

ERussell_P151512_NOSS

by Edward Russell

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Network Operating Systems and Security

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2-11-2018

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Worksheet 1

Task 1

Before starting the task, the three virtual machines had to be created in the Virtual Machine Manager software. These three virtual machines consist of two servers (Cardiff and Swansea) and a Windows 7 client (lab). This is shown in figure 1 below. The Cardiff server is the central server, with network connections to both Swansea and Lab on the 11 network and 0 network respectively.

Name	Status	Virtual Machine State	Availability Set Name	Host	Cloud	Job Status	Owner	User Role	CPU Average	Service	Operating System
Swansea	Running	Running				Completed	SOACU151226	Network Services Gro...	0%		Windows Server 2012...
Cardiff	Running	Running				Completed	SOACU151512	Network Services Gro...	0%		Windows Server 2012...
Lab-01-01	Running	Running				Completed	SOACU151226	Network Services Gro...	40%		Unknown

Figure 1 Shows the creation of the three servers has been completed.

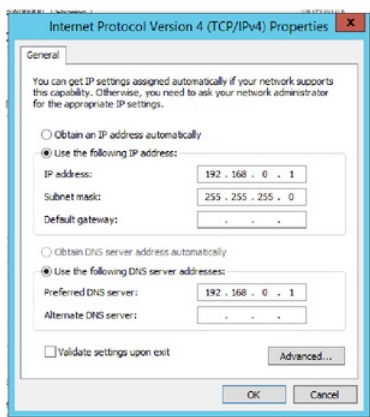


Figure 2 Shows the 0 network connection on the Cardiff Side.

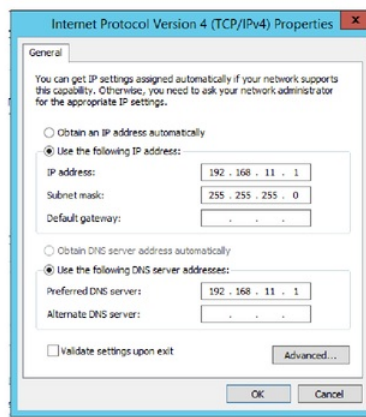


Figure 3 Shows the 11 network connection of the Cardiff side.

Figures 2 and 3 show the network connections at Cardiff. The 0 network connects to the Lab client. The 11 Network connects to the Swansea Server.

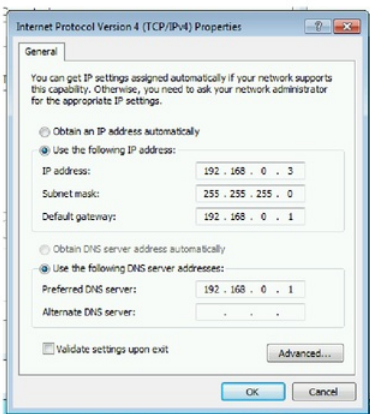


Figure 5 Shows the 0 network connection on the Lab client.

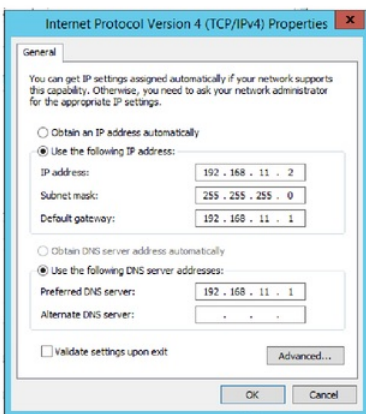


Figure 4 Shows the 11 network connection on the Swansea server.

Figure 4 shows the same network connection as figure 2, but from the Lab client at the opposite end of the network.

Figure 5 shows the shows the same network connection as figure 3, but from the Swansea server.

Task 2

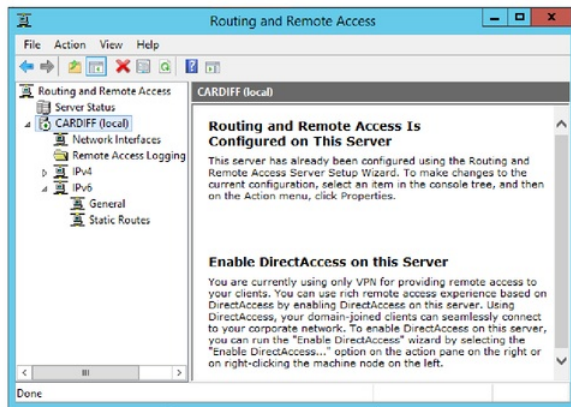


Figure 6 Shows the successful addition of RRAS to the Cardiff server.

Figure 6 shows the completion of adding Routing and Remote Access (RRAS) to the Cardiff server.

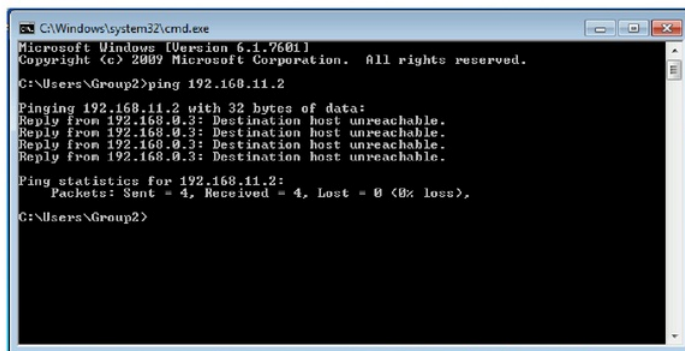


Figure 7 Shows a failed ping from Lab to Swansea.

Figure 7 shows the first attempt to ping the Swansea server from the Lab client. As can be seen it was unsuccessful as expected.

Task 3

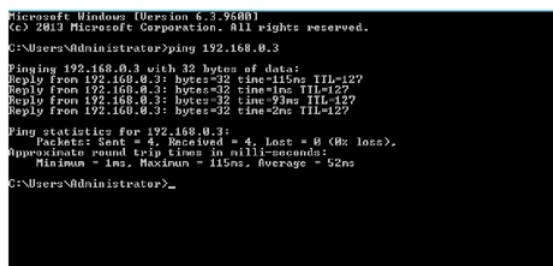


Figure 8 Shows a successful ping from Swansea to Lab.

Figures 8 through 11 show the now successful attempts at pinging between each of the three virtual machines.

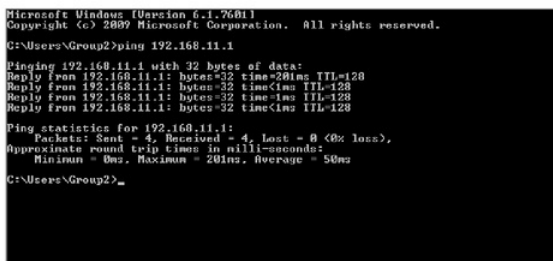


Figure 9 Shows a successful ping from Lab to Cardiff.

```

C:\Users\Administrator>ping 192.168.11.1
Pinging 192.168.11.1 with 32 bytes of data:
Reply from 192.168.11.2: Destination host unreachable.
Reply from 192.168.11.2: Destination host unreachable.
Reply from 192.168.11.2: Destination host unreachable.
Reply from 192.168.11.2: Destination host unreachable.

Ping statistics for 192.168.11.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
C:\Users\Administrator>ping 192.168.0.1
Pinging 192.168.0.1 with 32 bytes of data:
Reply from 192.168.0.1: bytes=32 time=140ms TTL=128
Reply from 192.168.0.1: bytes=32 time=2ms TTL=128
Reply from 192.168.0.1: bytes=32 time<1ms TTL=128
Reply from 192.168.0.1: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 140ms, Average = 35ms
C:\Users\Administrator>

```

Figure 10 Shows a successful ping from Swansea to Cardiff.

```

Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

C:\Users\Group2>ping 192.168.11.2
Pinging 192.168.11.2 with 32 bytes of data:
Reply from 192.168.11.2: bytes=32 time=1ms TTL=127
Reply from 192.168.11.2: bytes=32 time=2ms TTL=127
Reply from 192.168.11.2: bytes=32 time<1ms TTL=127
Reply from 192.168.11.2: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.11.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 2ms, Average = 0ms
C:\Users\Group2>

```

Figure 11 Shows a successful ping from Lab to Swansea.

Task 4

```

Administrator: Command Prompt

Microsoft Windows [Version 6.3.9600]
(c) 2013 Microsoft Corporation. All rights reserved.

C:\Users\Administrator>route print
=====
Interface List
14...00 15 5d 86 03 03 .....Microsoft Hyper-V Network Adapter #2
12...00 15 5d 86 03 0c .....Microsoft Hyper-V Network Adapter
1.....Software Loopback Interface 1
13...00 00 00 00 00 00 e0 Microsoft i8010P Adapter
15...00 00 00 00 00 00 e0 Microsoft i8010P Adapter #2
=====

IPv4 Route Table
=====
Active Routes:
Network Destination Netmask Gateway Interface Metric
127.0.0.0 255.255.255.255 On-link 127.0.0.1 306
127.0.0.1 255.255.255.255 On-link 127.0.0.1 306
127.255.255.255 255.255.255.255 On-link 127.0.0.1 306
192.168.0.0 255.255.255.0 On-link 192.168.0.1 261
192.168.0.1 255.255.255.255 On-link 192.168.0.1 261
192.168.0.255 255.255.255.255 On-link 192.168.0.1 261
192.168.11.0 255.255.255.0 On-link 192.168.11.1 261
192.168.11.1 255.255.255.255 On-link 192.168.11.1 261
192.168.11.255 255.255.255.255 On-link 192.168.11.1 261
224.0.0.0 240.0.0.0 On-link 127.0.0.1 306
224.0.0.0 240.0.0.0 On-link 192.168.11.1 261
224.0.0.0 240.0.0.0 On-link 192.168.0.1 261
255.255.255.255 255.255.255.255 On-link 127.0.0.1 306
255.255.255.255 255.255.255.255 On-link 192.168.11.1 261
255.255.255.255 255.255.255.255 On-link 192.168.0.1 261
=====
Persistent Routes:
None

IPv6 Route Table
=====
Active Routes:
If Metric Network Destination Gateway
1 306 ::1::1 On-link
12 261 fe80:::64 On-link
14 261 fe80:::64 On-link
14 261 fe80::2886:d9f:89d6:7135:: On-link
12 261 fe80::0192:276e:ede:208d:: On-link
1 306 ff00:: On-link
12 261 ff00:: On-link
14 261 ff00:: On-link
=====
Persistent Routes:
None

C:\Users\Administrator>_

```

Figure 12 Shows the routing table.

