Hardwarepraktikum

am Lehrstuhl III, Universität Würzburg

Internet-Technologien

Internet Routing

**Zuordnung der Kabel**

|  |  |
| --- | --- |
|  | Kabel Nummer |
| PC Flensburg (port1/2) | 1 |
| Tel für Flensburg(port 3/4) | 5 |
| PC für Distelhausen(port 5/6) | 3 |
| Tel für Distelhausen(port7/8) | 2 |
| Nessos FE 0/2/0 | Internet Distel |
| Styx FE 0/2/0 | Internet Flens |

|  |  |
| --- | --- |
| Nessos FE 0/1/0 | Port 9 |
| Styx FE 0/1/0 | Port 10 |

|  |  |
| --- | --- |
| Nessos GE 0/0 | Ate GE 0/0 |
| Styx GE 0/1 | Ate GE 0/1 |

**Routerkonfiguration :**

**Used commands :**

***Router#configure terminal*** : used to enter in global configuration mode**.**

***Router(config)#interface serial 0/0/0*** : used to enter in interface mode.

***Router(config-if)#ip address 192.168.0.253 255.255.255.252*** Command assigns IP address to interface.

***Router(config-if)#no shutdown*** Command brings interface up from its administrative shutdown status .(enable interface ).

**Router(config-if)# encapsulation dot1Q** …..: to activate the encapsulation (adding headers and trailers to the Data in layers .

***Router(config-if)#exit*** Command is used to return in global configuration mode.

**Router(config)# ip route destination\_network\_# [subnet\_mask] IP\_address\_of\_next\_hop\_neighbor** : configure the static route.

Nessos :

[sudo] password for hwp:

Welcome to minicom 2.7

OPTIONS: I18n

Compiled on Jan 1 2014, 17:13:22.

Port /dev/ttyUSB2, 10:20:14

Press CTRL-A Z for help on special keys

nessos>

nessos>enable

Password:

nessos#conf t

Enter configuration commands, one per line. End with CNTL/Z.

nessos(config)#interface FastEthernet0/1/0

nessos(config-if)#no shutdown

nessos(config-if)#exit

nessos(config)#interface FastEthernet0/1/0.21

nessos(config-subif)#encapsulation dot1Q 21

nessos(config-subif)#ip address 10.2.1.254 255.255.255.0

nessos(config-subif)#exit

nessos(config)#interface FastEthernet0/1/0.22

nessos(config-subif)#encapsulation dot1Q 22

nessos(config-subif)#ip address 10.2.2.254 255.255.255.0

nessos(config-subif)#exit

nessos(config)#interface GigabitEthernet0/0

nessos(config-if)#ip address 10.3.2.1 255.255.255.0

nessos(config-if)#no shutdown

nessos(config-if)#exit

nessos(config)#interface FastEthernet0/2/0

nessos(config-if)#ip address 10.3.5.1 255.255.255.0

nessos(config-if)#no shutdown

nessos(config-if)#exit

nessos(config)#ip route 10.1.1.0 255.255.255.0 10.3.2.2

nessos(config)#ip route 10.1.2.0 255.255.255.0 10.3.5.2

nessos(config)#exit

nessos#show ip route

Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, \* - candidate default, U - per-user static route

o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

172.16.0.0/24 is subnetted, 1 subnets

C 172.16.32.0 is directly connected, GigabitEthernet0/1

10.0.0.0/24 is subnetted, 6 subnets

C 10.2.1.0 is directly connected, FastEthernet0/1/0.21

S 10.1.2.0 [1/0] via 10.3.5.2

C 10.2.2.0 is directly connected, FastEthernet0/1/0.22

S 10.1.1.0 [1/0] via 10.3.2.2

C 10.3.2.0 is directly connected, GigabitEthernet0/0

C 10.3.5.0 is directly connected, FastEthernet0/2/0

S 132.187.0.0/16 [1/0] via 172.16.32.1

nessos#

Ate :

[sudo] password for hwp:

Welcome to minicom 2.7

OPTIONS: I18n

Compiled on Jan 1 2014, 17:13:22.

