Hands-on Session: Essentials of BGP, EBGP, IBGP

Ali AlSabeh, Jorge Crichigno
University of South Carolina
http://ce.sc.edu/cyberinfra

Internet2 Technology Exchange

Monday December 5th, 2022
Denver, Colorado

A Short Overview of BGP

BGP – Best Path

1. Prefer the path with **highest weight** (configured locally; set to 0 (default) for routes not originated by the router)
2. If weights are the same, prefer the path with **highest local preference** (set to 100 by default)
3. If the local preferences are the same, prefer the **path that was originated by BGP running on the router or redistributed from an Interior Gateway Protocol (IGP)**
4. If no route was originated, prefer the path with the **shortest AS_PATH**
5. If the paths have the same AS_PATH length, prefer the path with the **lowest origin type** (IGP is lower than Exterior Gateway Protocol (EGP), and EGP is lower than Incomplete)
6. If the origin codes are the same, prefer the path with the **lowest MED attribute** (set to 0 by default)
7. If the paths have the same MED, prefer the **External path (EBGP) over the Internal path (IBGP)**
8. If the paths are still the same, prefer the path through the **closest IGP neighbor (lowest IGP metric)**
9. If both paths are external, prefer the path that was **received first (oldest one)**
10. If the paths are still the same, prefer the path from the **BGP router with the lowest router ID**
11. If the router ID is the same for multiple paths, prefer the path with the **lowest IP address**

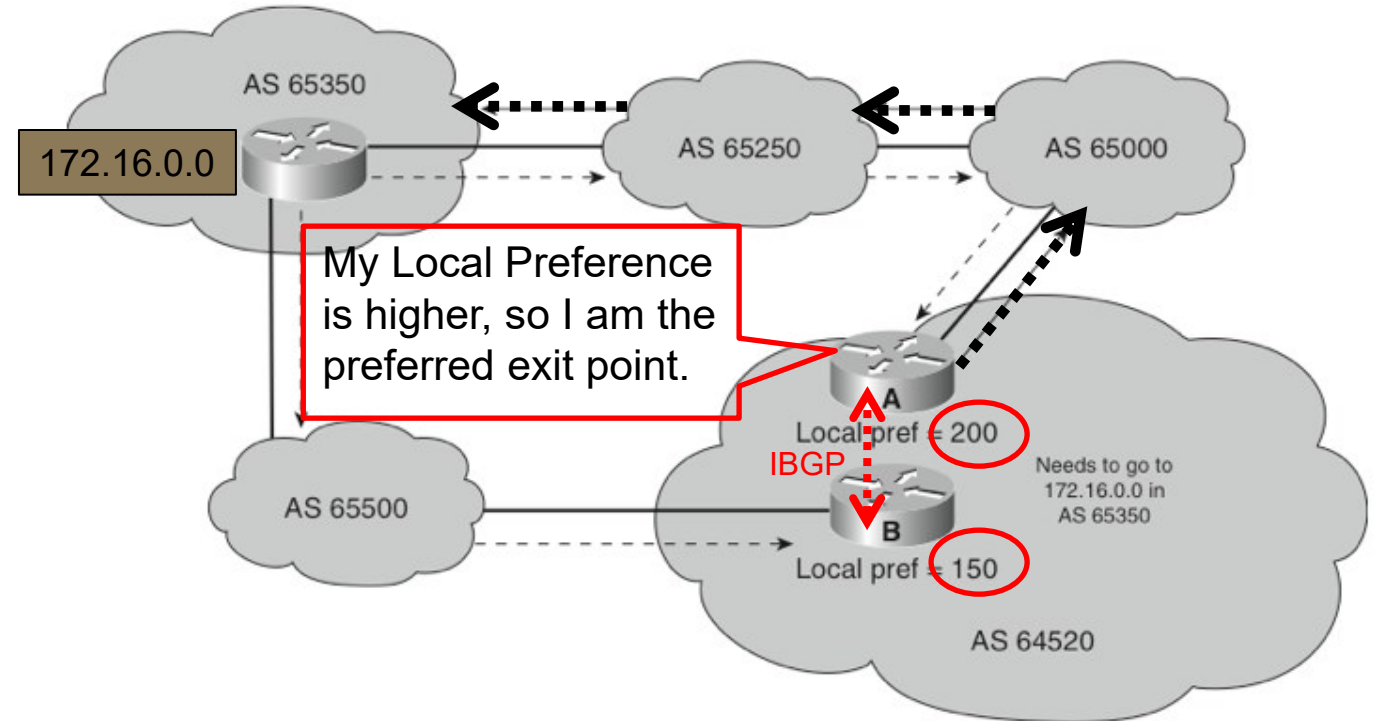Rick Graziani, "Implementing Cisco IP Routing," Cisco Press, 2015

