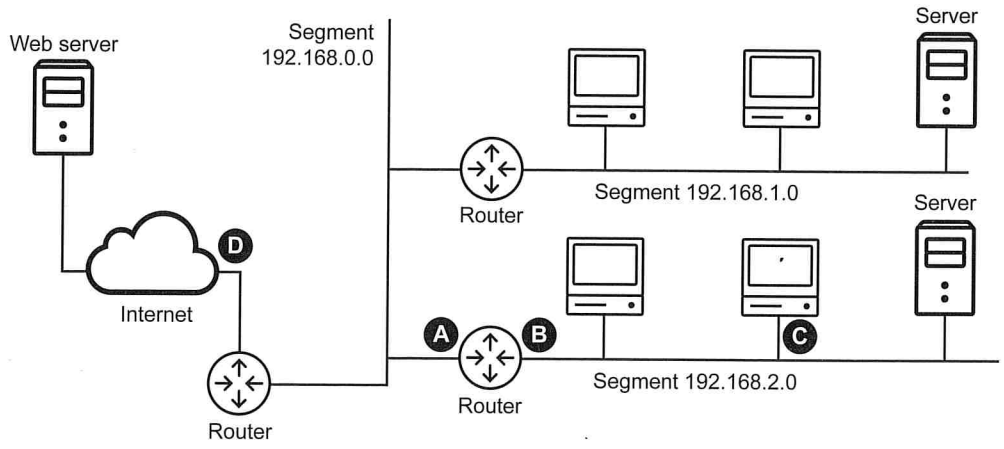
IP address and a unique port number. An incoming response, identified by the port number, is then rebadged with the original workstation's internal IP address and port number from the translation table. NAT provides a solution to the lack of public address in IPv4 while we undergo the transition to IPv6 which will afford everyone a unique address. It also offers an additional layer of security by automatically creating a **firewall** between the internal and external networks.

Port forwarding

Port forwarding is commonly a product of **Network Address Translation** when a public computer is trying to communicate with a server operating within a private network. Since there is no direct connection to the server, the NAT needs to forward all incoming requests to a particular IP address and port (for example web requests on port 80) to port 80 of an internal web server using a private IP address. Requests to access the internal server would be sent to the IP address of the external router, which can be programmed to filter out packets destined for certain computers or applications.

Exercises

1. The diagram below shows the physical topology of a Local Area Network connected to the Internet. The LAN uses the IPv4 protocol.



(a) State suitable IP addresses for:

(i) The router connection marked A. [1]

(ii) The router connection marked B. [1]

(iii) The Network Interface Card for the terminal marked C. [1]

(iv) The public router connection marked D. [1]

(b) The combined router and switch device has two IP addresses. One is a public address and the other is a private address.

Explain the difference between public and private IP addresses. [2]

(c) The network has been segmented using a technique called 'subnetting'.

(i) Explain the advantages to a network administrator of subnetting. [2]

(ii) The first 24 bits of the network's public IP address represent the Network ID. Two further bits are used for the Subnet ID and machines on the network were configured with a subnet mask of 11111111.11111111.11111111.11000000.

State the number of IP addresses available for the network devices. [2]

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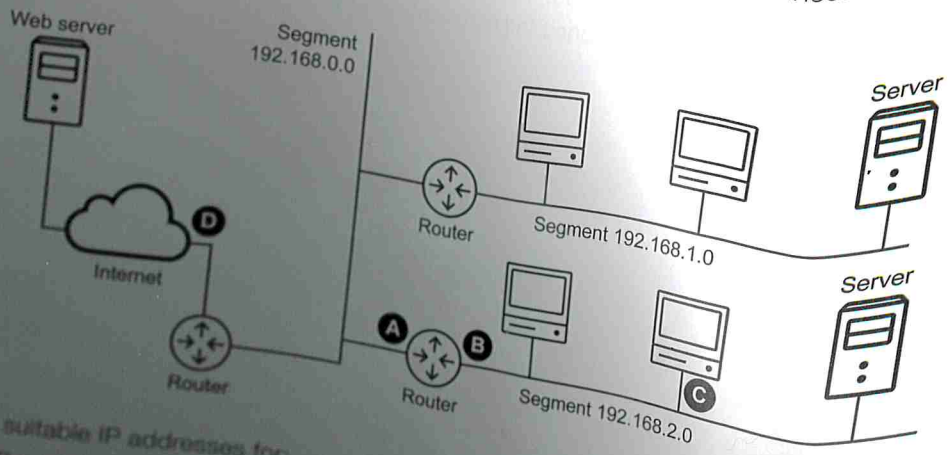

