**IPv6 Basics Session (Hands-on)**

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**version 1.01**

# 1. Lab information

## *Network Topology*

The network topology is shown in Figure 1. PCs belong to different VLANs, each of them having a different IPv6 address prefix. For example, the first three PCs in the 2nd row belong in the VLAN 3 and use the 2001:w:z:3::/64[1] address space.

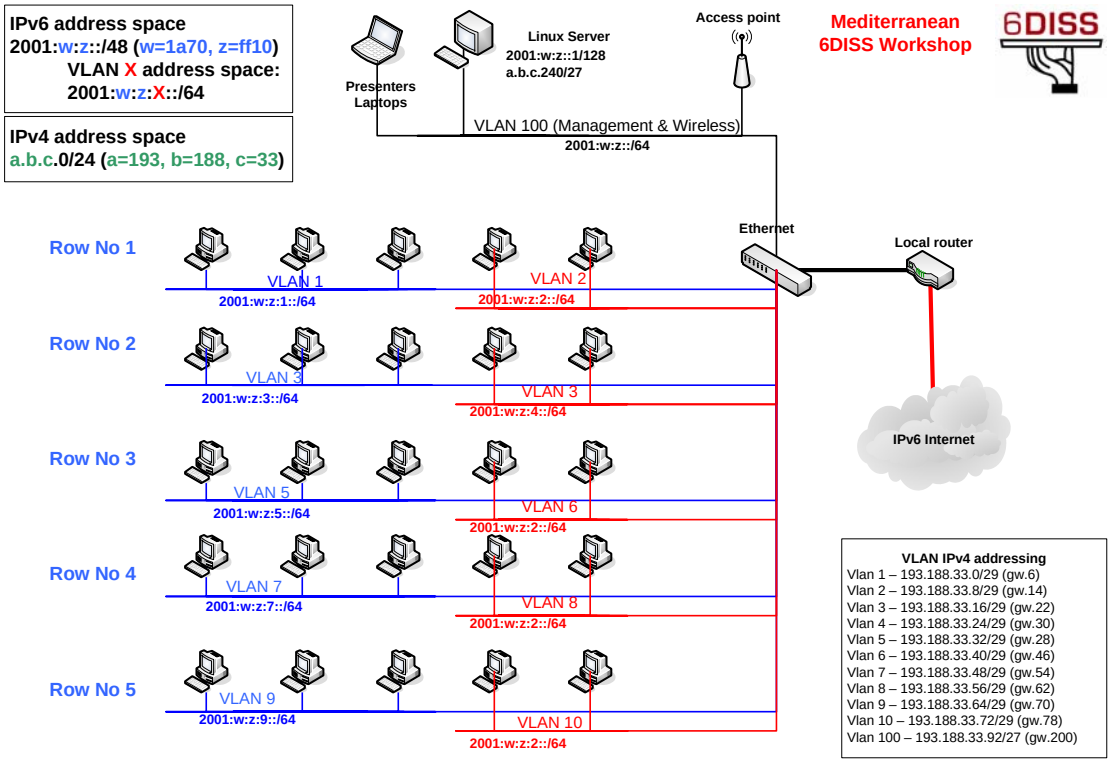



**Figure 1: 6DISS lab topology.**

## *Linux Server*

A PC having Scientific Linux 4.2 (https://www.scientificlinux.org/) is running BIND 9.2.4 (http://www.isc.org/sw/bind/) and Apache HTTP Web Server 2.0.55 (http://httpd.apache.org/). Access to the linux server is allowed via **SSH/FTP** at the

[1] For the values of "w" and "z" in the IPv6 address, please refer to Figure 1. Please note that in some of the following configuration examples, "w" and "z" have been replaced with the values "648" and "E000".

IPv6 address **2001:w:z:100:1/64** (or the IPv4 address a.b.c.240) using the **login/password: *root/6diss*.**

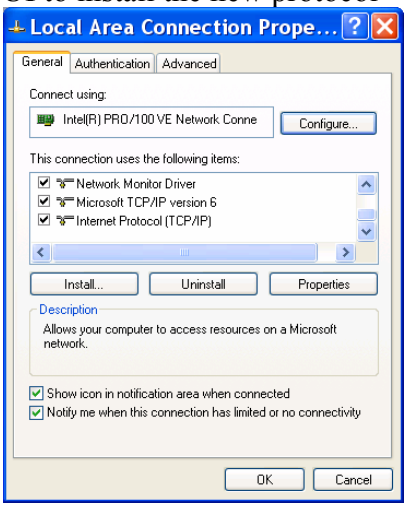
# Exercise A: Enable IPv6 to WinXP

## *Objectives*

Activate IPv6 protocol stack at the WinXP PCs and understand basic IPv6 concepts.