Figure 12 shows the routing table for the network. It shows all the network ID's and their subnet masks. It also shows the interface; which network interface is used for forwarding to that destination. The metric is the 'cost' of that route, a lower 'cost' equals a better route.

Observational Questions

Q1. Identify the benefits of Type 1 Hypervisor software services and briefly evaluate some suitable products.

A type 1 hypervisor runs directly on top of hardware, it requires a reduced overhead so provides better performance and greater flexibility. Type 1 Hypervisors are often single-purpose servers [1].

Two popular type 1 hypervisors are Microsoft Windows Server 2012 Hyper-V and VMware vSphere. Windows server 2012 Hyper-V has multiple versions (including a free option) for different requirements, it is highly scalable but only supports a few guest OS options, it also requires Windows OS updates over its lifetime [2]. VMware VSphere contains widespread OS support and can support more guests per host than Windows Server. It also comes with high quality support. It is however less user friendly with a steep learning curve, there is a free version of VMware however this does not come with full functionality.

Q2. Define the role of Routers in the Network Architecture, what types can be used?

A router connects at least two networks, forwarding data packets between them according to routing tables and packet headers. Some examples of networks they are often connected by routers include LANs (Local Area Networks) or WANs (Wide Area Networks) or a Lan and its ISP [3].

There are a few types of routers such as core or edge routers, either of which can be wired or wireless or virtual routers.

A core router distributes data packets within a network but not between networks, an edge router is the opposite, sharing data packets between networks. Both can be wired or wireless routers.

Wired routers have a single port which connects to a modem for the reception of internet data packets and additional ports for connection to devices on the network such as computers or printers. The most common variety is the Ethernet broadband router, these support network address translation (NAT) technology allowing multiple computers to share a single IP address if connected to the same router. They utilise DHCP for communication between devices on the network and utilise stateful packet inspection (SPI) firewalls for security.

A wireless router connects to a modem via a cable but distributes data packets using antennae. The router establishes a wireless local area network (WLAN), with the most common standard being known as wi-fi. For security they often make use of media access control (MAC) addresses and Wi-Fi Protected Access (WPA) [4]. A virtual router uses Virtual Router Redundancy Protocol (VRRP), only becoming active if a physical router fails.

Q3. Identify and discuss the usage of common Routing Protocols, what are the associated benefits of using Routing Protocols?

There are two main types of routing protocol, distance vector and link state.

Distance vector protocols determine the best path to a network through distance, measured in the number of routers to the destination. To do this they send the entire routing table to each connected router and then the best routes are calculated using the Bellman-Ford algorithm. They are simpler to configure and manage. They do however run the risk of routing loops and require more bandwidth as they send the entire routing table. RIP and IGRP are two examples of distance vector routing protocols, with EIGRP being a third, more advanced protocol developed by Cisco.

Link state protocols work with the same basic idea as distance vector protocols but implemented differently. Instead of sending the entire routing table, they advertise the topology of the network, neighbouring routers, directly connected link etc. This provides each router using link state protocol the same topological database. This allows them to require less bandwidth and converge much faster than distance vector protocols. They do require more CPU and memory usage and are harder to configure than distance vector routing protocols. Each router utilising link state routing protocol creates three tables.

- A neighbouring table containing neighbouring routers with the same protocol.
- A topology table containing the entire network topology.
- A routing table containing the best routes.

The best path is calculated using the Shortest Path First algorithm. OSPF and IS-IS are examples of link state routing protocols[5].

Q4. Define the role of Routing Tables, what are they. Breakdown and analyse the information a Routing Table provides us with.

A routing table contains the information required for forwarding data packets to their destination via the best path. As each packet contains origin and destination data, when it is received at a network device it is examined and matched to a location on the routing table. That location will provide the best for the data packets destination, the device is then given instructions by the routing table to send the packet on to the next router in the network.

Each routing table contains;

- The destination IP of the data packets destination.
- The IP address where the data packet is forwarded.
- The network interface the device should use when forwarding to the next destination.
- The Metric, a cost assigned to each route to find the most cost-effective path.
- The routes, directly attached subnets, indirect subnets and default routes for certain types of traffic or for a lack of information.

Routing tables can be maintained manually or dynamically. If the table is for a static network, it can only be changed by a network administrator. In dynamic routing, routing protocols are used automatically to exchange information about the surrounding network to build and maintain devices routing tables. Dynamic routing tables can be used to respond to device failures or congestion [6].

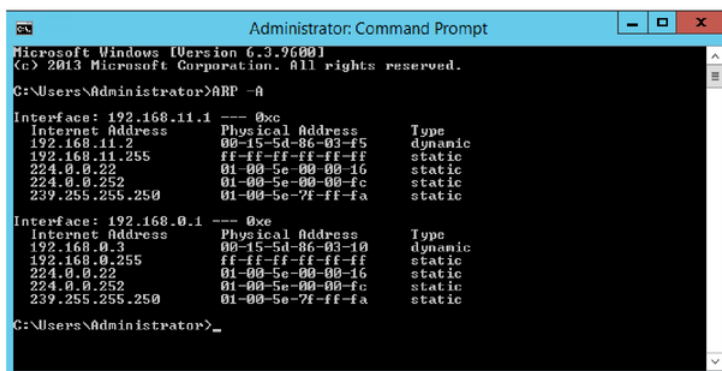
Q5. What is the Subnet Mask, what is the significance of this in the Routing Table?

A subnet mask is a 32-bit number which separates an existing IP address into discrete network and host addresses. The host section of an IP address can be further separated into additional subnets to route traffic within the larger subnet if necessary. The network section of an IP address is represented by a 1 in the subnet mask, and the host is represented by a 0.

In IPv4 addresses a subnet mask contains 4 bytes (32 bits). As 8 binary 1's is equal to 255 an example subnet mask is 255.255.255.0, this shows that the first three segments are the network portion and the final section is the host address [7]. When the routing table receives a data packet, its destination address is checked against the first subnet mask in the routing table. The result is compared against the network address of that router and if a match is found the packet is forwarded to the next hop address in that row, if not the process is continued on the next row of the routing table[8].

Worksheet 2

Task 1



```
Administrator: Command Prompt
Microsoft Windows [Version 6.3.9600]
(c) 2013 Microsoft Corporation. All rights reserved.

C:\Users\Administrator>arp -a

Interface: 192.168.11.1 --- 0xc
Internet Address      Physical Address      Type
192.168.11.2          00-15-5d-86-03-f5     dynamic
192.168.11.255        ff-ff-ff-ff-ff-ff     static
224.0.0.22            01-00-5e-00-00-16     static
224.0.0.252           01-00-5e-00-00-fc     static
239.255.255.250       01-00-5e-7f-ff-fa     static

Interface: 192.168.0.1 --- 0xe
Internet Address      Physical Address      Type
192.168.0.3           00-15-5d-86-03-f0     dynamic
192.168.0.255         ff-ff-ff-ff-ff-ff     static
224.0.0.22            01-00-5e-00-00-16     static
224.0.0.252           01-00-5e-00-00-fc     static
239.255.255.250       01-00-5e-7f-ff-fa     static

C:\Users\Administrator>
```

Figure 13 shows the Address Resolution Protocol (ARP) table from the Cardiff server.

Figure 13 Shows the Address Resolution Protocol from the Cardiff server.

Task 2

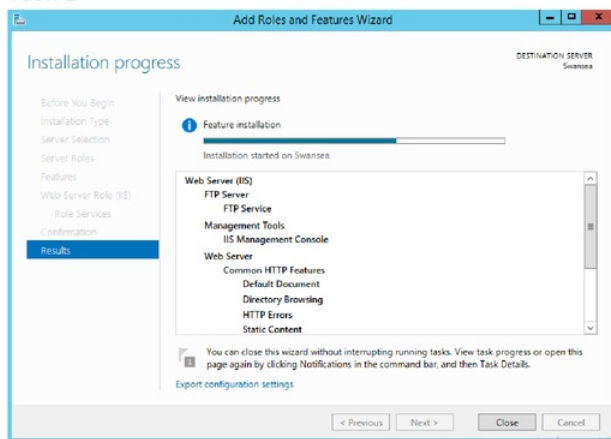


Figure 14 Shows the FTP service being added to the Swansea Server



Figure 15 Shows a new user being added to the FTP service.

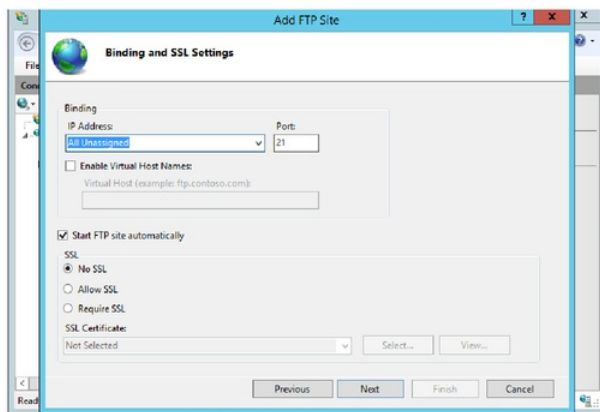


Figure 16 Shows the addition of a new FTP site.

