

COMPUTER NETWORKS - LABORATORY 075

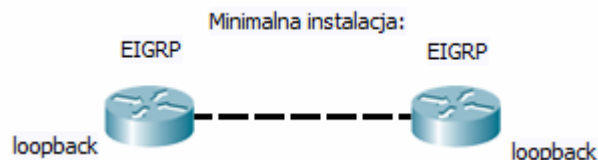
Subject:

Cisco routers. IGP (Interior) dynamic routing - EIGRP.
Inter-VLAN routing using external routers with sub-interfaces and IEEE 802.1Q encapsulation.

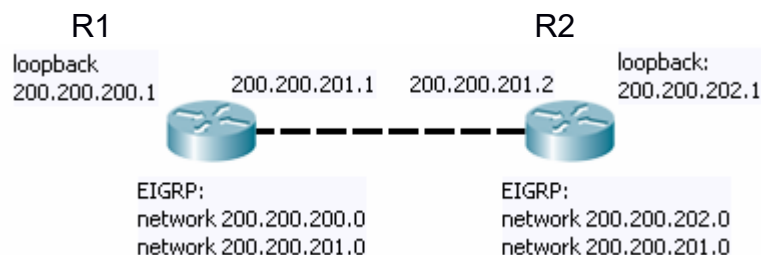
Task B: Dynamic Routing - EIGRP

1. Prepare some Cisco routers, connecting them with proper Ethernet wiring.
2. Configure and enable interfaces in these routers - defining different IP networks directly connected to routers in accordance with generally known principles. In each router configure and enable one or more loopback test interfaces.

Minimal configuration:



3. Enable IP routing and check if it is enabled:
Router (config) #ip routing
4. Starting EIGRP routing:
 - Enable the EIGRP routing:
Router (config) # router eigrp 1234
where 1234 is the ID of the EIGRP autonomous system (common to all routers in the system)
 - The interface can have a bandwidth feature (which affects link metric the calculation by routes):
Router (config-if) # bandwidth 128000



You must officially register all directly connected networks to be used in a dynamic routing protocol:

```
R1(config-router)#network 200.200.200.0 0.0.0.255
R1 (config-router #network 200.200.201.0 0.0.0.255
```

```
R2 (config-router) #network 200.200.202.0 0.0.0.255
R2 (config-router) #network 200.200.201.0 0.0.0.255
```

or generally:

```
R1 (config-router) #network 0.0.0.0
R2 (config-router) #network 0.0.0.0
```

EIGRP router is looking for their neighbors using IP networks to transmit IP multicast address (224.0.0.10). If defined medium (e.g., Point-to-point) does not support the IP multicast transmission, you have to switch EIGRP operating mode to communicate using IP unicast. This is done via explicit and consistent definition of neighbors for EIGRP routers on some interface:

```
R1 (config-router) #neighbor 200.200.201.2 fa 0/0
R2 (config-router) #neighbor 200.200.201.1 fa 0/0
```

where fa 0/0 is the interface to a neighbor.

These commands can also use when we want to authoritatively determine which routers EIGRP and with whom can communicate (connection occurs when both routers will receive a mutual display of each other as neighbors).

5. After a while (time for neighbor negotiation) check the results:

```
Router # show ip route
```

and ping or traceroute some remote loopback interface.

Also check the diagnostic commands for EIGRP:

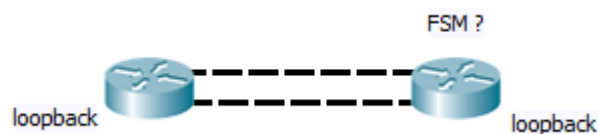
```
Router # sh ip eigrp topology
Router # sh ip eigrp topology all-links
Router # show ip eigrp topology 200.200.100.0
Router # sh ip eigrp neighbors
Router # sh ip eigrp traffic
```

and general:

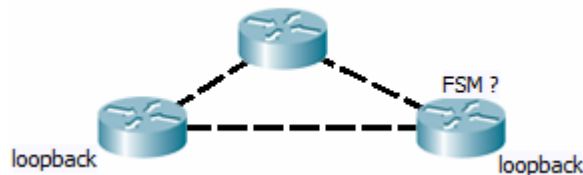
```
Router # debug ip routing
Router # show ip route
Router # show ip protocols
Router # debug ip routing
```

6. Mechanism of the alternate routes in EIGRP:

In order to check the behavior of EIGRP path loss situation it is best to use FSM tracking messages. EIGRP path with best Successor Feasible Metric is used as a route when previous route is lost. Build a loop with two or three alternative links between EIGRP routers. For testing use loopback interfaces in routers.



or:



In the router, where the activity will be analyzed, enable FSM tracking:
Router # debug eigrp fsm

Check the EIGRP topology on this router:
Router # show ip eigrp topology all-links

The cause a failure of one of the links (by removing physical cable) and watch the messages received on the FSM. Restore the link, and then observe the behavior of EIGRP.

7. In the EIGRP it is possible to activate a number of alternative routes at the same time, causing proportional deployment (load ballancing) of a traffic along these routes. This happens when the parameters of the Administrative Distance and EIGRP metrics for these routes are identical. Since automatic calculation of metrics performed by EIGRP, it is unlikely to get identical values here. So there is an additional parameter called the variance, the value by which the best metric is multiplied. If it the result is worse then second-best metrics, second-best link is also applied as a route. The default value of the variance is 1.

