



# CMP3214 Computer Communication Networks

## Lecture 4

# NTE

Network Training Emulator



netLabs!UG

**Diarmuid Ó Briain**

CEng, FIEI, FIET, CISSP

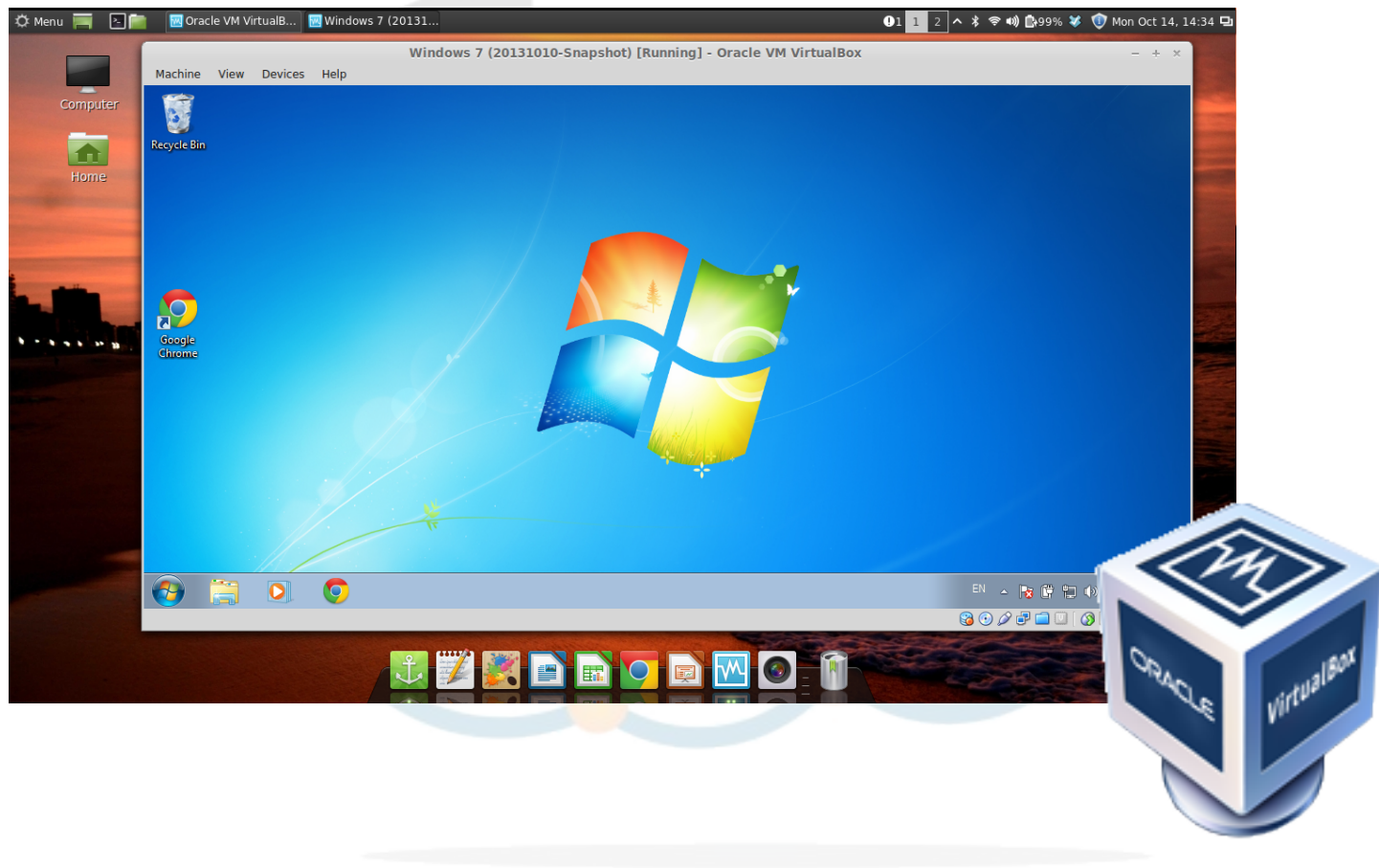
[diarmuid@obriain.com](mailto:diarmuid@obriain.com)

# Network Training Emulator



- Originally IMUNES - IP network emulator / simulator
  - University of Zagreb
  - Ericsson Nikola Tesla product testing
- CORE, fork of IMUNES
  - Network Technology research group, Boeing
  - US Naval Research Laboratory.
- NTE, fork of CORE
  - NetLabs!UG

# Virtualisation



# Install VirtualBox



- GNU/Linux

```
$ sudo apt-get update
```

```
$ sudo apt-get install virtualbox-5.1
```

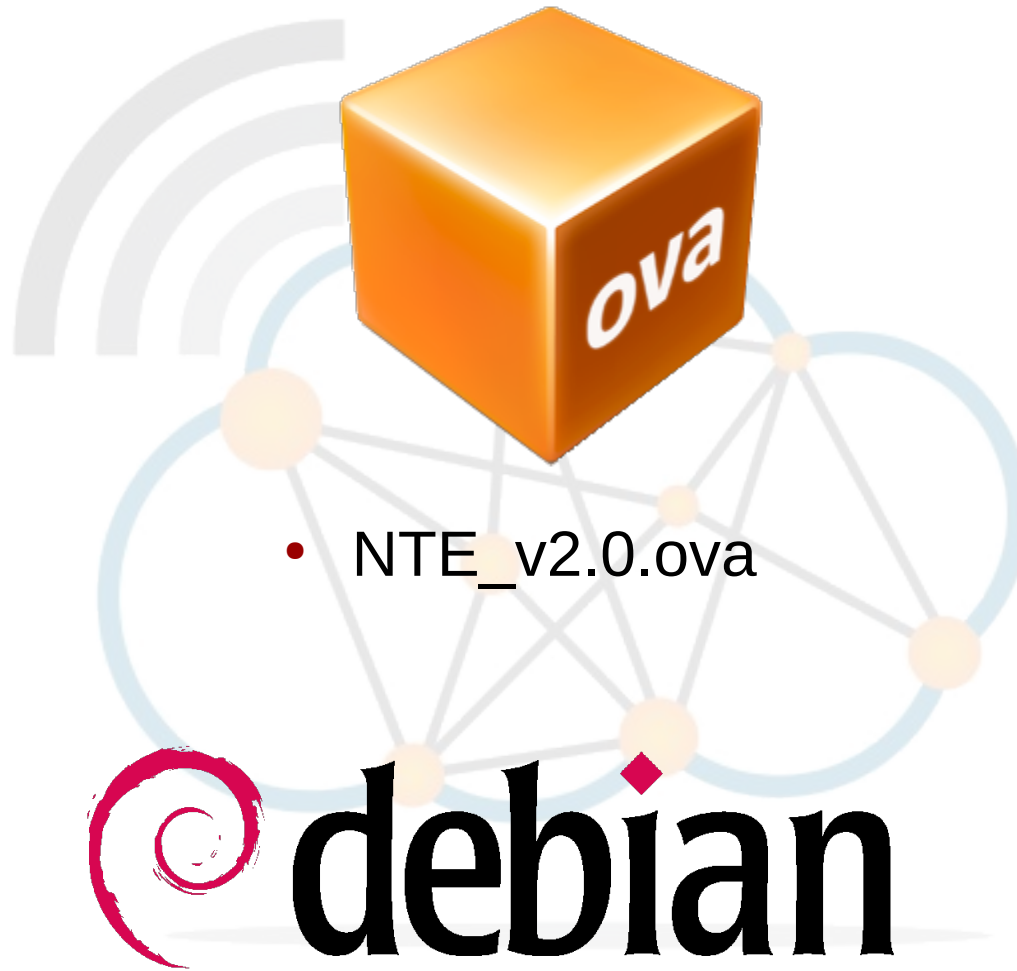
- Apple OS X

<http://download.virtualbox.org/virtualbox/5.1.16/VirtualBox-5.1.16-113841-OSX.dmg>

- Microsoft Windows

<http://download.virtualbox.org/virtualbox/5.1.16/VirtualBox-5.1.16-113841-Win.exe>

# Getting the netLabs!UG NTE



- NTE\_v2.0.ova

Version 8.7



# X-Window architecture

**Diarmuid Ó Briain**

CEng, FIEI, FIET, CISSP

[diarmuid@obriain.com](mailto:diarmuid@obriain.com)

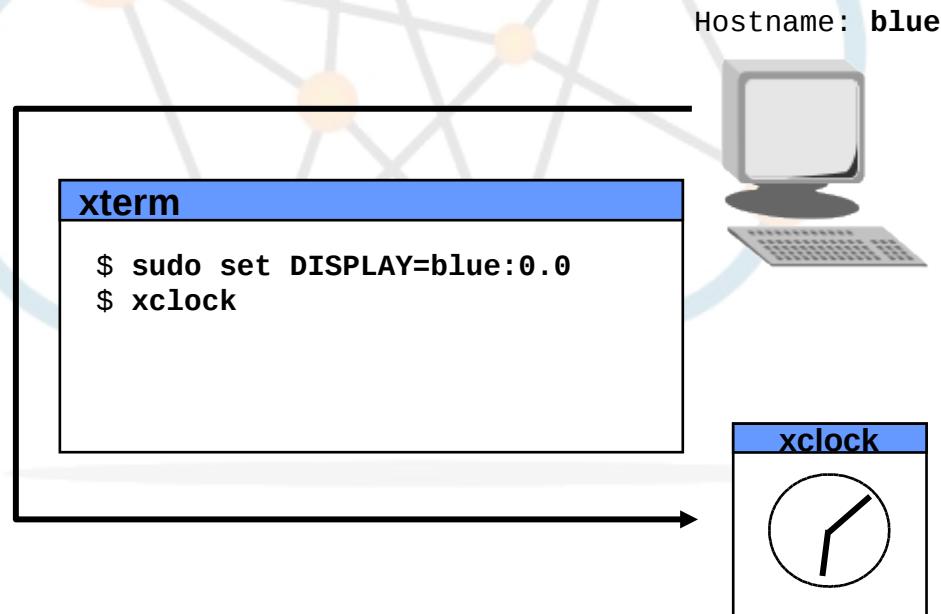


- Is a portable, network-transparent window system used in many computing platforms.
- X11 is the graphical system most widely used on Unix-like systems.
- X11 had a rough start, but the 1990's saw XFree86 emerge as the reference implementation because it was free software, portable, and maintained by a collaborative community.
- The rate of evolution slowed down plus a very controversial license change, led to the X.org fork in 2004.
- This is the current reference implementation, and Debian Wheezy uses X.org version 7.7.
- **Note:** From this version, X no longer creates `/etc/X11/xorg.conf` configuration file.

