

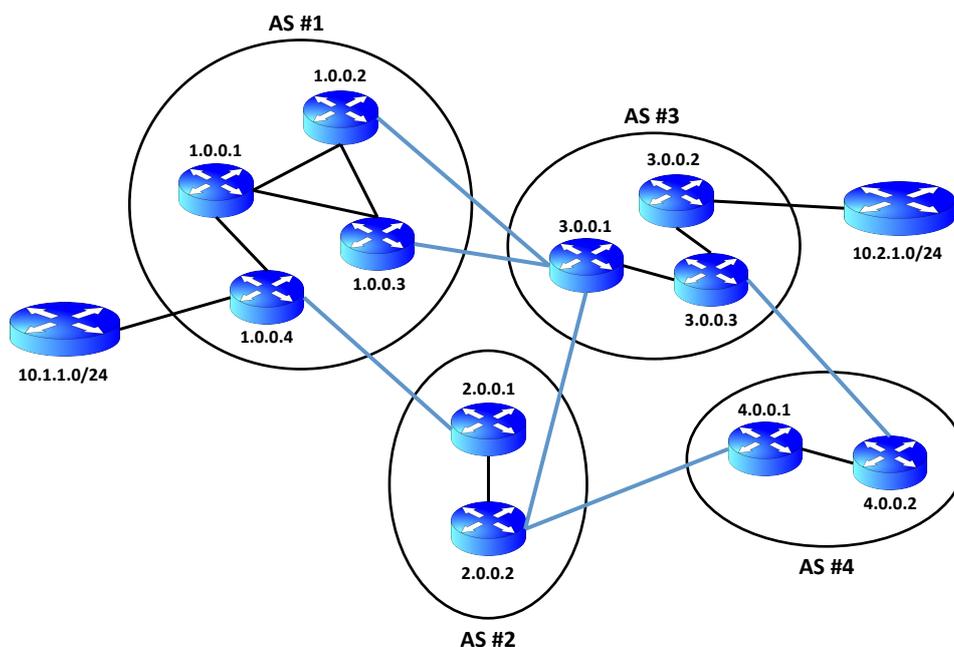
### Problem Sheet #3

Download and install cbgp and its dependency libgds. You can go to <http://c-bgp.sourceforge.net/> and <http://libgds.sourceforge.net/> to manually download and compile both source packages. The tutorial at <http://c-bgp.sourceforge.net/tutorial.php> explains how to build a topology using cbgp. You will find example scripts in `/usr/share/doc/cbgp/examples`. To understand them, refer to the comments as well as 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 `-c` or via stdin. All commands that are used in the scripts can be used in interactive mode and vice versa.

#### Problem 3.1: bgp simulation of filter rules

(3+3+2+2 = 10 points)

Extract the script 'topology.cli', which is appended to this problem sheet. It implements the following topology:



- a) What is the route the traffic takes from node 1.0.0.4 to 1.0.0.2 and vice-versa? Does changing the `igp-weight` to 15 in the following line make any difference to the traffic routes?

```
net link 1.0.0.1 1.0.0.2 igp-weight 10
```

Why or why not? What happens to the traffic routes if you change the `igp-weight` to 40 in the line shown above? Why?

- b) Modify the script by entering the following lines before `sim run`:

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

Does this change the routing table of 4.0.0.1 and 4.0.0.2? In what way and why? What happens if the `local-pref` values for the two peering relationships were swapped? Why? What is the result of having equal `local-pref` values for the two peering relationship? Why?

- c) Assume that operators of AS #3 decide that they no longer wish to serve as a transit AS for any of its peers. However, a contract already exists in place to ensure 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`.
- d) The operators of AS #3 now decide that they wish 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.