Figures 14 through 18 show the stages of creating an FTP user and site. Figure 14 shows the installation of the FTP service, figure 15 and 17 show the creation and authorisation of a FTP user. Figure 16 and 18 show the creation of an FTP site.

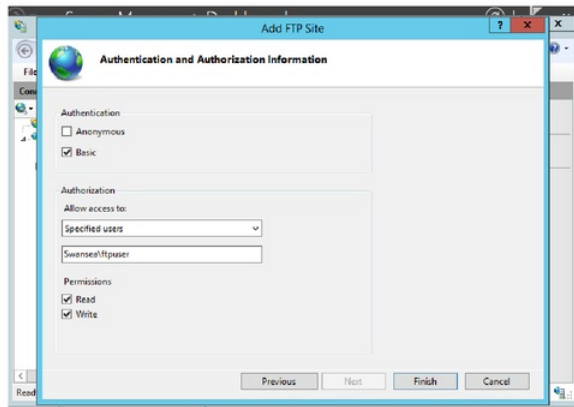


Figure 17 Shows the authentication of the FTP site.

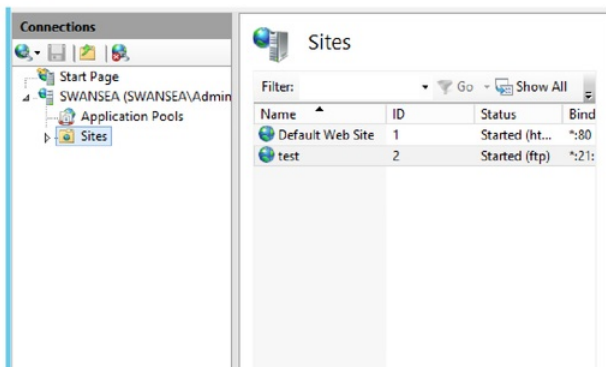


Figure 18 Shows that the new FTP site has been created.

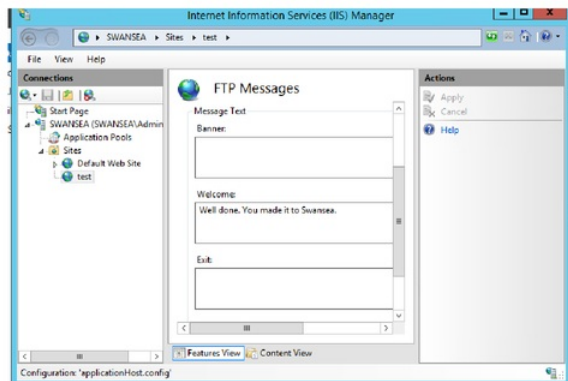


Figure 19 shows the addition of a welcome message to the newly created FTP site.

Figure 19 Shows the addition of a welcome message to the FTP server.

```
Administrator: Command Prompt - ftp 192.168.11.2
Microsoft Windows [Version 6.3.9600]
(c) 2013 Microsoft Corporation. All rights reserved.

C:\Users\Administrator>ftp 192.168.11.2
Connected to 192.168.11.2.
220 Microsoft FTP Service
User (192.168.11.2:(none)): Swansea\ftpuser
331 Password required
Password:
230 Well done. You made it to Swansea.
230 User logged in.
ftp> _
```

Figure 20 shows a successful connection to the FTP server from the Cardiff Server.

Figure 20 Shows a successful connection to the FTP server.

```
Administrator: Command Prompt - ftp 192.168.11.2
Microsoft Windows [Version 6.3.9600]
(c) 2013 Microsoft Corporation. All rights reserved.

C:\Users\Administrator>ftp 192.168.11.2
Connected to 192.168.11.2.
220 Microsoft FTP Service
User (192.168.11.2:(none)): Swansea\ftpuser
331 Password required
Password:
230 Well done. You made it to Swansea.
230 User logged in.
ftp> dir
200 PORT command successful.
125 Data connection already open; Transfer starting.
11-23-17 11:49AM 0 testftpdownload.txt
226 Transfer complete.
ftp> lcd c:\ftpdnloads
Invalid command.
ftp> lcd c:\ftpdnloads
Local directory now C:\ftpdnloads.
ftp> _
```

Figure 21 shows the directory for downloads

Figure 21 Shows the directory for FTP downloads being set.

```
Administrator: Command Prompt - ftp 192.168.11.2
(c) 2013 Microsoft Corporation. All rights reserved.

C:\Users\Administrator>ftp 192.168.11.2
Connected to 192.168.11.2.
220 Microsoft FTP Service
User (192.168.11.2:(none)): Swansea\ftpuser
331 Password required
Password:
230 Well done. You made it to Swansea.
230 User logged in.
ftp> dir
200 PORT command successful.
125 Data connection already open; Transfer starting.
11-23-17 11:49AM 0 testftpdownload.txt
226 Transfer complete.
ftp> lcd c:\ftpdnloads
Invalid command.
ftp> lcd c:\ftpdnloads
Local directory now C:\ftpdnloads.
ftp> get testftpdownload.txt
200 PORT command successful.
150 Opening ASCII mode data connection.
226 Transfer complete.
ftp> _
```

Figure 22 shows a successful download of a file from the FTP server.

Figure 22 Shows a successful download from the FTP server.

```
Administrator: Command Prompt - ftp 192.168.11.2
ftp> 63 bytes received in 0.01Seconds 12.60Kbytes/sec.
ftp> lcd c:\ftpdnloads
Invalid command.
ftp> lcd c:\ftpdnloads
Local directory now C:\ftpdnloads.
ftp> get testftpdownload.txt
200 PORT command successful.
150 Opening ASCII mode data connection.
226 Transfer complete.
ftp> lcd c:\ftpfilesupload
Local directory now C:\ftpfilesupload.
ftp> dir
200 PORT command successful.
150 Opening ASCII mode data connection.
11-23-17 11:49AM 0 testftpdownload.txt
226 Transfer complete.
ftp> put testftpuploads.txt
200 PORT command successful.
550 Access is denied.
ftp> put testftpuploads.txt
200 PORT command successful.
150 Opening ASCII mode data connection.
226 Transfer complete.
ftp> _
```

Figure 23 shows a successful upload from Cardiff to the FTP server.

Figure 23 Shows a successful upload to the FTP server.

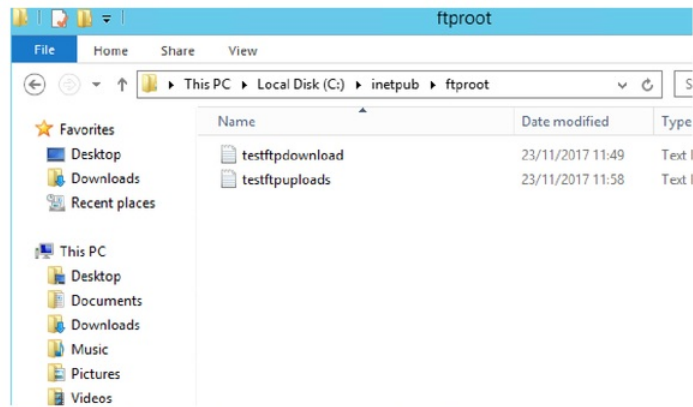


Figure 24 shows the file uploaded to the FTP server from Cardiff has been successful received in Swansea.

Figure 24 Shows the upload has been received in Swansea.

Task 3

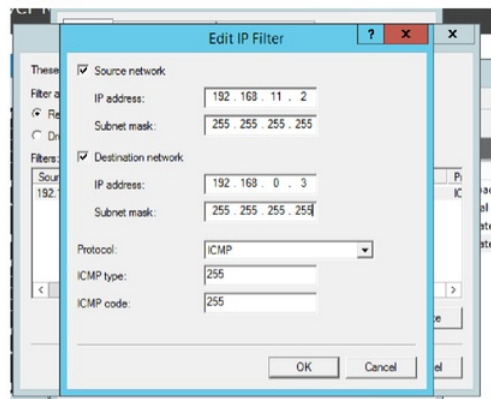


Figure 25 shows the inbound filter being set up, with figure 26 showing that the filter was successful in blocking Lab. Figure 27 shows that the filter was successful in only blocking Lab as it is still possible to ping Cardiff.

Figure 25 Shows the setting up of an Inbound filter.

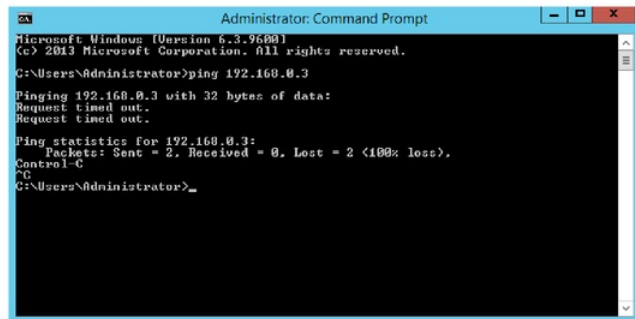


Figure 26 Shows that the inbound filter has been effective.

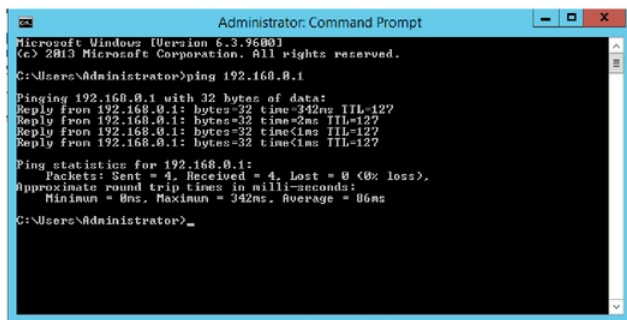


Figure 27 Shows that Swansea can still ping Cardiff.