## *Exercises steps*

1. There are two alternative methods for activation IPv6 in WinXP (SP2):
   - Use the WinXP GUI to install the new protocol




   - From a CLI run `"ipv6 install"`
2. Identify the available interface at your PC. Identify which of these interfaces are related to IPv6 transition mechanisms? From a CLI run the following commands
   - `ipconfig /all`
   - `netsh interface ipv6 show interface`
   - `ipv6 –v if`
3. Identify all the IPv6 addresses (link local, public addresses, etc)
   - Link local (Tip: Search for `fe80::...`)
   - Identify the auto-configuration IPv6 address (Tip: Search for `…ff:fe...`)
   - Identify the IPv6 address due to privacy extension
   - Identify the validity of addresses (Tip: Use the command `netsh interface ipv6 show address <interface>`)
4. Ping / traceroute IPv6 hosts
   - Ping the IPv6 localhost addresse (`::1`)
   - Ping other addresses
   - Ping IPv6 web sites (`www.grnet.gr`, `www.6diss.org`, `etc`)
5. Find IPv6 neighbours in your LAN. What could be the problem in terms of security?

- (Tip: Use the command `netsh interface ipv6 show neighbors`)

6. Identify the local router address.
   - What is the appropriate command? "`traceroute`"? "… `show neighbours`"?
7. Use "ethereal" tool to capture IPv6 traffic, e.g. advertisements (RAs), or own traffic. Which IPv6 address is used when communicating?
   - (Tip: See at the end of the document for ethereal filters.)
8. Disable privacy extensions (RFC3041). What could be the problem in terms of security if you enable / disable privacy extension?
   - (Tip: Use the command `netsh interface ipv6 set privacy …`)

# Exercise A _*b*: Enable IPv6 to a Linux PC

## *Objectives*

Activate IPv6 protocol stack at a Scientific Linux PC. Provided that you have successfully completed the previous exercises, some steps are skipped while others (more complex) are added.

## *Exercises steps*

1. IPv6 support is enabled by default during the installation. So there is nothing for you to do!
   - Have a look at the configuration file `/etc/sysconfig/network`. What seems to be missing?
   - (Tip: Look for `NETWORKING_IPV6=yes` and `IPV6INIT=yes` configuration lines)
   - (Tip: Have a look at the scripts in the directory `/etc/sysconfig/network-scripts/.` Also look at the configuration examples given at Appendix B).
2. Set a static IPv6 addresses at the local Ethernet interface, e.g. `eth0`.
   - (Tip: `ifconfig eth0 add 2001:w:z:VLAN_X::1/64`)
3. Ping / traceroute IPv6 hosts
   - (Tip: `ping6 2001:648:2320:1::1` )
   - (Tip: `traceroute6 -n 2001:648:2320:1::1`)
4. Capture IPv6 traffic
   - (Tip: `tcpdump -t -n -i eth0 -vv ip6`)
5. Show IPv6 static routes.
   - (Tip: `route -A inet6`)
6. A linux PC may become a router. This means that it can forward packets and transmit RAs to the local multicast addresses in order other PCs to automatically configure their addresses.[2]
   - You need to install a daemon for the generating route advertisements.

[2] This step should be skipped during the workshop training. Participants may finish this exercise by themselves.

- (Tip: Install the *Router Advertisement Daemon* – `radvd`. At startup, the `radvd` deamon looks at the `/etc/sysconfig/network` in order to verify that IPv6 is enabled. Therefore, configuration lines given in step 1 have to be present.)
- You need to enable packet forwarding at the configuration files.

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# Exercise B: Transition mechanisms

## *Objectives*

Familiarise with IPv6 in IPv4 static tunnels.

## *Exercises steps*

At the beginning of this exercise, the local edge routers stops to send any route advertisements (RAs). This causes the PCs to loose IPv6 connectivity with the rest of IPv6 Internet. Students are requested to create static tunnels between different VLANs and partially restore connectivity between two VLANs. Students in the same row of PCs should work as a group in order to complete the below exercises.

1. Reboot the system. Why is this needed? Why the connectivity is broken?
2. Create the address plan for the group of five PCs according the Figure 2.

