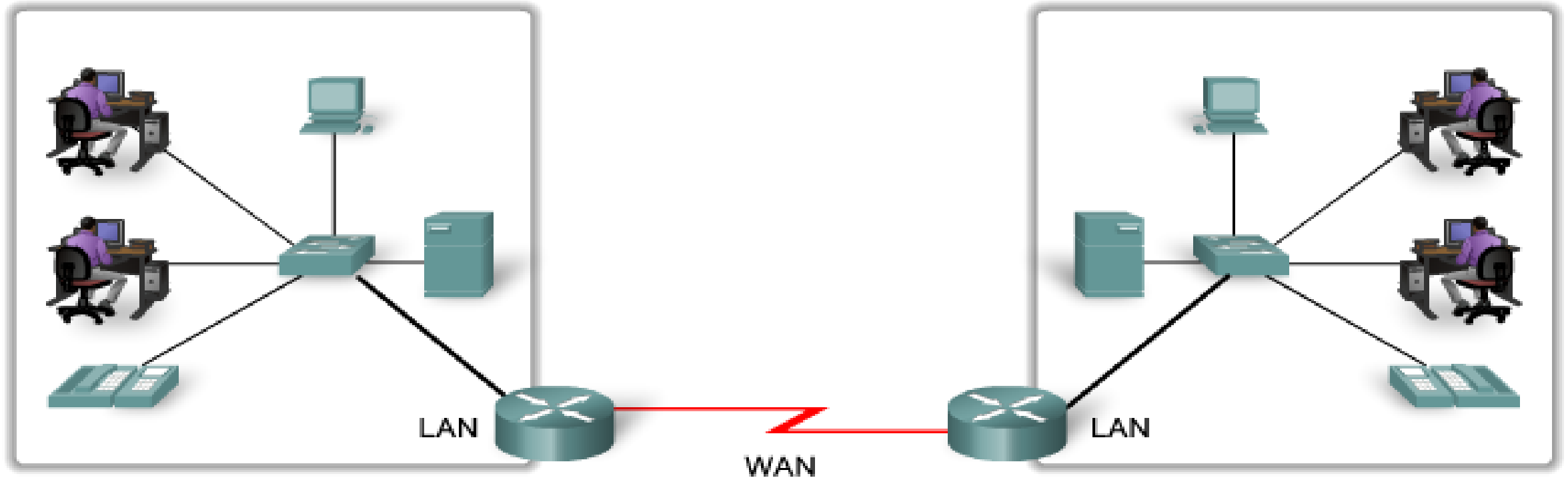


Local Area Networks (LAN)

- ❖ A **LAN** connects network devices over a relatively short distance.
- ❖ A networked office building, school, or home usually contains a single **LAN**, though sometimes one building will contain a few small LANs (perhaps one per room), and occasionally a LAN will span a group of nearby buildings
- ❖ In addition to operating in a limited space, **LANs** are also typically owned, controlled, and managed by a single person or organization.
- ❖ They also tend to use certain connectivity technologies, primarily Ethernet and Token_Ring.

Wide Area Networks (WAN)

LANs separated by geographic distance are connected by a network known as a Wide Area Network (WAN).

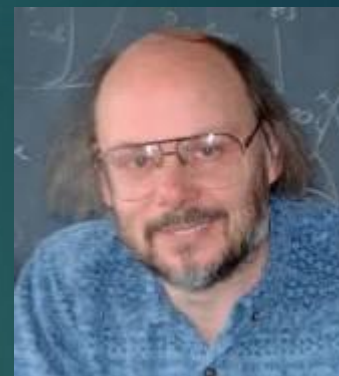


Wide Area Networks (WAN)

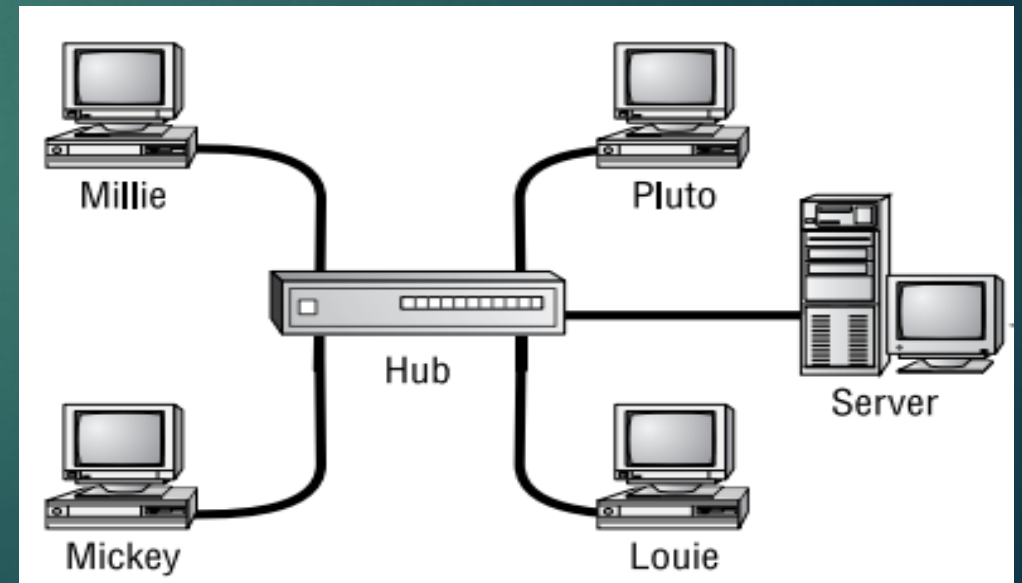
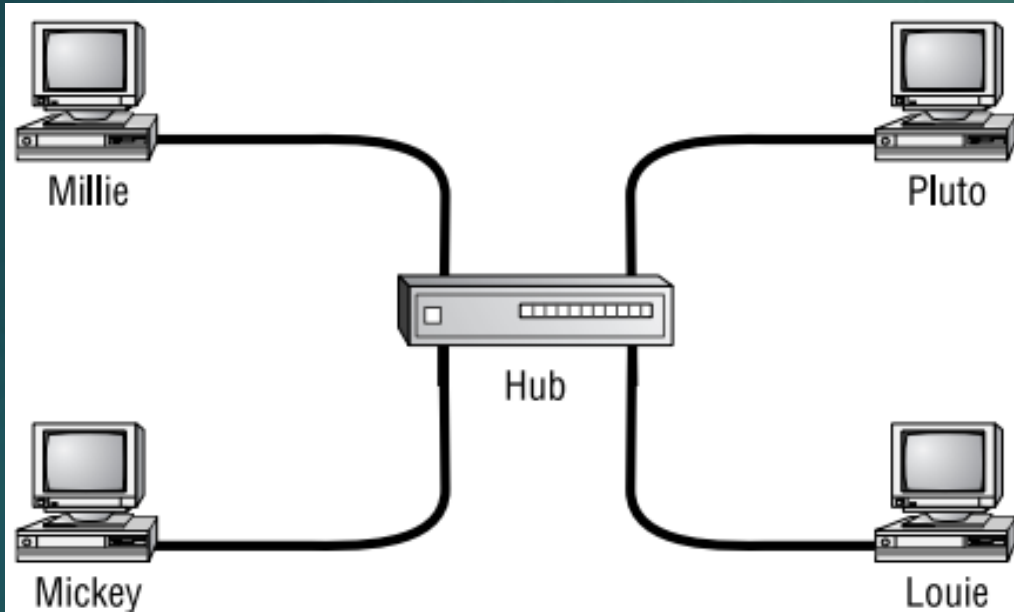
- ❖ As the term implies, a **WAN** spans a **large** physical distance.
- ❖ The **Internet** is the **largest** WAN, spanning the Earth.
- ❖ A **WAN** is a geographically-dispersed collection of LANs.
- ❖ A network device called a **router** connects LANs to a WAN.
- ❖ A **WAN** differs from a **LAN** in several important ways.
- ❖ Most **WANs** (like the Internet) are not owned by any **one organization** but rather exist under collective or **distributed ownership and management**.
- ❖ **WANs** tend to use technology like ATM, Frame_Relay and X.25 for connectivity over the longer distances.

