Homework1

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1 作业说明

1.1 实验目的

- 掌握 VirtualBox 虚拟机的安装与使用;
- 掌握 VirtualBox 的虚拟网络类型和按需配置;
- 掌握 VirtualBox 的虚拟硬盘多重加载;

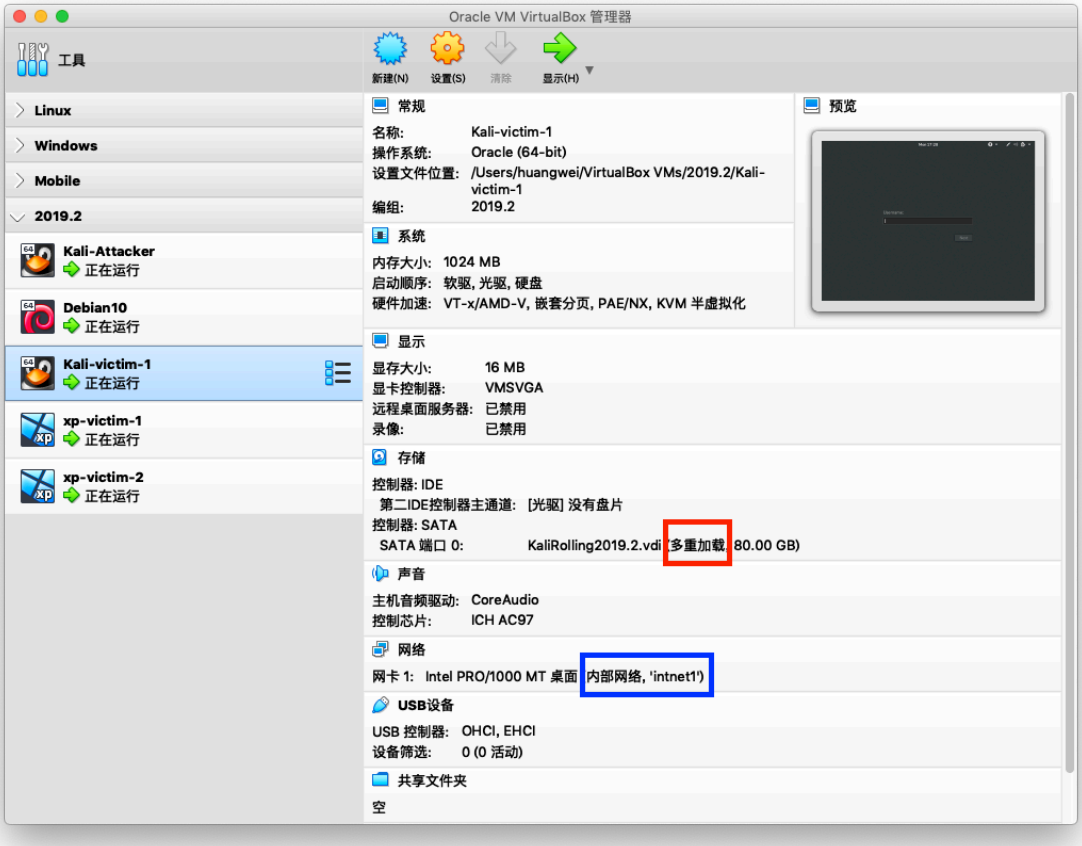
1.2 实验环境

以下是本次实验需要使用的网络节点说明和主要软件举例:

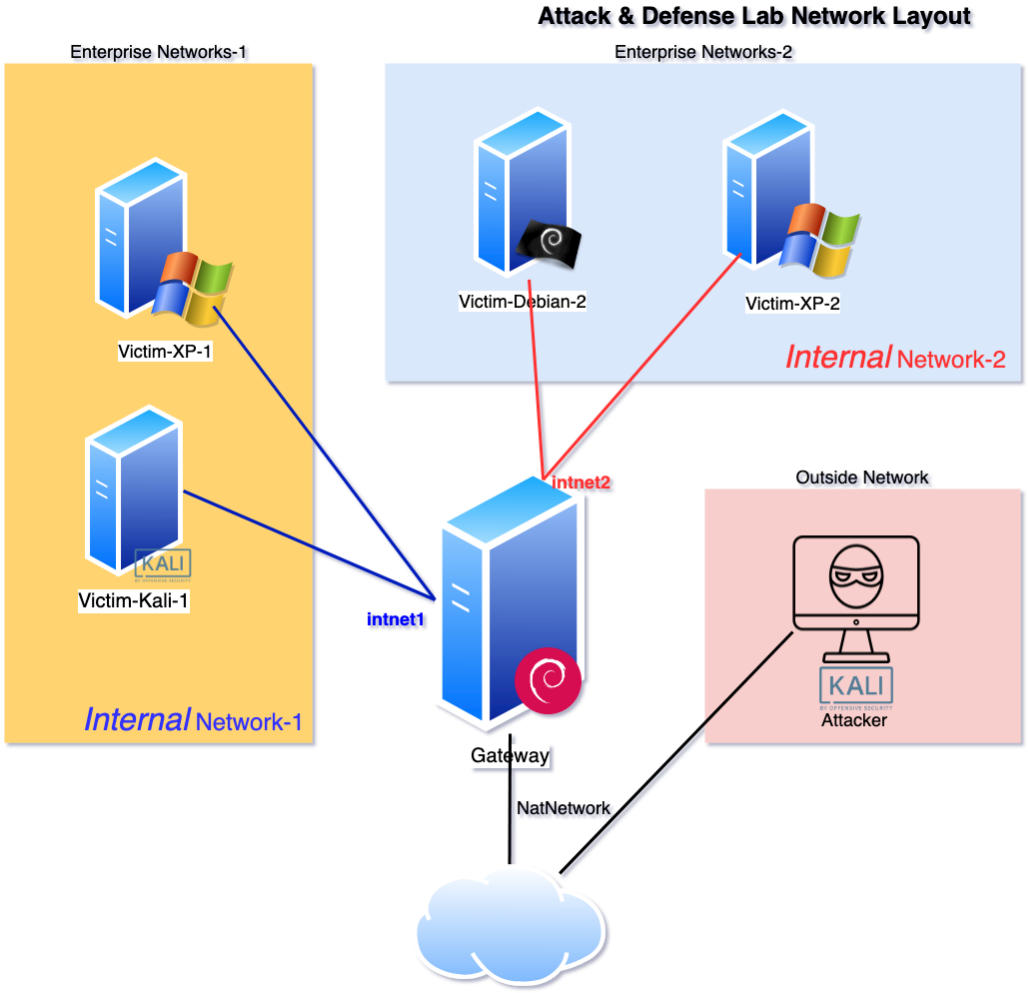
- VirtualBox 虚拟机
- 攻击者主机（Attacker）： Kali Rolling 2019.2
- 网关（Gateway, GW）： Debian Buster
- 靶机（Victim）： From Sqli to shell / xp-sp3 / Kali

1.3 实验要求

- 虚拟硬盘配置成多重加载，效果如下图所示;



· 搭建满足如下拓扑图所示的虚拟机网络拓扑；



根据实验宿主机的性能条件，可以适度精简靶机数量

- 完成以下网络连通性测试；
  - ☐ 靶机可以直接访问攻击者主机
  - ☐ 攻击者主机无法直接访问靶机
  - ☐ 网关可以直接访问攻击者主机和靶机
  - ☐ 靶机的所有对外上下行流量必须经过网关
  - ☐ 所有节点均可以访问互联网