Task 4

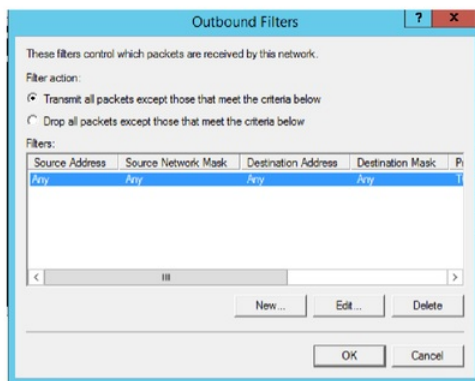


Figure 28 Shows the outbound filter set up to block access to the FTP.

Figure 28 shows the creation of an outbound filter designed to block all access to the FTP server. Figure 29 shows the success of that filter.

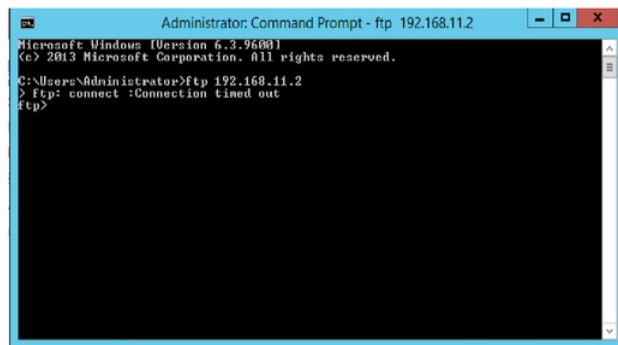
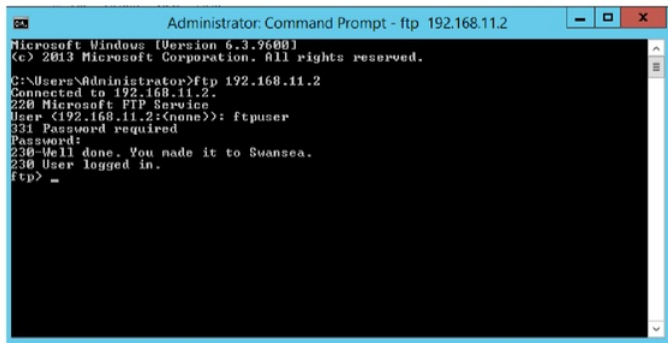


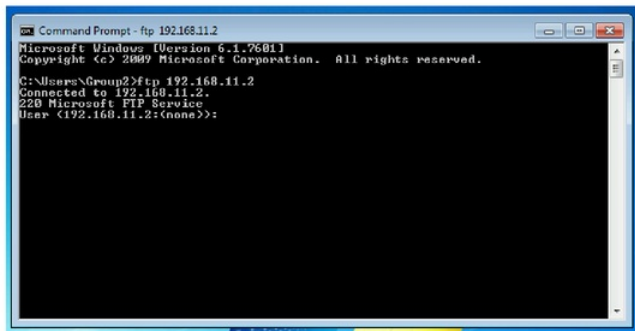
Figure 29 Shows that it is not possible to connect to the FTP.



```
Administrator: Command Prompt - ftp 192.168.11.2
Microsoft Windows [Version 6.3.9600]
(c) 2013 Microsoft Corporation. All rights reserved.

C:\Users\Administrator>ftp 192.168.11.2
Connected to 192.168.11.2.
220 Microsoft FTP Service
User (192.168.11.2:(none)): ftpusers
331 Password required
Password:
230 We'll done. You made it to Swansea.
230 User logged in.
ftp>
```

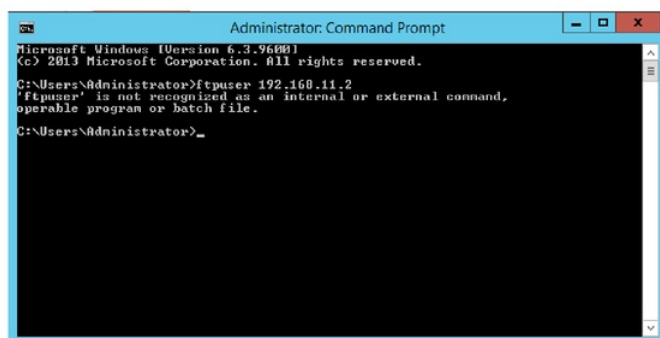
Figure 30 Shows that Cardiff is not blocked from accessing the FTP server.



```
Command Prompt - ftp 192.168.11.2
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

C:\Users\Group2>ftp 192.168.11.2
Connected to 192.168.11.2.
220 Microsoft FTP Service
User (192.168.11.2:(none)): ftpusers
331 Password required
Password:
230 We'll done. You made it to Swansea.
230 User logged in.
ftp>
```

Figure 31 Shows the FTP server is blocked from Lab.

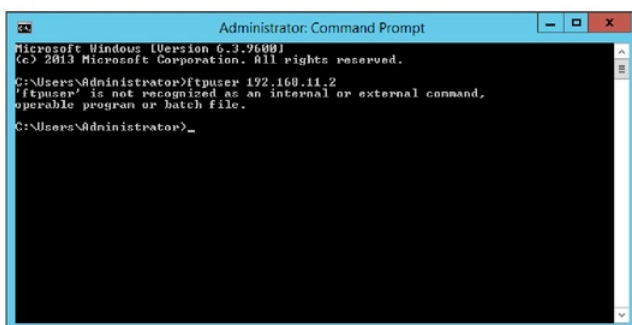


```
Administrator: Command Prompt
Microsoft Windows [Version 6.3.9600]
(c) 2013 Microsoft Corporation. All rights reserved.

C:\Users\Administrator>ftpuser 192.168.11.2
'ftpuser' is not recognized as an internal or external command,
operable program or batch file.

C:\Users\Administrator>
```

Figure 32 Shows the FTP server is blocked from Swansea.



```
Administrator: Command Prompt
Microsoft Windows [Version 6.3.9600]
(c) 2013 Microsoft Corporation. All rights reserved.

C:\Users\Administrator>ftpuser 192.168.11.2
'ftpuser' is not recognized as an internal or external command,
operable program or batch file.

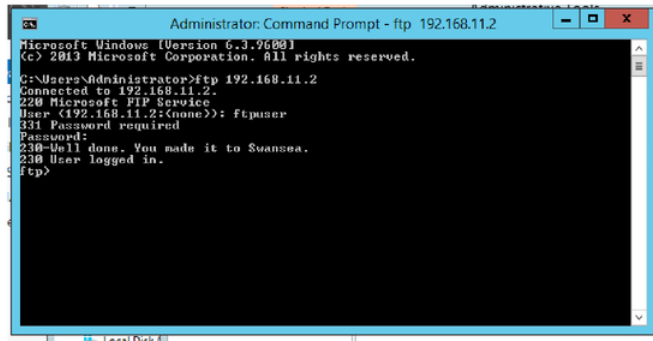
C:\Users\Administrator>
```

Figure 33 Shows that Cardiff is blocked from accessing the FTP server.

Figures 30 through 32 show the inbound filter designed to block both Swansea and Lab from accessing the FTP server whilst allowing Cardiff to access it. Figure 30 shows that Cardiff still has access whilst figure 31 and 32 show that Swansea and Lab do not.

Figure 33 shows that the third outbound filter removes access for Cardiff when trying to reach the FTP server.

Task 5

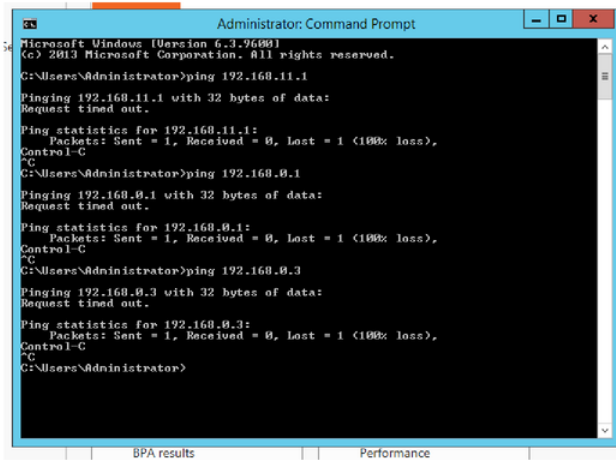


```
Administrator: Command Prompt - ftp 192.168.11.2
Microsoft Windows [Version 6.3.9600]
(c) 2013 Microsoft Corporation. All rights reserved.

C:\Users\Administrator>ftp 192.168.11.2
Connected to 192.168.11.2.
220 Microsoft FTP Service
User (192.168.11.2:(none)): ftpuser
331 Password required
Password:
230-Well done. You made it to Swansea.
230 User logged in.
ftp>
```

Figure 34 shows that Cardiff is still able to access the FTP server.