## Script topology.cli

```
#####  
# TOPOLOGY #  
#####  
  
# set up the topology for AS 1  
net add node 1.0.0.1  
net add node 1.0.0.2  
net add node 1.0.0.3  
net add node 1.0.0.4  
net add link 1.0.0.1 1.0.0.2  
net add link 1.0.0.1 1.0.0.3  
net add link 1.0.0.1 1.0.0.4  
net add link 1.0.0.2 1.0.0.3  
  
# set up the topology for AS 2  
net add node 2.0.0.1  
net add node 2.0.0.2  
net add link 2.0.0.1 2.0.0.2  
  
# set up the topology for AS 3  
net add node 3.0.0.1  
net add node 3.0.0.2  
net add node 3.0.0.3  
net add link 3.0.0.1 3.0.0.3  
net add link 3.0.0.2 3.0.0.3  
  
# set up the topology for AS 4  
net add node 4.0.0.1  
net add node 4.0.0.2  
net add link 4.0.0.1 4.0.0.2  
  
# set up inter domain links  
net add link 1.0.0.2 3.0.0.1  
net add link 1.0.0.3 3.0.0.1  
net add link 1.0.0.4 2.0.0.1  
net add link 2.0.0.2 3.0.0.1  
net add link 2.0.0.2 4.0.0.1  
net add link 3.0.0.3 4.0.0.2  
  
#####  
# IGP #  
#####  
  
# IGP configuration for AS 1  
  
net add domain 1 igp  
net node 1.0.0.1 domain 1  
net node 1.0.0.2 domain 1  
net node 1.0.0.3 domain 1  
net node 1.0.0.4 domain 1  
net link 1.0.0.1 1.0.0.2 igp-weight 10  
net link 1.0.0.2 1.0.0.1 igp-weight 10  
net link 1.0.0.1 1.0.0.3 igp-weight 10  
net link 1.0.0.3 1.0.0.1 igp-weight 10  
net link 1.0.0.1 1.0.0.4 igp-weight 10  
net link 1.0.0.4 1.0.0.1 igp-weight 10  
net link 1.0.0.2 1.0.0.3 igp-weight 10  
net link 1.0.0.3 1.0.0.2 igp-weight 10  
  
net domain 1 compute
```

```
# IGP configuration for AS 2

net add domain 2 igp
net node 2.0.0.1 domain 2
net node 2.0.0.2 domain 2
net link 2.0.0.1 2.0.0.2 igp-weight 10
net link 2.0.0.2 2.0.0.1 igp-weight 10
net domain 2 compute

# IGP configuration for AS 3

net add domain 3 igp
net node 3.0.0.1 domain 3
net node 3.0.0.2 domain 3
net node 3.0.0.3 domain 3
net link 3.0.0.1 3.0.0.3 igp-weight 10
net link 3.0.0.3 3.0.0.1 igp-weight 10
net link 3.0.0.2 3.0.0.3 igp-weight 10
net link 3.0.0.3 3.0.0.2 igp-weight 10
net domain 3 compute

# IGP configuration for AS 4

net add domain 4 igp
net node 4.0.0.1 domain 4
net node 4.0.0.2 domain 4
net link 4.0.0.1 4.0.0.2 igp-weight 10
net link 4.0.0.2 4.0.0.1 igp-weight 10
net domain 4 compute

#####
# ROUTES #
#####

# static routes for AS 1

net node 1.0.0.2 route add --oif=3.0.0.1 3.0.0.1/32 0
net node 1.0.0.3 route add --oif=3.0.0.1 3.0.0.1/32 0
net node 1.0.0.4 route add --oif=2.0.0.1 2.0.0.1/32 0

# static routes for AS 2

net node 2.0.0.1 route add --oif=1.0.0.4 1.0.0.4/32 0
net node 2.0.0.2 route add --oif=3.0.0.1 3.0.0.1/32 0
net node 2.0.0.2 route add --oif=4.0.0.1 4.0.0.1/32 0

# static routes for AS 3

net node 3.0.0.1 route add --oif=1.0.0.2 1.0.0.2/32 0
net node 3.0.0.1 route add --oif=1.0.0.3 1.0.0.3/32 0
net node 3.0.0.1 route add --oif=2.0.0.2 2.0.0.2/32 0
net node 3.0.0.3 route add --oif=4.0.0.2 4.0.0.2/32 0