	LAN	WAN
Definition	LAN (Local Area Network) is a computer network covering a small geographic area, like a home, office, school, or group of buildings.	WAN (Wide Area Network) is a computer network that covers a broad area (e.g., any network whose communications links cross metropolitan, regional, or national boundaries over a long distance).
Speed	High speed (1000 mbps)	Less speed (150 mbps)
Example	Network in an organization can be a LAN	Internet is a good example of a WAN
Technology	Tend to use certain connectivity technologies, primarily Ethernet and Token Ring	WANs tend to use technologies like MPLS, ATM, Frame Relay and X.25 for connectivity over longer distances

For more visit [http://www.diffen.com/difference/LAN vs WAN](http://www.diffen.com/difference/LAN_vs_WAN)



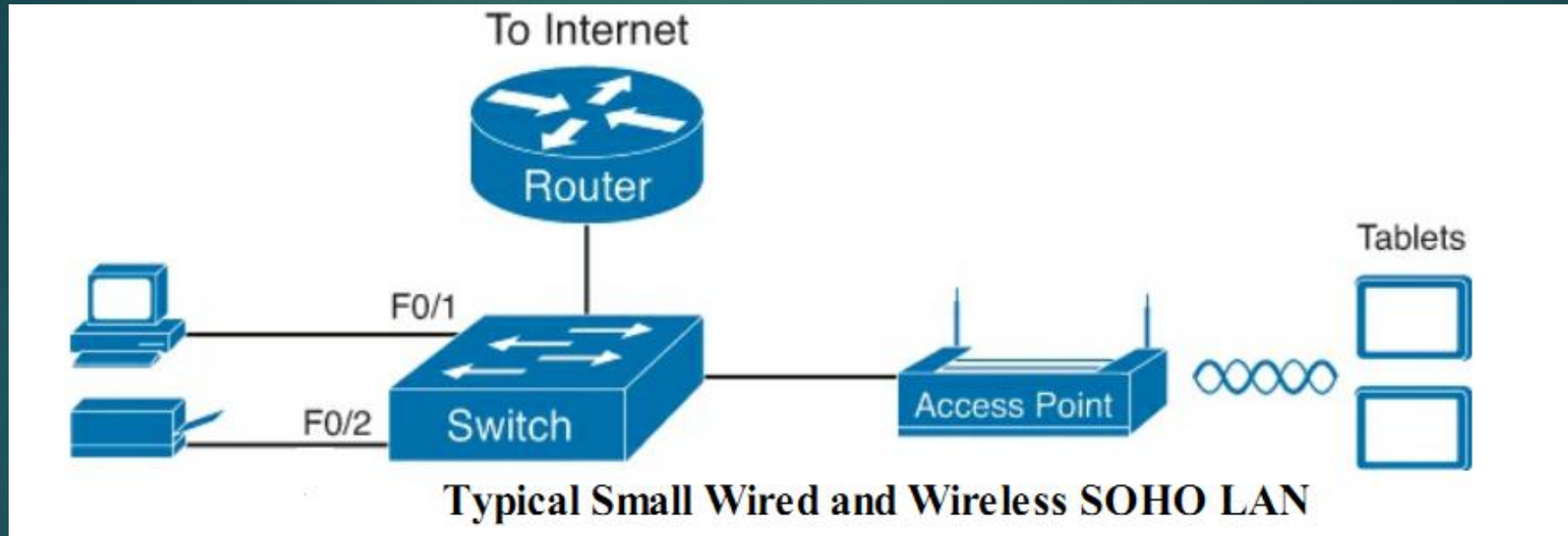
Peer to Peer vs Clients and Servers



Typical SOHO LANs

- ❖ Typical SOHO LANs today also support **wireless** LAN connections.
- ❖ Ethernet defines wired LAN technology only; in other words, Ethernet LANs use cables. However, you can build one LAN that uses both Ethernet LAN technology as well as wireless LAN technology, which is also defined by the **IEEE**.
- ❖ Wireless LANs, defined by the IEEE using standards that begin with **802.11**, use **radio** waves to send the bits from one node to the next

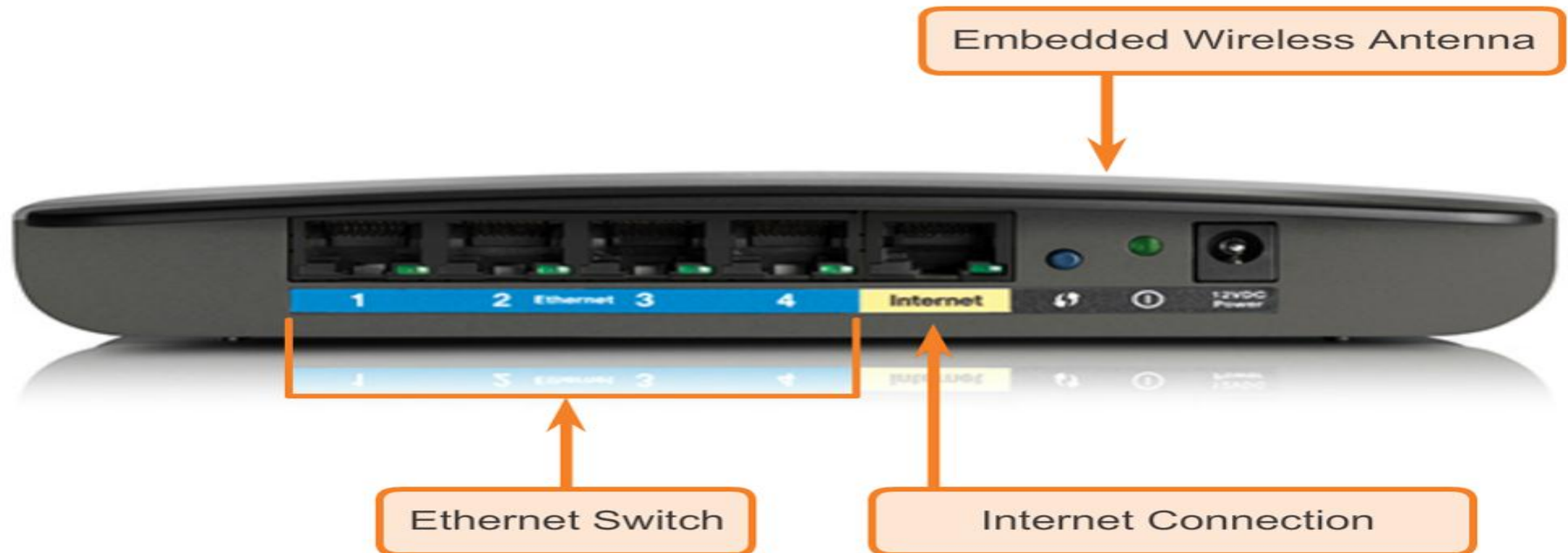
Typical SOHO LANs



Note that this drawing shows the router, Ethernet switch, and wireless LAN access point as three separate devices so that you can better understand the different roles. However, most SOHO networks today would use a single device, often labeled as a “wireless router” that does all these functions.