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(i) Explain the advantages of subnetting. [2]

(ii) The last 24 bits of the network ID. Two further bits are used for the Network ID. Two further hosts were configured with a subnet

State the number of [2]

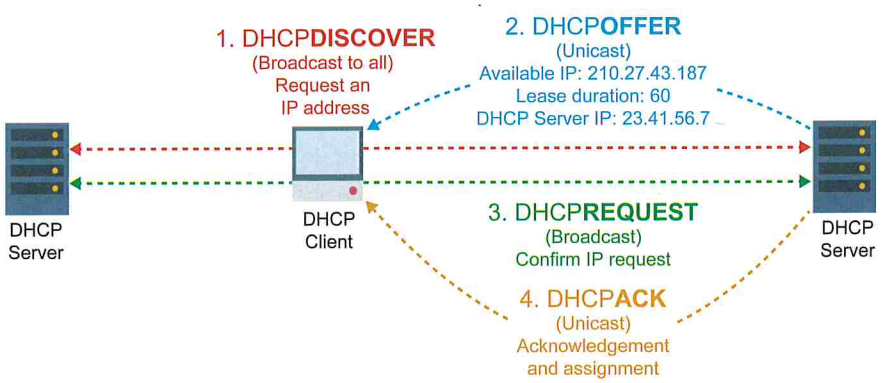
Public and private IP addresses

A **public** (or **routable**) IP address must be globally unique and can be addressed directly by any other computer in the world. A company's web server, or home Internet router for example, would require a public IP address. Within the local network, addresses can be **private** (or **non-routable**) and the web server or router can forward the data going through it to the correct internal device. All devices on the internal network will also have an IP address but this will be private and would not require registration with an **Internet registry**. As such, private IP addresses do not need to be globally unique; they must just be unique within their local network. The common IP blocks for a Class C private network are 192.168.0.0 to 192.168.255.255. Assigning private addresses to internally networked devices conserves the number of unique IPv4 addresses available for Internet-facing devices. A home network printer, for example would be allocated a private IP address to prevent others outside your network from being able to print to it. To allow external access to a privately addressed computer, a **Network Address Translator** (**NAT**) is required.

Q3: Why would a combined home router/hub device have both a public and a private IP address?

Dynamic Host Configuration Protocol

A **Dynamic Host Configuration Protocol** (**DHCP**) server is used to automatically assign a **dynamic IP address** from a pool of available addresses to a computer attempting to operate on a public network such as an Internet hotspot. Since IP addresses are in short supply, this system of dynamic addressing enables active computers to request an IP address for the duration they are online and release the address back to the pool for another computer when it is not in use. DHCP also provides the **subnet mask** and other automatic configuration details alongside the IP address, solving problems with manual configuration and centrally handling frequent changes of IP address such as those used with mobile devices moving from one area to another. DHCP is also used on private networks to allocate internal IP addresses to machines (e.g. 192.168.1.x). **Static IP addressing** is uncommon as it permanently allocates a networked computer a scarce IPv4 address.



Network Address Translation

Network Address Translation (**NAT**) is used to convert IP addresses as they pass between a **public address space** (via a router for example) using a public IP address and a LAN with a **private address space**. NAT is required to translate private IP addresses since they are not routable and therefore cannot be used for routing packets on the Internet. Private addresses are also not unique so external servers cannot send packets directly back to a unique private address. An outgoing server request made by a computer on a private network contains its own IP address and port number. The router logs these as an entry in a translation table and swaps the packet IP address and port number for its own external