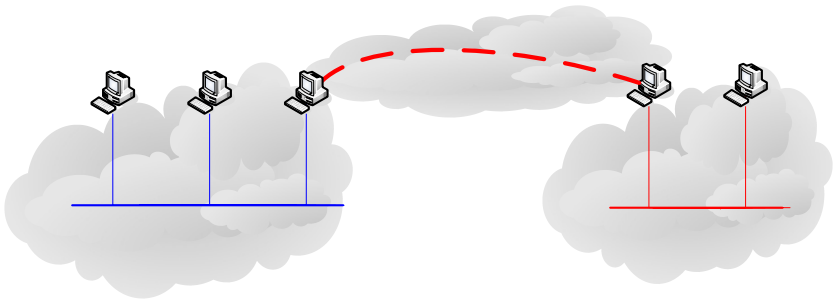

**Figure 2: Transitioning exercise**

- (Tip: Find the IPv4 addresses for the tunnel interfaces before start)

3. Put static IPv6 addresses in the appropriate interfaces. When finish, validate the connectivity inside the LAN.
   - (Tip: `netsh interface ipv6 add address <if_index> 2001:w:z:VLAN_X::a type=unicast valid=infinite`)
4. Create a static tunnels between the two routers (PCs)
   - (Tip: `netsh interface ipv6 add v6v4tunnel "Tunnel" <local_IPv4_addr> <remote_IPv4_add>`)
   - (Tip: `netsh interface ipv6 add address "Tunnel" 2001:w:z:100::1`)
5. Is there any connectivity between PCs in different VLANs? Yes? No? Explain.
6. Validate the IPv6 routes for PCs that terminate the tunnels.
   - (Tip: `netsh interface ipv6 show routes`)

**IPv6 address space**
**2001:w:z::/48 (w=1a70, z=ff10)**
**VLAN X address space:**

- (Tip: `netsh interface ipv6 show routes level=verbose`)

7. Add static route to tunnel interface.
   - (Tip: `netsh interface ipv6 add route ::/0 "Tunnel" 2001: w:z:100::1 publish=yes`)
8. Is there connectivity between the LANs? Yes? No? Partially? Explain.
9. Allow packet forwarding to "PC - routers"
   - (Tip: `netsh interface ipv6 set interface "Tunnel" forwarding=enable`)
10. Why we did not use auto-configuration? What could be a problem?
    - (Tip: How to select a router in the LAN!)
    - (Tip: `netsh interface ipv6 set interface "Local Area Network" forwarding=enable advertise=enable`)

# Supporting info

## *Appendix A: Compact "Ethereal" documentation*

Ethereal is used by network professionals around the world for troubleshooting, protocol analysis, software and protocol development, and education. Its open source license allows talented experts in the networking community to add enhancements. It runs on all popular computing platforms, including Unix, Linux, and Windows. See further information at http://www.ethereal.com/.

In order to capture packets, use the menu (Capture -> Start)
If you want to capture only a specific set of packets, use *capture filters* (Capture->Options), as shown in Figure 3.

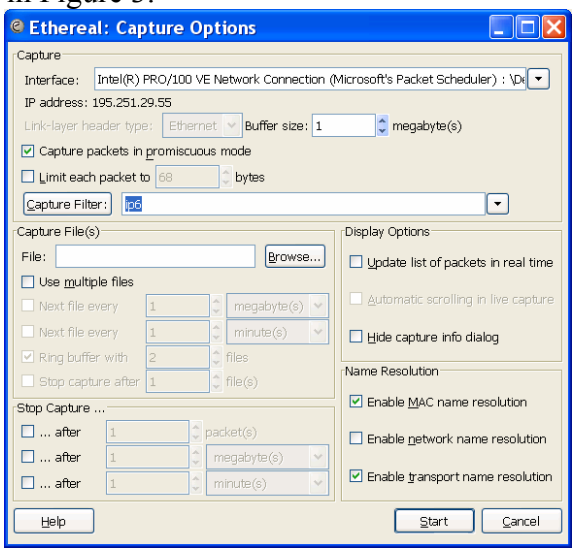


**Figure 3: Ethereal packet capture filters**

(Tip: Use the capture filter "`ip6`" to capture only IPv6 packets or "`icmp6`" capture only ICMPv6 packets)

After having captured some traffic, you can also filter the results using the "Filter" option, as shown in the Figure 4.

