ΤΜΗΜΑ ΗΛΕΚΤΡΟΛΟΓΩΝ ΜΗΧΑΝΙΚΩΝ & ΜΗΧΑΝΙΚΩΝ ΥΠΟΛΟΓΙΣΤΩΝ
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# Διαχείριση Δικτύων – Ευφυή Δίκτυα
## 9ο εξάμηνο ΗΜΜΥ, ακαδημαϊκό έτος 2024-25

## 6η Ομάδα Ασκήσεων

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## 1 ) ΔΗΜΙΟΥΡΓΙΑ ΚΑΙ ΣΥΝΔΕΣΗ ΣΕ ΕΙΚΟΝΙΚΑ ΜΗΧΑΝΗΜΑΤΑ

Δημιουργούμε το εικονικό μηχάνημα netman-router, συνδεόμαστε από το serial port /tmp/vbox, θέτουμε το ρολόι του μηχανήματος και δίνουμε διεύθυνση ip στο interface GigabitEthernet1 με dhcp. Τώρα μπορούμε να συνδεθούμε στο μηχάνημα με ssh στο 192.168.1.5.

```
netman-router>en
netman-router#clock set 11:47:00 13 Dec 2024
netman-router#show
*Dec 13 11:47:00.031: %SYS-6-CLOCKUPDATE: System clock has been updated from 11:47:20 UTC Fri Dec 13 20.
Dec 13 11:47:00.033: %PKI-6-AUTHORITATIVE_CLOCK: System clock has been set. PKI timers get initialized l
netman-router#show clo
netman-router#show clock
11:47:03.525 UTC Fri Dec 13 2024
```

```
netman-router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
netman-router(config)#interface GigabitEthernet1
netman-router(config-if)#ip address dhcp
netman-router(config-if)#
netman-router(config-if)#do show ip int brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet1       192.168.1.5     YES DHCP   up                    up
GigabitEthernet2       unassigned      YES NVRAM  up                    up
GigabitEthernet3       unassigned      YES NVRAM  up                    up
GigabitEthernet4       unassigned      YES NVRAM  administratively down down
netman-router(config-if)#
```

Δημιουργούμε επίσης το εικονικό μηχάνημα netman.

## 2 ) ΧΕΙΡΟΚΙΝΗΤΗ ΠΑΡΑΜΕΤΡΟΠΟΊΗΣΗ ΤΟΥ ΔΡΟΜΟΛΟΓΗΤΗ ΜΕΣΩ CLI

Δίνουμε διεύθυνση ip στο interface GigabitEthernet2 στο δίκτυο 10.2.2.1/24.

```
netman-router(config)#int GigabitEthernet2
netman-router(config-if)#ip address 10.2.2.1 255.255.255.0
netman-router(config-if)#sh
netman-router(config-if)#no shut
netman-router(config-if)#
netman-router(config-if)#do show ip int brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet1       192.168.1.5     YES DHCP   up                    up
GigabitEthernet2       10.2.2.1        YES manual up                    up
GigabitEthernet3       unassigned      YES NVRAM  up                    up
GigabitEthernet4       unassigned      YES NVRAM  administratively down down
netman-router(config-if)#
```

Συνδεόμαστε στο netman με ssh. Παραμετροποιήστε το interface eth1 του κόμβου netman εντός του υποδικτύου 10.2.2.0/24.

```
netman@debian-ok:~$ sudo ifconfig eth1 10.2.2.2/24
netman@debian-ok:~$ sudo ifconfig eth1 up
netman@debian-ok:~$ sudo ifconfig
eth0      Link encap:Ethernet  HWaddr 08:00:27:4d:b9:91
          inet addr:192.168.1.7  Bcast:192.168.1.255  Mask:255.255.255.0
          inet6 addr: 2a02:586:1d06:d9d4:a00:27ff:fe4d:b991/64 Scope:Global
          inet6 addr: fe80::a00:27ff:fe4d:b991/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:563 errors:0 dropped:0 overruns:0 frame:0
          TX packets:315 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:49872 (48.7 KiB)  TX bytes:29782 (29.0 KiB)

eth1      Link encap:Ethernet  HWaddr 08:00:27:80:bb:cf
          inet addr:10.2.2.2  Bcast:10.2.2.255  Mask:255.255.255.0
          inet6 addr: fe80::a00:27ff:fe80:bbcf/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
```