Figure 34 Shows that Cardiff is still able to access the FTP server.



```
Administrator: Command Prompt
Microsoft Windows [Version 6.3.9600]
(c) 2013 Microsoft Corporation. All rights reserved.

C:\Users\Administrator>ping 192.168.11.1
Pinging 192.168.11.1 with 32 bytes of data:
Request timed out.

Ping statistics for 192.168.11.1:
    Packets: Sent = 1, Received = 0, Lost = 1 (100% loss),
    Control-C
^C

C:\Users\Administrator>ping 192.168.0.1
Pinging 192.168.0.1 with 32 bytes of data:
Request timed out.

Ping statistics for 192.168.0.1:
    Packets: Sent = 1, Received = 0, Lost = 1 (100% loss),
    Control-C
^C

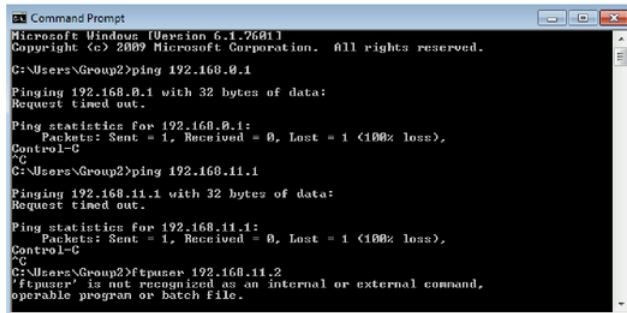
C:\Users\Administrator>ping 192.168.0.3
Pinging 192.168.0.3 with 32 bytes of data:
Request timed out.

Ping statistics for 192.168.0.3:
    Packets: Sent = 1, Received = 0, Lost = 1 (100% loss),
    Control-C
^C

C:\Users\Administrator>
```

Figure 35 and 36 show that Swansea and Lab respectively are unable to access the FTP server or ping any of the servers as intended.

Figure 35 Shows that Swansea is unable to ping or access the FTP server.



```
Command Prompt
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

C:\Users\Group2>ping 192.168.0.1
Pinging 192.168.0.1 with 32 bytes of data:
Request timed out.

Ping statistics for 192.168.0.1:
    Packets: Sent = 1, Received = 0, Lost = 1 (100% loss),
    Control-C
^C

C:\Users\Group2>ping 192.168.11.1
Pinging 192.168.11.1 with 32 bytes of data:
Request timed out.

Ping statistics for 192.168.11.1:
    Packets: Sent = 1, Received = 0, Lost = 1 (100% loss),
    Control-C
^C

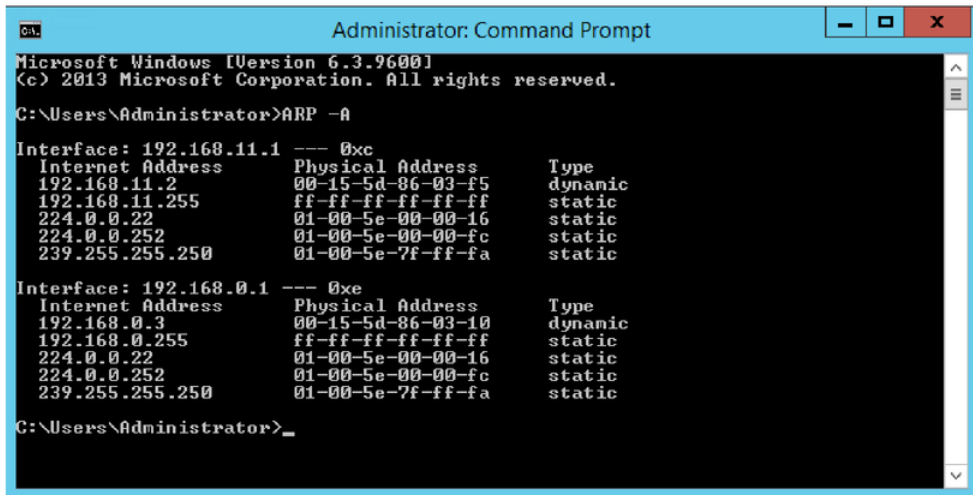
C:\Users\Group2>ftpuser 192.168.11.2
'ftpuser' is not recognized as an internal or external command,
operable program or batch file.
```

Figure 36 Shows that Lab is unable to ping or access the FTP server.

Observational Questions

Q1. Describe (using appropriate illustrations) how the ARP process operates in Networking Contexts?

ARP maps an IP address to a MAC address within a local network. IPv4 is the most common type of Internet Protocol in use and each address is 32 bits long whereas a MAC address is 48 bits long when in a local area network connected via Ethernet. An ARP table (or ARP cache) as seen in figure 37 keeps the correlation between corresponding IP and MAC addresses. When a gateway receives an incoming packet for a particular machine, the ARP program checks its cache and provides the address if it finds it, so that the packet can be converted to the right length and format and then be sent on. If no entry is found in the cache for the destination PC a broadcast is sent out to all machines on the LAN to find a machine with the associated IP address. If a machine is found it returns a reply and the ARP updates its table for future reference and sends on the packet [9].



```
Administrator: Command Prompt
Microsoft Windows [Version 6.3.9600]
(c) 2013 Microsoft Corporation. All rights reserved.

C:\Users\Administrator>arp -a

Interface: 192.168.11.1 --- 0xc
Internet Address      Physical Address      Type
192.168.11.2          00-15-5d-86-03-f5     dynamic
192.168.11.255        ff-ff-ff-ff-ff-ff     static
224.0.0.22            01-00-5e-00-00-16     static
224.0.0.252           01-00-5e-00-00-fc     static
239.255.255.250       01-00-5e-7f-ff-fa     static

Interface: 192.168.0.1 --- 0xe
Internet Address      Physical Address      Type
192.168.0.3           00-15-5d-86-03-10     dynamic
192.168.0.255         ff-ff-ff-ff-ff-ff     static
224.0.0.22            01-00-5e-00-00-16     static
224.0.0.252           01-00-5e-00-00-fc     static
239.255.255.250       01-00-5e-7f-ff-fa     static

C:\Users\Administrator>_
```

Figure 37 shows the ARP of the local network.

Q2. What is Packet Filtering? In our context, why is Packet Filtering termed 'IP Packet' Filtering? Why would you use Packet Filtering in your Network? What are the perceived benefits?

Packet filtering is a technique used by the firewall to monitor and control incoming and outgoing data packets. Whether a data packet is allowed through depends on a few things such as the source or destination IP addresses, protocols and ports. It is termed IP packet filtering because we are filtering it based on the source and destination IP addresses. It allows you to block data

packets the come from outside a LAN by denying all IP addresses bar those on the network. They are quick to set up and can process packets quickly [10].

Q3. Why is it possible for contradictory filters to occur when you use packet filtering?
Give an example of a Contradictory Filter:

If two filters overlap a conflict could occur causing ambiguity in the classification of a data packet. This can result in a data packet being mapped to multiple filters each designed to act in a different way leading to a conflict in the classification of that data packet [11].

Contradictory filters could occur if one interface allows incoming traffic but the output filter on the second interface blocks that traffic from being sent [12].

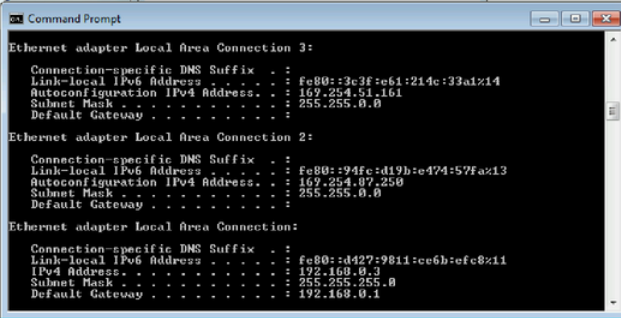
Q4. FTP Server is just one Role/Service we can configure our Server to provide? What other roles can the Server provide that would benefit our Infrastructure in both a *local* and *remote* context?

A server can provide many roles, such as Active Directory, File, Print, DNS, Web services (IIS).

Active Directory stores data about users, computers and printers on the network, it helps administrators to manage all the resources. DNS Can be used to assign logical names to IP addresses. Print services allow printers on a server to be managed and published in the Active Directory. File services can manage file sharing on a network.

Worksheet 3

Task 1



```
Command Prompt

Ethernet adapter Local Area Connection 3:

Connection-specific DNS Suffix . : 
Link-local IPv6 Address . . . . . : fe80::3c3f:e61:214c:33a1%14
Autoconfiguration IPv4 Address. . . : 169.254.51.161
Subnet Mask . . . . . : 255.255.0.0
Default Gateway . . . . . : 

Ethernet adapter Local Area Connection 2:

Connection-specific DNS Suffix . : 
Link-local IPv6 Address . . . . . : fe80::94fe:d19b:e474:57fa%13
Autoconfiguration IPv4 Address. . . : 169.254.87.250
Subnet Mask . . . . . : 255.255.0.0
Default Gateway . . . . . : 

Ethernet adapter Local Area Connection:

Connection-specific DNS Suffix . : 
Link-local IPv6 Address . . . . . : fe80::d427:9811:ce6b:efc8%11
IPv4 Address. . . . . : 192.168.0.3
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : 192.168.0.1
```

Figure 38 shows the automatically configured IP addresses from Lab.

Figure 38 Shows the Automatic Private IP Addresses from Lab.

```

C:\Users\Group2>ipconfig /release

Ethernet adapter Local Area Connection:

    Connection-specific DNS Suffix  . : 
    Link-local IPv6 Address . . . . . : fe80::d427:9811:ce6b:efc8x11
    IPv4 Address. . . . . : 192.168.0.3
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.0.1

Tunnel adapter isatap.{1E32251F-E7BD-4D8B-AFS2-P4F3537D680D}:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . : 

Tunnel adapter isatap.{906EBD4-065F-4479-BD99-500B55E7C721}:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . : 

Tunnel adapter isatap.{26F1B30E-3C73-4C17-B7DD-E8F0F276E56A}:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . : 

C:\Users\Group2>

```

Figure 39 Shows the ipconfig/release from Lab.