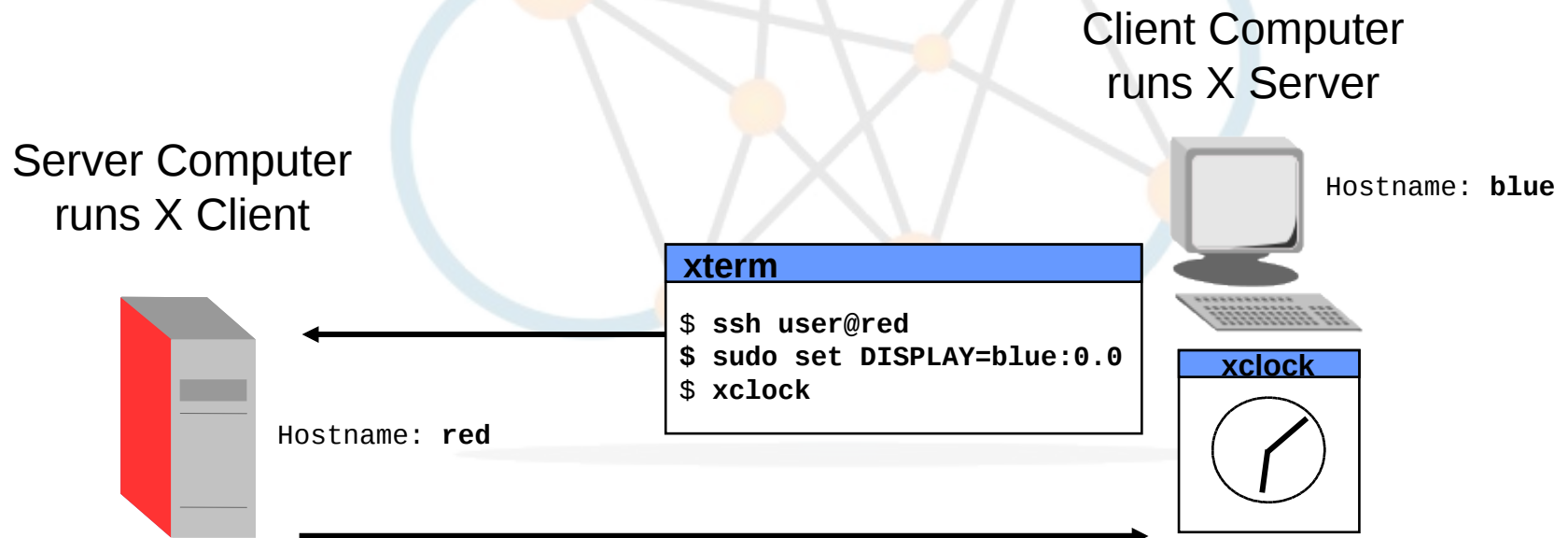
- X11 is the graphical system most widely used on Unix-like systems.
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- The rate of evolution slowed down plus a very controversial license change, led to the X.org fork in 2004.
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- **Note:** From this version, X no longer creates `/etc/X11/xorg.conf` configuration file.

- Computer runs X Server (X).
- Applications are sent to the X Server defined in the \$DISPLAY variable.
- On a single machine the display is sent from the X Client to the X Server on that machine, thus the \$DISPLAY Variable is :0.0 by default.

```
blue:/ # echo $DISPLAY  
:0.0
```



- Client machine runs an X Server and an xterminal, connects to the remote Server.
- On the Server the client changes the \$DISPLAY variable to point to the X Server on the client machine.
- When the xclock is called it is run on the Server computer but the display is on the Client computer.



```
nfe@NTE-i386:~$ X -version
```

```
X.Org X Server 1.16.4
```

```
Release Date: 2014-12-20
```

```
X Protocol Version 11, Revision 0
```

```
Build Operating System: Linux 3.2.0-4-amd64 i686 Debian
```

```
Current Operating System: Linux NTE-i386 3.16.0-4-586 #1 Debian 3.16.7-  
ckt20-1+deb8u3 (2016-01-17) i686
```

```
Kernel command line: BOOT_IMAGE=/boot/vmlinuz-3.16.0-4-586
```

```
root=UUID=e48f8a14-f3cd-49a4-a064-ecf61b919ccf ro quiet
```

```
Build Date: 11 February 2015 01:14:26AM
```

```
xorg-server 2:1.16.4-1 (http://www.debian.org/support)
```

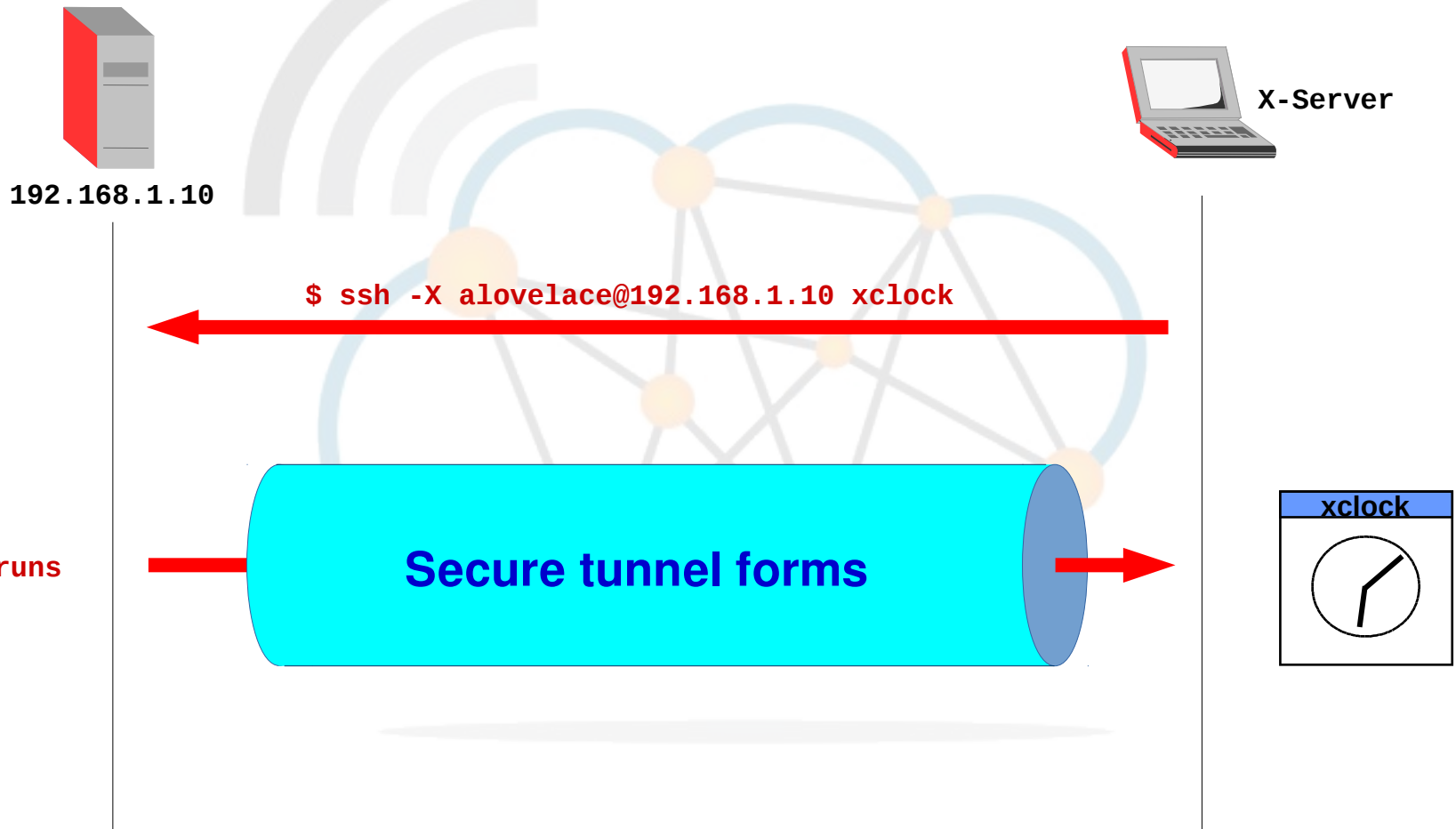
```
Current version of pixman: 0.32.6
```

```
Before reporting problems, check http://wiki.x.org  
to make sure that you have the latest version.
```

# SSH X11 Forwarding



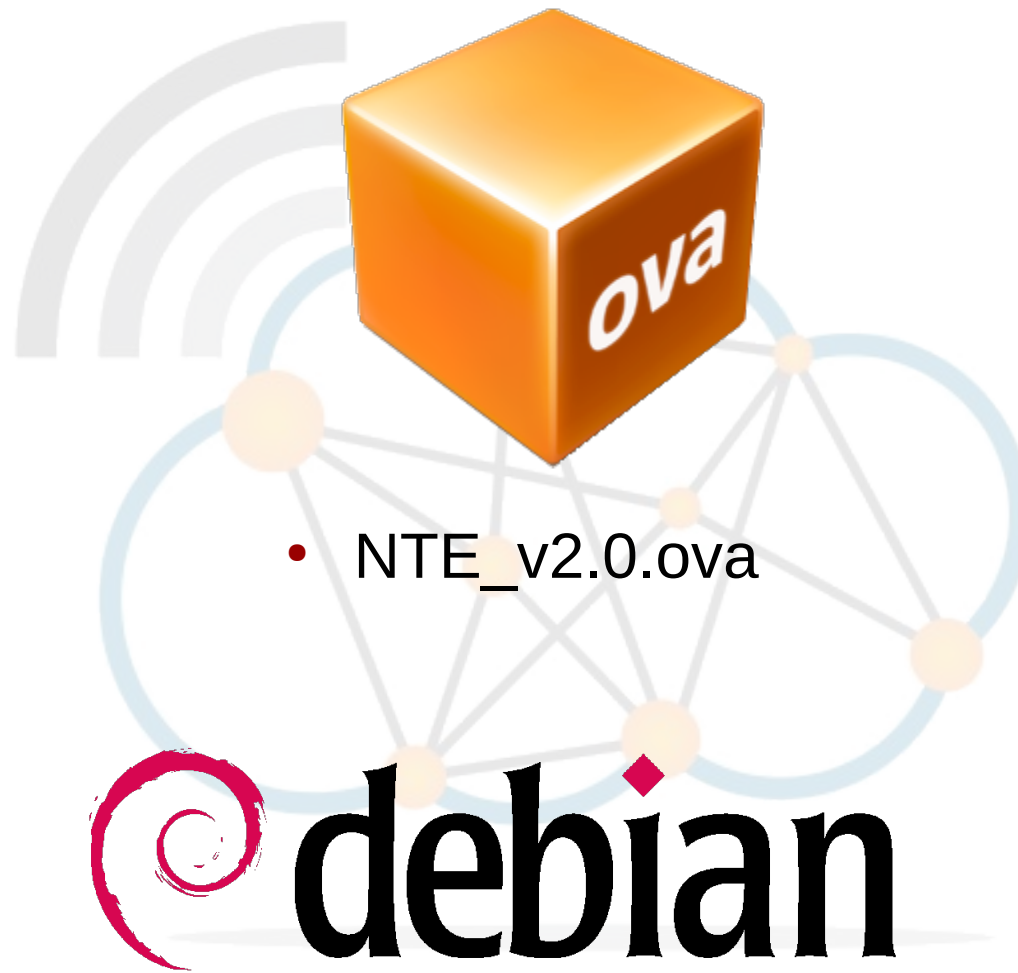
- SSH supports X11 forwarding with the -X option