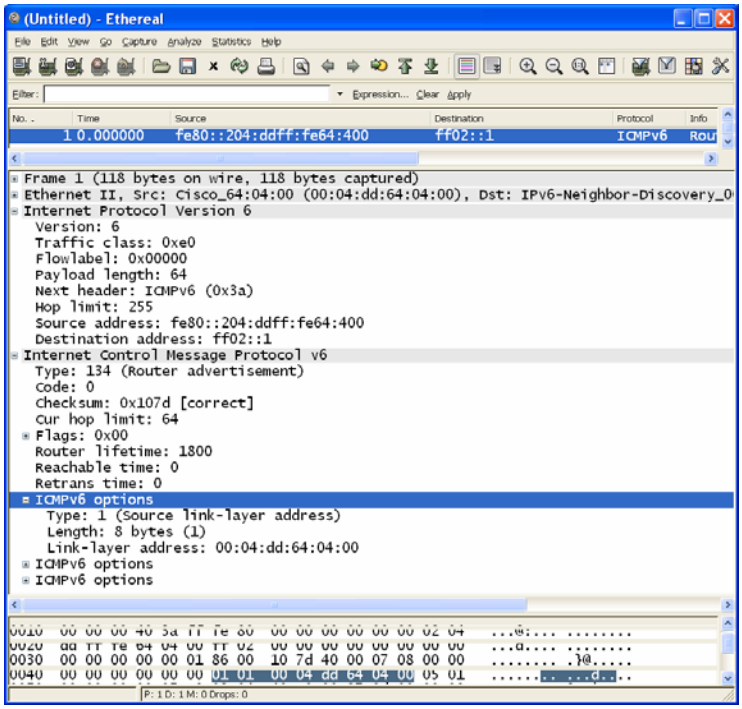


**Figure 4: Ethereal interface**

(Tip: Use the filter "`ip6`" to show only IPv6 packets, "`icmpv6.code==0`" to show ICMP packets of specific code or "`http`" to show HTTP traffic.)

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## *Appendix B: Examples of Linux configuration scripts*

Configuration file: `/etc/sysconfig/network`

```
# The following parameters may not be needed!
# See the /etc/sysconfig/network-scripts/*
NETWORKING_IPV6=yes
IPV6INIT=yes
IPV6FORWARDING=yes
IPV6_DEFAULTGW=2001:648:2320:BBBB::1
```

Configuration file: `/etc/sysconfig/network-scripts/ifcfg-eth0`

```
# Xircom CEM33 Ethernet/Modem
DEVICE=eth0
ONBOOT=yes
BOOTPROTO=none
HWADDR=00:80:C7:9B:1B:D7
NETMASK=255.255.255.0
IPADDR=10.10.10.202
USERCTL=no
PEERDNS=yes
GATEWAY=10.10.10.200
TYPE=Ethernet
IPV6INIT=yes
IPV6ADDR=2001:648:2314:1000::1/64
```

Configuration file: `/etc/sysconfig/network-scripts/ifcfg-sit1`

```
# Tunnel
DEVICE=sit1
ONBOOT=yes
BOOTPROTO=none
```

```
USERCTL=no
TYPE=SIT
IPV6INIT=yes
IPV6ADDR=2001:648:2314:BBBB::2/64
IPV6TUNNELIPV4=195.251.29.12
IPV6TUNNELIPV4LOCAL=10.10.10.202
```

## *Appendix C: Exercise B solution*

The successful completion of exercise B requires the following commands to be added:

```
PCb:
      netsh interface ipv6>add address "Local" 2001:w:z:1::2
      netsh interface ipv6>add route ::/0 "Local" 2001:w:z:1::1
R2:
      netsh interface ipv6>add address "Local" 2001:w:z:1::1
      netsh interface ipv6 add v6v4tunnel ″Tunnel″ 193.188.33.5
      193.188.33.10
      netsh interface ipv6>add address "Tunnel" 2001:w:z:100::2
      netsh interface ipv6>add route ::/0 "Tunnel" 2001:w:z:100::1
      netsh interface ipv6>add route 2001:w:z:1::/64 "Local"


R1:
      netsh interface ipv6>add address "Local" 2001:w:z:2::1
      netsh interface ipv6 add v6v4tunnel ″Tunnel″ 193.188.33.10
      193.188.33.5
      netsh interface ipv6>add address "Tunnel" 2001:w:z:100::1
      netsh interface ipv6>add route ::/0 "Tunnel" 2001:w:z:100::2
      netsh interface ipv6>add route 2001:w:z:2::/64 "Local"


PCa:
      netsh interface ipv6>add address "Local" 2001:w:z:2::2
      netsh interface ipv6>add route ::/0 "Local" 2001:w:z:2::1
```

Also, packet forwarding has to be enabled at the routers “Tunnel” and “Local” interfaces

## *Appendix D: Lab specifications*

PCs are running WinXP (SP2) and Scientific Linux 4.2. Workshop local router is a Cisco 1811 using `c181x-advipservicesk9-mz.124-2.XA.bin`. Ethereal Version 0.10.13 is also installed at the WinXP partition.