1.4 实验报告要求

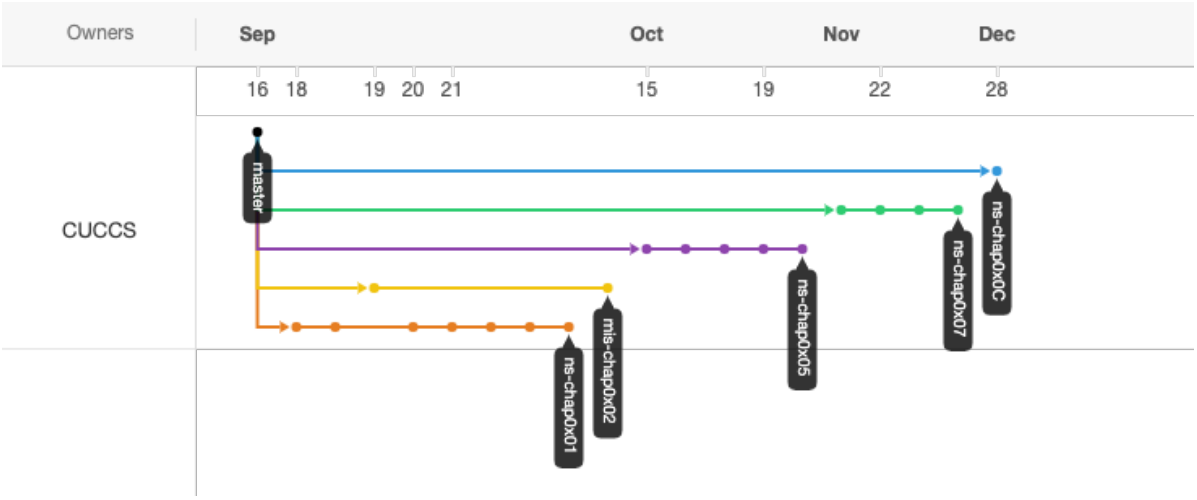
- Markdown 书写，且在 Github 上渲染出的排版效果正常，可读性强；
- 在 Github 上每次提交作业单独从 `master` 分支 **新** 开一个分支；
  - 每次作业均保存到 **独立不冲突** 的子目录；
- 图文并茂证明：

  - 实验关键步骤是自己做的;
  - **哪些** 实验结果符合实验要求预期;
- 如有涉及到代码、配置文件，请记得 commit **源代码** 文件;
- 规范的 Git 工作流程:
  - **提交作业等待批改**：提交 PR 请求将作业分支合并到 master 分支;
    * 未 PR 时的 commit 不会被批改;
  - 课程没有在教务处系统上查到分数之前，**禁止合并或关闭** 已有批改记录的 PR，可以在该 PR 对应的分支上继续提交新变更；;
  - 每次实验报告只保留一个 Open 状态的 PR，禁止同一次作业发起多个 PR;
  - PR 的标题应体现本次实验报告的主题;

  示例作业目录（所有分支合并到 master 分支后状态）如下:

```
.
├── .gitattributes
├── .gitignore
├── README.md
├── chap0x01
│   ├── README.md
│   └── img
│       ├── vb-setup.png
│       └── vb-victim-screenshot-1.png
├── chap0x02
│   └── README.md
├── chap0x03
│   └── README.md
├── chap0x04
│   └── README.md
└── chap0x05
    ├── README.md
    └── code
        ├── exp.py
        └── nginx.conf
```

  示例 Git 分支结构如下:



2 安装 VirtualBox 虚拟机软件

2.1 下载

首先，在https://www.virtualbox.org/下载 VirtualBox 虚拟机的安装包。

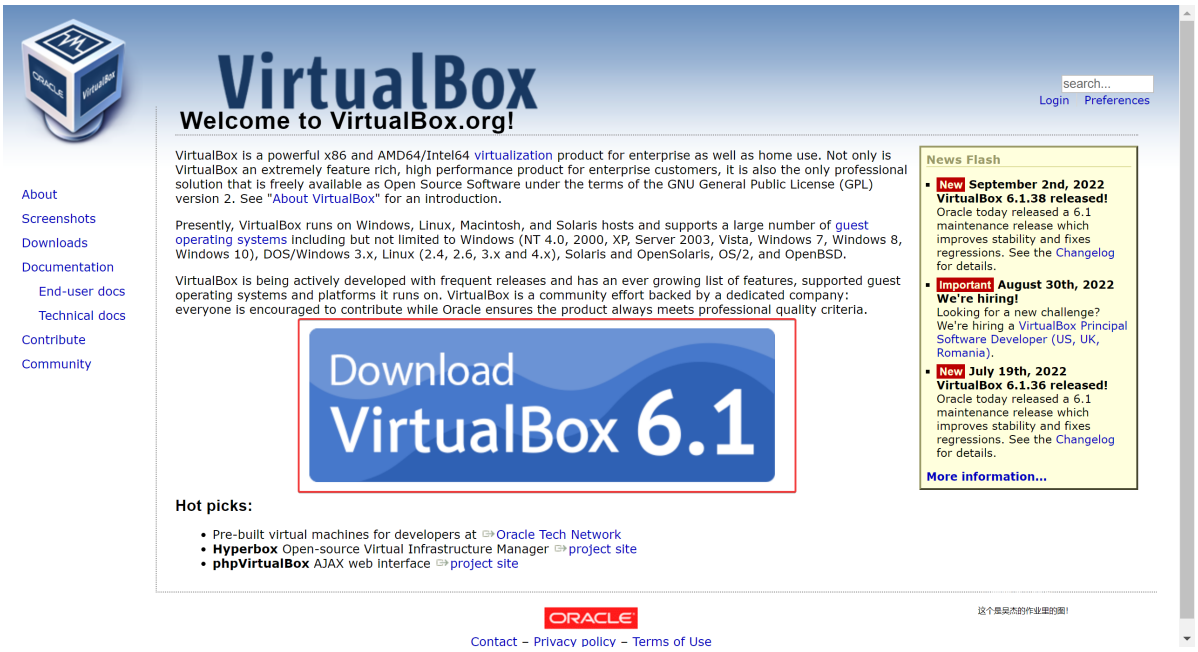


Figure 1: donwload_vbox.png

2.2 安装

随后进行安装，安装后打开软件主页面。

Figure 2: vbox_index.png

3 在 VirtualBox 虚拟机中安装XP

3.1 下载

在老师提供的链接中找到XP的镜像:

Figure 3: xp_kod.png

点击进行下载。

3.2 解压

下载完成后使用解压缩工具进行解压。

Figure 4: xp_unzipped.png

3.3 导入

随后需要将这个磁盘文件导入。

首先进入**虚拟介质管理**:

Figure 5: vdi_mng.png

将XP的vdi文件注册:

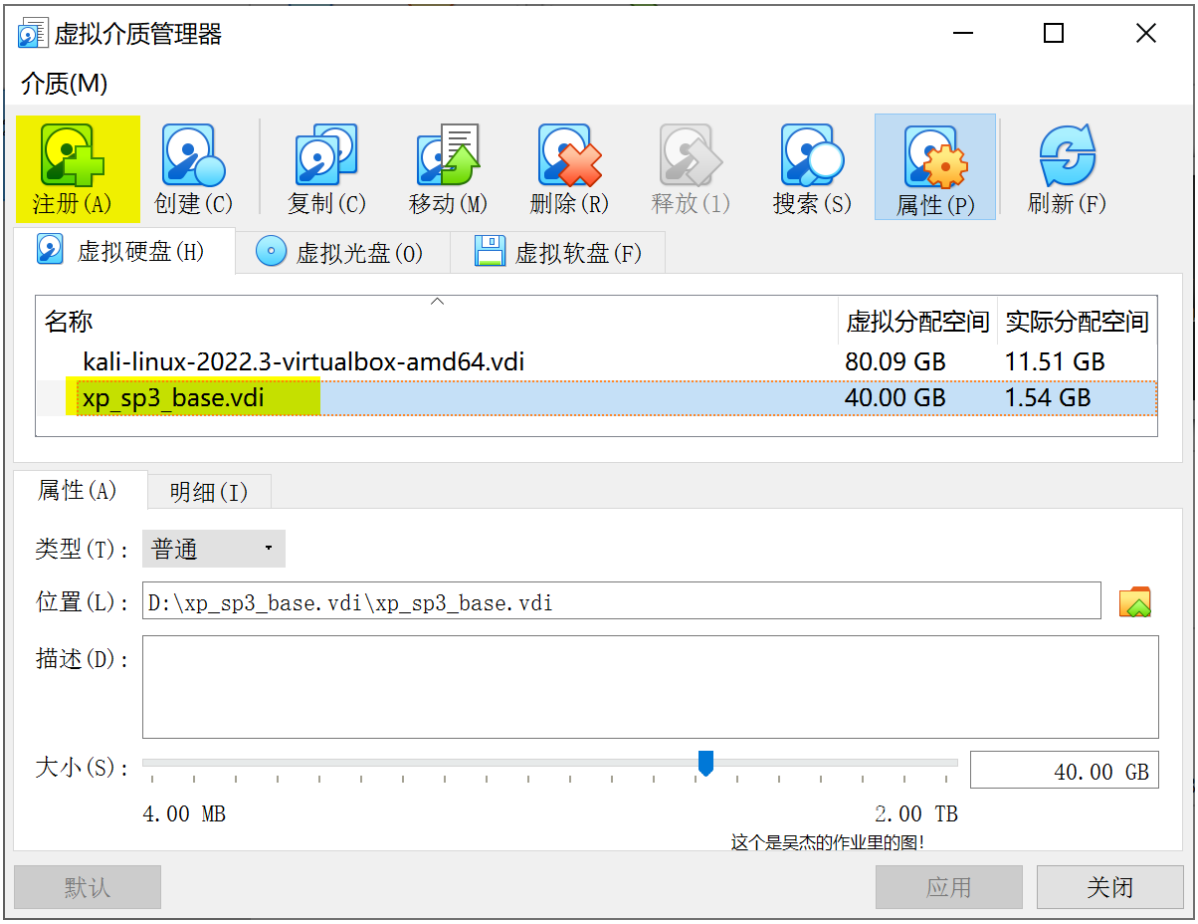


Figure 6: reg_xp_vid.png

3.4 安装XP1

点击新建按钮:

Figure 7: new_vm.png

设定虚拟机信息:

Figure 8: set_new_vm_info.png

设定内存:

Figure 9: set_new_vm_memory.png

将硬盘设定为刚刚下载的xp的vdi:

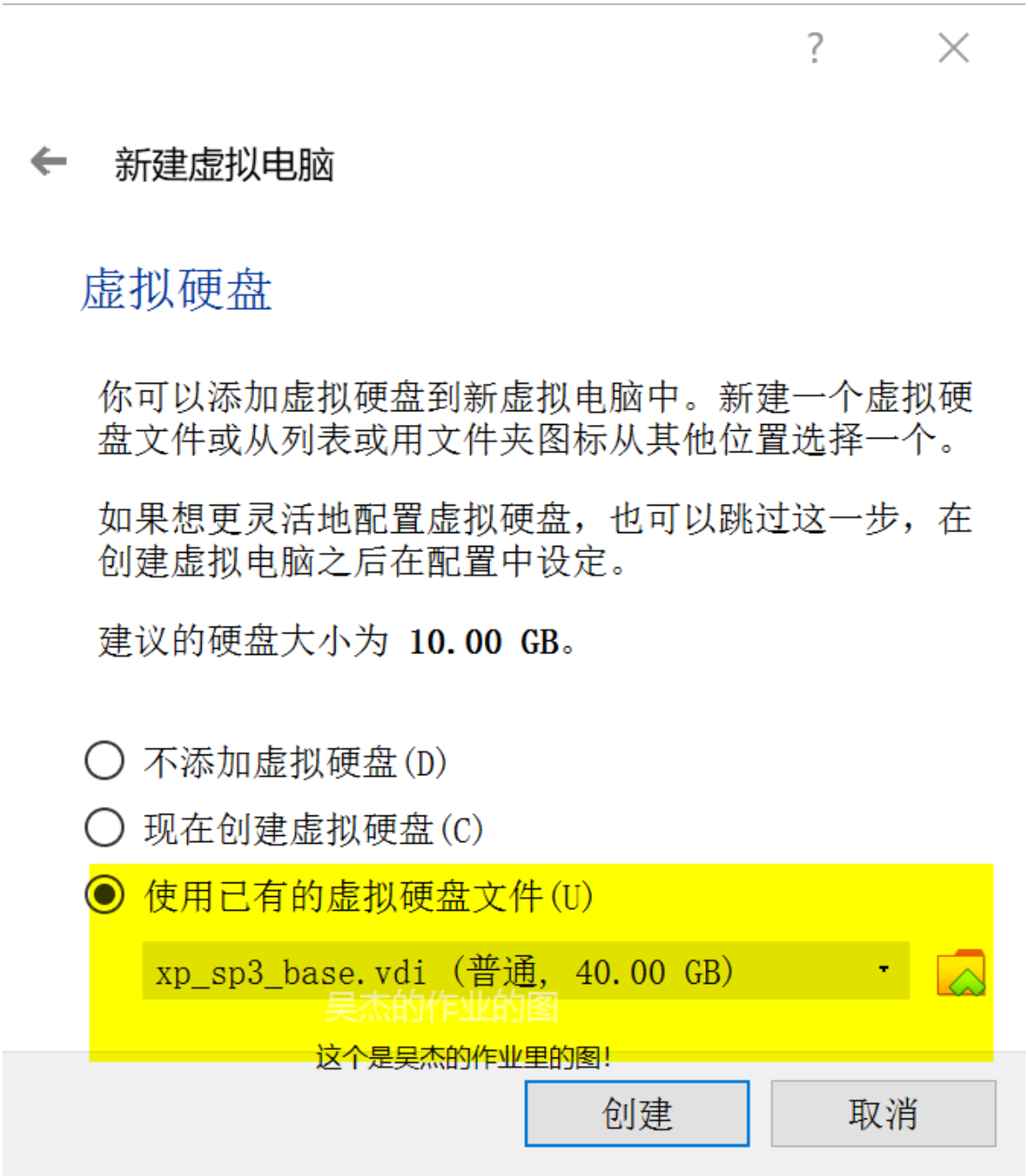


Figure 10: set_new_vm_vdi.png

随后完成创建，启动XP1：

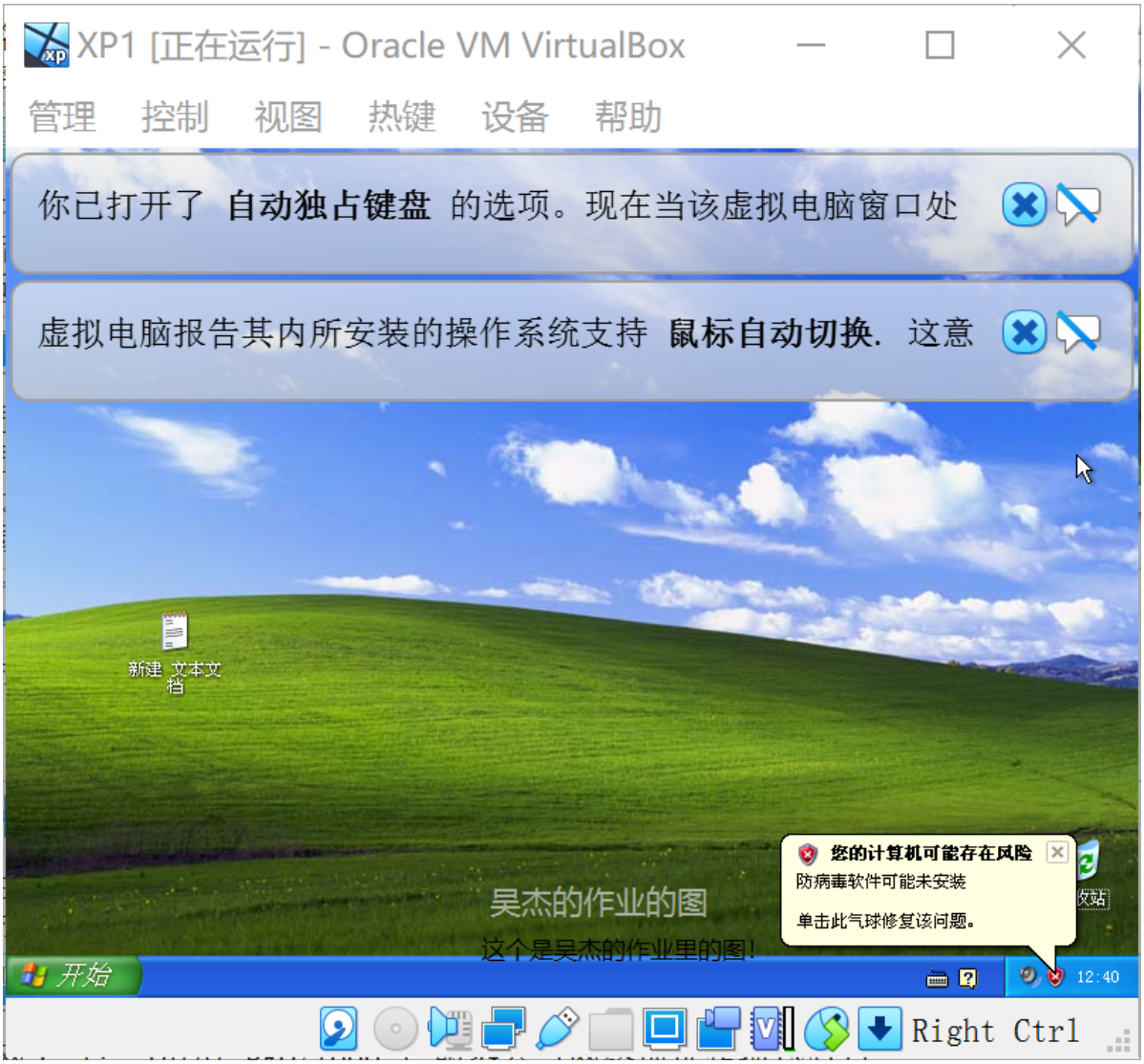


Figure 11: XP1_desktop.png

3.5 设置多重加载

由于这个镜像需要给多个虚拟机使用，所以设置多重加载。

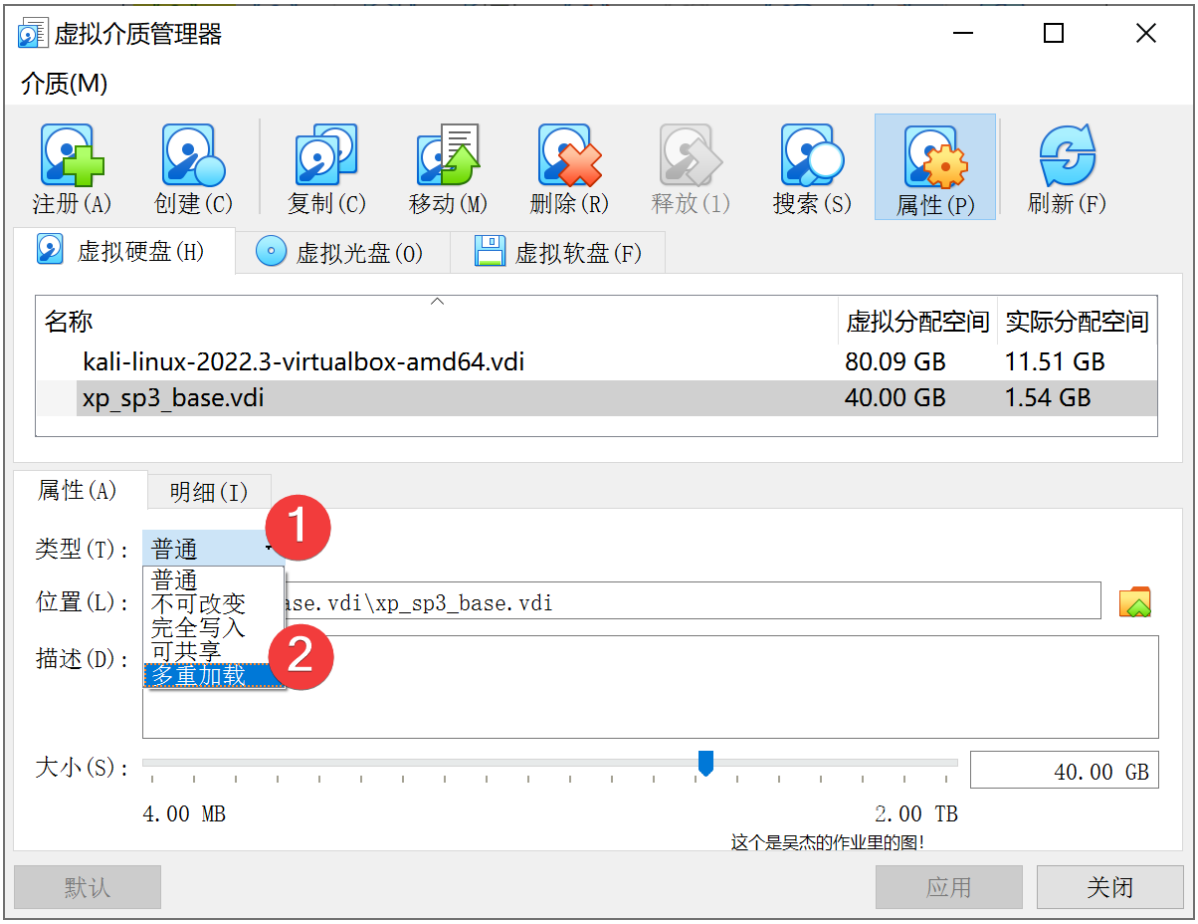


Figure 12: set_mult_attach.png

3.6 安装XP2

与XP1安装时的设置一致，磁盘同样选择下载的xp的vdi。

这样，两台XP就都装好了：

Figure 13: xp1_xp2_desktop.png

4 在 VirtualBox 虚拟机中安装 Kali

4.1 下载

在https://www.kali.org/get-kali/#kali-installer-images中找到已经配置好的Kali环境:

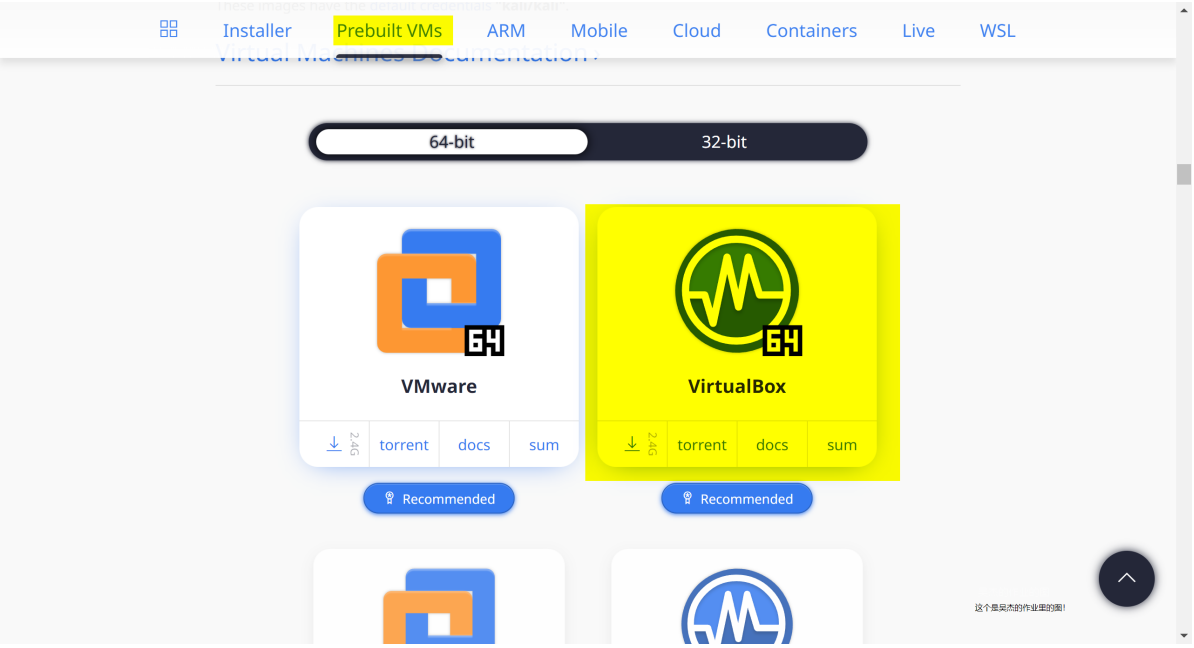


Figure 14: download_prebuild_kali_vbox.png

点击下载按钮，开始下载：

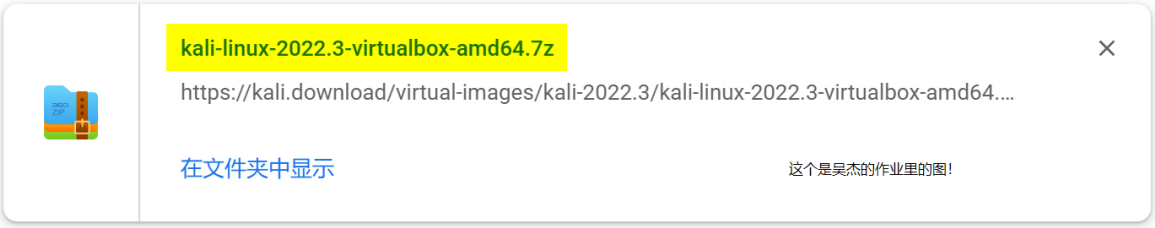


Figure 15: kali_vbox_downloaded.png

4.2 解压

随后使用压缩工具对其进行解压：

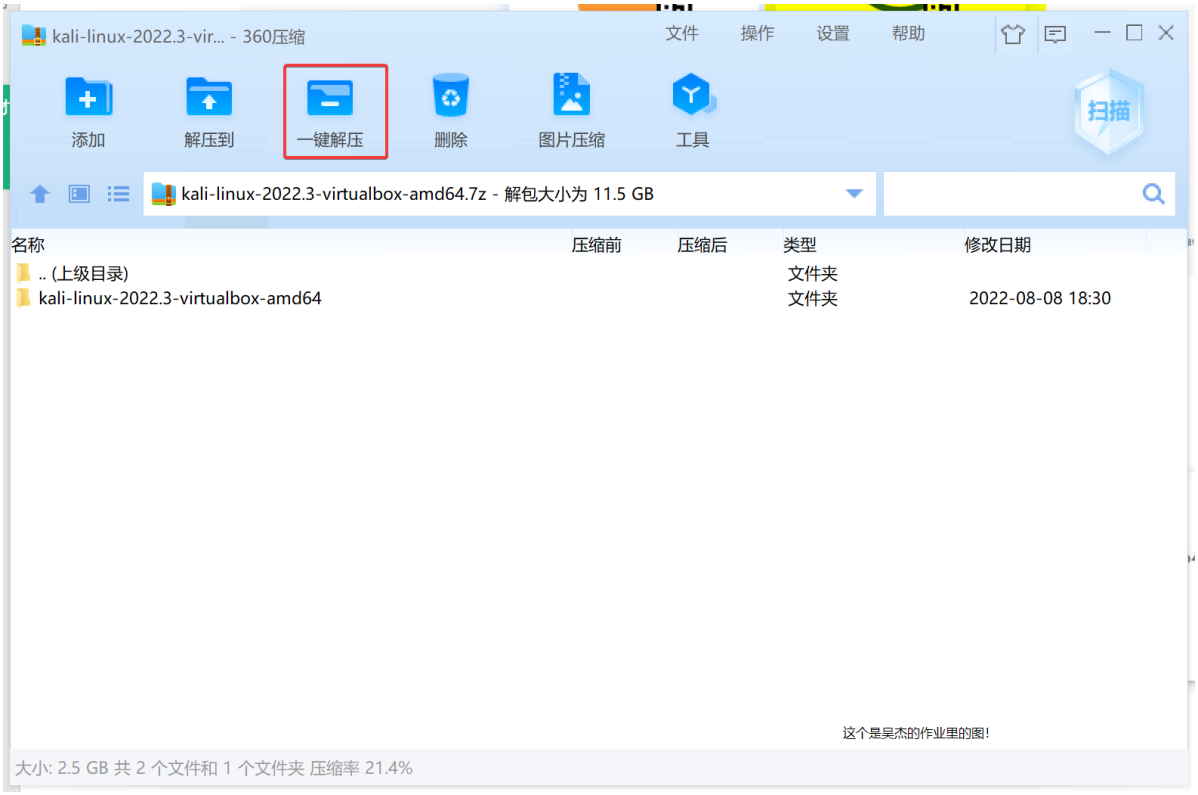


Figure 16: unzip_kali_box.png

4.3 安装Kali1

双击解压后的vbox文件，即可导入：

Figure 17: kali_imported.png

4.4 设置多重加载

同样的，因为有多台kali，需要设置多重加载：