Wireless Router

Home Router





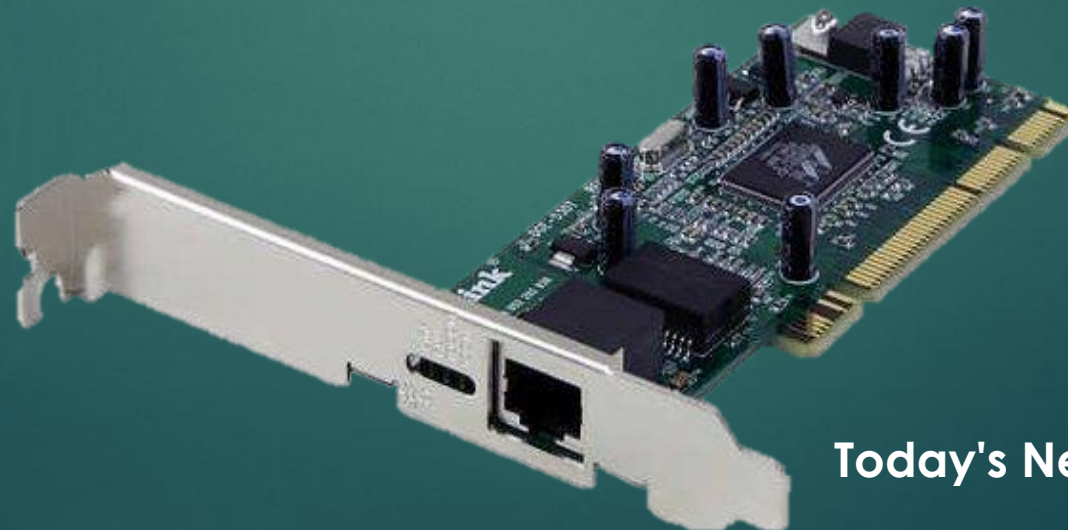
NIC

NETWORK INTERFACE CARD

Wireless Network Adapters



A 1990s network interface Card



Today's Network Interface card

Network Interface Card

- ▶ A **NIC** is a computer hardware provides interface between a computer and a network
- ▶ Some NIC cards work with wired connections while others are wireless.
- ▶ In new computers, many NICs are now pre-installed by the manufacturer. All NICs feature a speed rating such as 11 Mbps, 54 Mbps or 100 Mbps



MAC ADDRESS

MEDIA ACCESS CONTROL ADDRESS

MAC ADDRESS

- ▶ Is a unique identifier assigned to network interfaces for communications on the physical network segment
- ▶ A MAC address is given to a network adapter when it is manufactured. It is **hardwired** or hard-coded onto your computer's network interface card (NIC) and is **unique** to it
- ▶ Known as physical address because physically assigned to the host NIC

MAC Address structure

- ▶ MAC addresses are 12-digit hexadecimal numbers (48 bits in length). By convention, MAC addresses are usually written in one of the following two formats:

With Dashes 00-60-2F-3A-07-BC

With Colons 00:60:2F:3A:07:BC

With Periods 0060.2F3A.07BC

How do I know MAC Address

```
C:\WINDOWS\system32\cmd.exe

C:\>ipconfig /all

Windows IP Configuration

    Host Name . . . . . : computer
    Primary Dns Suffix . . . . . :
    Node Type . . . . . : Unknown
    IP Routing Enabled. . . . . : No
    WINS Proxy Enabled. . . . . : No

Ethernet adapter Local Area Connection:

    Connection-specific DNS Suffix  : 
    Description . . . . . : Broadcom 440x 10/100 Integrated Cont
roller
    Physical Address. . . . . : 00-C0-9F-A1-9D-4A
    Dhcp Enabled. . . . . : No
    IP Address. . . . . : 192.168.1.8
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.1.1
    DNS Servers . . . . . : 208.67.222.222
                           208.67.220.220

C:\>
```

IP



What is an IP address

- A unique string of numbers separated by periods that identifies each computer to communicate over a network.
- A way to identify machines on a network
- A unique identifier
- Known as a logical address because assigned logically

IP usage

- Used to connect to another computer
- Allows transfers of files and e-mail

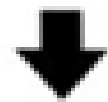
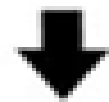
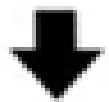
IPv4 structure

- IP addresses consist of four sections
- Each section is 8 bits long
- Each section can range from 0 to 255
- Written, for example, 128.35.0.72
- ▶ These four sections represent the machine itself and the network it is on

Example

An IPv4 address (dotted-decimal notation)

172 . 16 . 254 . 1



10101100.00010000.11111110.00000001



One byte = Eight bits



Thirty-two bits ($4 * 8$), or 4 bytes

Question 1:

Find the error in the following IP Address
75.45.301.14

Solution

In decimal notation each number ≤ 255
301 is out of the range

Question 2:

Expect the error in the following IP Address
111.56.045.78

Solution

There are no leading zeroes in
Dotted-decimal notation (045)

MAC vs IP

▶ **MAC address**

- This address does not change
- Similar to the name of a person
- Known as physical address because physically assigned to the host NIC

▶ **IP address**

- Similar to the address of a person
 - Based on where the host is actually located
 - Known as a logical address because assigned logically
 - Assigned to each host by a network administrator
-
- ▶ Both the physical MAC and logical IP addresses are required for a computer to communicate just like both the name and address of a person are required to send a letter

