Advanced Networking Architectures and Wireless Systems

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MPLS TE

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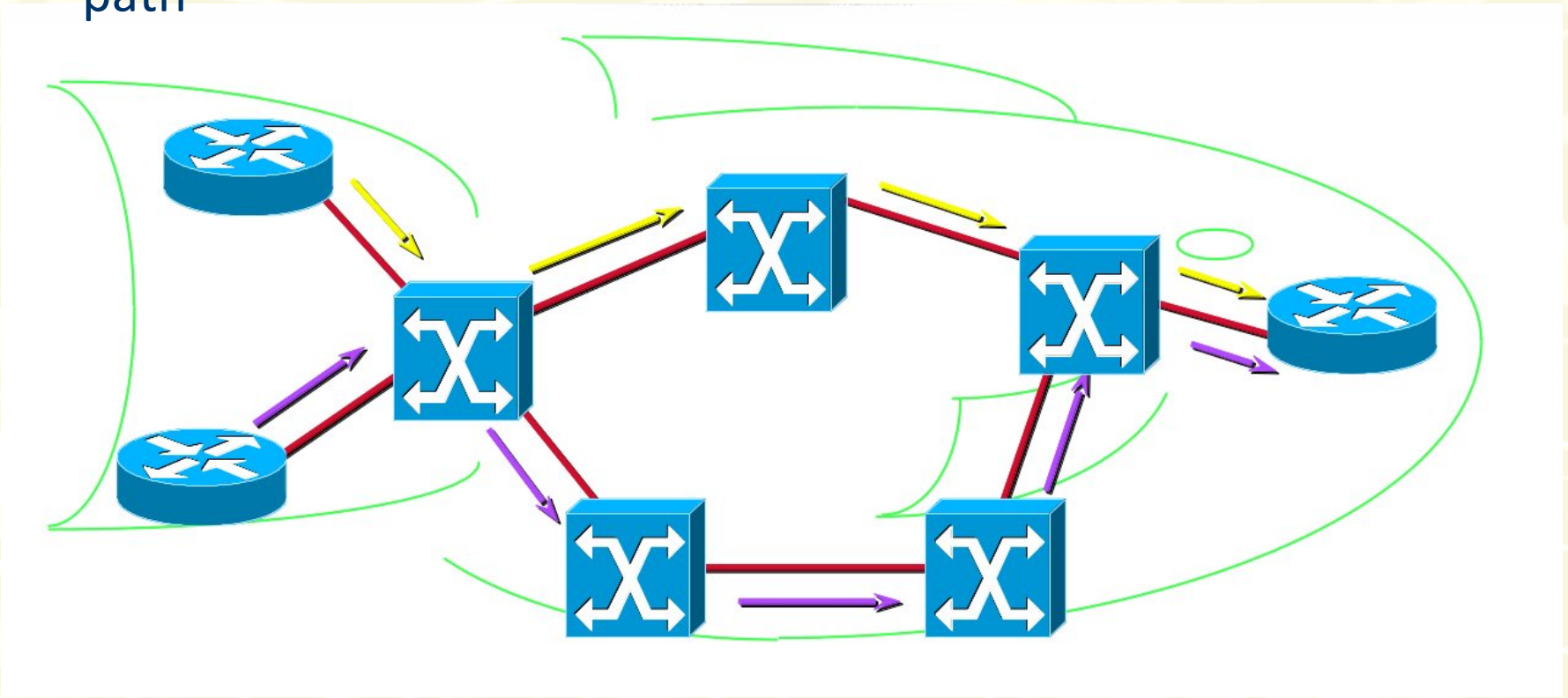
MPLS TE

- Traditional IP networks uses ***destination-based routing***
- ***Explicit routing*** (e.g. source based routing) is not supported
- MPLS networks can support ***destination-based and explicit routing simultaneously***
- ***MPLS TE*** uses extensions to RSVP and MPLS forwarding to support constrained-based routing (taking into account more information on network constraints and policy requirements)

MPLS TE

- Resource optimization, avoid over- and under- utilization of network parts, traffic not being aggregated on the shortest path