BGP – Best Path

- Without route manipulation, the most common reason for path selection is Step 4
  - ➢ If no route was originated, prefer the path with the **shortest AS_PATH**
- If multiple paths have the same number of autonomous systems to traverse, the second most common decision point is Step 7
  - ➢ If the paths have the same MED, prefer **EBGP over IBGP**

Rick Graziani, "Implementing Cisco IP Routing," Cisco Press, 2015

South Carolina

The Local Preference Attribute

- Indicates to routers in the AS which path is preferred **to exit the AS** (higher is better)

- AS 64520 receives updates about network 172.16.0.0 from two directions:
  - via AS 65500 (65500, 65350)
  - via AS 65000 (65000, 65250, 65350)

- Local preference:
  - On Router A for network 172.16.0.0 is 200
  - On Router B for network 172.16.0.0 is 150

- Local preference information is exchanged within AS 64520 via IBGP

- All traffic in AS 64520 addressed to network 172.16.0.0 is sent to Router A as an exit point from AS 64520

Rick Graziani, "Implementing Cisco IP Routing," Cisco Press, 2015

The Med Attribute

- Indicates to external neighbors the preferred path *into* an AS
- By default, a router compares the MED only for paths from neighbors in the **same AS**. Lowest Wins!
- MED is sent to EBGP peers:
  - Those routers propagate the MED within their AS
  - But do not pass it on to the next AS
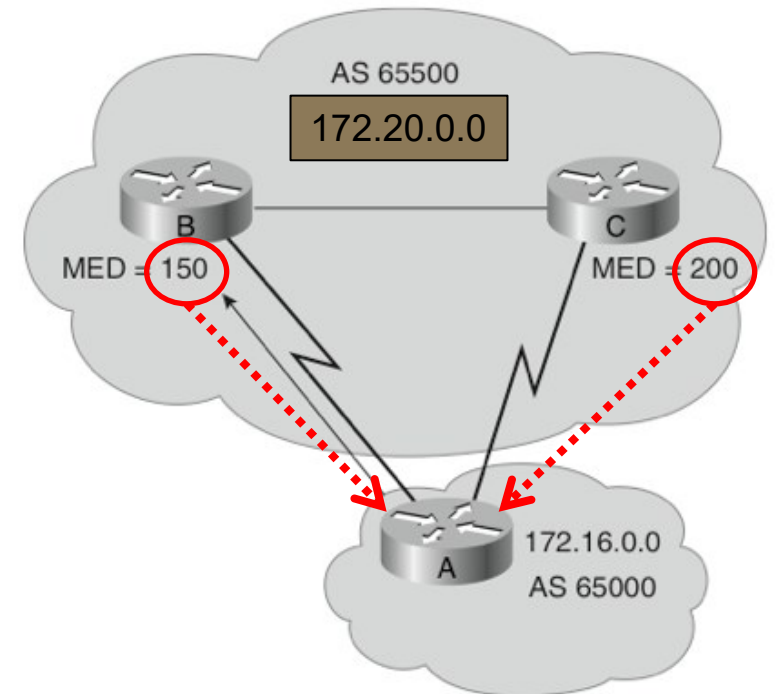
Rick Graziani, "Implementing Cisco IP Routing," Cisco Press, 2015