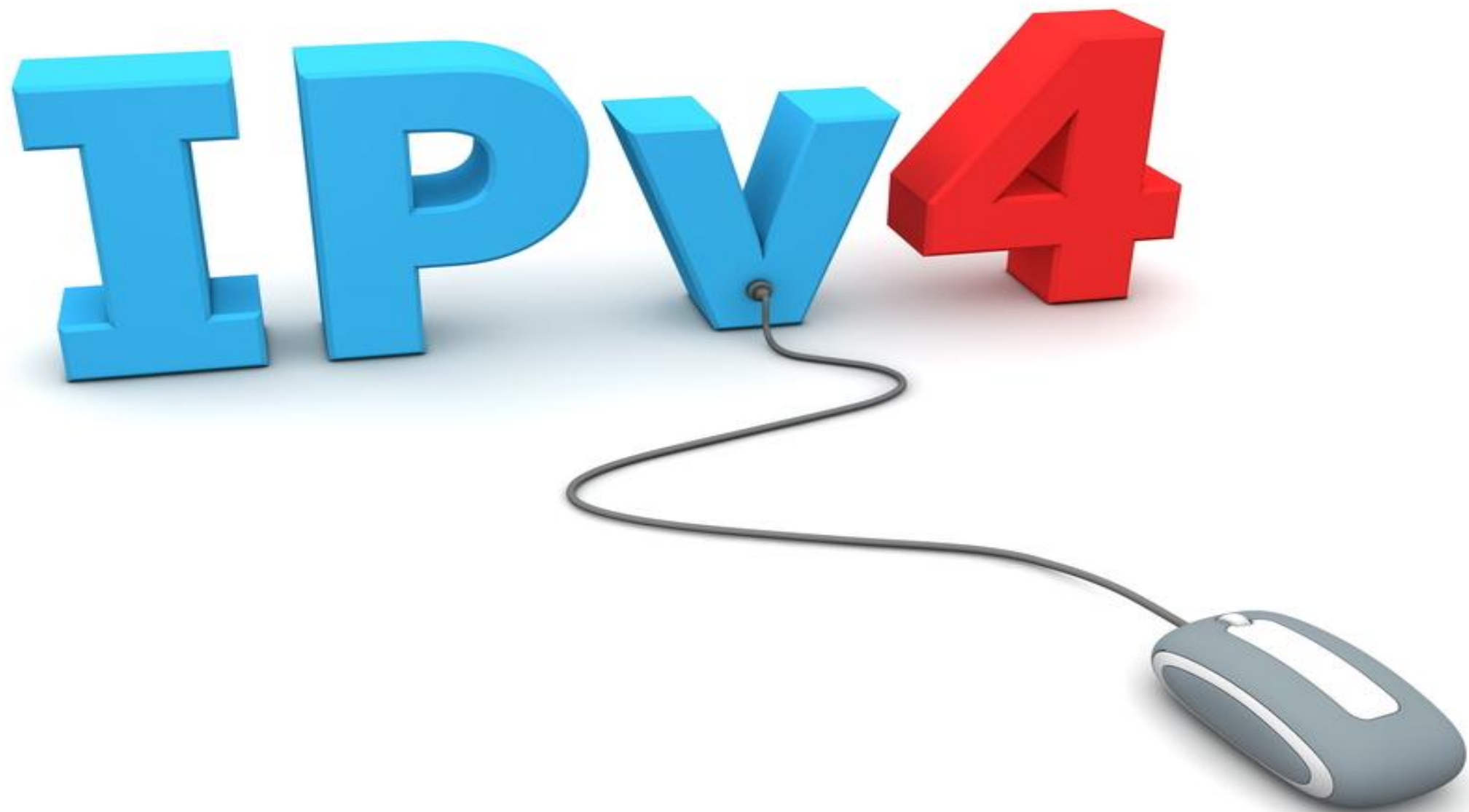
Guess the answer!

$$\text{Cylinder} + \text{Cylinder} + \text{Cylinder} = 24$$

$$\text{Cylinder} + \text{Cross} = 25$$

$$\text{Cross} - \text{Trapezoid} = 08$$

$$\text{Cross} + \text{Cylinder} + \text{Trapezoid} = ?$$





2012



IPv4 RUNS OUT



WE WERE WARNED

IPv4 Address Scalability

- ❖ The original design for the Internet required every organization to ask for, and receive, one or more registered classfull IP network numbers.
- ❖ Connecting to the Internet using only a registered network number, or several registered network numbers, worked well for a while.
- ❖ In the early to mid-1990s, it became apparent that the Internet was growing so fast that all IP network numbers would be assigned by the mid-1990s! Concern arose that the available networks would be completely assigned, and some organizations would not be able to connect to the Internet
- ❖ The solution is using **NAT** and **PAT**
- ❖ **Note:**
Estimates in the early 1990s predicted that the would run out of IPv4 addresses by the mid-1990s, but IANA did not exhaust the IPv4 address space until February 2011

Private Addressing

Table 24-2. RFC 1918 Private Address Space

Range of IP Addresses	Class of Networks	Number of Networks
10.0.0.0 to 10.255.255.255	A	1
172.16.0.0 to 172.31.255.255	B	16
192.168.0.0 to 192.168.255.255	C	256