Port /dev/ttyUSB0, 10:03:28

Press CTRL-A Z for help on special keys

ate>enable

Password:

ate#conf t

Enter configuration commands, one per line. End with CNTL/Z.

ate(config)#interface GigabitEthernet 0/1

ate(config-if)#ip address 10.3.1.2 255.255.255.0

ate(config-if)#no shutdown

ate(config-if)#exit

ate(config)#interface GigabitEthernet 0/0

ate(config-if)#ip address 10.3.2.2 255.255.255.0

ate(config-if)#no shutdown

ate(config-if)#exit

ate(config)#ip route 10.1.1.0 255.255.255.0 10.3.1.1

ate(config)#ip route 10.2.1.0 255.255.255.0 10.3.2.1

ate(config)# exit

ate#show ip route

Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, \* - candidate default, U - per-user static route

o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

10.0.0.0/24 is subnetted, 4 subnets

C 10.3.1.0 is directly connected, GigabitEthernet0/1

S 10.2.1.0 [1/0] via 10.3.2.1

S 10.1.1.0 [1/0] via 10.3.1.1

C 10.3.2.0 is directly connected, GigabitEthernet0/0

Styx :

[sudo] password for hwp:

Welcome to minicom 2.7

OPTIONS: I18n

Compiled on Jan 1 2014, 17:13:22.

Port /dev/ttyUSB1, 10:38:08

Press CTRL-A Z for help on special keys

styx>enable

Password:

styx#conf t

Enter configuration commands, one per line. End with CNTL/Z.

styx(config)#interface FastEthernet0/1/0

styx(config-if)#no shutdown

styx(config-if)#exit

styx(config)#interface FastEthernet0/1/0.11

styx(config-subif)#encapsulation dot1Q 11

styx(config-subif)#ip address 10.1.1.254 255.255.255.0

styx(config-subif)#exit

styx(config)#interface FastEthernet0/1/0.12

styx(config-subif)#encapsulation dot1Q 12

styx(config-subif)#ip address 10.1.2.254 255.255.255.0

styx(config-subif)#exit

styx(config)#interface GigabitEthernet0/1

styx(config-if)#ip address 10.3.1.1 255.255.255.0

styx(config-if)#no shutdown

styx(config-if)#exit

styx(config)#interface FastEthernet0/2/0

styx(config-if)#ip address 10.3.4.1 255.255.255.0

styx(config-if)#no shutdown

styx(config-if)#exit

styx(config)#ip route 10.2.1.0 255.255.255.0 10.3.1.2

styx(config)#ip route 10.2.2.0 255.255.255.0 10.3.4.2

styx(config)# exit

styx>show ip route

Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, \* - candidate default, U - per-user static route