Configuring IBGP and EBGP Sessions, Local Preference, and MED

Lab activities are described in Lab 8, BGP Lab Series

Hands-on Labs on BGP

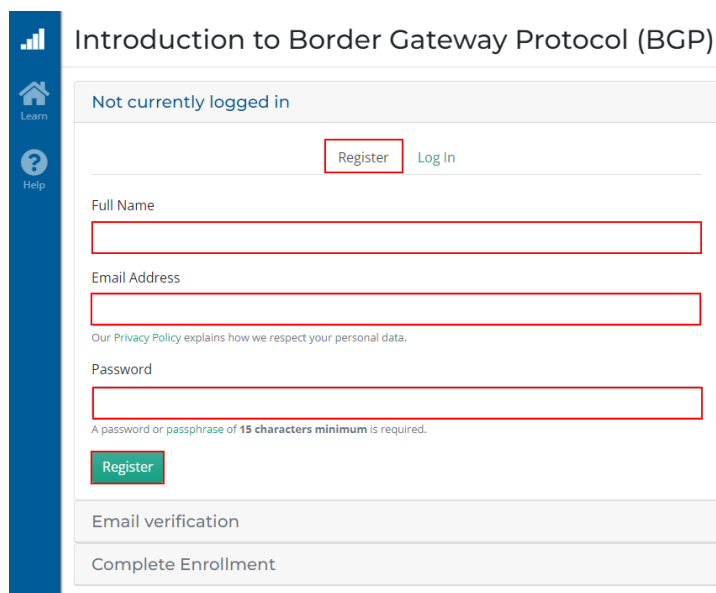- Webpage with PowerPoint presentations:

  http://ce.sc.edu/cyberinfra/workshop_2022_ie2_bgp.html

- Hands-on session 2 (10:40-11:40pm): if you are not already registered, access the labs for Session 2 (Local Preference and MED attributes) using the following link:

  https://portal.netdevgroup.com/learn/34b2cp/enroll/

South Carolina

Registering to the Netlab Portal

- Click on the enrollment link: https://portal.netdevgroup.com/learn/34b2cp/enroll/
- Register and check your email for the verification key
- Finalize the registration by claiming your free access

Accessing the Virtual Labs

- If already registered, login to the portal: https://portal.netdevgroup.com/account/login
- Click on the course "Introduction to Border Gateway Protocol (BGP)"
- Select the lab you want to run (e.g., Lab 3)
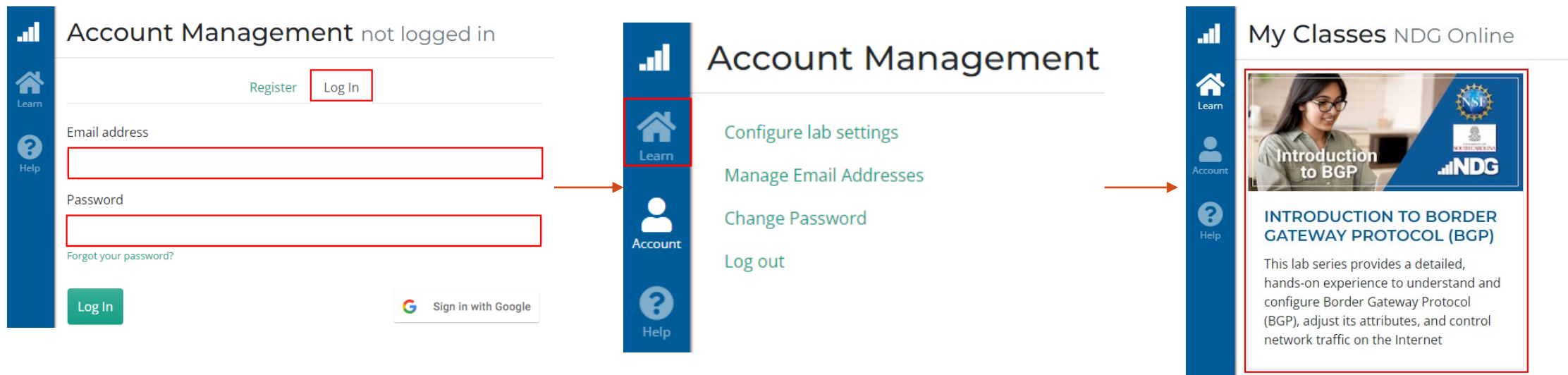
Lab Topology