Network Address Translation Concepts

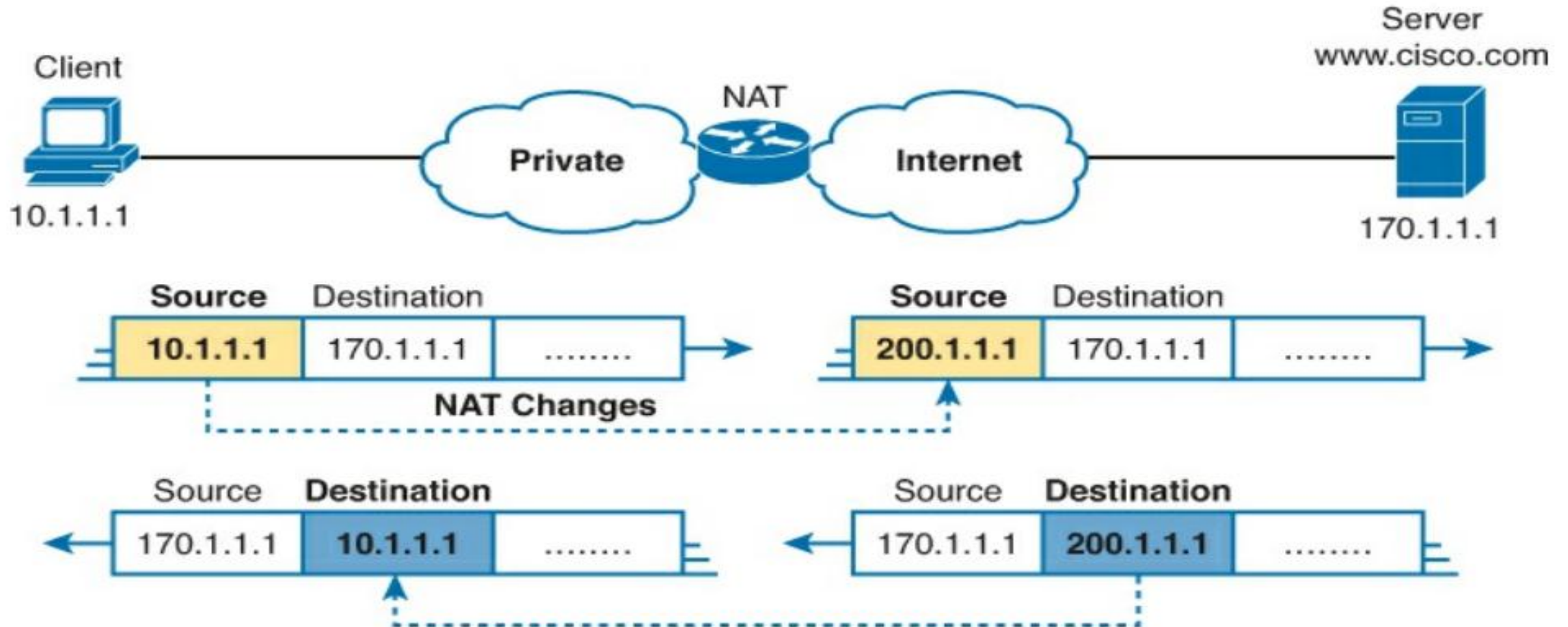


Figure 24-2. NAT IP Address Swapping: Private Addressing

Static NAT

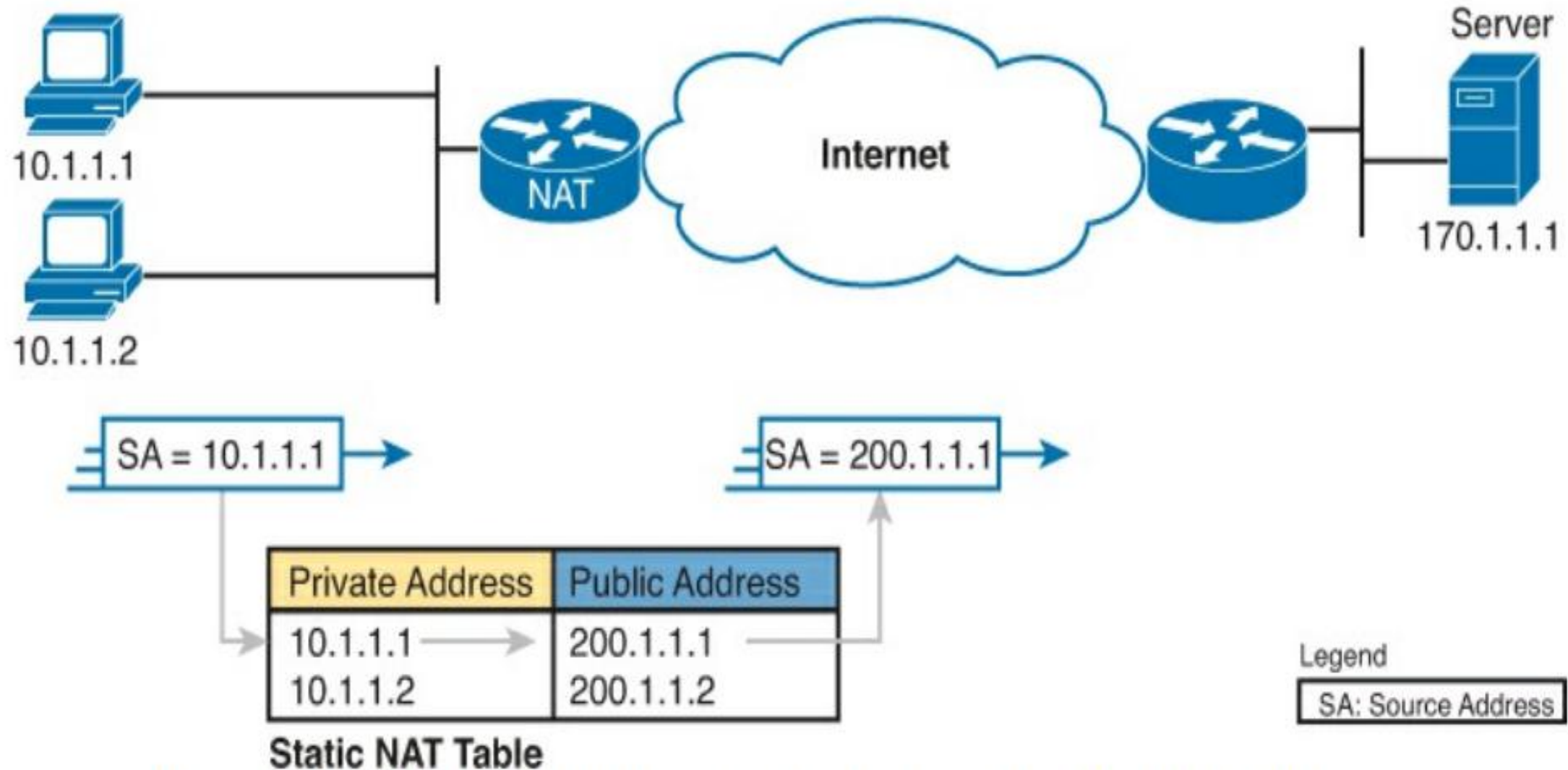


Figure 24-3. Static NAT Showing Inside Local and Global Addresses

Dynamic NAT

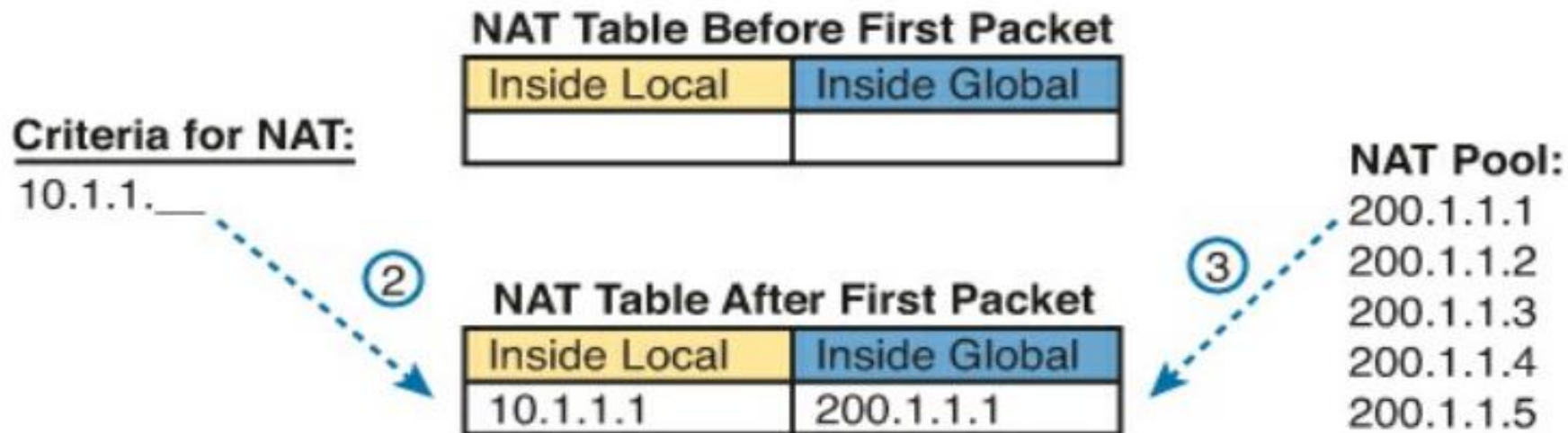
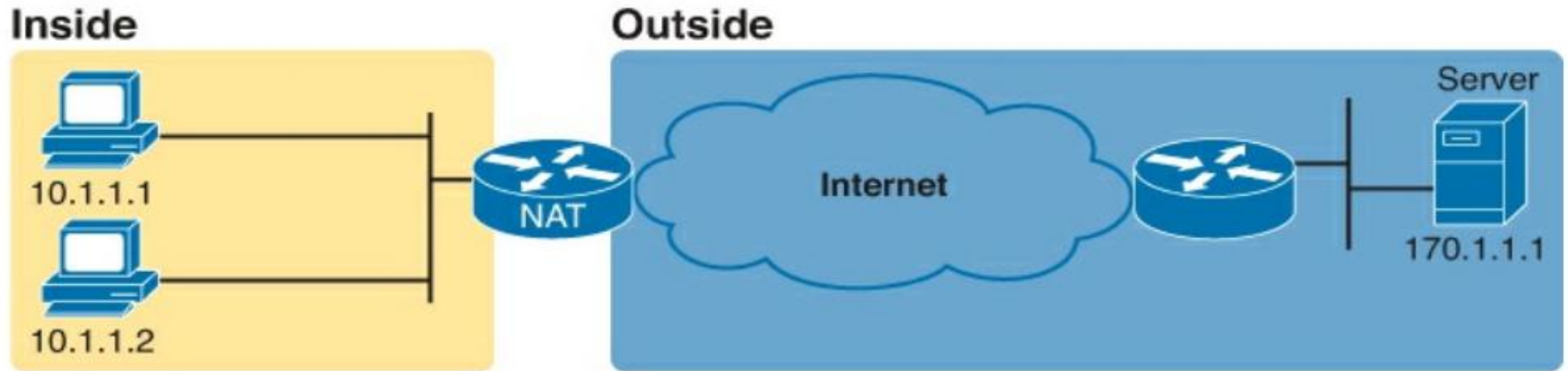