- <http://www.straightrunning.com/XmingNotes/>



# Import Appliance



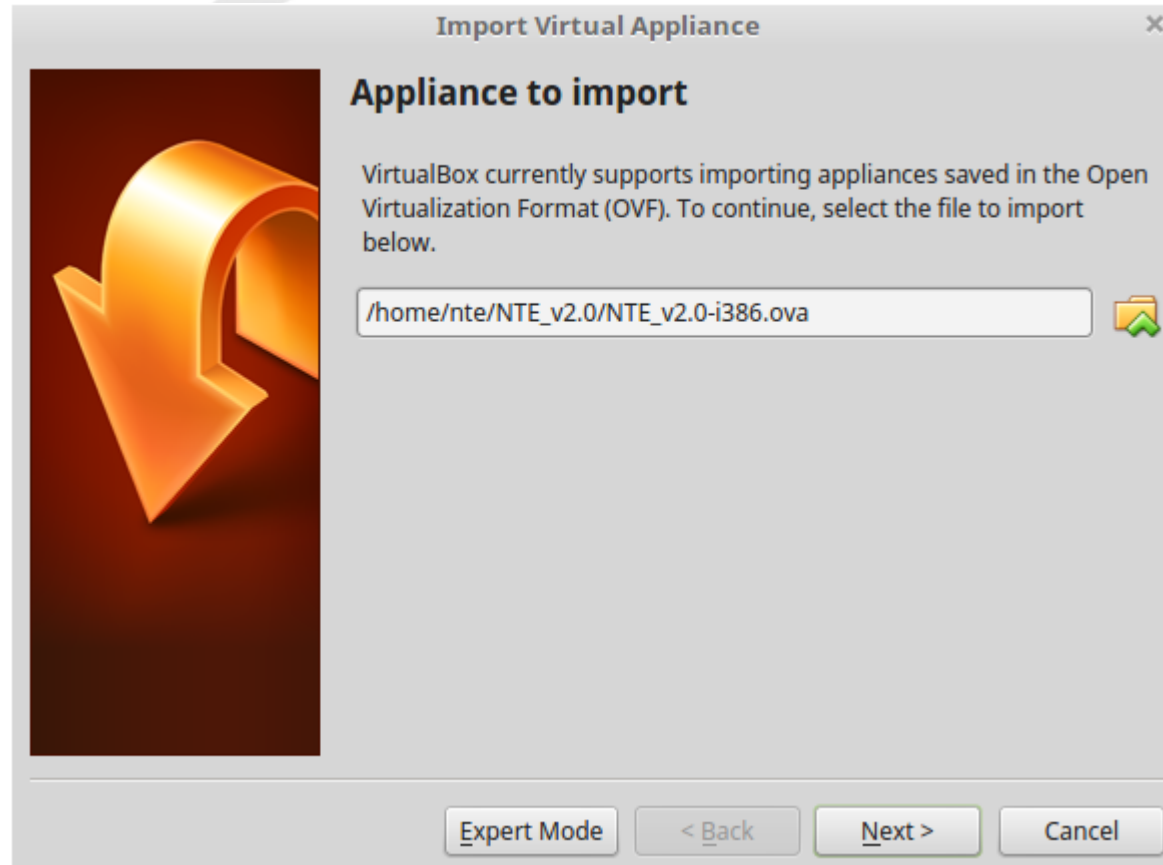
- NTE\_v2.0.ova

Version 8.7

# Installing NTE VM on VirtualBox

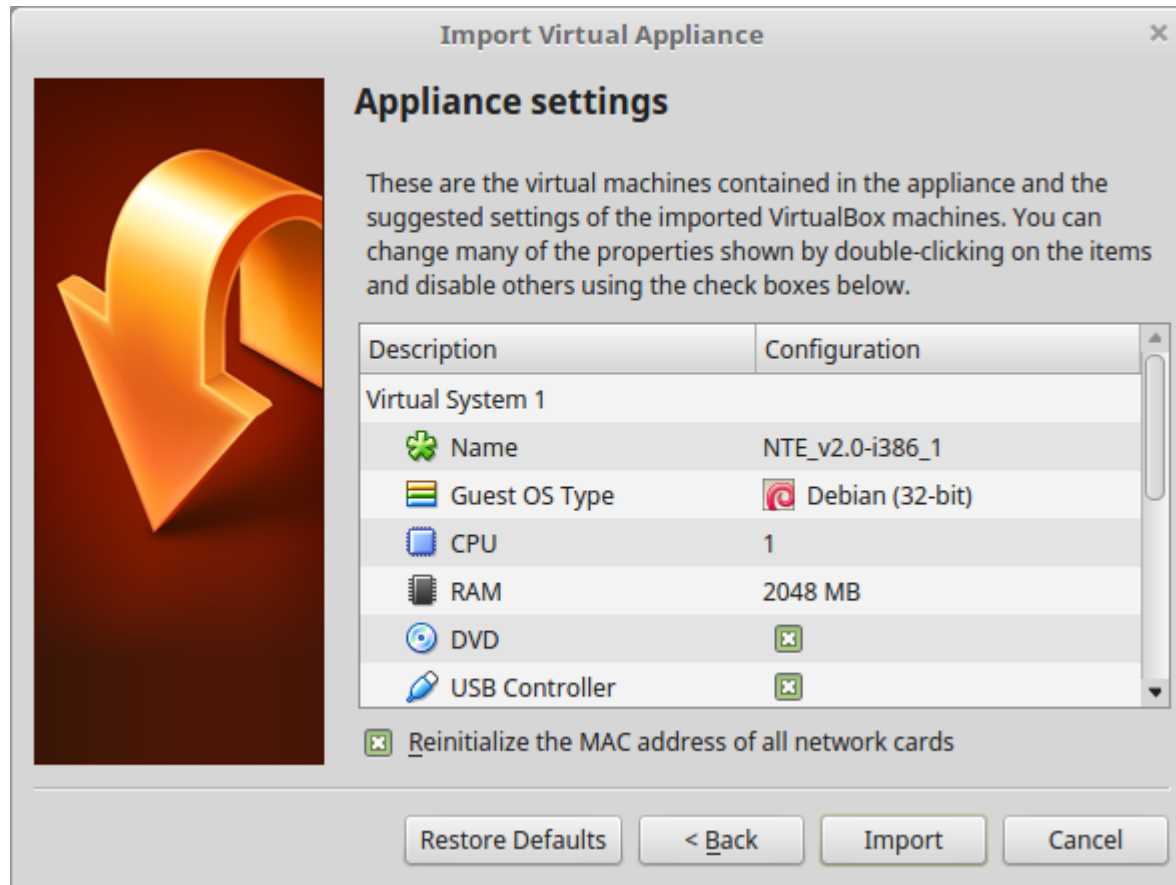


***File > Import Appliance***



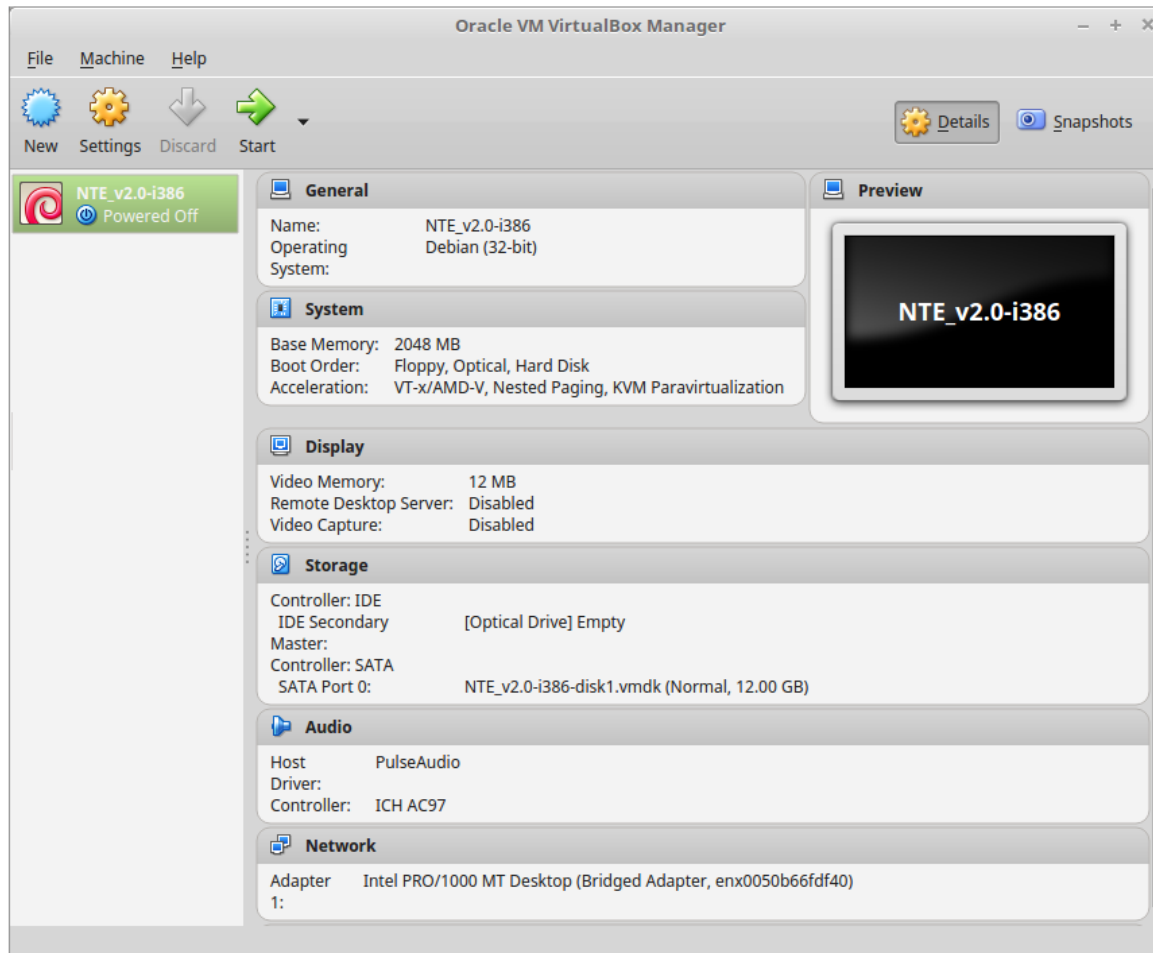
Select the ***NTE v2.0-i386.ova*** and click ***Next >***.