o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

172.16.0.0/24 is subnetted, 1 subnets

C 172.16.32.0 is directly connected, GigabitEthernet0/0

10.0.0.0/24 is subnetted, 6 subnets

C 10.3.1.0 is directly connected, GigabitEthernet0/1

S 10.2.1.0 [1/0] via 10.3.1.2

C 10.1.2.0 is directly connected, FastEthernet0/1/0.12

S 10.2.2.0 [1/0] via 10.3.4.2

C 10.1.1.0 is directly connected, FastEthernet0/1/0.11

C 10.3.4.0 is directly connected, FastEthernet0/2/0

S 132.187.0.0/16 [1/0] via 172.16.32.1

**Überprufen mit traceroute**

**Pc flensburg --------- pc distelhausen :**

hwp@flensburg:~$ traceroute 10.2.1.1

traceroute to 10.2.1.1 (10.2.1.1), 30 hops max, 60 byte packets

1 10.1.1.254 (10.1.1.254) 1.199 ms 1.209 ms 1.431 ms

2 10.3.1.2 (10.3.1.2) 1.181 ms 1.167 ms 1.384 ms

3 10.3.2.1 (10.3.2.1) 1.379 ms 1.669 ms 1.663 ms

4 10.2.1.1 (10.2.1.1) 1.084 ms 1.076 ms 1.067 ms

**Pc flensburg ---------Telefon distelhausen :**

hwp@flensburg:~$ traceroute 10.2.2.2

traceroute to 10.2.2.2 (10.2.2.2), 30 hops max, 60 byte packets

1 10.1.1.254 (10.1.1.254) 1.117 ms 1.106 ms 1.096 ms

2 10.3.4.2 (10.3.4.2) 196.101 ms 324.911 ms 378.232 ms

3 10.3.5.1 (10.3.5.1) 181.891 ms 201.301 ms 191.126 ms

4 10.2.2.2 (10.2.2.2) 184.072 ms 185.580 ms 182.609 ms

**PC Distelhausen: Telefon Flensburg :**

hwp@distelhausen:~$ traceroute 10.1.2.2

traceroute to 10.1.2.2 (10.1.2.2), 30 hops max, 60 byte packets

1 10.2.1.254 (10.2.1.254) 0.997 ms 0.983 ms 0.974 ms

2 10.3.5.2 (10.3.5.2) 52.398 ms 36.420 ms 56.899 ms

3 10.3.4.1 (10.3.4.1) 101.112 ms 105.085 ms 105.881 ms

4 10.1.2.2 (10.1.2.2) 100.662 ms 108.836 ms \*

**PC Distelhausen: PC Flensburg :**

hwp@distelhausen:~$ traceroute 10.1.1.1

traceroute to 10.1.1.1 (10.1.1.1), 30 hops max, 60 byte packets

1 10.2.1.254 (10.2.1.254) 1.083 ms 1.074 ms 1.318 ms

2 10.3.2.2 (10.3.2.2) 1.045 ms 1.038 ms 1.280 ms

3 10.3.1.1 (10.3.1.1) 1.264 ms 1.275 ms 1.509 ms

4 10.1.1.1 (10.1.1.1) 1.232 ms 1.221 ms 1.212 ms

**2.1.2 Bonusaufgabe: Telefonieren über die Leased Lines**

Wir löschen die alten Routen über das Internet mit dem Befehl „no ip route“ und

legen mit dem Befehl „ip route“ die Route über die leased lines fest.

Konfiguration für Nessos

Nessos(config)#no ip route 10.1.2.0 255.255.255.0 10.3.5.2

Nessos(config)#ip route 10.1.2.0 255.255.255.0 10.3.2.2

Konfiguration für Styx

styx(config)#no ip route 10.2.2.0 255.255.255.0 10.3.4.2

styx(config)#ip route 10.2.2.0 255.255.255.0 10.3.1.2

Konfiguration für Ate

Ate(config)# ip route 10.1.2.0 255.255.255.0 10.3.1.1

Ate(config)# ip route 10.2.2.0 255.255.255.0 10.3.2.1

Die Qualität auf den leased lines ist besser als die Qualität über das Internet. Dem Chef Gesprächs zu testen. Sollte die Qualität dann immer noch besser sein als die über das Internet, verwenden wir die leased lines auch in Zukunft.

schlagen wir vor, an einem Tag, an dem alle PC ́s in Betrieb sind, die Qualit.

**2.2 Quality-of-Service-Monitoring mit Cisco IP SLA**

1- den IP SLA responder auf dem Styx-router mit dem Befehl „ip sla responder”

styx#configuration terminal

styx(config)#ip sla responder

styx(config)#ip route 10.3.5.0 255.255.255.0 10.3.4.2

2- eine Sitzung anlegen auf dem Nessos-router , mit dem befehl ip sla x“,

Mit dem Befehl „udp-jitter Ziel-IP port Anzahl

der Pakete Intervall“ legen wir das Ziel fest, an welchen Port (frei wählbar), welche

Anzahl an Paketen verschickt werden soll und in welchem Intervall.

Die Frequenz wird dann mit „frequency 15“ auf 15 Sekunden gesetzt bei dem sich alles wiederholt.

Mit dem Befehl „ip sla schedule 1 start-time now life forever“ starten wir den Test

mit dem Befehl „ip sla statistics 1“

das Ergebnis ansehen.

nessos(config)#ip route 10.3.4.0 255.255.255.0 10.3.5.2

nessos(config)#ip sla 1

nessos(config-ip-sla)#udp-jitter 10.1.2.254 17000 num-packets 10 interval 20

nessos(config-ip-sla-jitter)#frequency 15

nessos(config-ip-sla-jitter)#exit

nessos(config)#ip sla schedule 1 start-time now life forever

nessos(config)#exit

nessos#show ip sla statistics 1

IPSLAs Latest Operation Statistics

IPSLA operation id: 1

Latest RTT: 615 milliseconds

Latest operation start time: 16:46:36.863 CDT Fri May 27 2016

Latest operation return code: OK

RTT Values:

Number Of RTT: 10 RTT Min/Avg/Max: 537/615/684 millisecons

Latency one-way time:

Number of Latency one-way Samples: 4

Source to Destination Latency one way Min/Avg/Max: 390/408/446 millisecs

Destination to Source Latency one way Min/Avg/Max: 135/179/200 millisecs

Jitter Time:

Number of SD Jitter Samples: 1

Number of DS Jitter Samples: 1

Source to Destination Jitter Min/Avg/Max: 12/12/12 milliseconds

Destination to Source Jitter Min/Avg/Max: 65/65/65 milliseconds

Packet Loss Values:

Loss Source to Destination: 0 Loss Destination to Source: 0

Out Of Sequence: 6 Tail Drop: 0

Packet Late Arrival: 0 Packet Skipped: 0

Voice Score Values:

Calculated Planning Impairment Factor (ICPIF): 0

Mean Opinion Score (MOS): 0

Number of successes: 3

Number of failures: 0

Operation time to live: Forever

packet 20 frequency 15

nessos#show ip sla statistics 2

IPSLAs Latest Operation Statistics

IPSLA operation id: 2

Latest RTT: 470 milliseconds

Latest operation start time: 16:52:40.240 CDT Fri May 27 2016

Latest operation return code: OK

RTT Values:

Number Of RTT: 19 RTT Min/Avg/Max: 391/470/536 millisecons

Latency one-way time:

Number of Latency one-way Samples: 10

Source to Destination Latency one way Min/Avg/Max: 389/395/406 millisecs

Destination to Source Latency one way Min/Avg/Max: 2/40/121 milliseconds

Jitter Time:

Number of SD Jitter Samples: 3

Number of DS Jitter Samples: 3

Source to Destination Jitter Min/Avg/Max: 2/8/14 milliseconds

Destination to Source Jitter Min/Avg/Max: 0/16/36 milliseconds

Packet Loss Values:

Loss Source to Destination: 0 Loss Destination to Source: 1

Out Of Sequence: 9 Tail Drop: 0

Packet Late Arrival: 0 Packet Skipped: 0

Voice Score Values:

Calculated Planning Impairment Factor (ICPIF): 0

Mean Opinion Score (MOS): 0

Number of successes: 11

Number of failures: 0

Operation time to live: Forever

packets 10 frequency 30

nessos(config)#ip sla 3

nessos(config-ip-sla)#udp-jitter 10.1.2.254 17000 num-packets 10 interval 20

nessos(config-ip-sla-jitter)#frequency 30

nessos(config-ip-sla-jitter)#exit

nessos(config)#ip sla schedule 3 start-time now life forever

nessos(config)#exit

nessos#show ip sla statistics 3

IPSLAs Latest Operation Statistics

IPSLA operation id: 3

Latest RTT: 138 milliseconds

Latest operation start time: 16:56:44.421 CDT Fri May 27 2016

Latest operation return code: OK

RTT Values:

Number Of RTT: 9 RTT Min/Avg/Max: 64/138/214 milliseconds

Latency one-way time:

Number of Latency one-way Samples: 4

Source to Destination Latency one way Min/Avg/Max: 54/91/123 millisecons

Destination to Source Latency one way Min/Avg/Max: 3/23/59 milliseconds

Jitter Time:

Number of SD Jitter Samples: 1

Number of DS Jitter Samples: 0

Source to Destination Jitter Min/Avg/Max: 19/19/19 milliseconds

Destination to Source Jitter Min/Avg/Max: 0/0/0 milliseconds

Packet Loss Values:

Loss Source to Destination: 0 Loss Destination to Source: 1

Out Of Sequence: 5 Tail Drop: 0

Packet Late Arrival: 0 Packet Skipped: 0

Voice Score Values:

Calculated Planning Impairment Factor (ICPIF): 0

Mean Opinion Score (MOS): 0

Number of successes: 2

Number of failures: 0

Operation time to live: Forever

**2.3 Netzwerkmonitoring mit SNMP**

nessos(config)#snmp-server community public R0

nessos(config)#snmp-server community private RW

![A description...](data:None;base64,)

Min und Max RTT.

![A description...](data:None;base64,)

PacketLoss.