Figure 24-5. Dynamic NAT

Dynamic NAT

numbers 1, 2, 3, and 4 in the figure refer to the following sequence of events:

1. Host 10.1.1.1 sends its first packet to the server at 170.1.1.1.
2. As the packet enters the NAT router, the router applies some matching logic to decide whether the packet should have NAT applied. Because the logic has been configured to match source IP addresses that begin with 10.1.1, the router adds an entry in the NAT table for 10.1.1.1 as an inside local address.
3. The NAT router needs to allocate an IP address from the pool of valid inside global addresses. It picks the first one available (200.1.1.1, in this case) and adds it to the NAT table to complete the entry.
4. The NAT router translates the source IP address and forwards the packet

Dynamic NAT

NAT can be configured with more IP addresses in the inside local address list than in the inside global address pool. The router allocates addresses from the pool until all are allocated.

If a new packet arrives from yet another inside host, and it needs a NAT entry, but all the pooled IP addresses are in use, the router simply discards the packet. The user must try again until a NAT entry times out, at which point the NAT function works for the next host that sends a packet.

Essentially, the inside global pool of addresses needs to be as large as the maximum number of concurrent hosts that need to use the Internet at the same time—unless you use PAT, as is explained in the next section.

Overloading NAT with Port Address Translation (PAT)

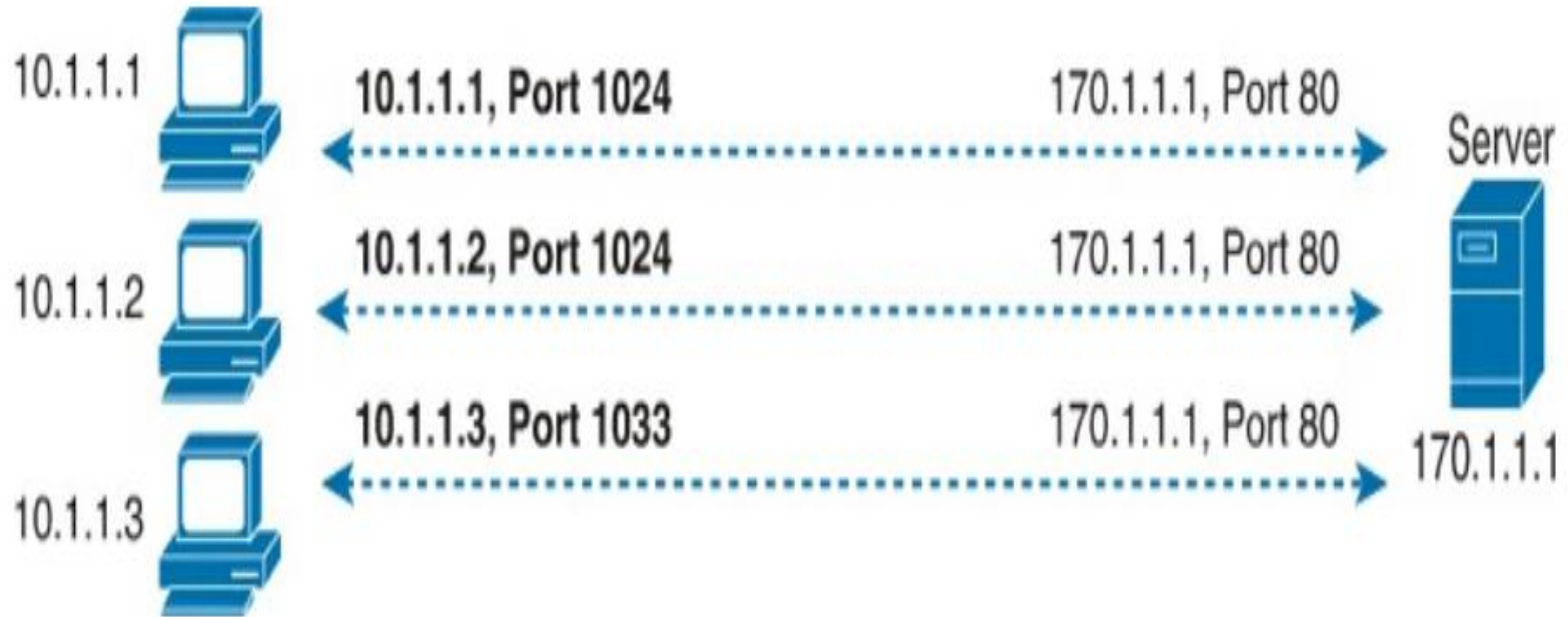
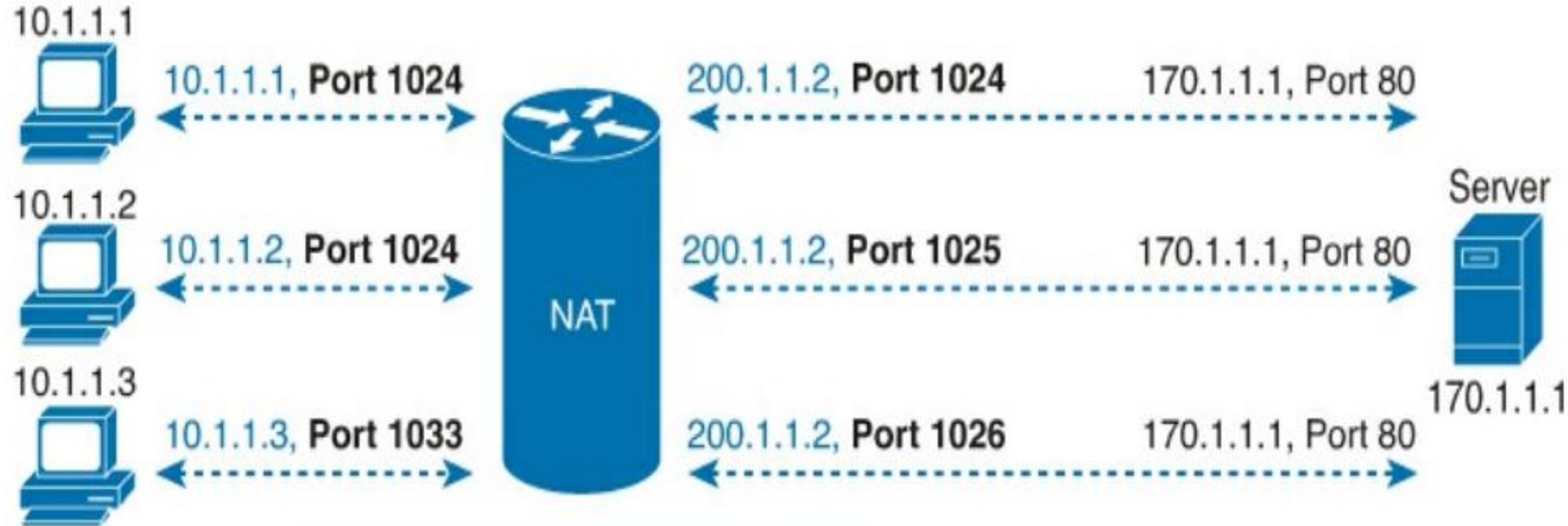