# Installing NTE VM on VirtualBox



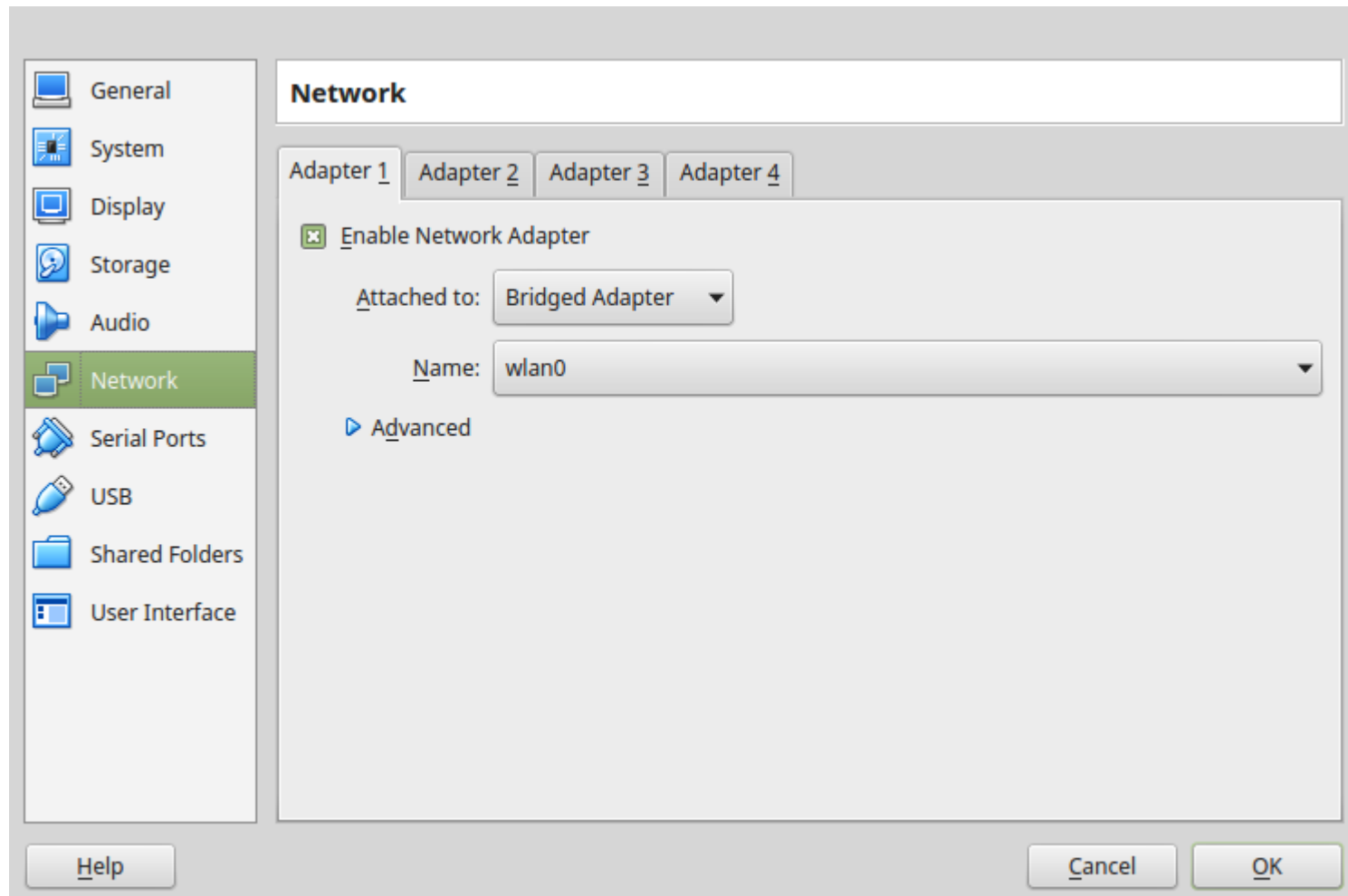
Check the tickbox for “***Reinitialise the MAC address of all network cards***”  
Select **Import**.

# Starting NTE VM on VirtualBox



Right click on VM, Select **Network**

# Settings NTE VM on VirtualBox



Change Attached to: **Bridged Adapter**



# Running NTE

**Diarmuid Ó Briain**

CEng, FIEI, FIET, CISSP

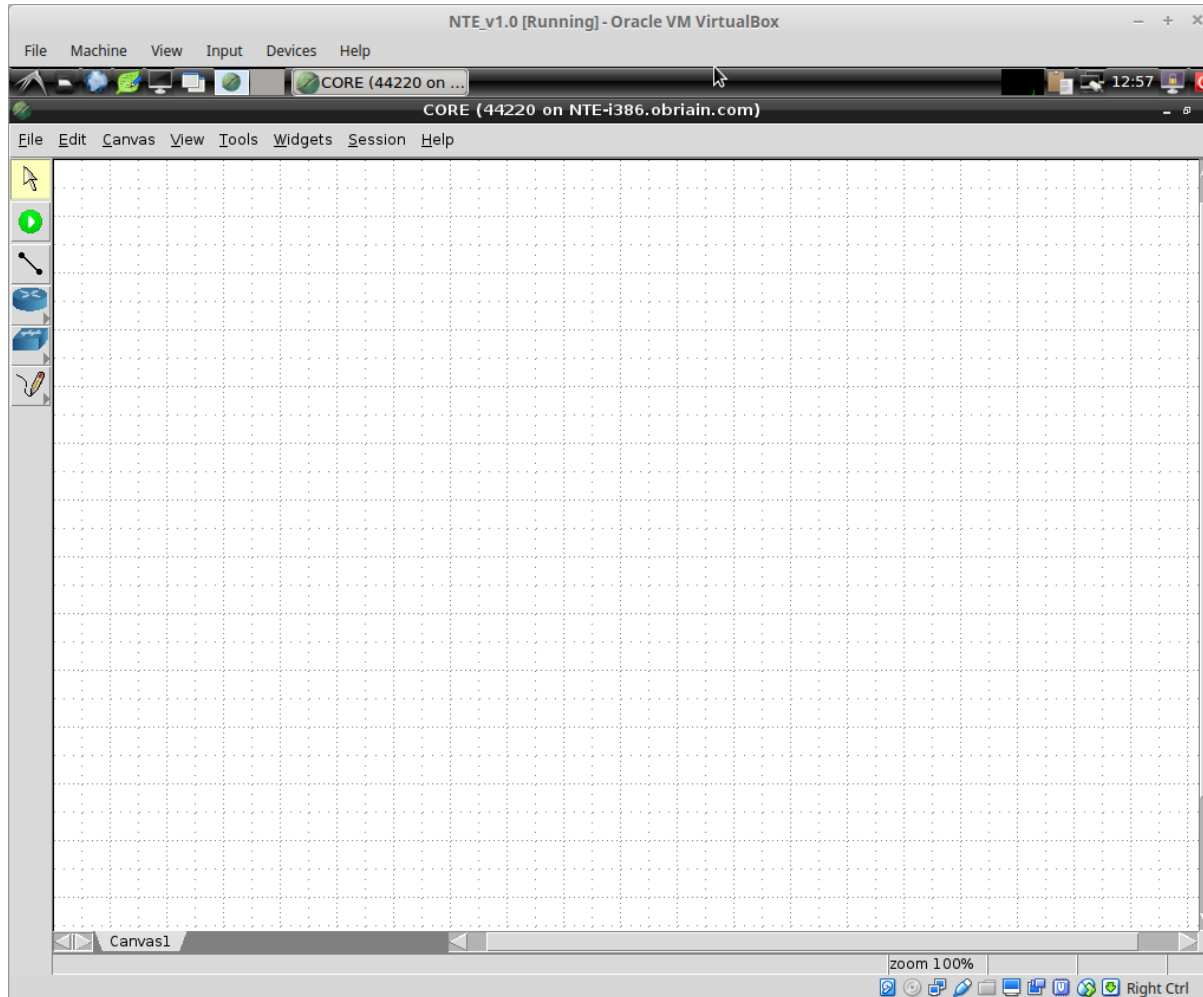
[diarmuid@obriain.com](mailto:diarmuid@obriain.com)

# Running NTE VM on VirtualBox



Username: **nte** Password: **nte**

# Running NTE VM natively in VirtualBox



Double click on NTE icon.

# Running NTE VM over SSH X11 forwarding



Get IP address with **ip addr list**.

# Running NTE VM over SSH X11 forwarding



```
$ ssh -X nte@192.168.10.6
```

```
The authenticity of host '192.168.10.6 (192.168.10.6)' can't be
established.
```

```
ECDSA key fingerprint is
```

```
dd:bd:74:25:ed:4b:ea:9f:05:e4:ae:ac:3f:46:21:a4.
```

```
Are you sure you want to continue connecting (yes/no)? yes
```

```
Warning: Permanently added '192.168.10.6' (ECDSA) to the list of
known hosts.
```

```
nte@192.168.10.6's password: nte
```

```
The programs included with the Debian GNU/Linux system are free
software; the exact distribution terms for each program are
described in the individual files in /usr/share/doc/*/copyright.
```

```
Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the
extent
```

```
permitted by applicable law.
```

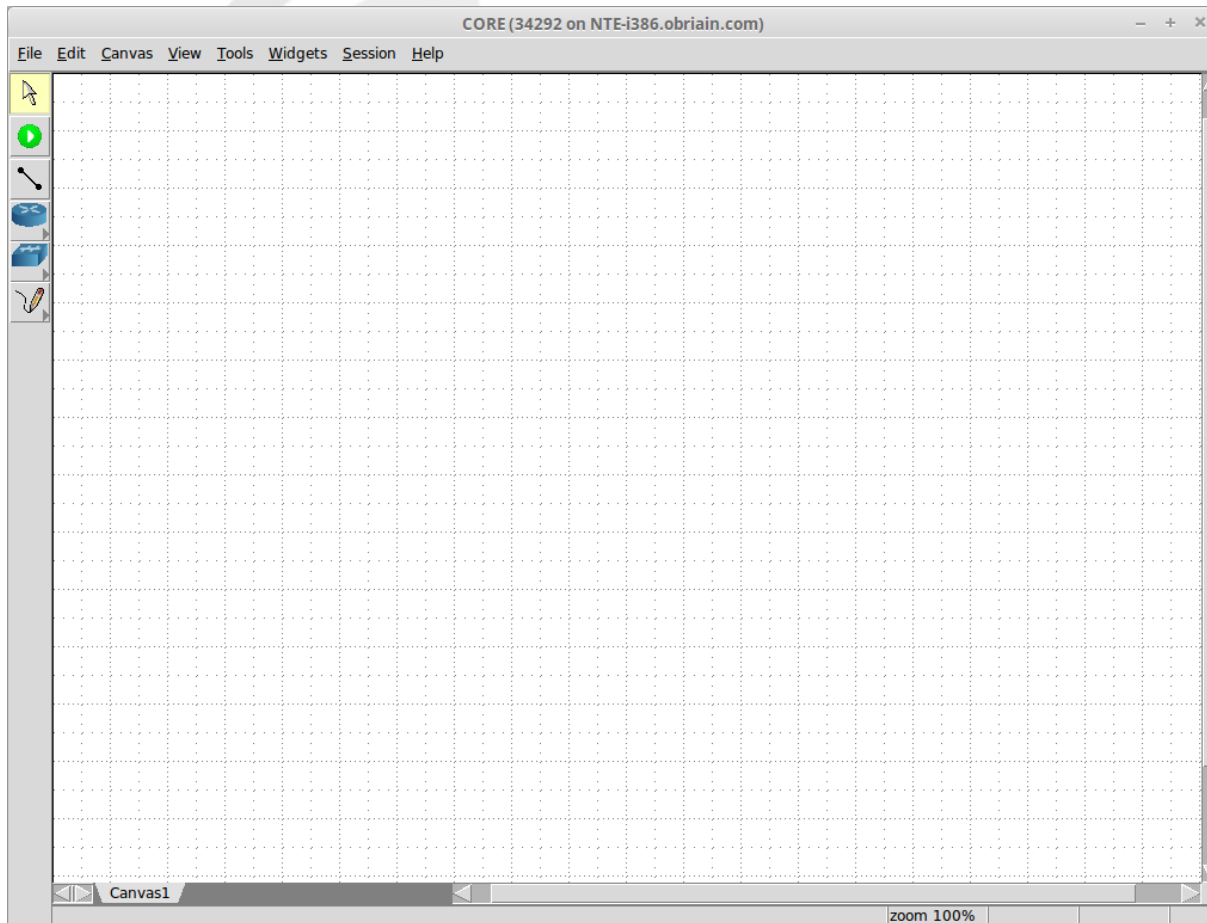
```
Last login: Fri Feb 19 15:56:56 2016 from 192.168.10.2
```

```
nte@NTE-i386:~$
```

