

7th Assignment: Network Protocols and Architectures, WS 13/14

Question 1: (5 + 5 + 5 + 5 + 5 + 5 + 5 = 35 points) *Routing / The border gateway protocol*

- Explain briefly the difference between routing and forwarding. What is a router and an interface? Do routers have IP addresses? If yes, how many?
- Why are policies in the area of Intra-AS-routing protocols (e.g., OSPF) of little importance ?
- Why do policies on the other hand play a more important role within Inter-AS-traffic compared to global traffic optimization?
- Why doesn't it make sense to make routing decisions only based on minimum (packet) delay in intra AS routing protocols?
- How does BGP—as a member of the path-vector protocol family—bypass the problem of routing loops?
- The de-facto standard for Inter-AS routing is BGP. Why is it difficult to enforce alternatives to BGP or switch completely to a different protocol that is incompatible with BGP?
- Why are private address spaces in IPv4 (10/8, 172.16/12, 192.168/16) used, which are not routed in the Internet?

Question 2: (5 + 5 + 10 + 5 = 25 points) *Properties of BGP*

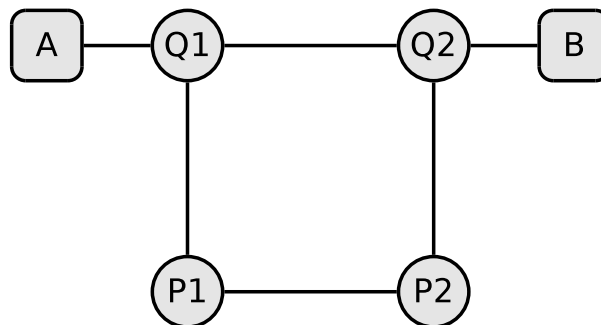


Figure 1: Intra-AS setup

Consider the topology shown in Figure 1. All edges have a weight of 5. An intra-AS routing protocol should be used.

- Identify the cost-optimal route from A to B.
- Suppose that the edge weight between Q1 and Q2 increases to 20. Given this case, state the cost optimal route from A to B.

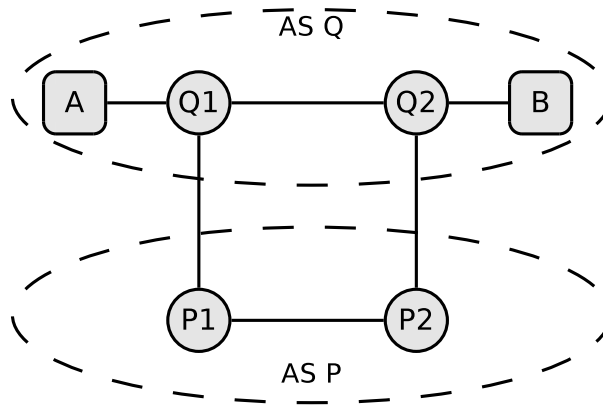


Figure 2: BGP Setup

As shown in Figure 2, the network is now split into two autonomous systems (AS). BGP is used as routing protocol between those autonomous systems.

- (c) The edge weight between Q1 and Q2 is still 20. How will a packet from A to B be routed? Explain why.
- (d) Supposing that the connection between Q1 and Q2 drops out. How are packets routed from A to B in this case? Explain why.

Question 3: (5 + 20 + 10 + 5 = 40 points) *BGP experiment*

We are going to explore BGP in a more practical manner by visualizing the route to the University of Tasmania. First we need the IP address of the target host:

```
$ host www.utas.edu.au
www.utas.edu.au is an alias for www-cms.utas.edu.au.
www-cms.utas.edu.au has address 131.217.3.111
```

Connect now by using *telnet* to *route-server.ip.tiscali.net* The above stated server provides you with an emulation of a Cisco IOS shell with the possibility to explore BGP routes from there to any IP address in the world. Enter the following command at the prompt:

```
route-server.as3257.net>show ip bgp 131.217.3.111
```

- (a) Which ASes are hit on the BGP route to *www.utas.edu.au*? State the AS number and the corresponding name of the AS. Copy the result of `show ip bgp` to your solution.
 - Hint: The line that starts with 3257 represents the BGP route. AS 3257 represents the Tiscali backbone network. To receive more detailed information about AS numbers, please visit <http://www.arin.net/> (US), <http://wq.apnic.net/apnic-bin/whois.pl> (Oceania) or <http://www.ripe.net/whois> (Europe). The syntax to query the RIPE database to get information about the AS number needs a capital “AS” as prefix.
- (b) Next, we examine the route of a host (the tiscali server) to the target by using `traceroute`¹. Visualize the result of `traceroute` in a drawing with each AS as a dashed ellipses, routers as small circles and links as lines. Include the IP addresses and AS numbers and the location information that you may guess from the routers name.