Figure 24-6. Three TCP Connections from Three PCs

PAT



Figure 24-7. Three TCP Connections from One PC



Inside Local	Inside Global
10.1.1.1: 1024	200.1.1.2: 1024
10.1.1.2: 1024	200.1.1.2: 1025
10.1.1.3: 1033	200.1.1.2: 1026

Dynamic NAT Table, With Overloading

Figure 24-8. NAT Overload (PAT)

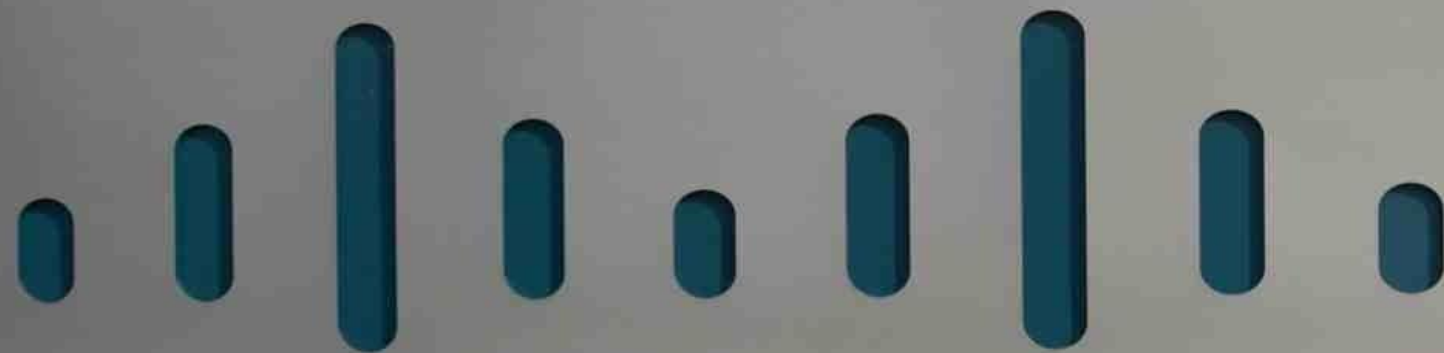
Does PAT solve the problem ??