# Running NTE over SSH X11 forwarding



```
nfe@NTE-i386:~$ core-gui  
Connecting to "core-daemon" (127.0.0.1:4038)...connected.
```



# Running NTE VM headless



```
$ vboxmanage startvm NTE_v2.0-i386 --type headless
```

```
Waiting for VM "NTE_v2.0-i386" to power on...
```

```
VM "NTE_v2.0-i386" has been successfully started.
```

```
$ vboxmanage showvminfo NTE_v2.0-i386 | grep State
```

```
State:                running (since 2016-02-19T15:46:35.817000000)
```

```
$ vboxmanage showvminfo NTE_v2.0-i386 --details | grep 'NIC 1'
```

```
NIC 1:                MAC: 0800279D3BDA, Attachment: Bridged Interface 'wlan0',  
Cable connected: on, Trace: off (file: none), Type: 82540EM, Reported  
speed: 0 Mbps, Boot priority: 0, Promisc Policy: deny, Bandwidth group:  
none
```

```
$ arp
```

| Address                 | HWtype | HWaddress         | Flags | Mask | Iface |
|-------------------------|--------|-------------------|-------|------|-------|
| 192.168.10.4            | ether  | 08:00:27:9d:3b:da | C     |      | wlan0 |
| smile-admin.localdomain | ether  | f4:63:49:19:e4:82 | C     |      | wlan0 |
| 192.168.10.5            |        | (incomplete)      |       |      | wlan0 |

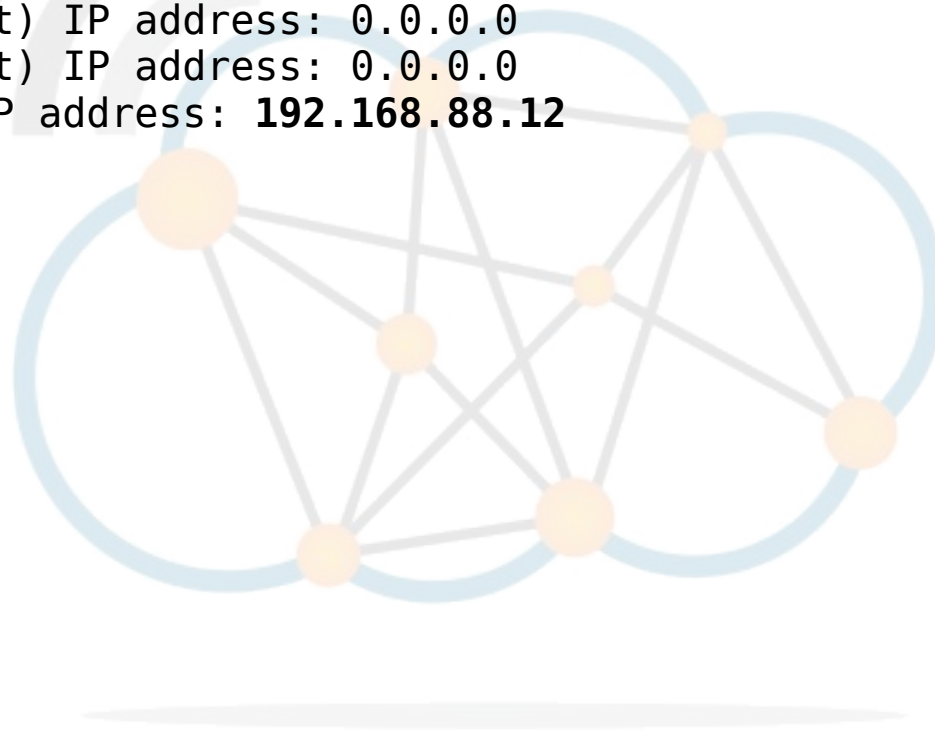
**0800279D3BDA --> 08:00:27:9d:3b:da --> 192.168.10.4**

# Running NTE VM headless



- Capture BOOTP (DHCP) response.

```
ob@e550:~$ sudo tshark -i eth0 -0 bootp | grep "Your (client) IP address:"  
Capturing on 'wlan0'  
116      Your (client) IP address: 0.0.0.0  
119      Your (client) IP address: 0.0.0.0  
        Your (client) IP address: 192.168.88.12
```



# Running NTE on headless VM



```
$ ssh -X nte@192.168.10.6
nte@192.168.10.6's password: nte
```

The programs included with the Debian GNU/Linux system are free software; the exact distribution terms for each program are described in the individual files in /usr/share/doc/\*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent

permitted by applicable law.

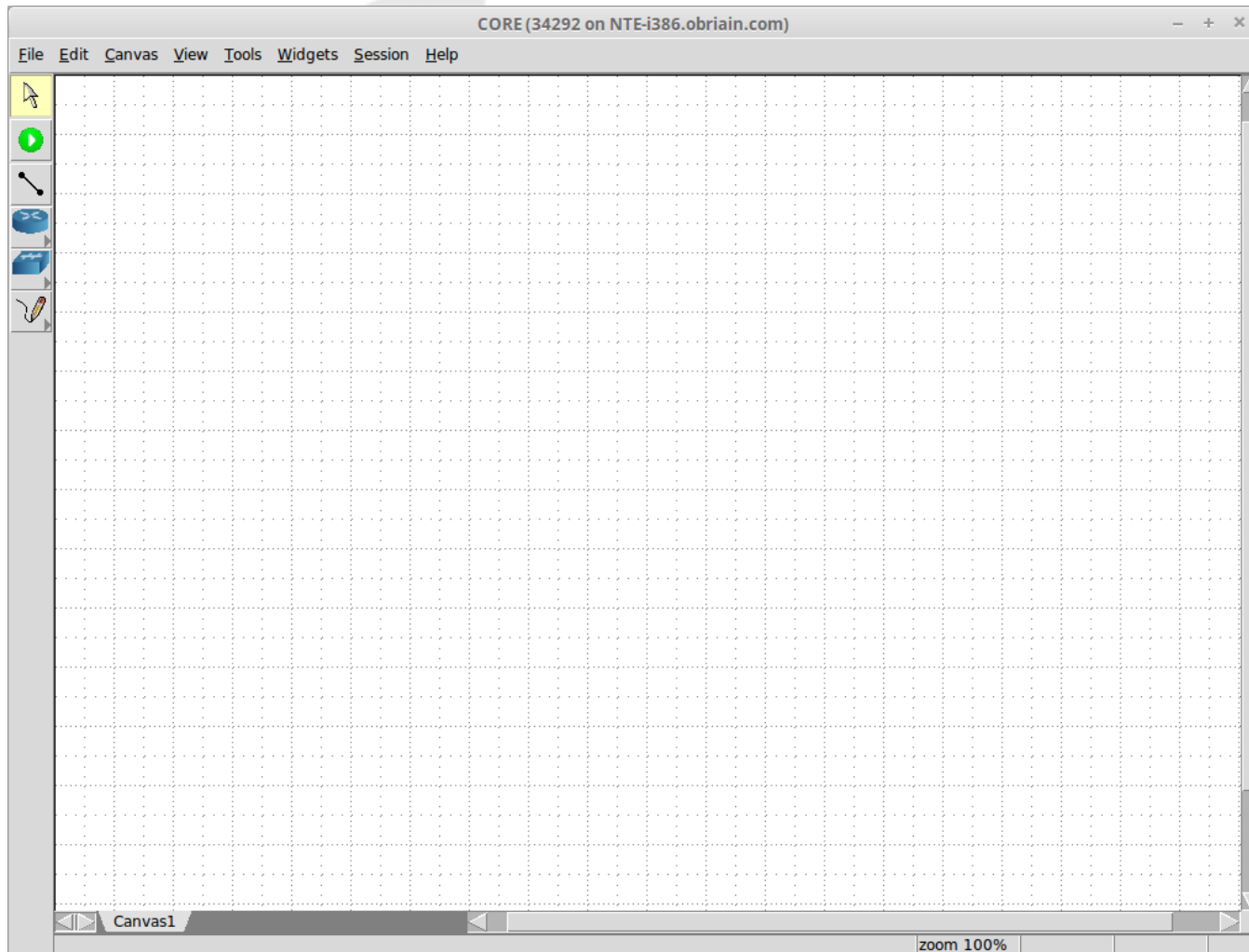
Last login: Fri Feb 19 15:56:56 2016 from 192.168.10.2

nte@NTE-i386:~\$

# Running NTE on headless VM



```
nfe@NTE-i386:~$ core-gui
```



# Power off headless VM

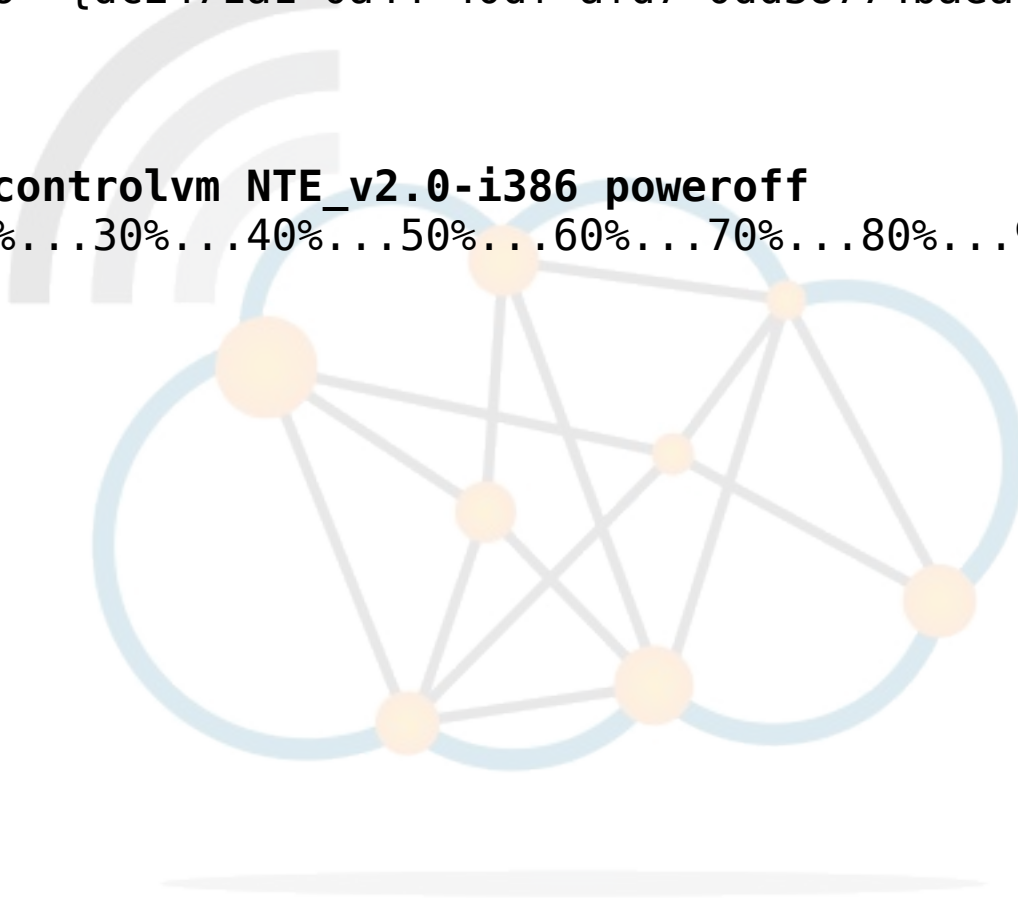


```
$ vboxmanage list runningvms
```

```
"NTE_v2.0-i386" {dc2471a1-0a44-40df-afd7-0dd38774baea}
```

```
$ vboxmanage controlvm NTE_v2.0-i386 poweroff
```

```
0%...10%...20%...30%...40%...50%...60%...70%...80%...90%...100%
```



# Running NTE on headless VM



```
$ ssh -X nte@192.168.10.6  
nt@192.168.10.6's password: nte
```

The programs included with the Debian GNU/Linux system are free software; the exact distribution terms for each program are described in the individual files in /usr/share/doc/\*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent

permitted by applicable law.