- Configure IBGP within AS 200
- Configure EBGP between AS 100 and AS 200
- Configure LOCAL_PREF and MED attributes to favor the primary link over the secondary one
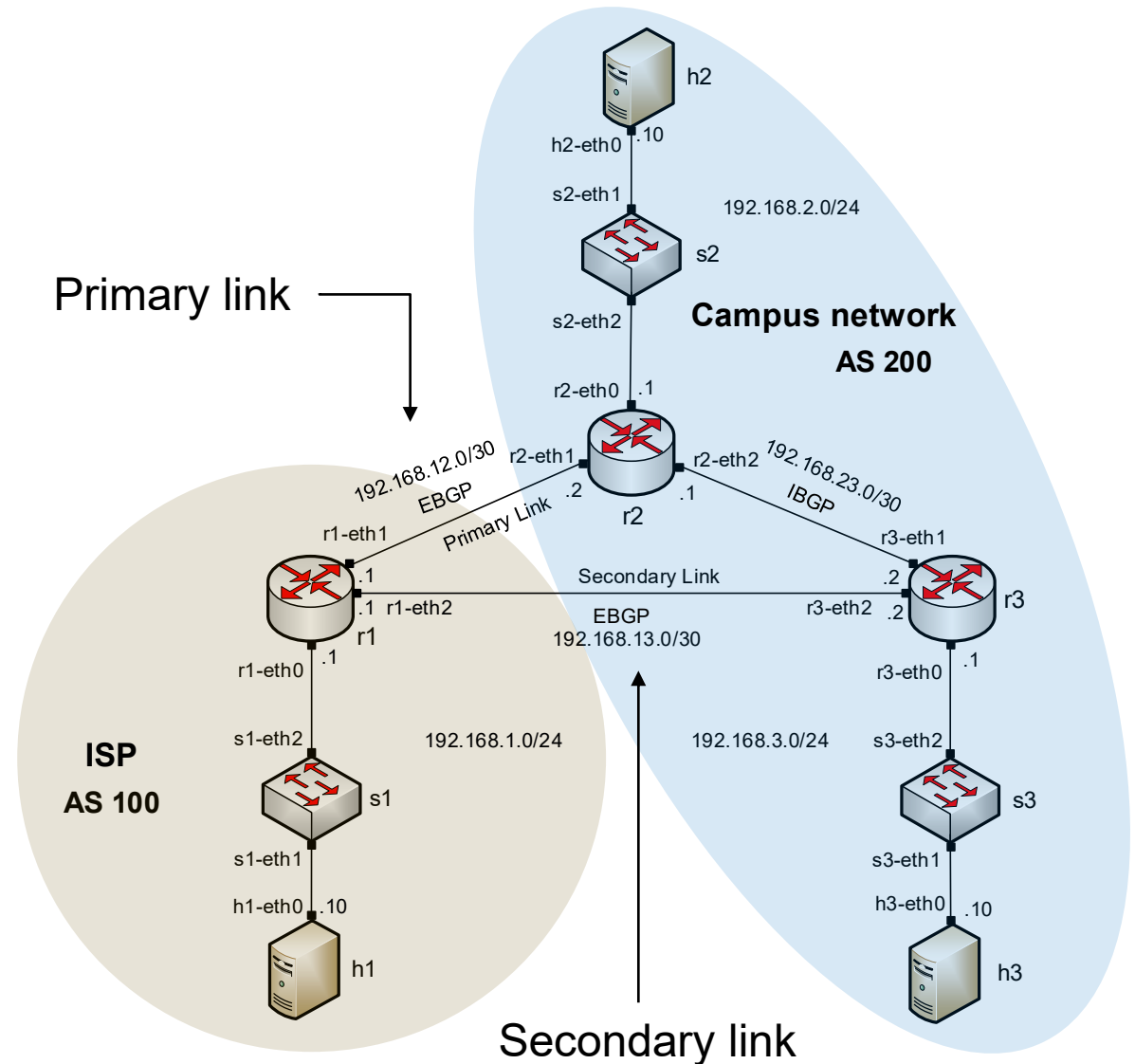
Lab Topology