OSPF configuration

- RIP is a distance vector routing protocol, only link-state routing protocols that provide constant updates on the link state can be used
- For this reason we need to configure OSPF (already done in the MPLS scenario)
  - `router ospf 100`
  - `network 10.1.1.0 0.0.0.3 area 1`
  - `network 10.2.2.0 0.0.0.3 area 1`
  - `network 192.168.1.0 0.0.0.255 area 1`
  - `network 192.168.2.0 0.0.0.255 area 1`
  - `network 192.168.3.0 0.0.0.255 area 1`

Loopback configuration

- It is mandatory to setup a Loopback interface with IP mask of 32 bits on each router to be used as router-id
  - `interface Loopback0`
  - `ip address 172.16.1.5 255.255.255.255`
  - `router ospf 100`
  - `network 172.16.1.5 0.0.0.0 area 1`

MPLS

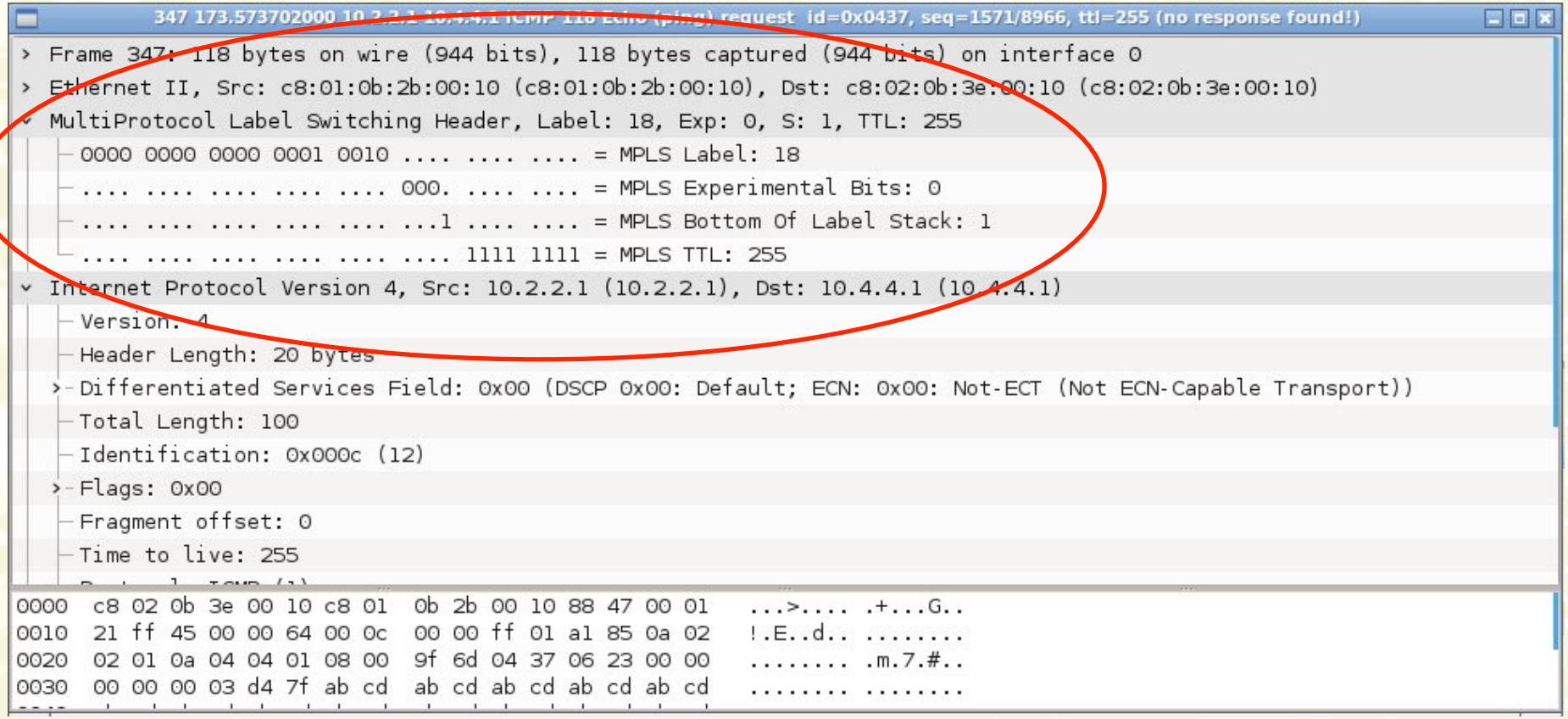
- Cisco MPLS implementation requires CEF – Cisco Express Forwarding
- CEF is an advanced layer 3 switching technology adopted in cisco routers to increase packet switching speed
- CEF keeps track of adjacencies to build the Forwarding Information Base (FIB)