Last login: Fri Feb 19 15:56:56 2016 from 192.168.10.2

nte@NTE-i386:~\$



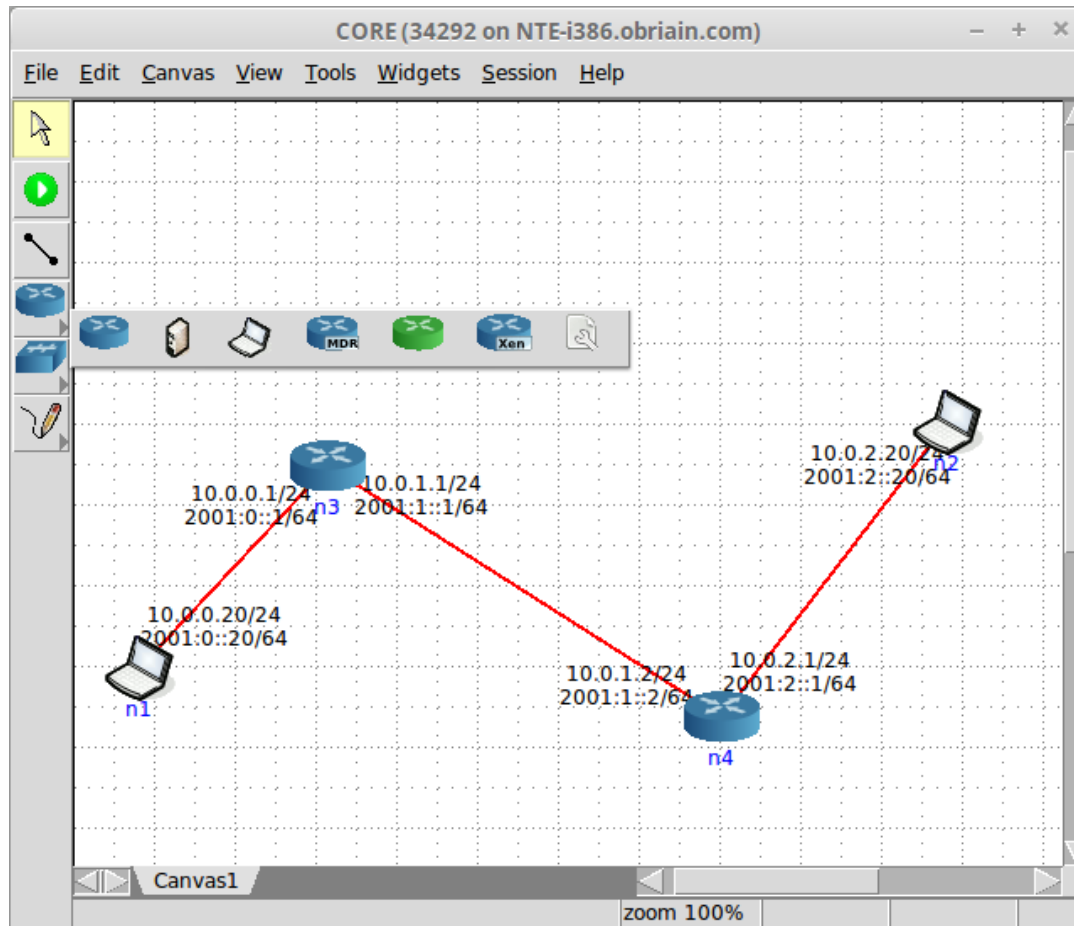
# Building a simple network

**Diarmuid Ó Briain**

CEng, FIEI, FIET, CISSP

[diarmuid@obriain.com](mailto:diarmuid@obriain.com)

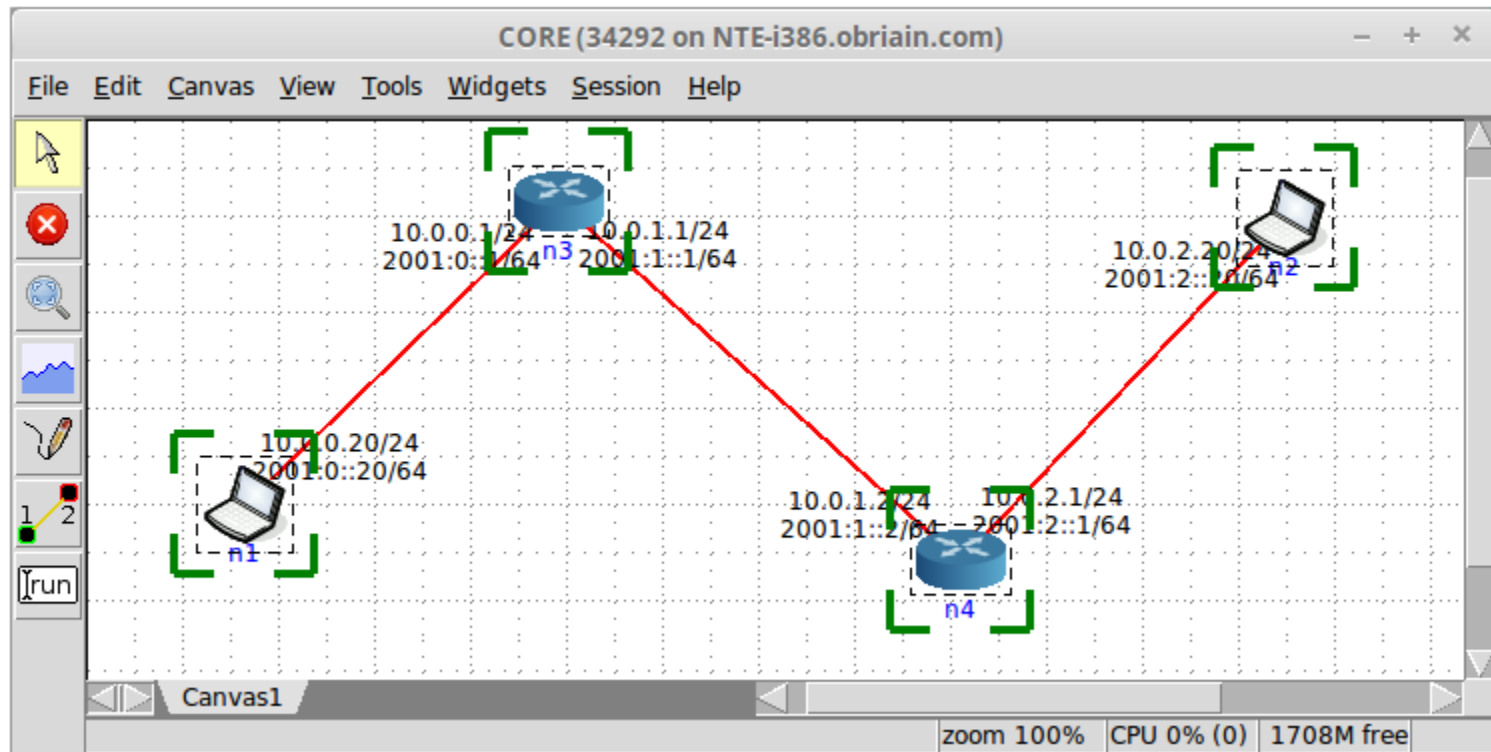
# Simple network



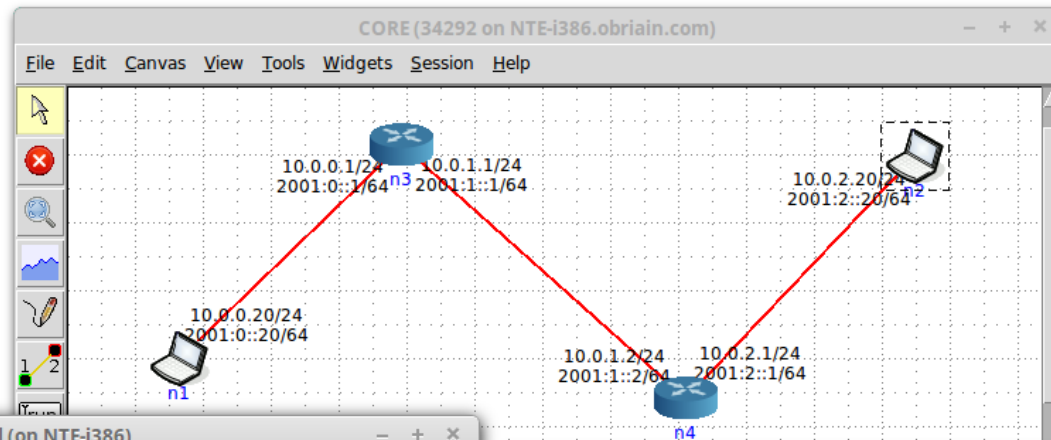
Start session



# Session started



# Access devices



LXTerminal (on NTE-i386)

File Edit Tabs Help

```
PING 2001:2::20(2001:2::20) 56 data bytes
64 bytes from 2001:2::20: icmp_seq=1 ttl=62 time=0.088 ms
64 bytes from 2001:2::20: icmp_seq=2 ttl=62 time=0.052 ms
64 bytes from 2001:2::20: icmp_seq=3 ttl=62 time=0.051 ms
64 bytes from 2001:2::20: icmp_seq=4 ttl=62 time=0.067 ms
64 bytes from 2001:2::20: icmp_seq=5 ttl=62 time=0.136 ms
64 bytes from 2001:2::20: icmp_seq=6 ttl=62 time=0.072 ms
64 bytes from 2001:2::20: icmp_seq=7 ttl=62 time=0.056 ms
64 bytes from 2001:2::20: icmp_seq=8 ttl=62 time=0.065 ms
64 bytes from 2001:2::20: icmp_seq=9 ttl=62 time=0.055 ms
64 bytes from 2001:2::20: icmp_seq=10 ttl=62 time=0.056 ms
64 bytes from 2001:2::20: icmp_seq=11 ttl=62 time=0.058 ms
64 bytes from 2001:2::20: icmp_seq=12 ttl=62 time=0.054 ms
64 bytes from 2001:2::20: icmp_seq=13 ttl=62 time=0.058 ms
64 bytes from 2001:2::20: icmp_seq=14 ttl=62 time=0.069 ms
64 bytes from 2001:2::20: icmp_seq=15 ttl=62 time=0.061 ms
64 bytes from 2001:2::20: icmp_seq=16 ttl=62 time=0.093 ms
64 bytes from 2001:2::20: icmp_seq=17 ttl=62 time=0.051 ms
64 bytes from 2001:2::20: icmp_seq=18 ttl=62 time=0.091 ms
64 bytes from 2001:2::20: icmp_seq=19 ttl=62 time=0.055 ms
64 bytes from 2001:2::20: icmp_seq=20 ttl=62 time=0.063 ms
64 bytes from 2001:2::20: icmp_seq=21 ttl=62 time=0.053 ms
64 bytes from 2001:2::20: icmp_seq=22 ttl=62 time=0.052 ms
```