Figure 39 and 40 show the ipconfig /release and /renew from lab. The /renew failed, this was expected as there was no DHCP to contact.

```

C:\Users\Group2>ipconfig /renew

Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

C:\Users\Group2>ipconfig /renew

Windows IP Configuration

An error occurred while renewing interface Local Area Connection 3 : unable to contact your DHCP server. Request has timed out.

```

Figure 40 Shows the ipconfig/renew from Lab.

```

Administrator: Command Prompt

Tunnel adapter isatap.{9BD2801D-3EBE-4038-8EC3-9FB6F1E43D05}:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . : 

C:\Users\Administrator>ipconfig /renew

Windows IP Configuration

An error occurred while renewing interface Ethernet 3 : unable to contact your DHCP server. Request has timed out.

C:\Users\Administrator>ping 192.168.0.3

Pinging 192.168.0.3 with 32 bytes of data:
PING: transmit failed. General failure.
PING: transmit failed. General failure.
PING: transmit failed. General failure.
PING: transmit failed. General failure.

Ping statistics for 192.168.0.3:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\Users\Administrator>

```

Figure 41 Shows a failed ping from Swansea to Lab.

Figure 41 and 42 show failed pings from Swansea to Lab and vice versa. This was expected as there is no assigned default gateway.

```

C:\Users\Group2>ping 192.168.11.2

Pinging 192.168.11.2 with 32 bytes of data:
PING: transmit failed. General failure.
PING: transmit failed. General failure.
PING: transmit failed. General failure.

Ping statistics for 192.168.11.2:
    Packets: Sent = 3, Received = 0, Lost = 3 (100% loss),
    Control-C
C:\Users\Group2>

```

Figure 42 Shows a failed ping from Lab to Swansea.

Task 2

Task 2 was simply installing the DHCP server onto the Cardiff Server.

Task 3

Task 3 was to authorise the DHCP server installed during Task 2.

Task 4

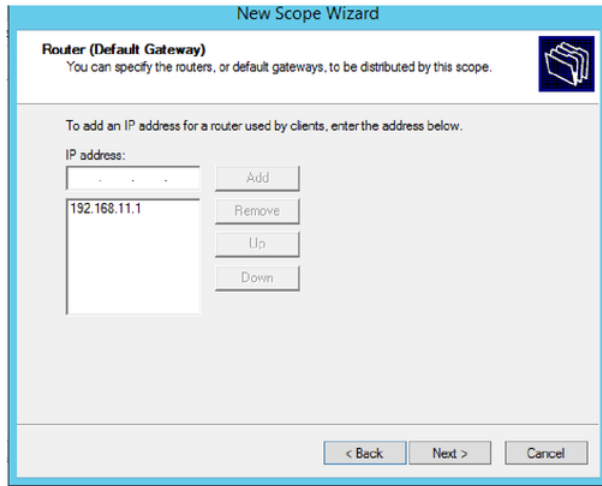
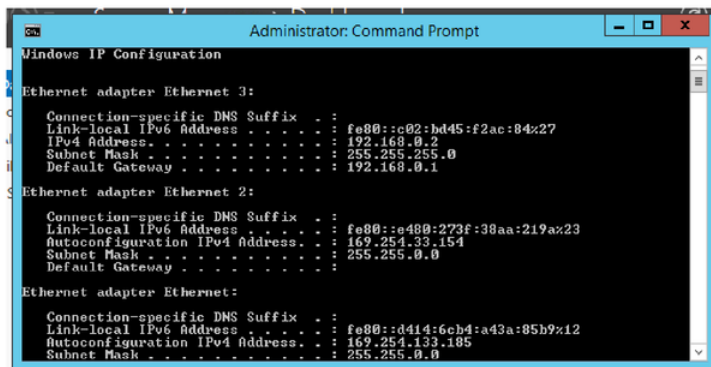


Figure 43 shows the addition of a new DHCP scope to the Cardiff server.

Figure 43 Shows the addition of a new scope to Cardiff.



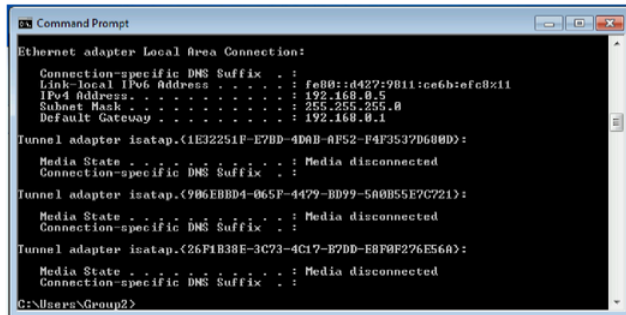
Shows that the IP address of Swansea is the DHCP server IP address for the Partner Network Connection.

Figure 44 Shows the IP address for the Partner Network Connection is Swansea.

Why is it important to use Reservations when using DHCP?

Reservations make sure that a specific device on a subnet always receives the same IP address. This is extremely handy for devices such as servers without support for DNS dynamic updates [13].

Task 5



```
Command Prompt
Ethernet adapter Local Area Connection:
    Connection-specific DNS Suffix . : 
    Link-local IPv6 Address . . . . . : fe80::d427:9811:ce6b:efc8%11
    IPv4 Address. . . . . : 192.168.0.5
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.0.1

Tunnel adapter isatap.{1E32251F-E7BD-4DAB-AF52-F4F3537D688D}:
    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix . : 

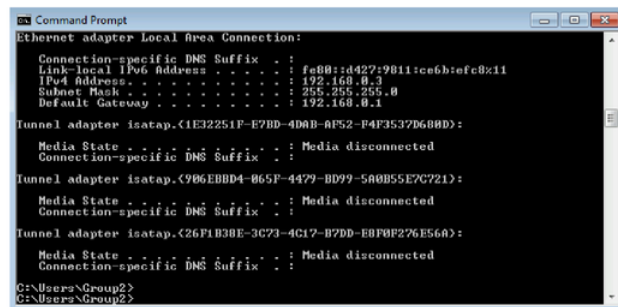
Tunnel adapter isatap.{906EBBD4-065F-4479-BD99-5A0B55E7C721}:
    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix . : 

Tunnel adapter isatap.{26F1B38E-3C73-4C17-B7DD-EBF0F276E56A}:
    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix . : 

C:\Users\Group2>
```

Figure 45 shows the IP config displaying the IP address of Lab to be 192.168.0.5.

Figure 45 shows the IP address at the Lab client set to 0.5.



```
Command Prompt
Ethernet adapter Local Area Connection:
    Connection-specific DNS Suffix . : 
    Link-local IPv6 Address . . . . . : fe80::d427:9811:ce6b:efc8%11
    IPv4 Address. . . . . : 192.168.0.3
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.0.1

Tunnel adapter isatap.{1E32251F-E7BD-4DAB-AF52-F4F3537D688D}:
    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix . : 

Tunnel adapter isatap.{906EBBD4-065F-4479-BD99-5A0B55E7C721}:
    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix . : 

Tunnel adapter isatap.{26F1B38E-3C73-4C17-B7DD-EBF0F276E56A}:
    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix . : 

C:\Users\Group2>
C:\Users\Group2>
```

Figure 46 shows the IP config displaying the IP address of Lab to be 192.168.0.3.

Figure 46 Shows the IP address at the Lab client set to 0.3.

Observational Questions

Q1. Define the role of the DHCP Server in your Network?

Dynamic Host Configuration Protocol (DHCP) is a protocol that automatically provides an IP host with an IP address, subnet mask and default gateway. Because it is done automatically without a user input it minimises configuration errors such as typing errors or conflicts. It reduces required network administration by centralising and automating TCP/IP configuration whilst efficiently handling the changes of IP addresses for devices that change locations on the network often.

The server maintains a pool of IP addresses and leases them to a DHCP enabled device when it is turned on and connected to the network. Any IP address that is no longer in use is automatically returned to be reallocated [14].

Q2. What happens when we have dynamically configured TCP/IP for our NIC, but then consequently cannot contact a DHCP server?

If a DHCP server cannot be contacted the DHCP client checks alternate configuration settings. Here there are two options, Automatic private IP address or User Configured. If Automatic private IP address is chosen the client automatically configures an IP address and subnet mask and test for address conflicts on the network, it will retry this up to 10 times. It configures its IP address and subnet mask from the Microsoft-reserved Class B network 169.254.0.0 with the subnet mask 255.255.0.0. If User Configured was selected, the client configures a static IP address and tests for a conflict. If a conflict is found it will indicate that to the user [15].

Q3. Illustrate (with illustrations!!) the 4 stage process involved when DHCP clients look to obtain an IP address via DHCP?

There are four main stages to DHCP clients attempting to get an IP address via DHCP. These stages are discussed below and shown in figure 47 [16].

- DHCPDISCOVER where the client broadcasts a DHCP server request.
- DHCPOFFER a DHCP server on the network offers than client an address.
- DHCPREQUEST the client broadcasts a request to lease an IP address from one of the DHCP servers that offered an address in the previous stage.
- DHCPACK the DHCP server acknowledges the client and assigns it the configured DHCP settings, whilst updating its database. The client can then begin network communication having bound its TCP/IP protocol and initialising. [16]

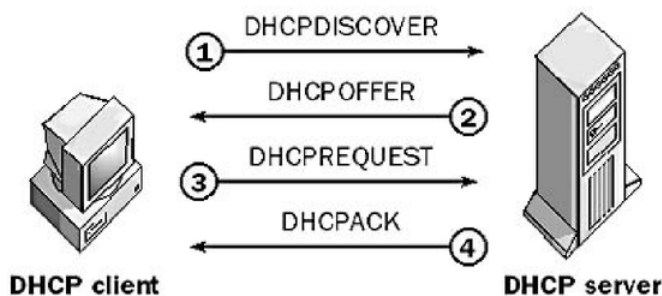


Figure 47 Shows the 4 stages of a DHCP client obtaining a DHCP IP Address

Q4. Describe the advantages of using a relay agent. Explain (with descriptions and illustrations) how and why we would setup the Relay Agent on our Router?