# static routes for AS 4

net node 4.0.0.1 route add --oif=2.0.0.2 2.0.0.2/32 0
net node 4.0.0.2 route add --oif=3.0.0.3 3.0.0.3/32 0

#####
# BGP #
#####
```

```
# full-mesh of iBGP sessions in AS 1
```

```
bgp add router 1 1.0.0.1  
bgp add router 1 1.0.0.2  
bgp add router 1 1.0.0.3  
bgp add router 1 1.0.0.4  
bgp domain 1 full-mesh
```

```
# full-mesh of iBGP sessions in AS 2
```

```
bgp add router 2 2.0.0.1  
bgp add router 2 2.0.0.2  
bgp domain 2 full-mesh
```

```
# full-mesh of iBGP sessions in AS 3
```

```
bgp add router 3 3.0.0.1  
bgp add router 3 3.0.0.2  
bgp add router 3 3.0.0.3  
bgp domain 3 full-mesh
```

```
# full-mesh of iBGP sessions in AS 1
```

```
bgp add router 4 4.0.0.1  
bgp add router 4 4.0.0.2  
bgp domain 4 full-mesh
```

```
# Setup eBGP sessions for AS 1
```

```
bgp router 1.0.0.2  
    add peer 3 3.0.0.1  
    peer 3.0.0.1  
        next-hop-self  
        up  
    exit  
exit
```

```
bgp router 1.0.0.3  
    add peer 3 3.0.0.1  
    peer 3.0.0.1  
        next-hop-self  
        up  
    exit  
exit
```

```
bgp router 1.0.0.4  
    add peer 2 2.0.0.1  
    peer 2.0.0.1  
        next-hop-self  
        up  
    exit  
exit
```

```
# Setup eBGP sessions for AS 2
```

```
bgp router 2.0.0.1  
    add peer 1 1.0.0.4  
    peer 1.0.0.4  
        next-hop-self  
        up  
    exit  
exit
```

```
bgp router 2.0.0.2
```

```

    add peer 3 3.0.0.1
    peer 3.0.0.1
        next-hop-self
        up
    exit
    add peer 4 4.0.0.1
    peer 4.0.0.1
        next-hop-self
        up
    exit
exit

# Setup eBGP sessions for AS 3
bgp router 3.0.0.1
    add peer 1 1.0.0.2
    peer 1.0.0.2
        next-hop-self
        up
    exit
    add peer 1 1.0.0.3
    peer 1.0.0.3
        next-hop-self
        up
    exit
    add peer 2 2.0.0.2
    peer 2.0.0.2
        next-hop-self
        up
    exit
exit

bgp router 3.0.0.3
    add peer 4 4.0.0.2
    peer 4.0.0.2
        next-hop-self
        up
    exit
exit

# Setup eBGP sessions for AS 4
bgp router 4.0.0.1
    add peer 2 2.0.0.2
    peer 2.0.0.2
        next-hop-self
        up
    exit
exit

bgp router 4.0.0.2
    add peer 3 3.0.0.3
    peer 3.0.0.3
        next-hop-self
        up
    exit
exit

# Originate own prefixes for AS 1
bgp router 1.0.0.2 add network 1/8
bgp router 1.0.0.3 add network 1/8
bgp router 1.0.0.4 add network 1/8

# Originate own prefixes for AS 2
bgp router 2.0.0.1 add network 2/8

```

```
bgp router 2.0.0.2 add network 2/8

# Originate own prefixes for AS 3
bgp router 3.0.0.1 add network 3/8
bgp router 3.0.0.3 add network 3/8

# Originate own prefixes for AS 4
bgp router 4.0.0.1 add network 4/8
bgp router 4.0.0.2 add network 4/8

# Add other networks to AS 1
bgp router 1.0.0.4 add network 10.1.1.0/24

# Add other networks to AS 3
bgp router 3.0.0.2 add network 10.2.1.0/24

#####
# SIMULATION #
#####

sim run
```