LXTerminal (on NTE-i386)

File Edit Tabs Help

```
13:13:04.124053 IP6 2001:2::20 > 2001:2::20: ICMP6, echo reply, seq 15, length 64
13:13:05.124103 IP6 2001:2::20 > 2001:2::20: ICMP6, echo request, seq 16, length 64
13:13:05.124120 IP6 2001:2::20 > 2001:2::20: ICMP6, echo reply, seq 16, length 64
13:13:06.124008 IP6 2001:2::20 > 2001:2::20: ICMP6, echo request, seq 17, length 64
13:13:06.124016 IP6 2001:2::20 > 2001:2::20: ICMP6, echo reply, seq 17, length 64
13:13:07.124146 IP6 2001:2::20 > 2001:2::20: ICMP6, echo request, seq 18, length 64
13:13:07.124159 IP6 2001:2::20 > 2001:2::20: ICMP6, echo reply, seq 18, length 64
13:13:08.124082 IP6 2001:2::20 > 2001:2::20: ICMP6, echo request, seq 19, length 64
13:13:08.124090 IP6 2001:2::20 > 2001:2::20: ICMP6, echo reply, seq 19, length 64
13:13:09.127550 IP6 2001:2::20 > 2001:2::20: ICMP6, echo request, seq 20, length 64
13:13:09.127560 IP6 2001:2::20 > 2001:2::20: ICMP6, echo reply, seq 20, length 64
13:13:10.126542 IP6 2001:2::20 > 2001:2::20: ICMP6, echo request, seq 21, length 64
13:13:10.126550 IP6 2001:2::20 > 2001:2::20: ICMP6, echo reply, seq 21, length 64
13:13:11.125542 IP6 2001:2::20 > 2001:2::20: ICMP6, echo request, seq 22, length 64
13:13:11.125550 IP6 2001:2::20 > 2001:2::20: ICMP6, echo reply, seq 22, length 64
```

# Observer tool



CORE (34292 on NTE-i386.obriain.com)

File Edit Canvas View Tools Widgets Session Help

None  
processes  
ifconfig  
IPv4 routes  
IPv6 routes  
• OSPFv2 neighbors  
OSPFv3 neighbors  
Listening sockets  
IPv4 MFC entries  
IPv6 MFC entries  
firewall rules  
IPSec policies  
docker logs  
OSPFv3 MDR level  
PIM neighbors  
Edit...

| Neighbor ID | Pri | State   | Dead Time | Address  | Interface     | RXmtL | RqstL | DBsmL |
|-------------|-----|---------|-----------|----------|---------------|-------|-------|-------|
| 10.0.1.2    | 1   | Full/DR | 30.884s   | 10.0.1.2 | eth1:10.0.1.1 | 0     | 0     | 0     |

10.0.0.1/24  
2001:0::1/64

10.0.1.2/24  
2001:1::2/64

10.0.2.1/24  
2001:2::1/64

n3

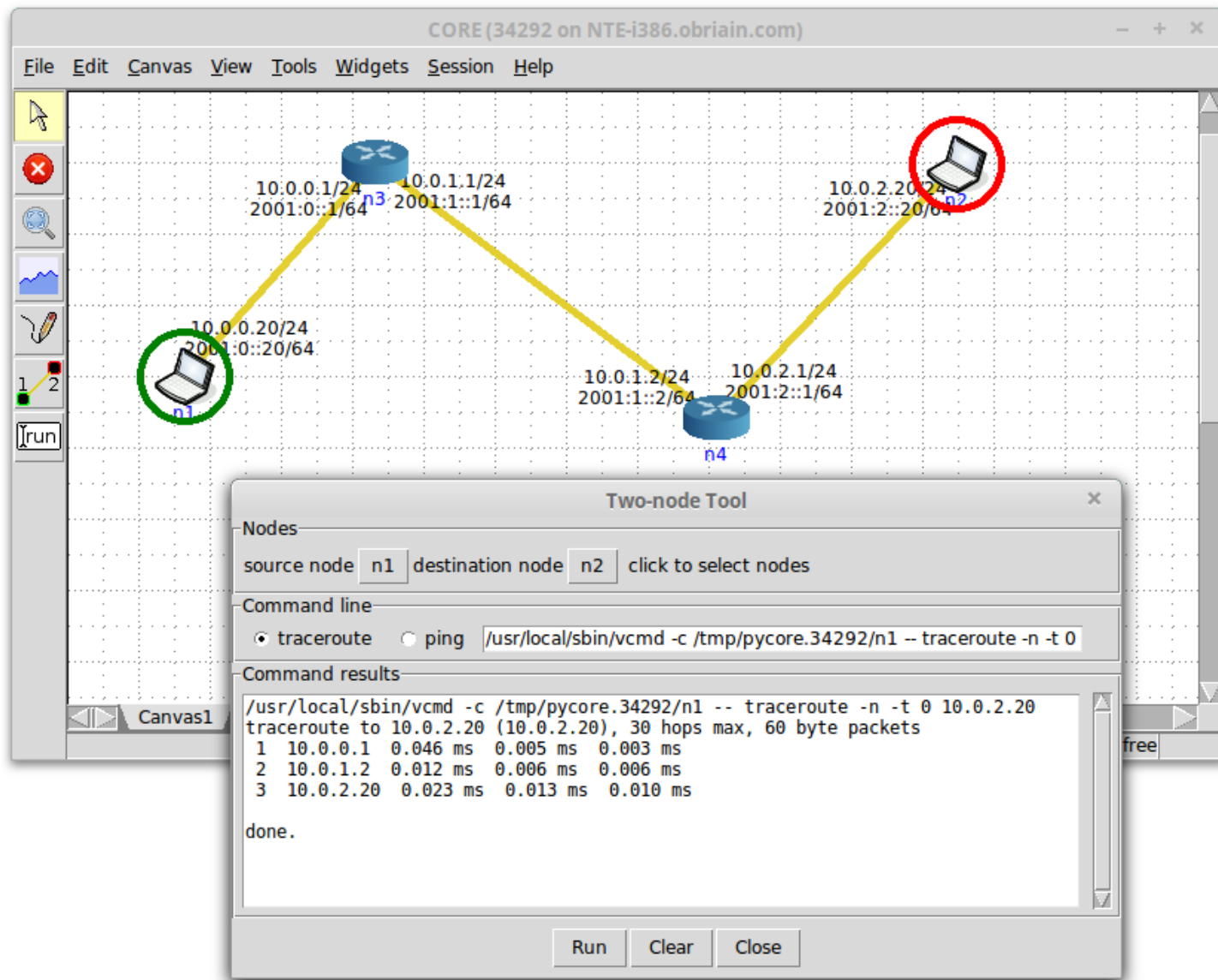
n4

Canvas1

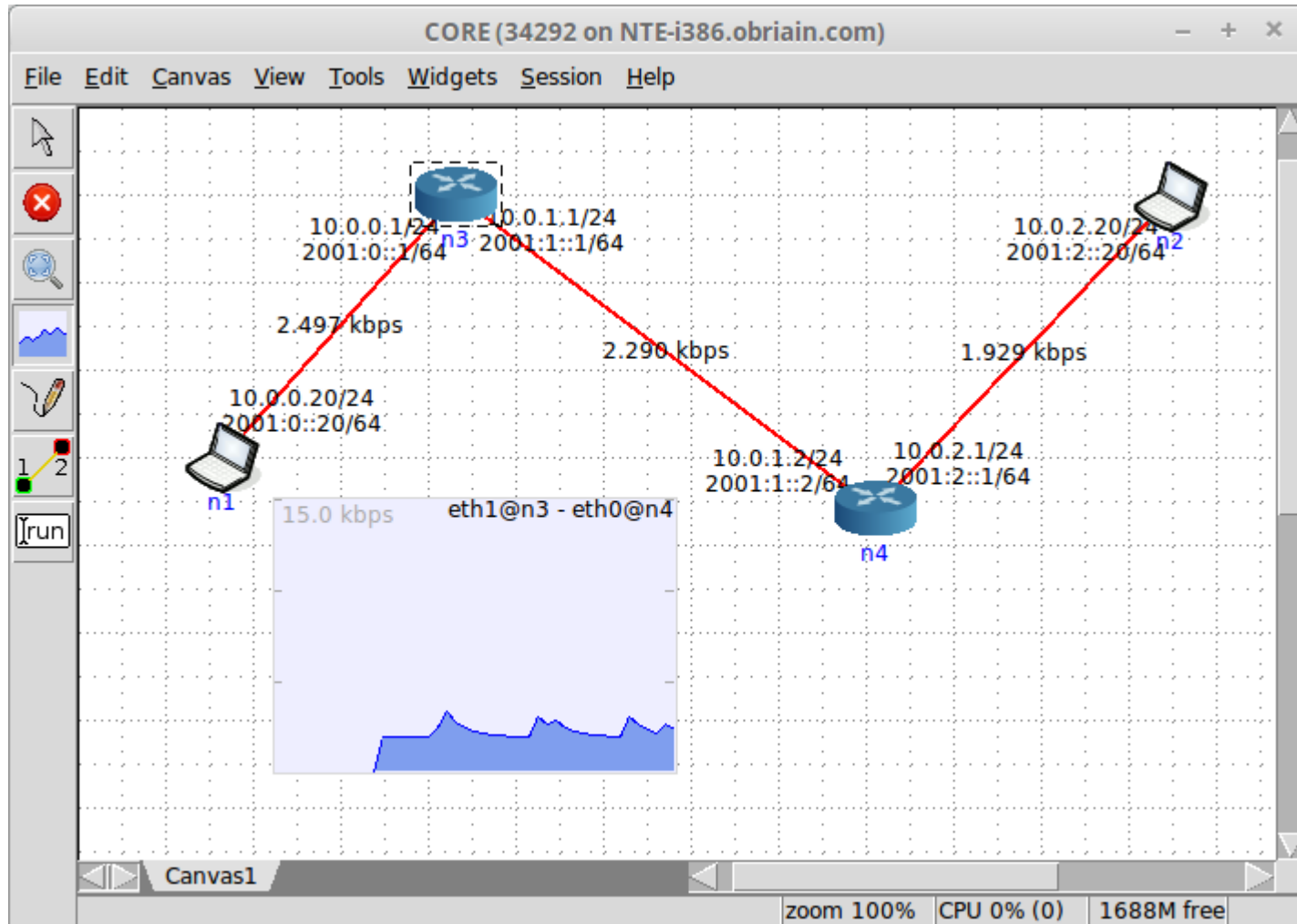
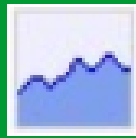
{n3} n3 (router): eth0:10.0.0.1/24 eth1:10.0.1.1/24 <207.0, 48.0>