In order to start the load-ballancing must first be set / check-value maximum paths for EIGRP (must be greater than 1),
Router (config-router) # maximum-paths 4
Router # show ip protocols

You can also activate load balancing in per-packet mode (the default mode: per-destination):

Router (config) #interface fa 0/0
Router (config-if) #ip load-sharing per-packet

Check the current satiation:
Router # clear ip route eigrp
Router # show ip eigrp topology
Router # show ip route eigrp

Then adjust multiplier variance (to allow other routes as well):
Router (config-router) #variance 3

and check the situation again:
Router # clear ip route eigrp
Router # show ip eigrp topology
Router # show ip route eigrp

Test a load ballancing operation (ping *some_address* repeat 10000).

It is also convenient to include tracking of changes in the routing table:

```
Router # debug ip routing
and statistics for the interfaces
Router # show int fa 0/1 summary
Router # show int fa 0/0 summary
```

Note: The mechanism of load ballancing works only when the routing table is unaffected by other rules with better administrative distance.

Check the impact of bandwidth characteristics change on the links to a value of calculated EIGRP metrics:

```
Router (config-if) #bandwidth 128
Router # show ip eigrp topology 200.200.200.0 255.255.255.0
Router # show ip eigrp topology all-links
```

Task C: Inter VLAN routing with sub-interfaces

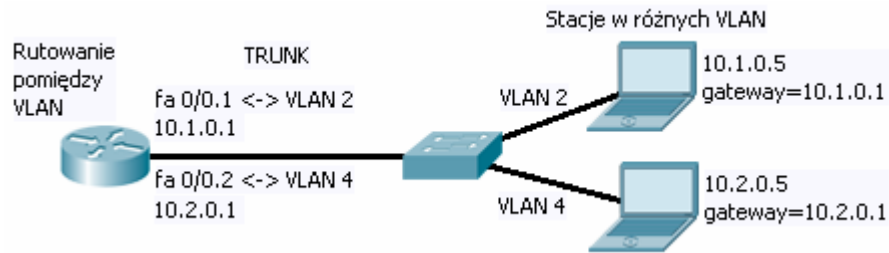
1. An additional issue is to configure routing between VLANs performed by switches and external router with IEEE 802.1Q Ethernet link. Instead of multiple port-based VLANs connected to the router with individual physical links, a single IEEE 802.1Q link will be used. Configuration of such infrastructure requires defining a sub-interfaces for each VLAN in a router.
2. Build a system consisting a switch having at least two VLANs and at least one port (802.1Q trunk) for multiple VLAN traffic defined in its configuration. Connect this port to the router.
3. Connect the switch ports qualified for the individual VLANs to PC stations. The trunk should be connected to a router.
4. In the router configuration enable the interface but don't define (or remove) an IP address (IP addresses compatible with each VLAN's IP networks will be assigned to sub-interfaces):

```
Router (config) #int fa 0/0
Router (config-if) #no ip address
Router (config-if) #no shutdown
Router (config-if) #exit
```

5. Define a sub-interface for each VLAN. For each sub-interface choose the encapsulation type as 802.1Q with w proper VLAN ID tag:

```
Router (config) #int fa 0 / 0.1
Router (config-subif) #encapsulation dot1q 2
Router (config) #int fa 0 / 0.2
Router (config-subif) #encapsulation dot1q 4
```

where the numbers 2 and 4 are VIDs (VLAN IDs) corresponding to VLANs in your switch. The fa0/0.1 is the first sub-interface of interface fa0/0 (sub-interfaces are indexed starting from 1, not 0).



6. Next, specify the IP addresses of sub-interfaces according to the addressing of individual VLAN, eg .:

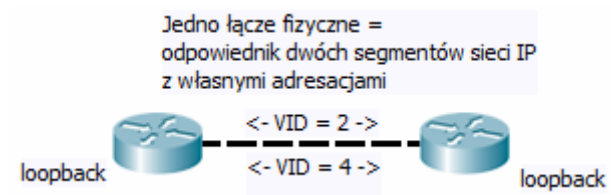

```
Router (config) #int fa 0 / 0.1
Router (config-subif) #ip addr 10.1.0.1 255.255.0.0
Router (config) #int fa 0 / 0.2
Router (config-subif) #ip addr 10.2.0.1 255.255.0.0
```
7. Check through the PC computers connected to the switch ports and belonging to different VLANs, whether it is possible to route between VLANs.
8. Remind: PC must have a "default gateway" configured to indicate the corresponding router's sub-interface. Only then you can use these it to test the routing between VLANs.

Task D: Multiple logical links between routers defined by 802.1Q encapsulation

1. 802.1Q sub-interfaces encapsulated in some interface can also create logical links between routers only. That will provide a method of isolating the traffic in physical links. So it is possible to create multiple isolated links (by ISO OSI layer 2) between routers, using only one physical Ethernet connection between them.
2. Conditions to be met:
 - 802.1Q VID sub-interface identifiers must be identical on both ends
 - in each link IP addressing must define individual IP network. Connect two routers and verify the ability to communicate within the 801Q:

```
R1(config)#interface fa 0 / 1.4
R1 (config-subif) #encapsulation dot1q 2
R1 (config-subif) #ip address 11.0.0.1 255.255.255.0
R1 (config-subif) #exit
R1 (config) #interface fa 0 / 1.7
R1 (config-subif)# encapsulation dot1q 4
R1 (config-subif) #IP address 13.0.0.1 255.255.255.0

R2 (config) #interface fa 0 / 1.10
R2 (config-subif) #encapsulation dot1q 2
R2 (config-subif) #ip address 11.0.0.2 255.255.255.0
R2 (config-subif) #exit
R2 (config) #interface fa 0 / 1.11
R2 (config-subif) #encapsulation dot1q 4
R2 (config-subif) #ip address 13.0.0.2 255.255.255.0
```



The above example defines two links in networks 11.0.0.0/24 and 13.0.0.0/24. The first uses VID = 2 and second - VID = 4.