A relay agent is a small program which relays a specific type of message to other hosts on a network. They are used when the client and the server are on separate physical subnets [17]. Relay agents allow fewer DHCP servers to support multiple subnets and they allow precise control of DHCP network traffic, reducing the number of broadcast based traffic on the network [18]. Relays are not the same as forwarding. Forwarding sends the packet from one interface to the next without any additional processing whereas a relay processes the

packet and may make changes to the original packet [19]. An illustrative configuration for a DHCP relay agent is shown in figure 48 [20].

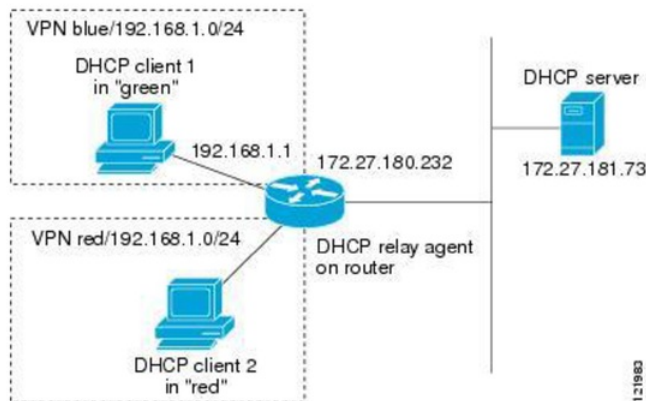


Figure 48 Shows a DHCP relay agent configuration.

Worksheet 4

Task 1

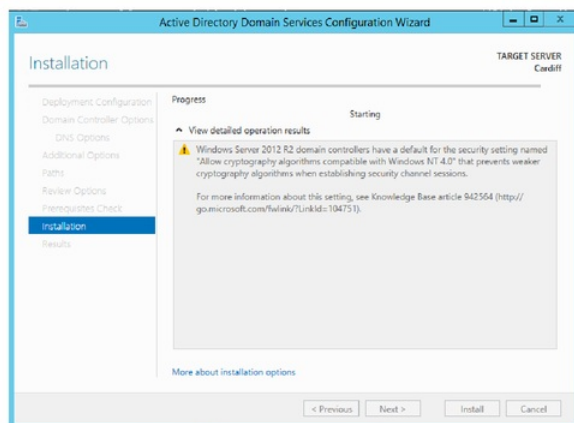


Figure 49 Shows the addition of Active Director Domain Services to Cardiff.

Figure 49 shows the addition of Active Director Domain Services (ADDS) to the Cardiff Server.

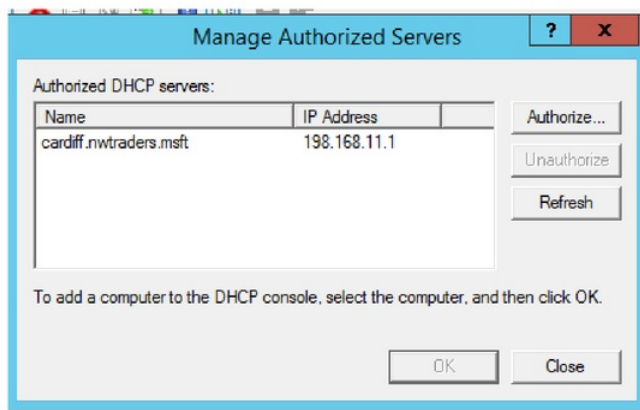
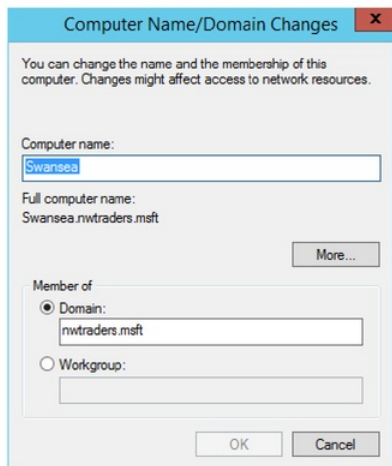


Figure 50 shows the Cardiff server as an authorised DHCP server.

Figure 50 Shows the authorisation of the DHCP server on Cardiff.



Figures 51 and 52 show the addition of both Swansea and Lab to the nwtraders.msft domain.

Figure 51 Shows that Swansea has been added to the nwtraders.msft domain.

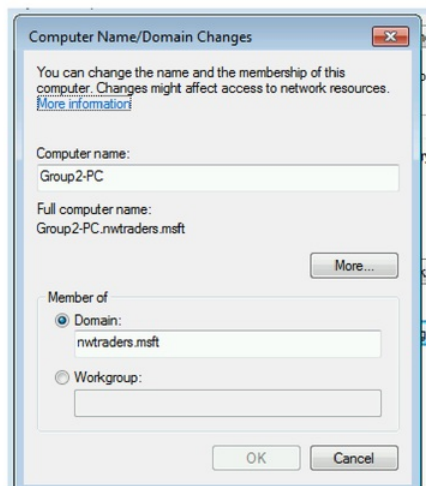
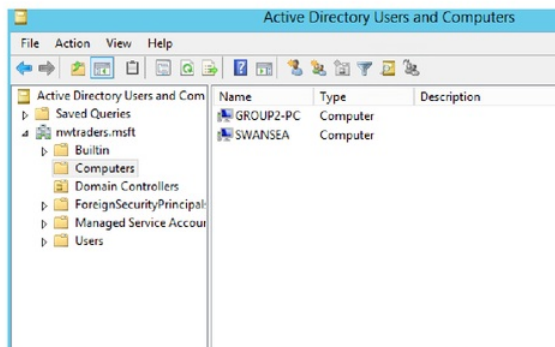


Figure 52 Shows that lab has been added to the nwtraders.msft domain.



Figures 53 and 54 show that Cardiff, Swansea and lab (displayed as Group2-PC) are all now successfully added to

Figure 53 Shows both Lab and Swansea on the nwtraders.msft domain.

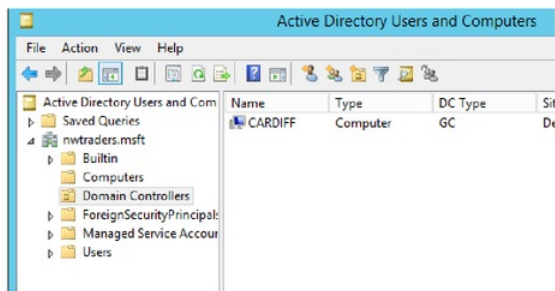


Figure 54 Shows Cardiff as the domain controller for the nwtraders.msft domain.

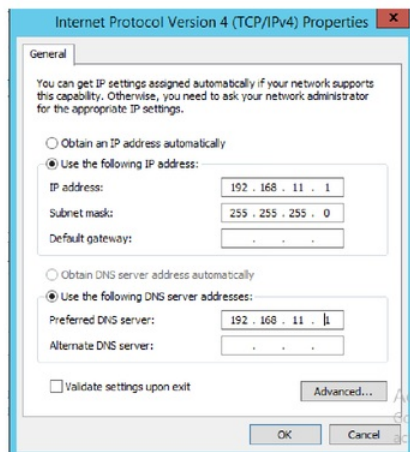


Figure 55 demonstrates how a server would be made a client of itself.

Figure 55 Shows Cardiff acting as a client of itself.

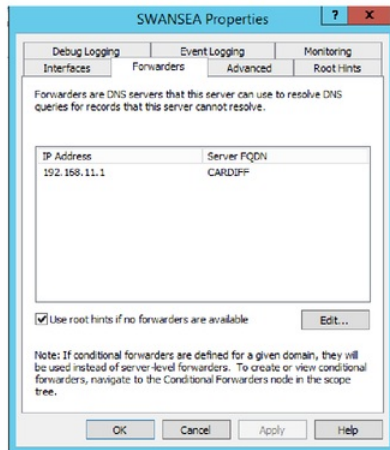


Figure 56 shows that Swansea is using a DNS forwarder with Cardiff being the selected forwarder.

Figure 56 Shows a DNS forwarder being setup between Swansea and Cardiff.

Server Fully Qualified Domain Name (FQDN)	IP Address
192.168.11.2	[192.168.11.2]
a.root-servers.net.	[198.41.0.4]
b.root-servers.net.	[192.228.79.201]
c.root-servers.net.	[192.33.4.12]
d.root-servers.net.	[199.7.91.13]
e.root-servers.net.	[192.203.230.10]

Figure 57 shows that Swansea is the root hints address of Cardiff.

Figure 57 Shows the root hints from the Cardiff server.

```
C:\Users\Administrator>ipconfig /flushdns
Windows IP Configuration
Successfully flushed the DNS Resolver Cache.
```

Figure 58 shows a successful clearing of the DNS cache of Cardiff.

Figure 58 Shows that the DNS cache of Cardiff has been cleared.

Task 2

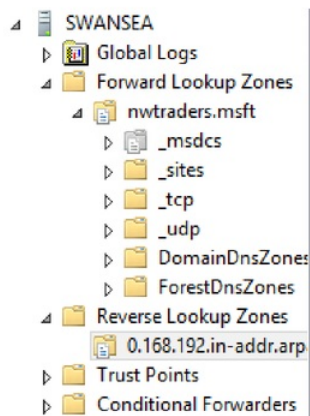


Figure 59 shows that the Swansea server has both forward and reverse look up zones configured.

Figure 59 Shows a reverse look up zone on Swansea.