- Local_PREF attribute configuration on routers r2 and r3
  - Configure a route-map
  - Set the LOCAL_PREF attribute
  - Assign the route-map to the BGP neighbor


```
                          "Host: r2"                    – ⤢ ×
frr-pc# configure terminal
frr-pc(config)# route-map primary_in permit 10
frr-pc(config-route-map)# set local-preference 150
frr-pc(config-route-map)# exit
frr-pc(config)# router bgp 200
frr-pc(config-router)# neighbor 192.168.12.1 route-map primary_in in
frr-pc(config-router)#
```

```
                          "Host: r3"                    – ⤢ ×
frr-pc# configure terminal
frr-pc(config)# route-map secondary_in permit 10
frr-pc(config-route-map)# set local-preference 125
frr-pc(config-route-map)# exit
frr-pc(config)# router bgp 200
frr-pc(config-router)# neighbor 192.168.13.1 route-map secondary_in in
frr-pc(config-router)# end
```
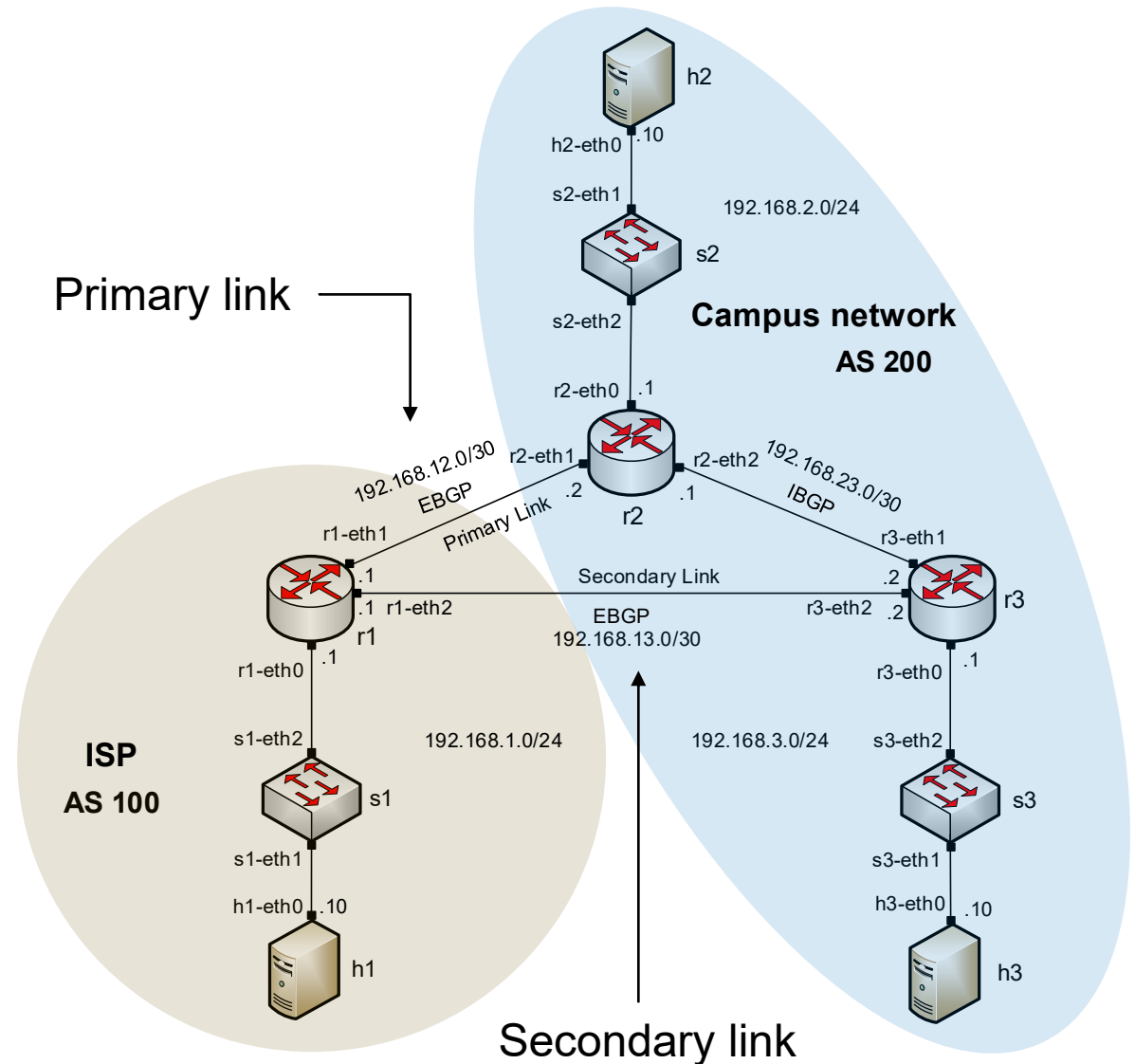
Lab Topology