## 3 ) ΑΥΤΟΜΑΤΟΠΟΙΗΜΕΝΗ ΠΑΡΑΜΕΤΡΟΠΟΙΗΣΗ ΤΟΥ ΔΡΟΜΟΛΟΓΗΤΗ

Κάνουμε clone το repository https://github.com/doup123/netman-ntua-automation-lab. Επεξεργαζόματε το αρχείο netconf_set_loopbacks.py ώστε να δημιουργήσουμε εικονικά loopback interfaces που αντιστοιχούν σε κτήρια του ΕΜΠ.

```
netman-router#show ip int brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet1       192.168.1.5     YES DHCP   up                    up
GigabitEthernet2       10.2.2.1        YES manual up                    up
GigabitEthernet3       unassigned      YES NVRAM  up                    up
GigabitEthernet4       unassigned      YES NVRAM  administratively down down
Loopback1              147.102.0.1     YES other  up                    up
Loopback2              147.102.1.1     YES other  up                    up
Loopback3              147.102.2.1     YES other  up                    up
Loopback4              147.102.3.1     YES other  up                    up
Loopback5              147.102.4.1     YES other  up                    up
Loopback6              147.102.5.1     YES other  up                    up
Loopback7              147.102.6.1     YES other  up                    up
Loopback8              147.102.7.1     YES other  up                    up
Loopback9              147.102.8.1     YES other  up                    up
Loopback10             147.102.9.1     YES other  up                    up
```

```python
#! /usr/bin/env python

# Import libraries
from ncclient import manager
from xml.dom import minidom
import xmltodict
import sys
from time import sleep


loopback = {"int_name": "Loopback1",
            "description": "Test Building",
            "ip": "1.1.1.1",
            "netmask": "255.255.0.0"}

# Create config template for an interface
config_data = """
<config>
  <interfaces xmlns="urn:ietf:params:xml:ns:yang:ietf-interfaces">
      <interface>
        <name>{int_name}</name>
        <description>{description}</description>
        <type xmlns:ianaift="urn:ietf:params:xml:ns:yang:iana-if-type">
    ianaift:softwareLoopback
        </type>
        <enabled>true</enabled>
        <ipv4 xmlns="urn:ietf:params:xml:ns:yang:ietf-ip">
          <address>
            <ip>{ip}</ip>
            <netmask>{netmask}</netmask>
          </address>
        </ipv4>
      </interface>
  </interfaces>
</config>
"""

# Open NETCONF connection to device
with manager.connect(host = '10.2.2.1',
                     port = 830,
                     username = 'cisco',
                     password = 'cisco-netman',
                     hostkey_verify = False,allow_agent=False) as m:
    # ADD YOUR CODE HERE FOR MULTIPLE LOOPBACKS
    # Create desired NETCONF config payload and <edit-config>

    for i in range(1, 11):
      loopback["int_name"] = "Loopback" + str(i)
      if i % 2 == 1:
        description = "NTUA-Building-" + str(i)
      else:
        description = "ECE-NTUA-Building-1"
      loopback["description"] = description
      loopback["ip"] = "147.102." + str(i-1) + ".1"
      loopback["netmask"] = "255.255.255.0"

      config = config_data.format(**loopback)
      r = m.edit_config(target = "running", config = config)
      sleep(2)
      print("NETCONF RPC OK: {}".format(r.ok)+" Loopback1 created")
```

Για να δούμε τα interfaces που φτιάξαμε επεξεργαζόμαστε το αρχείο netconf_get_loopbacks.py

```
config_data = """<filter>
  <interfaces xmlns="urn:ietf:params:xml:ns:yang:ietf-interfaces">
    <interface>
      <name>{int_name}</name>
    </interface>
  </interfaces>
</filter>"""

# Open NETCONF connection to device
with manager.connect(host = '10.2.2.1',
                     port = 830,
                     username = 'cisco',
                     password = 'cisco-netman',
                     hostkey_verify = False,allow_agent=False) as m:
    # ADD YOUR CODE HERE FOR MULTIPLE LOOPBACKS
    # Create desired NETCONF config payload and <edit-config>
    for i in range(1, 11):
      interface_name = "Loopback" + str(i)
      config = config_data.format(int_name = interface_name)
      r = m.get_config("running", config)
      sleep(2)
      xml_doc = minidom.parseString(r.xml)
      #print(xml_doc.toprettyxml(indent = "   "))
      # Process the XML data into Python Dictionary and use
      interface = xmltodict.parse(r.xml)
      # Only if RPC returned data
      if not interface["rpc-reply"]["data"] is None:
          interface = interface["rpc-reply"]["data"]["interfaces"]["interface"]

          print("The interface {name} has ip address {ip}/{mask}".format(
                  name = interface["name"]["#text"],
                  ip = interface["ipv4"]["address"]["ip"],
                  mask = interface["ipv4"]["address"]["netmask"],
                  )
              )
      else:
          print("No interface {} found".format("GigabitEthernet2"))
```