Hints:

- `route-server.as3257.net > traceroute 131.217.3.111`
- The AS numbers are given in the `traceroute` output. In general, the IP to AS number mapping can be obtained by invoking `show ip bgp` for each IP address or by using a web service². For a quick verification, any of the IP addresses out of the network of TU Berlin (e. g., 130.149.7.201) should be mapped to ASN 680, which is DFN.

¹<http://en.wikipedia.org/wiki/Traceroute>

²<http://asn.cymru.com/cgi-bin/whois.cgi>

- “fra”, “syd”, ... represent city names. “fra” is equivalent to Frankfurt/Main. Hint: Abbreviations for city names in DNS names of routers are often chosen according to airport codes³.
 - 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 remaining part of the IP address, e. g., 33.81, 144.221, and 145.137.
 - You can use geolocation databases like <http://www.maxmind.com/> or <http://www.iplocation.net/> in addition. (Those information might not be always accurate!)
- (c) Compare the route established from route-server.ip.tiscali.net to www.utas.edu.au with the route specified given below (which was obtained by running traceroute from a machine in the network of TU Berlin) towards www.utas.edu.au. Which part of the paths are identical? Where do they differ? Also comment on the routes to www.utas.edu.au regarding the geographical distance.

```
$ traceroute 131.217.3.111
traceroute to 131.217.3.111 (130.149.220.126), 30 hops max, 60 byte packets
 1 firebird.net.t-labs.tu-berlin.de (130.149.220.126)  0.228 ms  0.215 ms  0.419 ms
 2 130.149.235.1 (130.149.235.1)  0.758 ms  1.036 ms  0.965 ms
 3 xr-tub2-te2-4.x-win.dfn.de (188.1.235.117)  0.941 ms  1.322 ms  1.313 ms
 4 cr-tub1-be5-50.x-win.dfn.de (188.1.144.157)  2.140 ms  2.130 ms  2.977 ms
 5 cr-er11-hundredgige0-6-0-0-7.x-win.dfn.de (188.1.144.186)  9.176 ms  9.618 ms  9.614 ms
 6 cr-fra1-hundredgige0-1-0-0-7.x-win.dfn.de (188.1.144.102)  12.872 ms  13.031 ms  12.975 ms
 7 dfn.mx1.fra.de.geant.net (62.40.124.217)  12.429 ms  12.378 ms  12.352 ms
 8 abilene-wash-gw.mx1.fra.de.geant.net (62.40.125.18)  106.549 ms  126.144 ms  106.414 ms
 9 * * *
10 ae-1.10.rtr.hous.net.internet2.edu (64.57.28.112)  142.963 ms  157.017 ms  167.760 ms
11 * * *
12 * * *
13 et-1-0-0.bb2.a.syd.aarnet.net.au (202.158.194.109)  355.930 ms  356.348 ms  356.313 ms
14 ge-6-1-0.bb1.a.mel.aarnet.net.au (202.158.194.70)  357.247 ms  371.375 ms  357.653 ms
15 so-0-0-0.bb1.b.hba.aarnet.net.au (202.158.194.114)  382.061 ms  368.036 ms  381.976 ms
16 tengigabitethernet2-1.er2.utas.cpe.aarnet.net.au (202.158.204.2)  379.122 ms  379.016 ms  378.756 ms
```

- (d) To which AS does the www.utas.edu.au host belong to?

Due Date: Wednesday, December, 11th 2013 only until 09:55 h s. t.

- **As PDF files (no MS Office or OpenOffice files):** Uploaded via ISIS (<https://www.isis.tu-berlin.de/2.0/course/view.php?id=349>)
- **On paper:** Postbox in the Telefunkenhochhaus (basement, behind the doorman right)
- Put your name, StudentID number (Matrikelnummer) **and** the name of your tutor on your solution.

³http://en.wikipedia.org/wiki/List_of_airports_by_IATA_code