- BGP table of router r3 after configuring the LOCAL_PREF attribute


```
                          "Host: r3"                          - ⤢ ✕
frr-pc# show ip bgp
BGP table version is 6, local router ID is 3.3.3.3, vrf id 0
Default local pref 100, local AS 200
Status codes:  s suppressed, d damped, h history, * valid, > best, = multipath,
               i internal, r RIB-failure, S Stale, R Removed
Nexthop codes: @NNN nexthop's vrf id, < announce-nh-self
Origin codes:  i - IGP, e - EGP, ? - incomplete

   Network          Next Hop          Metric LocPrf Weight Path
*>i192.168.1.0/24   192.168.12.1           0    150      0 100 i
*                   192.168.13.1           0    125      0 100 i
*>i192.168.2.0/24   192.168.23.1           0    100      0 i
*> 192.168.3.0/24   0.0.0.0                0         32768 i
*>i192.168.12.0/30  192.168.23.1           0    100      0 i
*> 192.168.13.0/30  0.0.0.0                0         32768 i

Displayed  5 routes and 6 total paths
frr-pc#
```
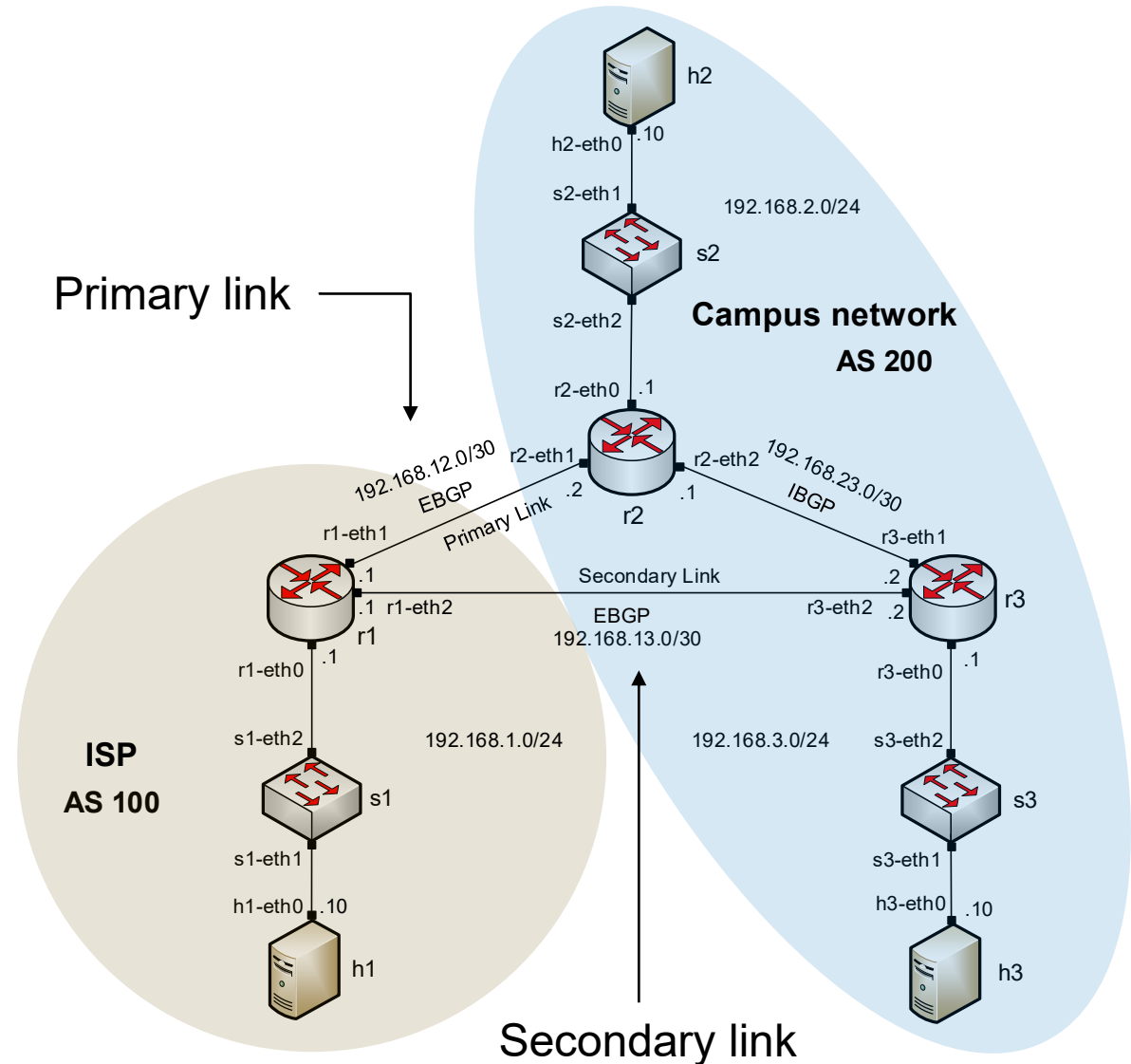
Primary link

