Computer Networks
Jacobs University Bremen
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CN Problem Sheet #4

Download and install cbgp and its dependency libgds. You can go to https://sourceforge.net/projects/c-bgp/files/ and https://sourceforge.net/projects/libgds/files/ to manually download and compile both source packages. The current version as of this writing is c-bgp 2.3.2 and libgds 2.2.2. The tutorial at http://c-bgp.sourceforge.net/tutorial.php explains how to build a topology using cbgp. For further information, please check the documentation at http://c-bgp.sourceforge.net/doc/html/index.html. The cbgp executable can either run in interactive mode (no arguments) or read commands that can otherwise be given in interactive mode from a script specified with the -c option. All commands that are used in the scripts can be used in interactive mode and vice versa.

Problem 4.1: *cbgp routing simulation*   (2+1+1+2+2+2 = 10 points)

Download the cbgp script p4-topology.cli, which is linked to the course web page, http://cnds.eecs.jacobs-university.de/courses/cn-2017/. The script creates the following topology:
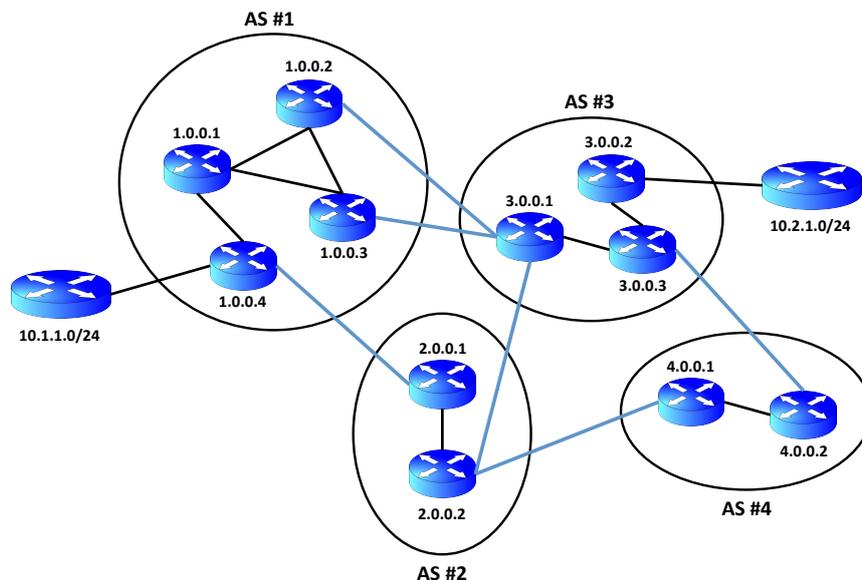
To answer the following questions, write short cbgp scripts that include the p4-topology.cli and then invoke the necessary cbgp commands to answer the questions. For example, the following script list the nodes of the four autonomous systems.

```
include p4-topology.cli
show version
print "\nIGP domain 1:\n"
net domain 1 show nodes
print "\nIGP domain 2:\n"
net domain 2 show nodes
print "\nIGP domain 3:\n"
net domain 3 show nodes
print "\nIGP domain 4:\n"
net domain 4 show nodes
```

Some questions require an additional written explanation. Note that changes to the internal topology of an autonomous system require to compute the domain again. Changes to the BGP sessions require to reset the peering relationship and to run the simulation again.

a) What is the route node 1.0.0.4 to 1.0.0.2 and vice-versa? Does changing the `igp-weight` of the link using

```
net link 1.0.0.1 1.0.0.2 igp-weight 15
net domain 1 compute
```

make any difference to the routes between these two nodes? Why or why not? What happens to the two routes if you change the `igp-weight` to 40?

```
net link 1.0.0.1 1.0.0.2 igp-weight 40
net domain 1 compute
```

Explain what you observe.

b) What is the route between node 2.0.0.2 to 1.0.0.2 and vice-versa? Is this the shortest possible route in terms of the number of links? Explain why this route is used.

c) What is the content of the routing table of node 2.0.0.2? Explain what the entries mean and why they exist.

d) What is the effect of the following two BGP input filters that AS #4 might deploy?

```
bgp router 4.0.0.1 peer 2.0.0.2
  filter in
    add-rule
      match any
      action "local-pref 100"
      exit
    exit
  exit
bgp router 4.0.0.1 peer 2.0.0.2 reset

bgp router 4.0.0.2 peer 3.0.0.3
  filter in
    add-rule
      match any
      action "local-pref 50"
      exit
    exit
  exit
bgp router 4.0.0.2 peer 3.0.0.3 reset
```

What happens if the local-pref values 100 and 50 are swapped?

e) The operator of AS #3 decides to no longer serve as a transit AS for any of its peers. However, a contract already exists that requires that traffic from AS #4 should continue to function as normal. Do not touch the routing policies of any other AS than AS #3. Do not use metric or local-pref.

f) The operator of AS #3 now decides to force AS #1 to send all traffic arriving to AS #3 via the link between 1.0.0.2 and 3.0.0.1. However, any traffic originating at 1.0.0.2 and 1.0.0.3 should come via their direct links to 3.0.0.1. Do not touch the routing policies of any other AS than AS #3 to implement these rules.