zoom 100% CPU 2% (2) 1689M free

# Two node tool



# Plot tool

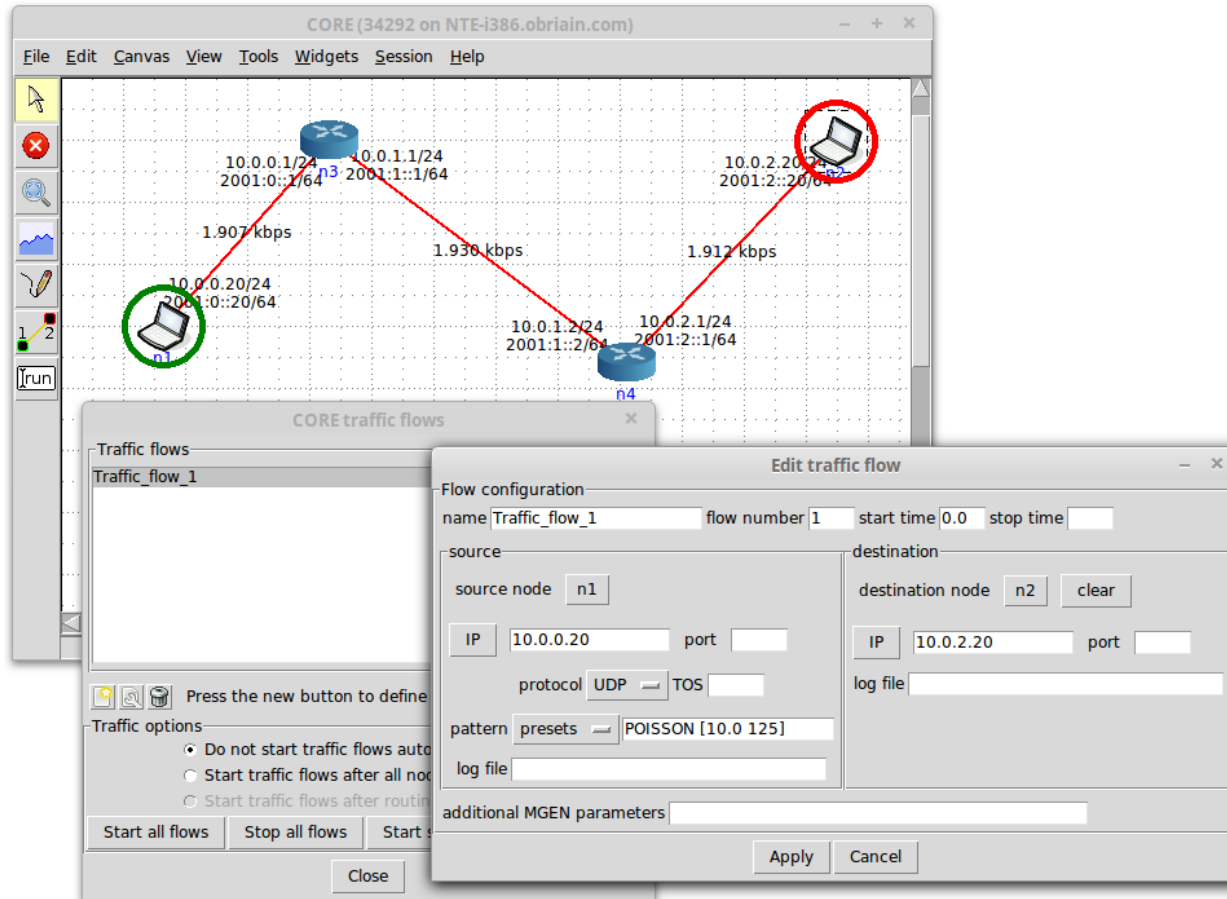


# Traffic flows



**Tools -> Traffic...**

**Widgets -> Configure Throughput...**



**Throughput config**

- ☒ Show throughput label on every link
- ☒ Use exponentially weighted moving average

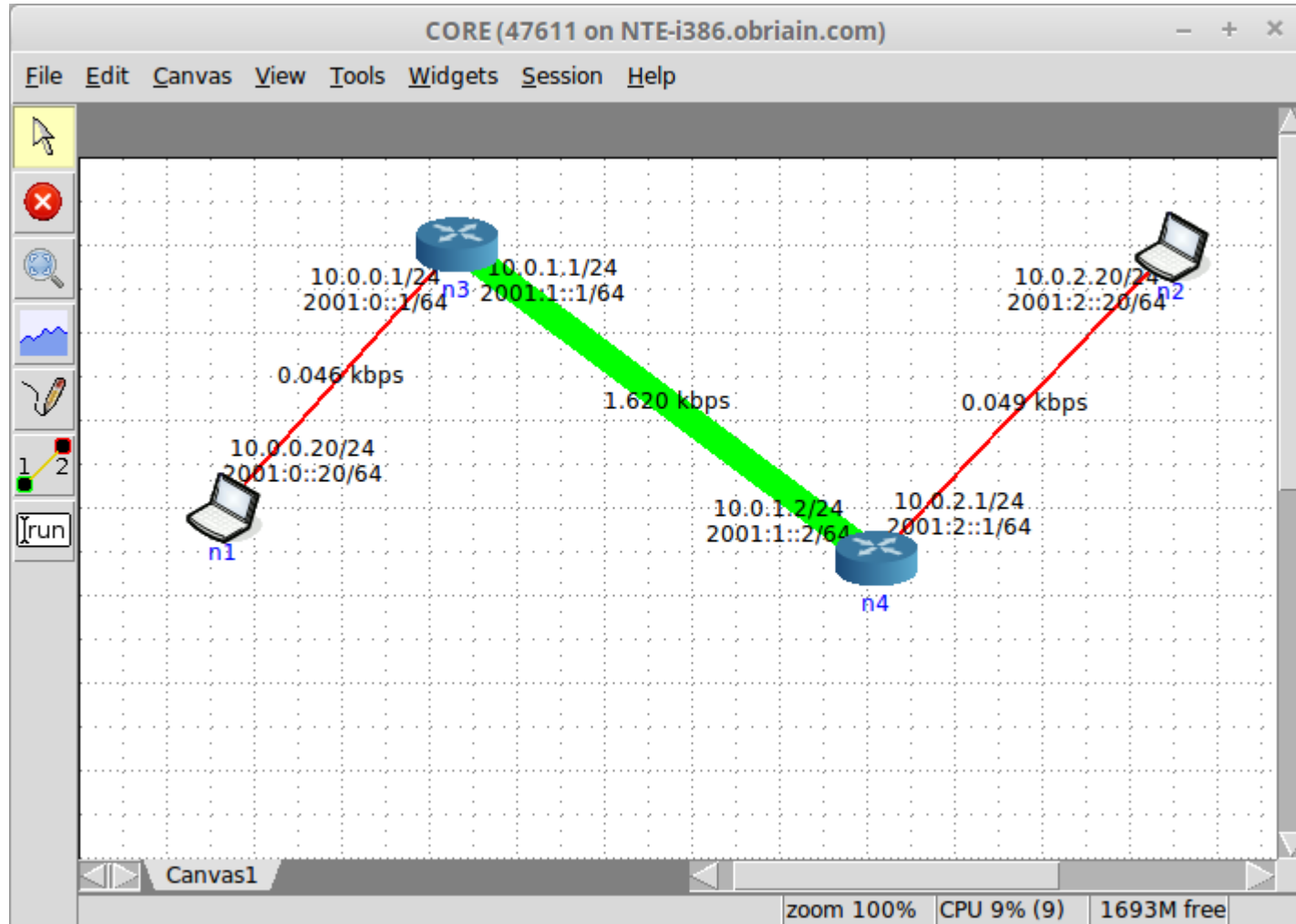
Link highlighting

Highlight link if throughput exceeds this threshold (0 for disabled):  kbps

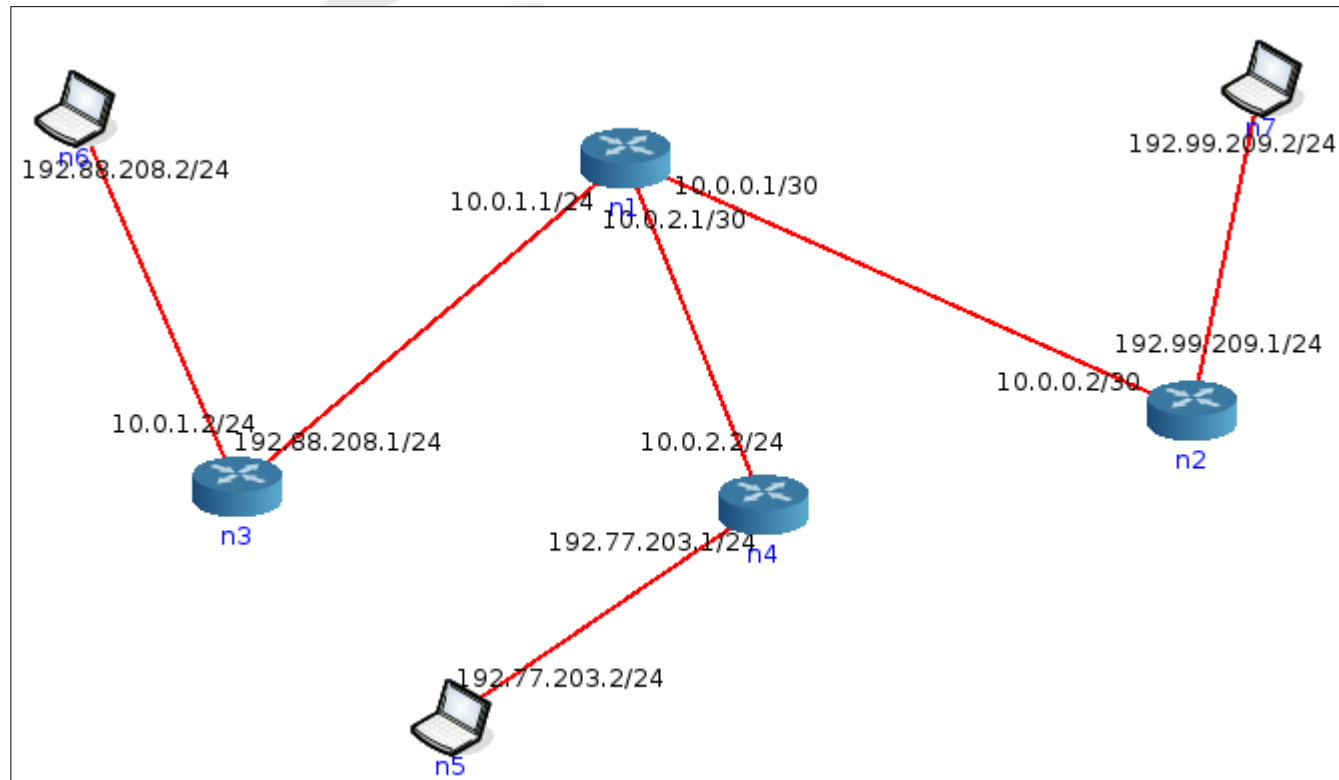
Highlight link width:

Highlight color:

# Viewing throughput



# Lab exercise





# Thank You

**Diarmuid Ó Briain**

CEng, FIEI, FIET, CISSP

[diarmuid@obriain.com](mailto:diarmuid@obriain.com)