Secondary link

Lab Topology

- MED attribute configuration on routers r2 and r3
  - Configure a route-map
  - Set the MED attribute
  - Assign the route-map to the BGP neighbor


```
"Host: r2"                                          – ⤢ ×
frr-pc# configure terminal
frr-pc(config)# route-map primary_med_out permit 10
frr-pc(config-route-map)# set metric 50
frr-pc(config-route-map)# exit
frr-pc(config)# router bgp 200
frr-pc(config-router)# neighbor 192.168.12.1 route-map primary_med_out out
frr-pc(config-router)#
```

```
"Host: r3"                                          – ⤢ ×
frr-pc# configure terminal
frr-pc(config)# route-map secondary_med_out permit 10
frr-pc(config-route-map)# set metric 75
frr-pc(config-route-map)# exit
frr-pc(config)# router bgp 200
frr-pc(config-router)# neighbor 192.168.13.1 route-map secondary_med_out out
frr-pc(config-router)# end
frr-pc#
```
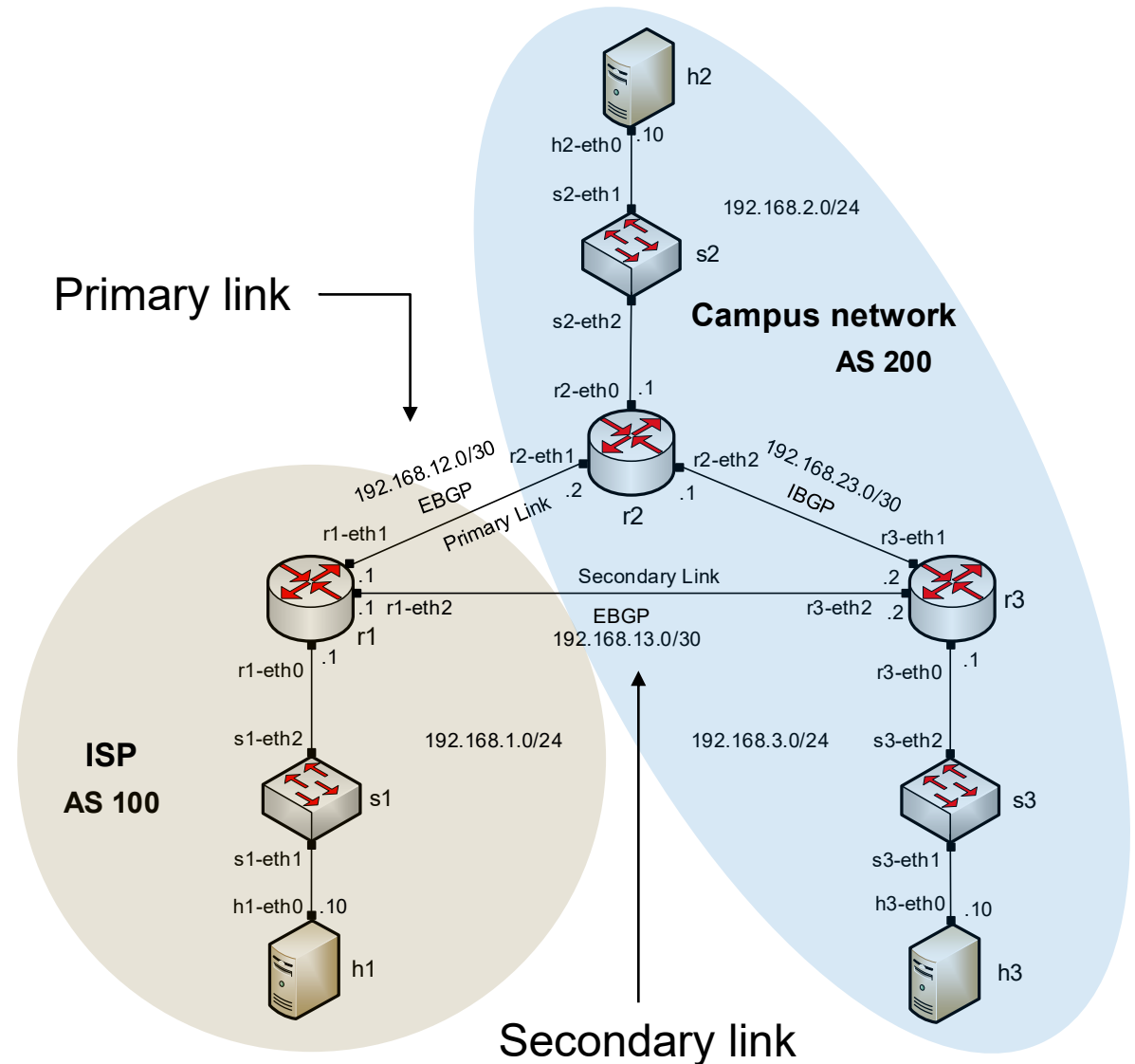
Lab Topology

- BGP table of router r1 after configuring the MED attribute


```
"Host: r1"                                                    - ⤢ ×
frr-pc# show ip bgp
BGP table version is 17, local router ID is 1.1.1.1, vrf id 0
Default local pref 100, local AS 100
Status codes:  s suppressed, d damped, h history, * valid, > best, = multipath,
               i internal, r RIB-failure, S Stale, R Removed
Nexthop codes: @NNN nexthop's vrf id, < announce-nh-self
Origin codes:  i - IGP, e - EGP, ? - incomplete

   Network          Next Hop          Metric LocPrf Weight Path
*> 192.168.1.0/24   0.0.0.0                0           32768 i
*  192.168.2.0/24   192.168.13.2          75               0 200 i
*>                  192.168.12.2          50               0 200 i
*> 192.168.3.0/24   192.168.12.2          50               0 200 i
*                   192.168.13.2          75               0 200 i
*  192.168.12.0/30  192.168.13.2          75               0 200 i
*>                  192.168.12.2          50               0 200 i
*> 192.168.13.0/30  192.168.12.2          50               0 200 i
*                   192.168.13.2          75               0 200 i

Displayed  5 routes and 9 total paths
frr-pc#
```

Primary link

Secondary link