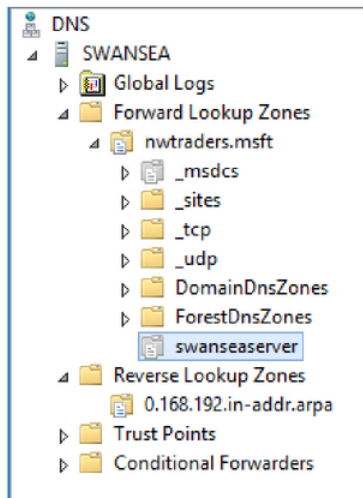


Figure 60 shows that the zone transfer using DNS has been successful on the Swansea server.

Figure 60 Shows that the zone transfer has taken place on Swansea.

Task 3

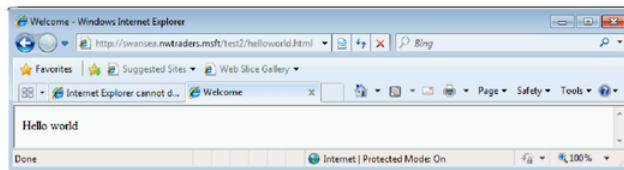


Figure 61 Shows the successful loading of the test site from the domain server.

Figure 61 shows that loading the test2 site that displays Hello World has been successfully done via the Swansea Network.

Observational Questions

Q1. What steps does a client take (what is the process involved) when trying to resolve a Name to an IP address?

DNS is a way of naming computers and then converting this between names and IP addresses. This is used because domain names are considerable easier to remember. When a client requests a file from another client on the network, the name of that client is put through a Name Resolution Service (NRS) which returns the IP address of that client allowing the client to retrieve the required resources.

Q2. Describe how the Recursive Query and Iterative Query Processes resolve DNS Client Requests?

A recursive query does not allow a DNS server to refer the client to a different DNS server, it requires that the server responds to the clients request with either the requested resource record or an error message. An iterative query

however allows the DNS server to return an answer based on its cache or zone data, if the server does not have an exact match it can return a referral to another DNS server [21].

Q3. Explain the significance of root hints and how this process enables us to resolve names that are not managed (or kept in an authoritative DNS server in our network)?

The root hints file holds the information that is required for resolving names outside of the authoritative DNS domains. Within it there are the names and addresses of root DNS servers. Root hints use iterative queries [22]. If a DNS client is querying a domain, and a DNS server is unable to locate an authoritative server for the domain it needs to be able to query the root servers for the DNS namespace. The root servers can then offer the DNS server a referral to the authoritative server which can in turn be referred to the DNS client [23].

Q4. We have a Server called **Server1**, this server will be hosted in a subdomain called 'subcontA' with a root domain called **nwtraders.msft**, answer the following questions:

(1). *What is the exact FQDN for this host.*

(2). *Illustrate how the Domain Name System breaks up this FQDN into Host and Domain Namespace.*

(1). *What is the exact FQDN for this host.*

The FQDN is **Server1.subcontA.nwtraders.msft**.

(2). *Illustrate how the Domain Name System breaks up this FQDN into Host and Domain Namespace.*

The FQDN is broken into two parts, the host name and the domain name. In this case the host name is **Server1**. The domain name can include a subdomain, in the case of this question as there is both a subdomain and a primary domain the subdomain (subcontA) comes prior to the primary domain (nwtraders.msft) [24].

Q5. Explain how DNS Zones are used in DNS, give examples to illustrate the use of multiple zones and how these can be used to manage resource records of domains. What important factors/characteristics do we need to be aware of?

A DNS zone is a certain portion within the global DNS. Each zone is managed by certain entities and represents a boundary of authority. They are organized in a hierarchical order of cascading lower-level domains forming the DNS namespace [25].

Websites are an example of multiple levels of DNS zones. Starting with the root domain, simply '.' The next level domain in the hierarchy is a top-level domain such as 'com', 'net', 'org' or 'uk'. There are second-level domains below this such as 'org.uk'.

Each DNS record has both a type, and a name. They are organized according to the data contained within them. Two common types of record are 'A' and 'MX'. An 'A' record maps a name to an IPv4 address whilst an 'MX' maps a name to a mail server [26].

Worksheet 5

You are required to evaluate a suitable clustering strategy for hosting a '3-tier web development system.

What is a 3-tier web development system?

A 3 tier web development system is a method of developing a web database application based around the 3 tier model. The three tiers in hierarchical order are [27], [28];

1. The client tier.
2. The application tier.
3. The database tier.

The first tier is the client tier or the interface, this usually consists of a web hosting, including the graphical user interface (GUI) and interactive forms and windows. It comprises of web browsers for HTTP clients using standard protocols to efficiently co-ordinate and interact with the client.

The second tier is the application tier, sometimes known as the business logic. This is located on a server or shared computer and acts as the server for the client requests from the interface. It determines what data is needed and where it is located. It acts as a mid-point between the client interface and the database. It does this by taking the inputs and selections from the client tier and reaching out to the database to retrieve the requested data [27], [28].

The third and final tier is the database tier, which includes both the database and the required database management system (DBMS) to access its contents.

What is a cluster?

Clustering is using multiple servers, combined via a network, to add redundancy and split the workload. This increases the complexity but as it requires not specialist hardware it reduces the cost. By running tasks on multiple machines can drastically increase the time taken to complete individual tasks with consideration to Amdahl's Law.

There are three main types of cluster, Compute/High Performance clusters, Failover clusters and network load balancing clusters.

High performance clusters are designed to utilise parallel computing and consists of a multitude of computers (or nodes) configured identically. Within the high-performance cluster there are two main types of node. The compute node where the computing is undertaken, these can execute one or more tasks whilst accounting for a schedule. The master node is where the administrative task are undertaken, these include administrative orders to individual nodes or keeping track of the status of individual nodes [29]. These are used to complete highly complex tasks such as protein unwinding and scientific calculations.

A failover cluster, on the other hand, prioritises redundancy, these are vital within businesses and anywhere which requires 100% uptime. If one of the nodes fail, another can pick up its workload with no downtime. They are made up of between 2 and 8 identical servers connected to at least 2 switches and 2 storage area networks (SANs). The servers must be identical to ensure total compatibility and the switches connect all the servers and SANs together. Unlike high-performance clusters where tasks and applications are parallelised, on failover clusters they can only exist on one physical server at a time [30].

The last type of cluster is a Network load balancing cluster. These are less complex than failover clusters whilst providing scalability and reliability to complex applications. Scalability is important for handling client requests in large quantities without unnecessary and unwanted delays. They are used commonly in services such as Web, terminal, proxy, virtual private networking (VPN) and streaming media. It is particularly useful to enterprises deploying services requiring e-commerce applications with links to back end databases and other services like transaction applications. NLB can distribute IP traffic to multiple instances of a service such as a web server, with each instance running off a host located within the cluster. If the requirements for the server increase an additional server can be plugged into the cluster for easy scalability [31].

Evaluation of a suitable clustering strategy

The three tiers of a web development system are, a client interface, application/business logic, and a database. These tiers considered, a network load balancing cluster would be the most suitable clustering strategy for hosting a 3-tier web development system.

A high-performance clustering strategy is only required for highly intensive tasks and as a result, the cost and complexity of implementing such a strategy would be drastically more than is required. A system such as this would be easily capable of handling the required tasks and an increasing amount of client requirements. Much of this computing power would be wasted daily however making this an ineffective strategy.

A failover cluster would provide excellent redundancy for the system, this strategy is still overly complex however. As applications and tasks are not parallelised, it would also struggle to keep up with the requirements of multiple clients attempting to access the applications and database.

Ergo a network load balancing cluster would be the most suitable strategy. It provides easy scalability with strong reliability. This scalability is ideal for the handling of large quantities of client requests whilst the reliability minimises the risk of downtime or slowdowns. As it is able to distribute IP traffic to multiple server instances whilst providing links to other applications and the back end database.

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FINAL GRADE

GENERAL COMMENTS

Instructor

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Comment 1

This is a run-on sentence.



Comment 2

Some of this is a tad too close to the original source material for comfort.

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Comment 3

Far too close to the original source.

PAGE 9



Comment 4

No apostrophe here - you'd say "binary ones" not "binary one's".

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GRADING FORM: SMU GENERIC_GJ

EDWARD RUSSELL

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RESEARCH-INFORMED LITERATURE

 A very good number of sources used, though a massive over-reliance on dubious web sources. I have a feeling that your primary research methodology for this work was to google the question and cite what you found. While that's not necessarily an issue for finding information, you should always aim to cite peer reviewed sources, e.g. journal articles, which've been through formal review before publication. Some web sources can be acceptable - e.g. you've used TechNet in a fair few places. Microsoft can be considered authoritative, though not necessarily objective on their technologies - fine to cite, though caution must be taken when talking about anything potentially subjective.

6

KNOWLEDGE AND UNDERSTANDING

 Some fairly good knowledge and understanding demonstrated. While the report itself is actually plenty long enough, it is a little brief in key areas (e.g. some of the specifics of filtering).

13

ANALYSIS

 Some synthesis of material, though you adhere a little too closely to the "say one thing, cite one source" approach, which has a tendency to result in material which is rather too close to the original source(s), and, as in this case, often results in slightly superficial analysis. You may also want to consider including some more robust concluding remarks - this'd actually help tie your report together better.

11

PRACTICAL APPLICATION AND DEP.

 Some very good practical work, worksheets completed to a reasonable standard. Comments are generally good, though a tad low on detail where there're complex things to explain. A few key images would also help - e.g. other than one obscure screenshot, there's a lack of depiction of the other side of the DHCP process.

26

SKILLS FOR PROFESSIONAL PRAC.

 You write fairly well - be careful with apostrophes and hyphens. A reasonably well-presented document.

7