MPLS Configuration

- Enable
  - `ip cef`
    - Enable CEF
  - `interface Ethernet 0/0`
  - `tag-switching ip`
    - Enable tag switching on this interface
- Check
  - `show tag-switching forwarding-table`

Test

- Open Wireshark and try to ping Console3 from Console 1



MPLS - TE

- Unlike conventional IP routing MPLS traffic engineering (TE) uses the implicit MPLS characteristic of separation between the forwarding plane and the control plane to allow routing decisions to be made on criteria other than the destination address
- Label switched paths (LSPs), referred as “traffic engineering tunnels” are setup to steer traffic through the network allowing links not included in the shortest path to be used

MPLS TE - Tunnels

- Enable the creation of mpls tunnels for TE:
  - `mpls traffic-eng tunnels`
    - Enable tunnels creation on the router
  - `Interface Ethernet 0/0`
  - `mpls traffic-eng tunnels`
  - `ip rsvp bandwidth 512 512`
    - Enable MPLS tunnel creation on the interface specifying the reservable bandwidth and largest reservable flow on the interface
  - `router ospf 100`
  - `mpls traffic-eng area 1`
  - `mpls traffic-eng router-id Loopback0`
    - Enable TE extension on OSPF

RSVP adopted also as admission control

MPLS TE - Tunnels

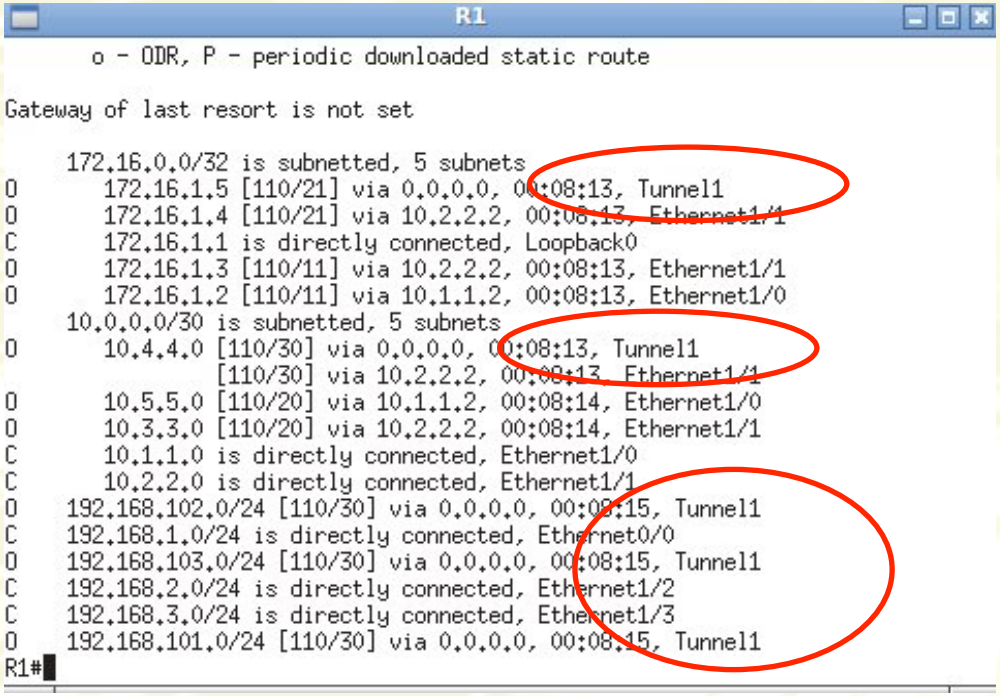
- Define a new tunnel:
  - `interface Tunnel0`
  - `ip unnumbered Loopback0`
  - `tunnel destination 172.16.1.5`
  - `tunnel mode mpls traffic-eng`
  - `tunnel mpls traffic-eng autoroute announce`
  - `tunnel mpls traffic-eng priority 2 2`
  - `tunnel mpls traffic-eng bandwidth 400`
  - `tunnel mpls traffic-eng path-option 1 dynamic`
    - The path of the tunnel will be dynamically selected
- Check the status:
  - `show mpls traffic-eng tunnels`