Αφού το τρέξουμε βλέπουμε ότι δημιουργούνται τα παρακάτω interfaces.

```
netman@debian-ok:~/netman-ntua-automation-lab$ python netconf_get_loopbacks.py
/usr/lib/python2.7/dist-packages/Crypto/Cipher/blockalgo.py:141: FutureWarning: CTR mode needs counter parameter, not IV
  self._cipher = factory.new(key, *args, **kwargs)
The interface Loopback1 has ip address 147.102.0.1/255.255.255.0
The interface Loopback2 has ip address 147.102.1.1/255.255.255.0
The interface Loopback3 has ip address 147.102.2.1/255.255.255.0
The interface Loopback4 has ip address 147.102.3.1/255.255.255.0
The interface Loopback5 has ip address 147.102.4.1/255.255.255.0
The interface Loopback6 has ip address 147.102.5.1/255.255.255.0
The interface Loopback7 has ip address 147.102.6.1/255.255.255.0
The interface Loopback8 has ip address 147.102.7.1/255.255.255.0
The interface Loopback9 has ip address 147.102.8.1/255.255.255.0
The interface Loopback10 has ip address 147.102.9.1/255.255.255.0
netman@debian-ok:~/netman-ntua-automation-lab$
```

## 4 ) ΕΦΑΡΜΟΓΗ BLACKHOLING ΜΕΣΩ ΑΥΤΟΜΑΤΟΠΟΙΗΣΗΣ

Παραμετροποιούμε το interface GigabitEthernet3 του netman router εντός του υποδικτύου 10.3.3.0/24 και ορίστε στον κόμβο netman διαδρομή προς αυτό το interface.

```
netman@debian-ok:~$ sudo ip route add 10.3.3.0/24 via 10.2.2.1
netman@debian-ok:~$ netstat -rn
Kernel IP routing table
Destination     Gateway         Genmask         Flags   MSS Window  irtt Iface
0.0.0.0         192.168.1.1     0.0.0.0         UG        0 0          0 eth0
10.2.2.0        0.0.0.0         255.255.255.0   U         0 0          0 eth1
10.3.3.0        10.2.2.1        255.255.255.0   UG        0 0          0 eth1
192.168.1.0     0.0.0.0         255.255.255.0   U         0 0          0 eth0
netman@debian-ok:~$
```

Παραμετροποιούμε το δρομολογητή ώστε πακέτα με next-hop τη διεύθυνση 192.0.0.1/32 να απορρίπτονται στο εικονικό interface Null0.

```
netman-router(config)#ip route 192.0.0.1 255.255.255.255 Null0
netman-router(config)#do show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is 192.168.1.1 to network 0.0.0.0

S*    0.0.0.0/0 [254/0] via 192.168.1.1
      10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
C        10.2.2.0/24 is directly connected, GigabitEthernet2
L        10.2.2.1/32 is directly connected, GigabitEthernet2
C        10.3.3.0/24 is directly connected, GigabitEthernet3
L        10.3.3.2/32 is directly connected, GigabitEthernet3
      147.102.0.0/16 is variably subnetted, 20 subnets, 2 masks
C        147.102.0.0/24 is directly connected, Loopback1
L        147.102.0.1/32 is directly connected, Loopback1
C        147.102.1.0/24 is directly connected, Loopback2
L        147.102.1.1/32 is directly connected, Loopback2
C        147.102.2.0/24 is directly connected, Loopback3
L        147.102.2.1/32 is directly connected, Loopback3
C        147.102.3.0/24 is directly connected, Loopback4
L        147.102.3.1/32 is directly connected, Loopback4
C        147.102.4.0/24 is directly connected, Loopback5
L        147.102.4.1/32 is directly connected, Loopback5
C        147.102.5.0/24 is directly connected, Loopback6
L        147.102.5.1/32 is directly connected, Loopback6
C        147.102.6.0/24 is directly connected, Loopback7
L        147.102.6.1/32 is directly connected, Loopback7
C        147.102.7.0/24 is directly connected, Loopback8
L        147.102.7.1/32 is directly connected, Loopback8
C        147.102.8.0/24 is directly connected, Loopback9
L        147.102.8.1/32 is directly connected, Loopback9
C        147.102.9.0/24 is directly connected, Loopback10
L        147.102.9.1/32 is directly connected, Loopback10
      192.0.0.0/32 is subnetted, 1 subnets
S        192.0.0.1 is directly connected, Null0
      192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.1.0/24 is directly connected, GigabitEthernet1
```