**WHAT IS THIS
IPV4?**

**A HOUSE FOR
ANTS?**

memegenerator.net

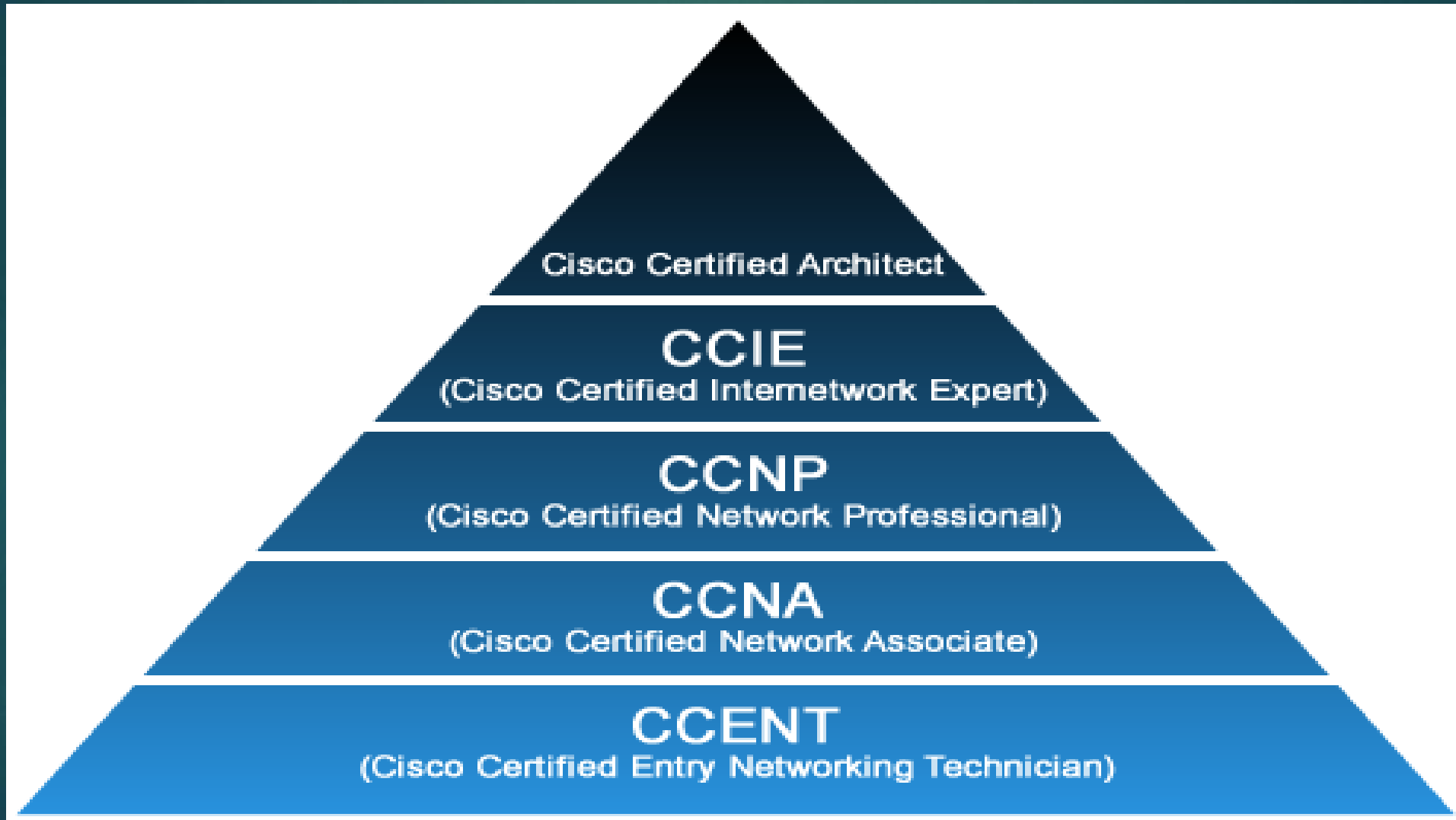




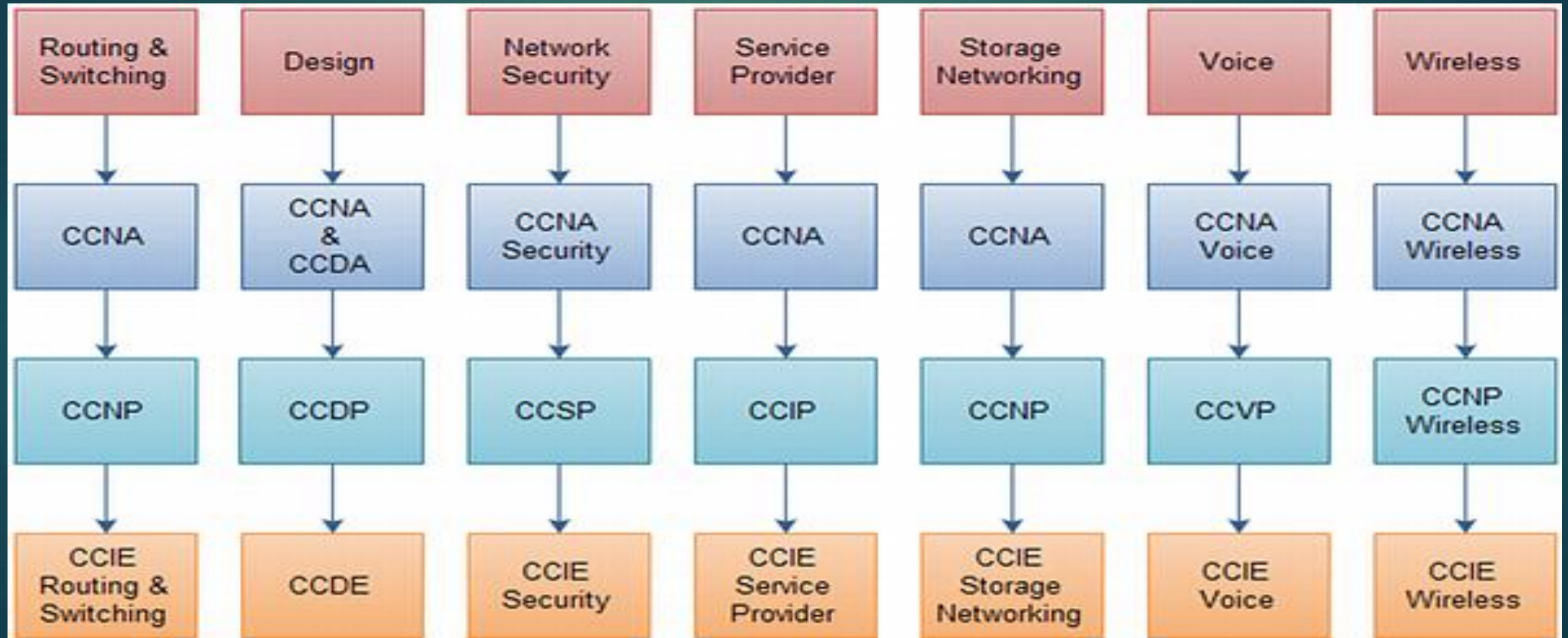
CISCO

Founders of Cisco





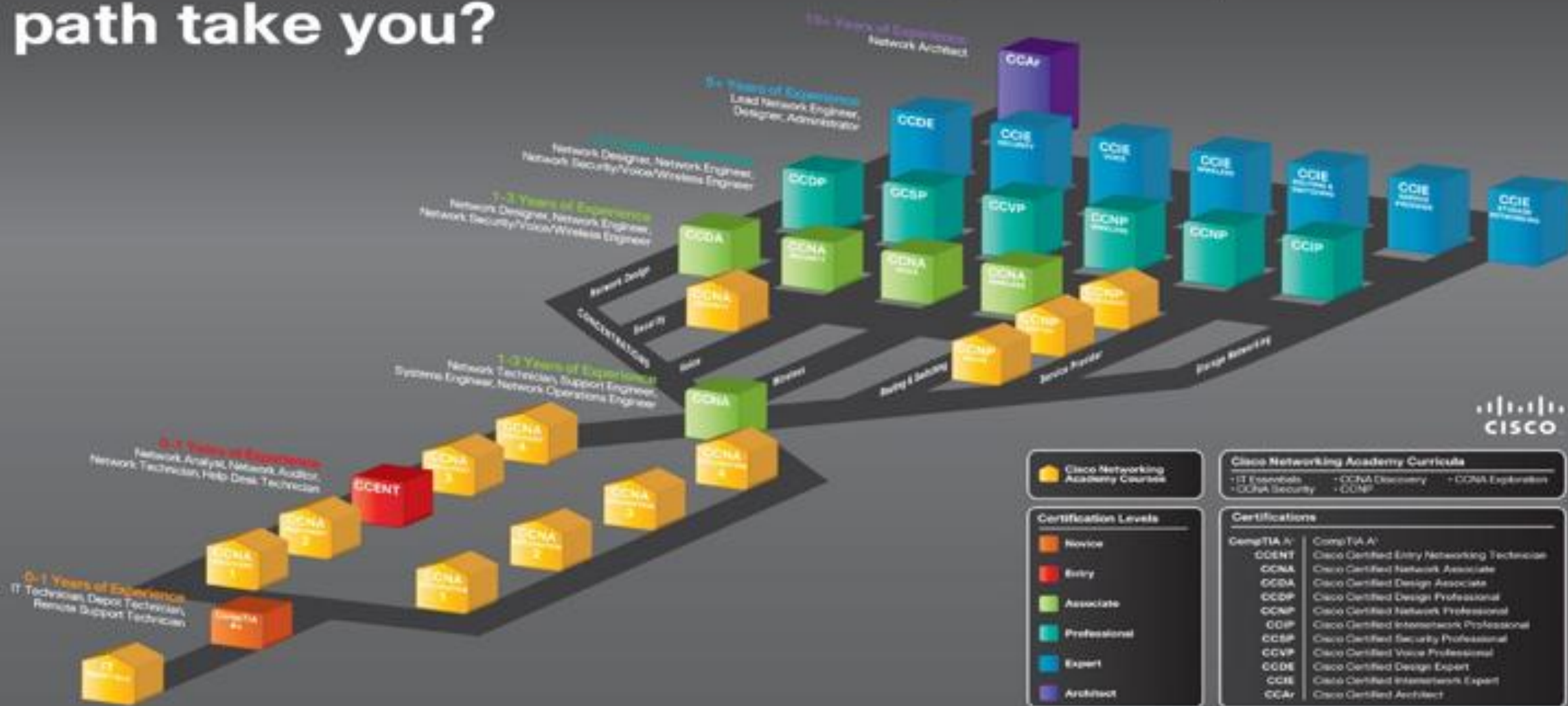
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gerranzuv@gmail.com
fb.com/kenan.abbas.7