MPLS TE - Tunnels

- Define a tunnel with explicit path:
  - `interface Tunnel1`
  - `ip unnumbered Loopback0`
  - `tunnel destination 172.16.1.5`
  - `tunnel mode mpls traffic-eng`
  - `tunnel mpls traffic-eng autoroute announce`
  - `tunnel mpls traffic-eng priority 2 2`
  - `tunnel mpls traffic-eng bandwidth 400`
  - `tunnel mpls traffic-eng path-option 1 explicit name longpath`
  - `tunnel mpls traffic-eng path-option 2 dynamic`
- Define the path:
  - `ip explicit-path name longpath enable`
  - `next-address 10.2.2.2`
  - `next-address 10.3.3.2`
  - `next-address 10.4.4.2`

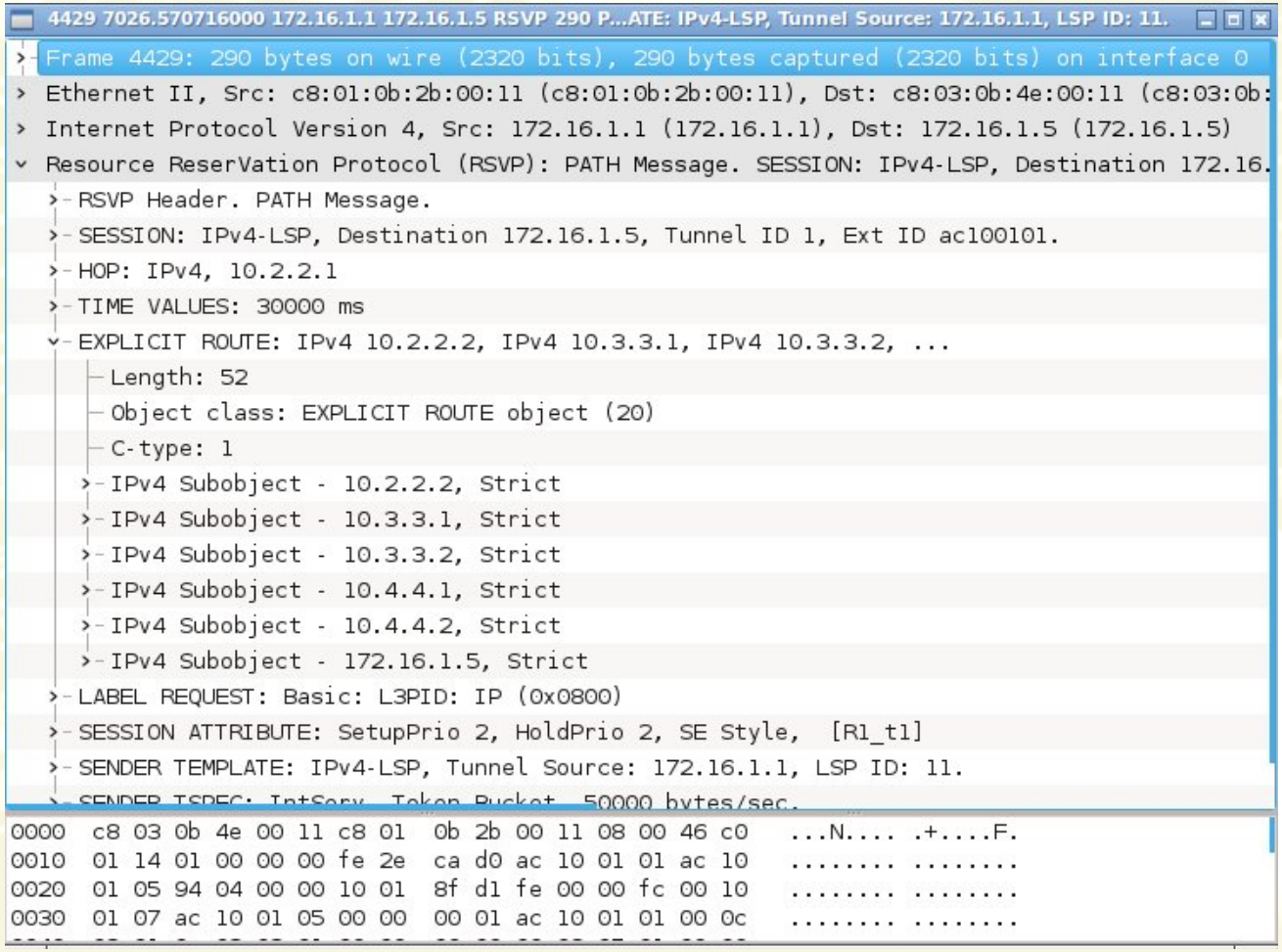
Test

- show ip route



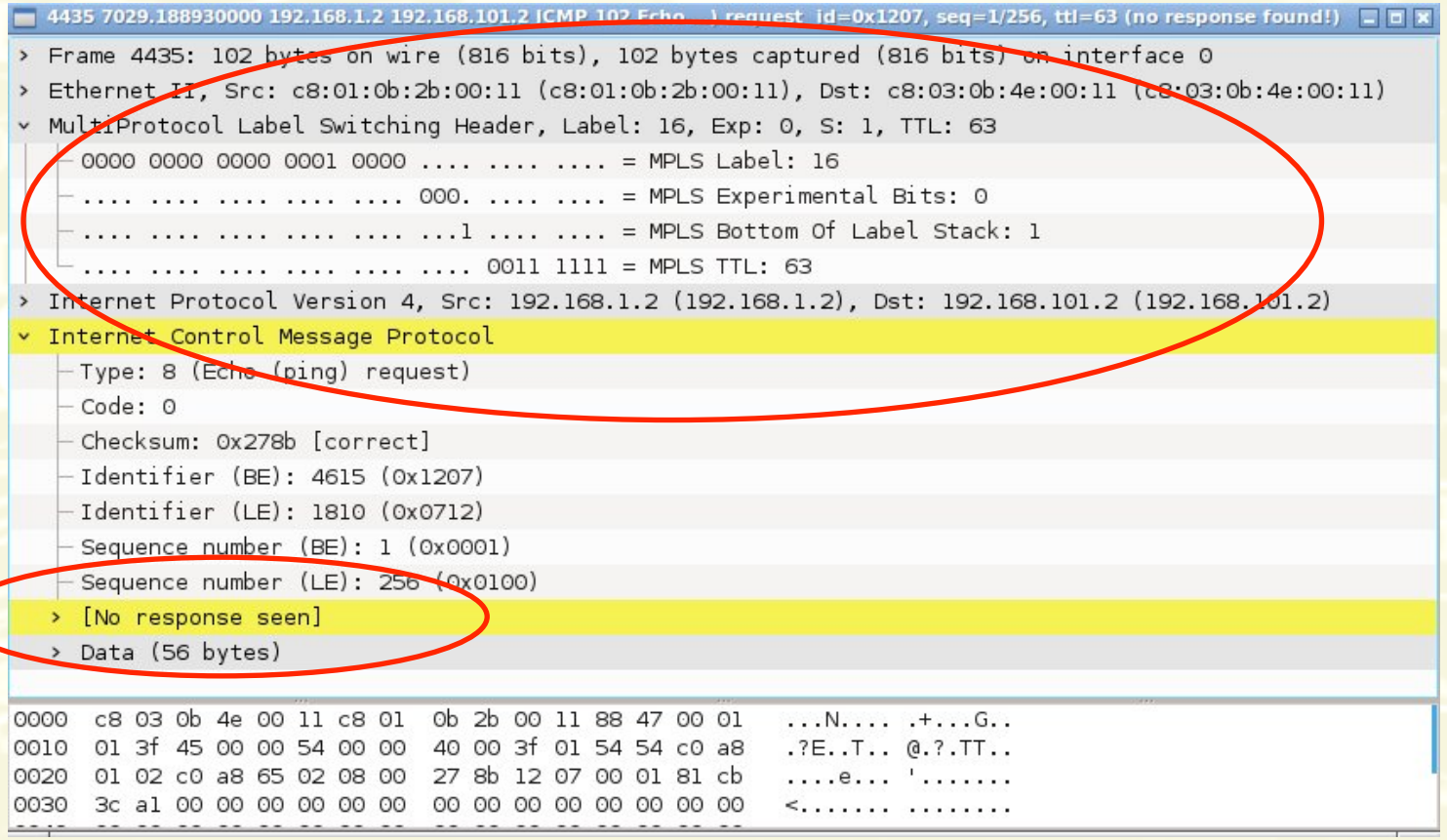
Test

- RSVP messages can be seen



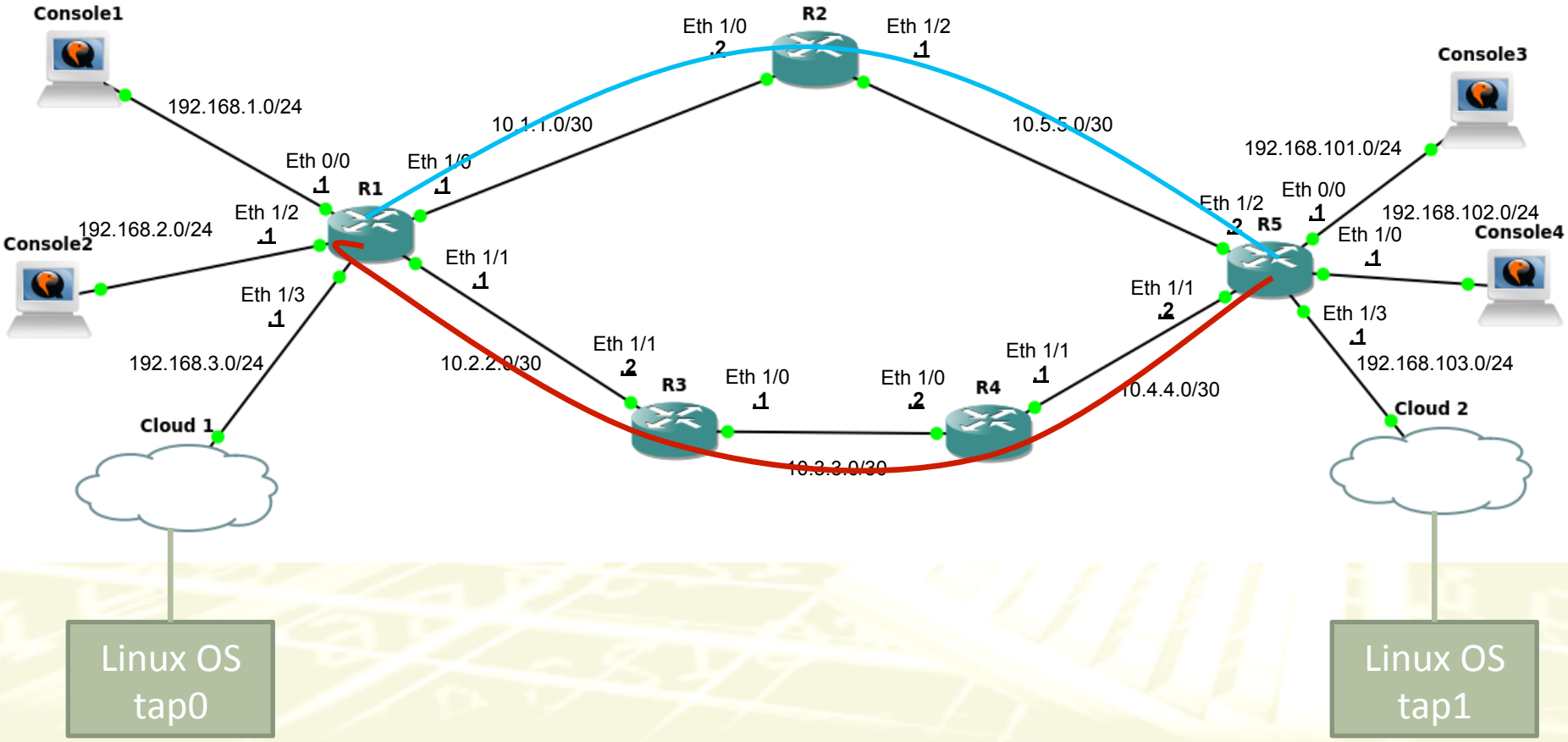
Test

- Open Wireshark on one of the links in the long path and try to ping Console3 from Console 1



