TECHNISCHE UNIVERSITÄT BERLIN
Fakultät IV – Elektrotechnik und Informatik
Fachgebiet Intelligente Netze
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11th Assignment: Network Protocols and Architectures, WS 20/21

Question 1: $(5+5+5+5+5+10+10+10=55$ points) *BGP experiment*

In this experiment we are going to investigate routes towards the Charles Darwin University in Australia. The target host will be the webserver of the university front page `www.cdu.edu.au` with the IP address `138.80.10.69`.

(a) To which AS does this IP belong? State the **number** and **name** of the AS.
Hint: use a lookup service like `https://asn.cymru.com/` to obtain AS numbers and names.

Our vantage point is a route server `route-server.as3257.net` located close to Frankfurt, Germany. As the domain name suggests, this route server is part of AS3257 which is a large backbone network spanning routers in many parts of the world.

Now connect to the route server `route-server.as3257.net` using *telnet*. This server provides a Juniper JUNOS shell with the possibility to explore BGP routes from there to any IP address in the world.

Please carefully read through the welcome message. After the login you will see some city names where some of the BGP routers of AS3257 are located.

Check possible routes towards `www.cdu.edu.au`. To achieve that, enter the following command at the prompt:

```
public@route-server.as3257.net-re0> show route 138.80.10.69
```

(b) From the output of the above command, please copy **only the *~~Active Route~~*** to your solution. Do not include alternative routes.

(c) What **prefix** has been announced by the network of `www.cdu.edu.au`?

(d) From **which router** has this route been learned? In **which city** is the router located?

(e) State the **AS path** towards `www.cdu.edu.au` and the corresponding **AS names**.
Hint 1: The so-called AS path begins with 3257 and ends with the AS from (a). Also, the AS path may contain identical consecutive ASes, see AS path prepending for more information.
Hint 2: You can find out AS names using the same lookup service `https://asn.cymru.com/`.

Next, from the route server we perform a traceroute towards `www.cdu.edu.au`:

```
public@route-server.as3257.net-re0> traceroute 138.80.10.69
```

Please turn!

(f) **Visualize the result of traceroute** in a drawing with each AS as a dashed ellipse, routers as small circles and links as lines. Include the **IP addresses** and **AS numbers** as well as the **location information** that you may guess from the routers name.

Hints:

- Depending on the state of the networks along the route, traceroute may not reach the destination network.
- "ham", "ams", ... represent city names. "ham" is equivalent to Hamburg. Abbreviations for city names in DNS names of routers are often chosen according to airport codes[1].
- Instead of using the complete IP address scheme, you can also use a prefix, e. g., 188.1.0.0/16 and label the router with the remainig part of the IP address, e. g., 33.81, 144.221, and 145.137.
- You can use geolocation databases like `http://www.iplocation.net/` in addition. (This information might not be always accurate!)

(g) Compare the traceroute from the route server with the route below, originating at TU Berlin towards `www.cdu.edu.au`. What is **similar** to the traceroute you did from the public route server, and what is **different**? Please analyze **specific aspects**, instead of just stating which hops are different: E.g., through what kinds of ASes and geographic locations does the packet travel?

```
traceroute to www.cdu.edu.au (138.80.10.69), 30 hops max, 60 byte packets
 1  marwall-birdcage.net.t-labs.tu-berlin.de (130.149.220.126)  0.170 ms  0.209 ms  0.196 ms
 2  ta-inet.gate.tu-berlin.de (130.149.235.193)  1.071 ms  1.074 ms  1.075 ms
 3  e-n-hft.gate.tu-berlin.de (130.149.126.57)  1.035 ms  0.989 ms  0.976 ms
 4  cr-tub2-te0-0-0-7-5.x-win.dfn.de (188.1.235.117)  0.943 ms  0.899 ms  0.884 ms
 5  dfn.mx1.ham.de.geant.net (62.40.112.145)  10.490 ms  10.486 ms  10.475 ms
 6  ae3.mx1.ams.nl.geant.net (62.40.98.60)  16.895 ms  16.829 ms  16.821 ms
 7  ae2.mx1.lon.uk.geant.net (62.40.98.80)  24.461 ms  24.379 ms  24.403 ms
 8  internet2-gw.mx1.lon.uk.geant.net (62.40.124.45)  99.150 ms  99.180 ms  99.172 ms
 9  et-7-3-0.4072.rtsw.atla.net.internet2.edu (198.71.45.6)  111.919 ms  111.943 ms  111.934 ms
10  et-10-2-0.105.rtr.hous.net.internet2.edu (198.71.45.13)  135.781 ms  135.729 ms  135.736 ms
11  et-7-1-0.4070.rtsw.losa.net.internet2.edu (198.71.45.21)  168.143 ms  167.843 ms  168.055 ms
12  * * *
13  et-2-0-0.pe2.brwy.nsw.aarnet.net.au (113.197.15.98)  334.038 ms  334.195 ms  334.197 ms
14  et-2-3-0.pe1.mcqp.nsw.aarnet.net.au (113.197.15.144)  334.895 ms  334.481 ms  334.487 ms
15  et-0-3-0.pe1.fvly.qld.aarnet.net.au (113.197.15.7)  346.554 ms  346.046 ms  345.746 ms
16  xe-2-0-0.pe1.drwn.nt.aarnet.net.au (113.197.15.121)  391.145 ms  391.237 ms  391.119 ms
17  gw1.cdu.pe1.drwn.nt.aarnet.net.au (138.44.208.2)  391.517 ms  391.592 ms  391.443 ms
18  * * *
19  www.cdu.edu.au (138.80.10.69)  391.961 ms  391.932 ms  392.403 ms
```

(h) Comment on (at least two) **possible reasons for the observed differences**. Explain in your own words, using full sentences.

Please turn!

[1] `http://en.wikipedia.org/wiki/List_of_airports_by_IATA_code`

Question 2: $(15 + 15 + 15 = 45$ points) *Soft State / Hard State: Car Rental*

Assume the following scenario: A car pool startup offers cars for rent via the Internet under these revolutionary and game-changing conditions: The customers only have to pay for the duration of actually using (driving) a car. Merely reserving a car does not cost anything. After some issues with unfair customers exploiting this feature, the company grudgingly decided to only allow reservations for a limited and fixed time period (e.g., one hour). Hence, if a reserved car is not used during that time period, the reservation expires and the car becomes available for all customers again. The reservation process is of course suspended while the car is in use and continues after the car stops being used, at which point the timer gets reset. Finally, after a lot of confusion and debugging, they also decided to add the rule that a car can only be reserved if there is no current reservation and the car is not in use.

Note: Make sure that your state diagram reflects the scenario described above.

(a) **Draw a state diagram** that shows the reservation state of a car. That is, it contains only a state where the car is reserved and a state where the car is available. Include state transitions.
Indicate for each of the two states whether it is a **soft state** or **a hard state and why**.

(b) Augment your state diagram with the information about the **current usage of a car**. That is, add a third state where the car is used. Include state transitions.
Indicate whether this third state is a **soft state** of **a hard state and why**.

(c) How would the service change if the system were using **only soft states or only hard states**?

Due Date: Wednesday, February, 10th 2019 11.59 pm (end of day)

- **As PDF files (no MS Office or OpenOffice files)**, uploaded via ISIS: `https://isis.tu-berlin.de/course/view.php?id=21979`
- Put the names and Student ID numbers (Matrikelnummer) of **all** your group members **and** the tutorial slot on your solution!