Με τη χρήση του netconf_add_route.py προσθέτουμε διαδρομή ώστε τα πακέτα που πηγαίνουν στο netman στο ip 10.2.2.2 ως μέρος μιας επίθεσης να απορρίπτονται.

```
# New Loopback Details
route = {"destination_prefix": "10.2.2.2/32",  #e.g. 1.1.1.1/32
            "next_hop_address": "192.0.0.1/32"}  #e.g. 2.2.2.2

config_data="""
<config>
   <routing xmlns="urn:ietf:params:xml:ns:yang:ietf-routing">
      <routing-instance>
         <name>default</name>
         <description>default-vrf [read-only]</description>
         <interfaces/>
         <routing-protocols>
            <routing-protocol>
               <type>static</type>
               <name>1</name>
               <static-routes>
                  <ipv4 xmlns="urn:ietf:params:xml:ns:yang:ietf-ipv4-unicast-routing">
                     <route>
                        <destination-prefix>{destination_prefix}</destination-prefix>
                        <next-hop>
                           <next-hop-address>{next_hop_address}</next-hop-address>
                        </next-hop>
                     </route>
                  </ipv4>
               </static-routes>
            </routing-protocol>
         </routing-protocols>
      </routing-instance>
   </routing>
</config>
"""

# Open NETCONF connection to device
with manager.connect(host = ' 10.2.2.1',
                     port = 830,
                     username = 'cisco',
                     password = 'cisco-netman',
                     hostkey_verify = False,allow_agent=False) as m:

    # Create desired NETCONF config payload and <edit-config>
    config = config_data.format(**route)
    r = m.edit_config(target = "running", config = config)

    # Print OK status
    print("NETCONF RPC OK: {}".format(r.ok))
```

Αφού τρέξουμε το script κοιτάμε τα routes του router και ελέγχουμε ότι όντως έχει διακοπεί η επικοινωνία με τον κόμβο στο 10.2.2.2.

```
netman-router(config)#do show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is 192.168.1.1 to network 0.0.0.0

S*    0.0.0.0/0 [254/0] via 192.168.1.1
      10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
C        10.2.2.0/24 is directly connected, GigabitEthernet2
L        10.2.2.1/32 is directly connected, GigabitEthernet2
S        10.2.2.2/32 [1/0] via 192.0.0.1
C        10.3.3.0/24 is directly connected, GigabitEthernet3
L        10.3.3.2/32 is directly connected, GigabitEthernet3
      147.102.0.0/16 is variably subnetted, 20 subnets, 2 masks
C        147.102.0.0/24 is directly connected, Loopback1
L        147.102.0.1/32 is directly connected, Loopback1
C        147.102.1.0/24 is directly connected, Loopback2
L        147.102.1.1/32 is directly connected, Loopback2
C        147.102.2.0/24 is directly connected, Loopback3
L        147.102.2.1/32 is directly connected, Loopback3
C        147.102.3.0/24 is directly connected, Loopback4
 --More--
```

```
netman@debian-ok:~/netman-ntua-automation-lab$ ping 10.2.2.1
PING 10.2.2.1 (10.2.2.1) 56(84) bytes of data.
^C
--- 10.2.2.1 ping statistics ---
43 packets transmitted, 0 received, 100% packet loss, time 42091ms
```