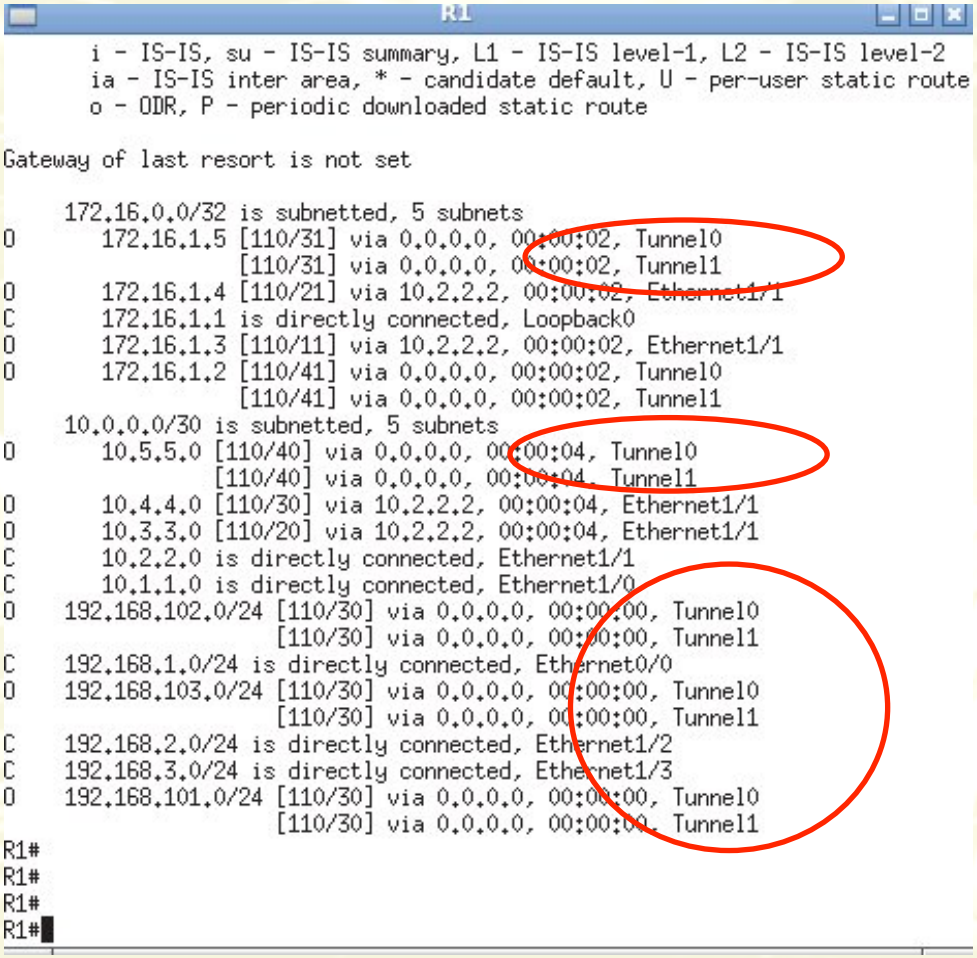
Response is sent on the short path!

Create two tunnels



Test

- show ip route



Differentiate routing

- To differentiate routing you can set static routes (e.g. for load balancing):
  - `ip route 192.168.101.0 0.0.0.255 Tunnel0`
  - `ip route 192.168.102.0 0.0.0.255 Tunnel1`

Policy Based Routing and MPLS-TE

- Define Classification
  - `access-list 1 permit 192.168.1.2 0.0.0.0`
- Define Marking:
  - `interface Ethernet 0/0`
  - `ip policy route-map prio`
  - `route-map prio permit 10`
  - `match ip address 1`
  - `set interface Tunnel 0`

References

- MPLS TE: http://www.cisco.com/c/en/us/td/docs/ios/12_0s/feature/guide/TE_1208S.html