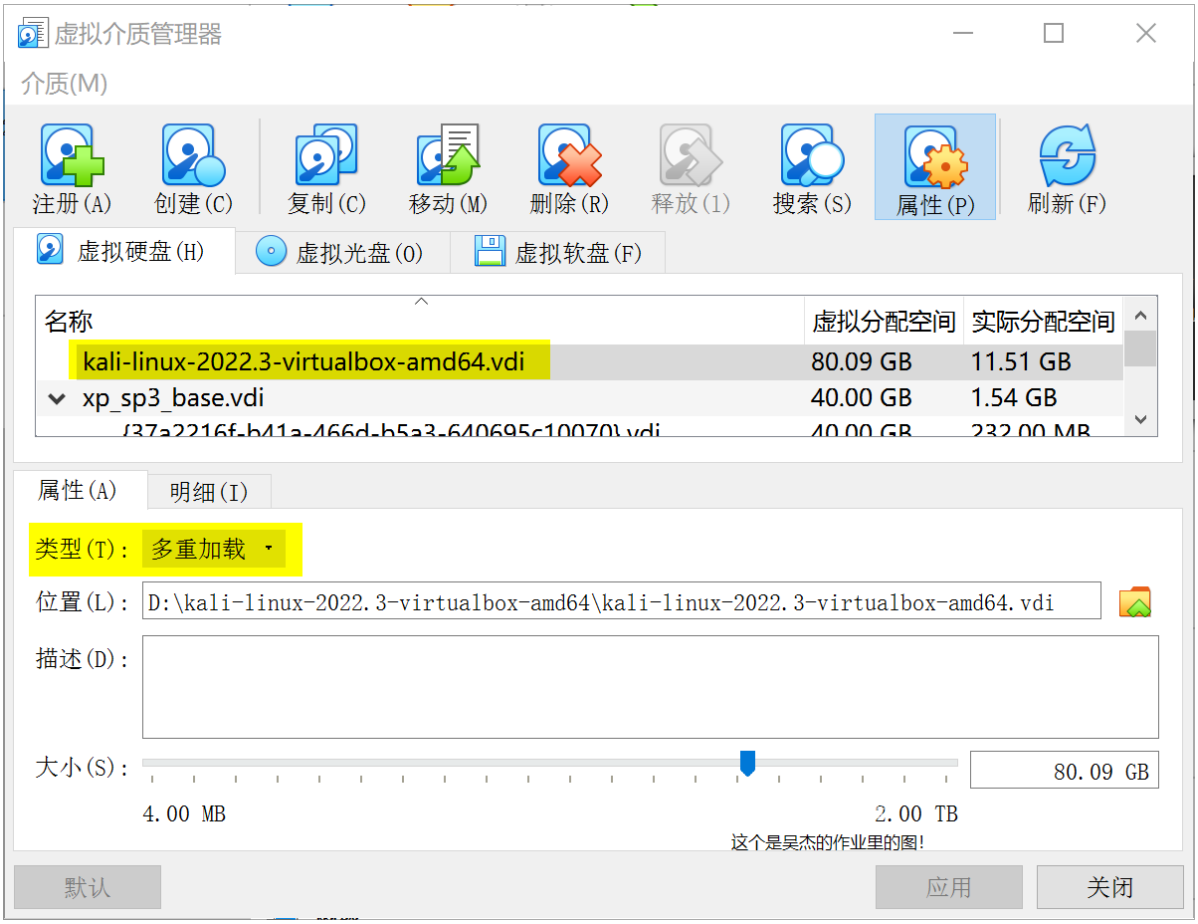


Figure 18: set_kali_mult_att.png

4.5 安装Kali2

使用和XP一样的方法安装第二台Kali

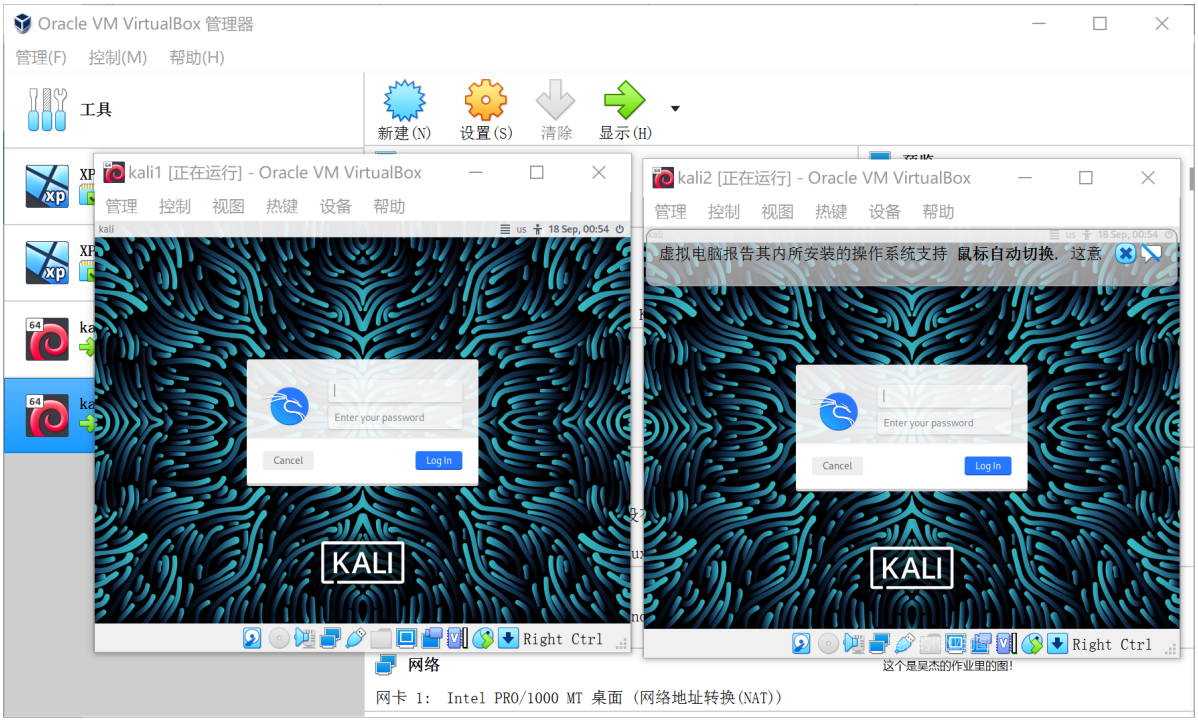


Figure 19: kali1_kali2_login.png

5 在 VirtualBox 虚拟机中安装安装 Debian

和XP、Kali一样:

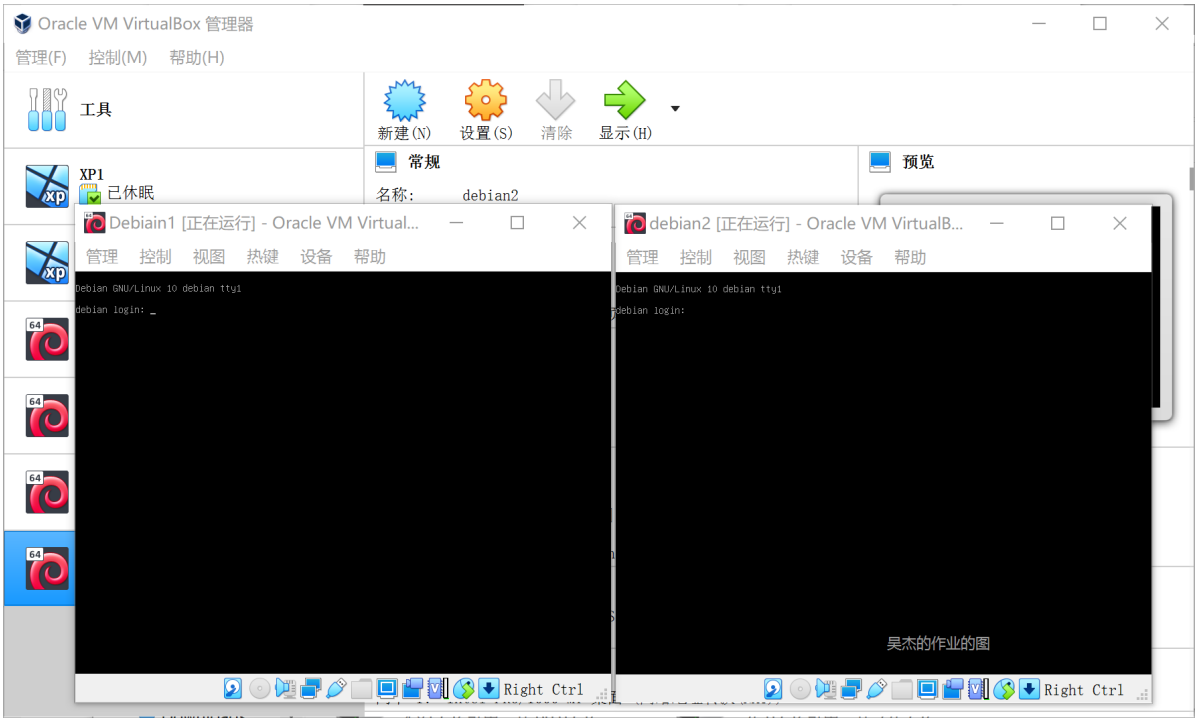


Figure 20: debian1_debian2_login.png

6 设置网络

6.1 修改名称

首先，根据网络拓扑图，修改各个虚拟机的名称：

Figure 21: rename_vms.png

6.2 设置内部网络1

网络内有:

- XP1
- Kali1
- 网关

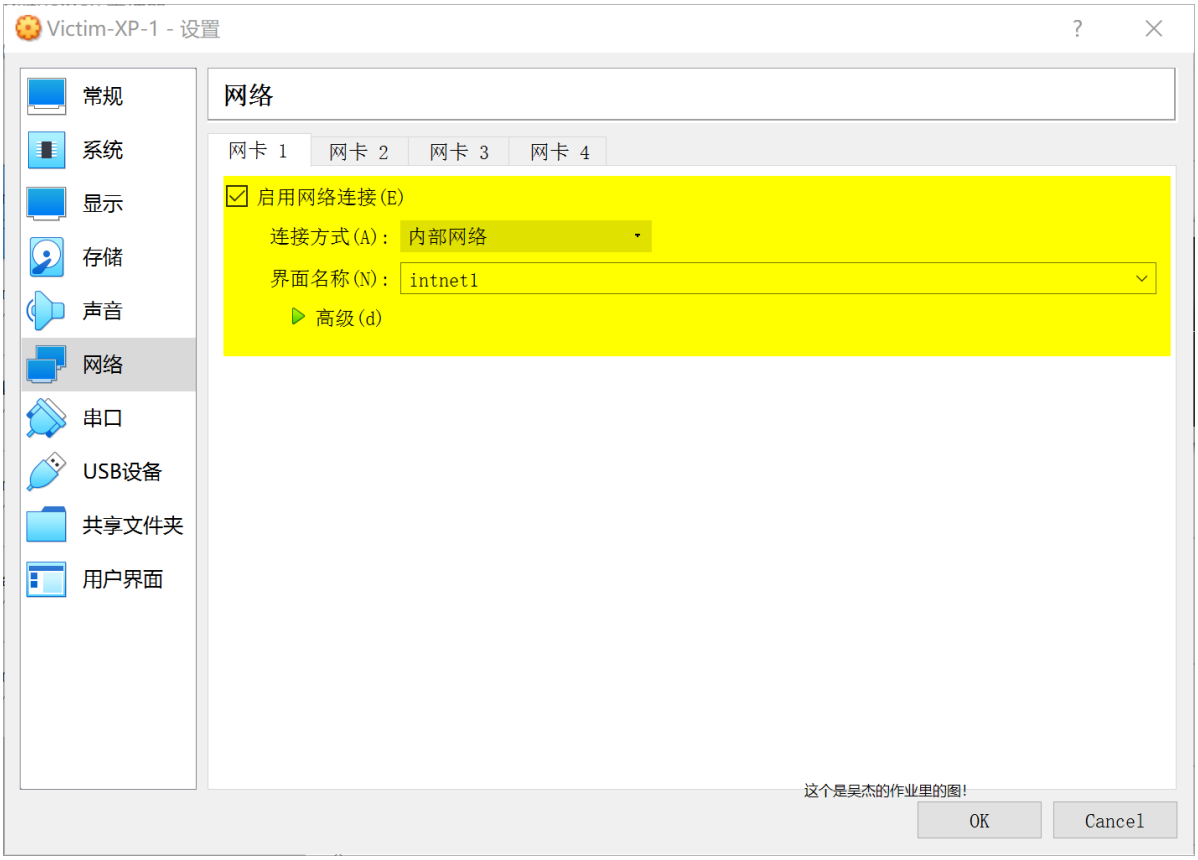


Figure 22: intnet_xp1.png

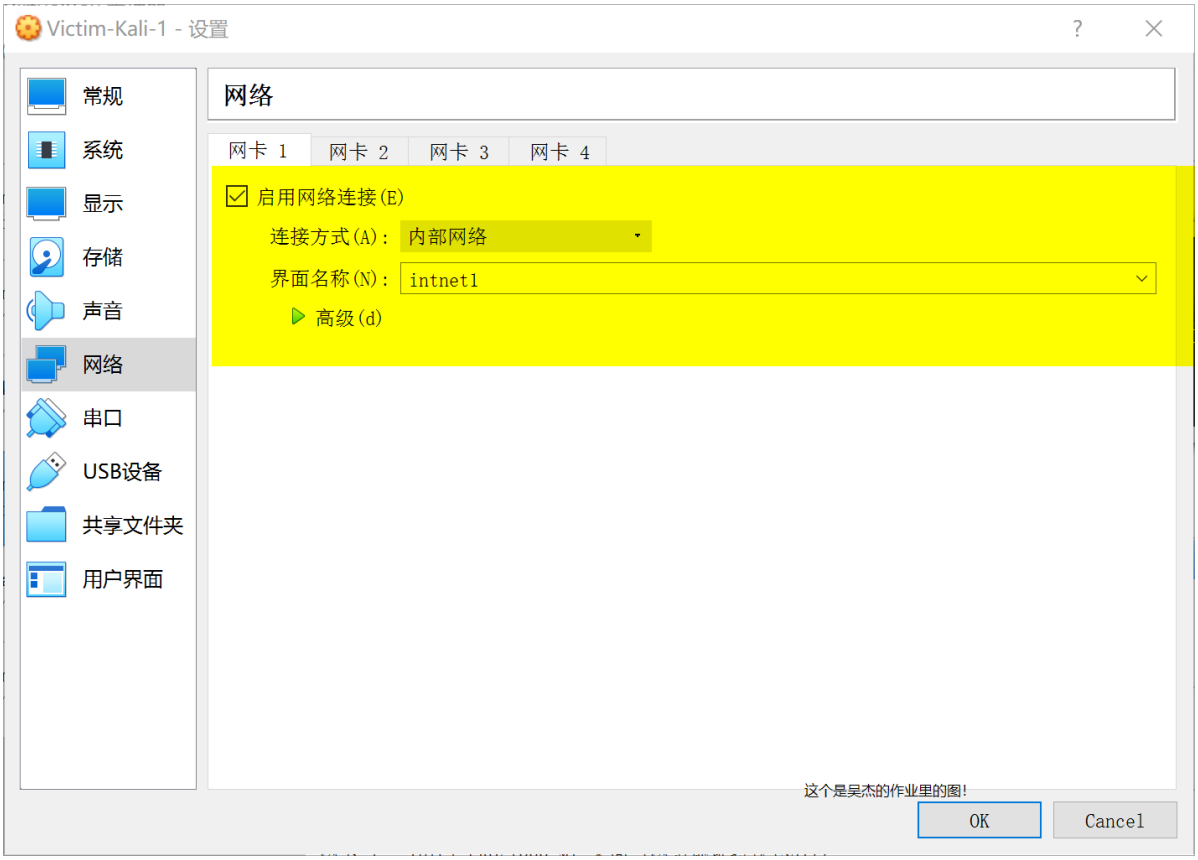


Figure 23: intnet_kali1.png

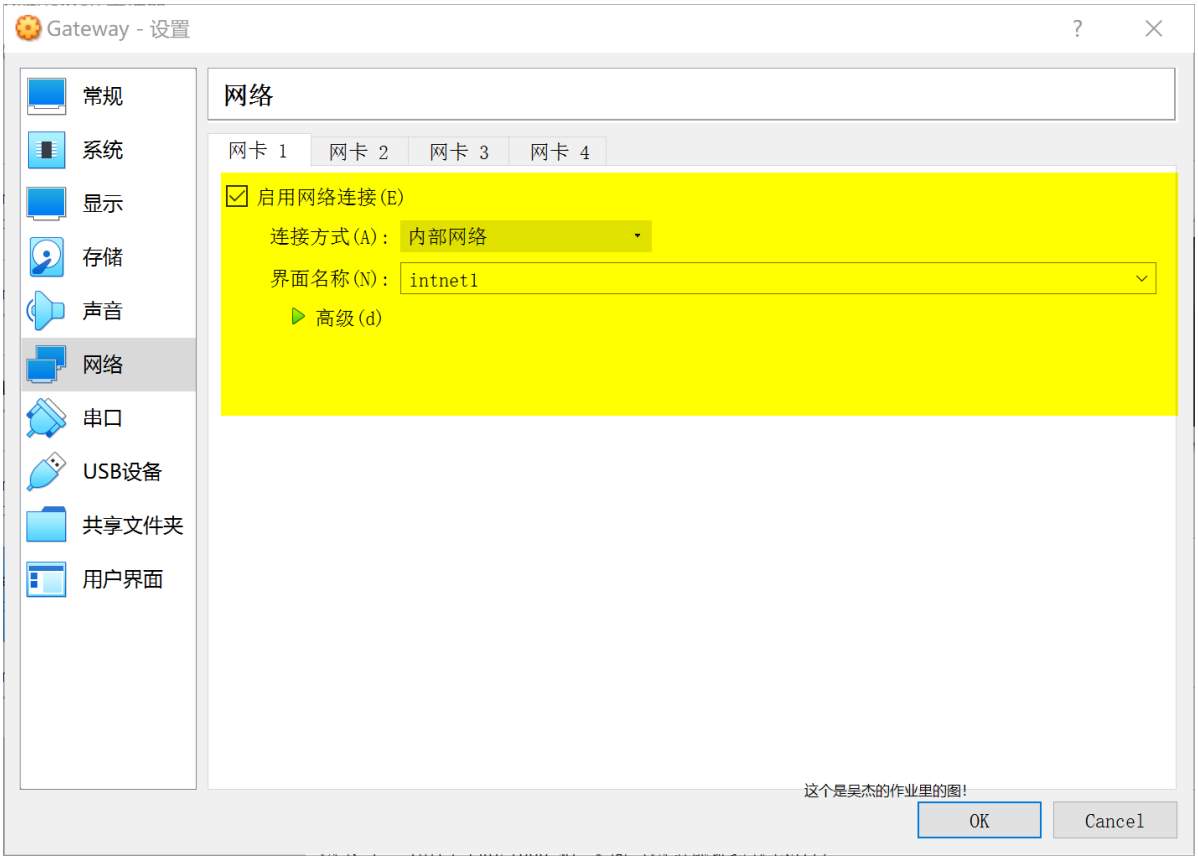


Figure 24: intnet_gw.png

6.3 设置内部网络2

网络内有:

- XP2
- Debian2
- 网关（另一块网卡）

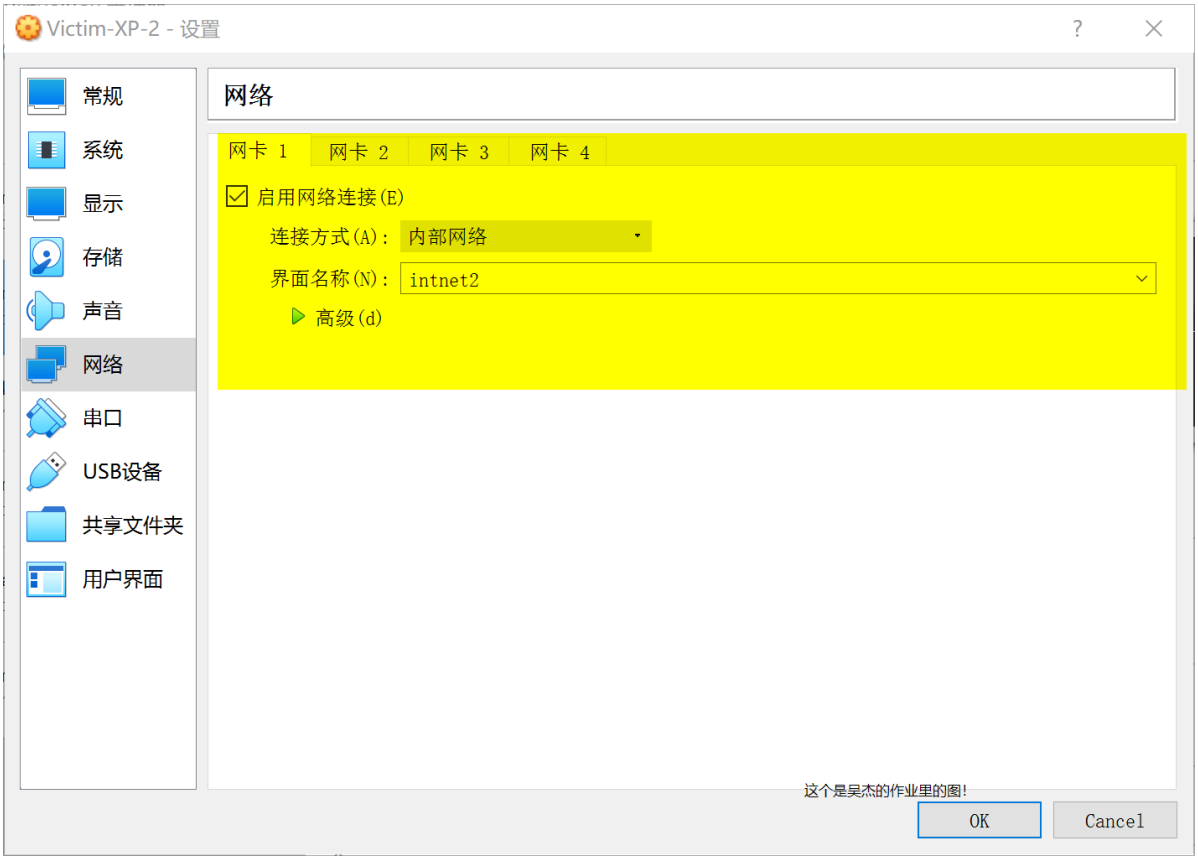


Figure 25: inetnet2_xp2.png

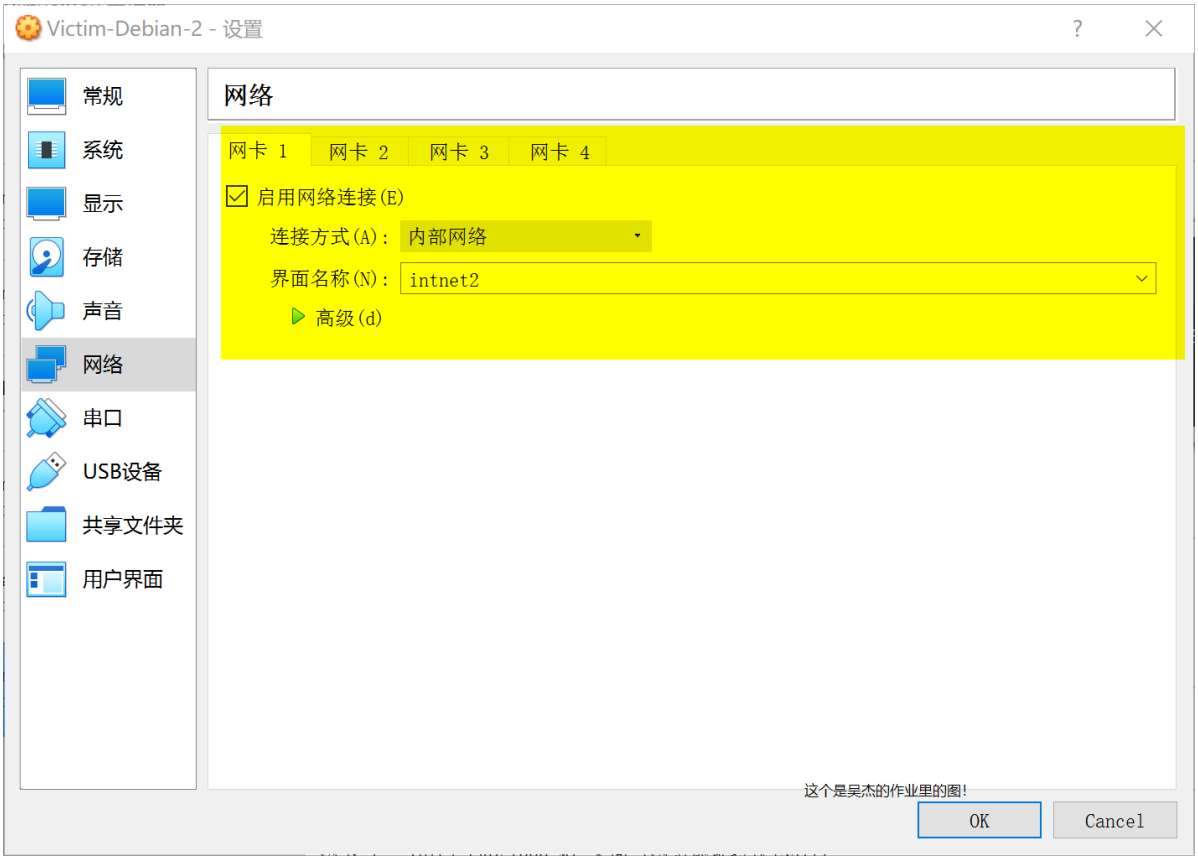


Figure 26: intnet2_debian2.png

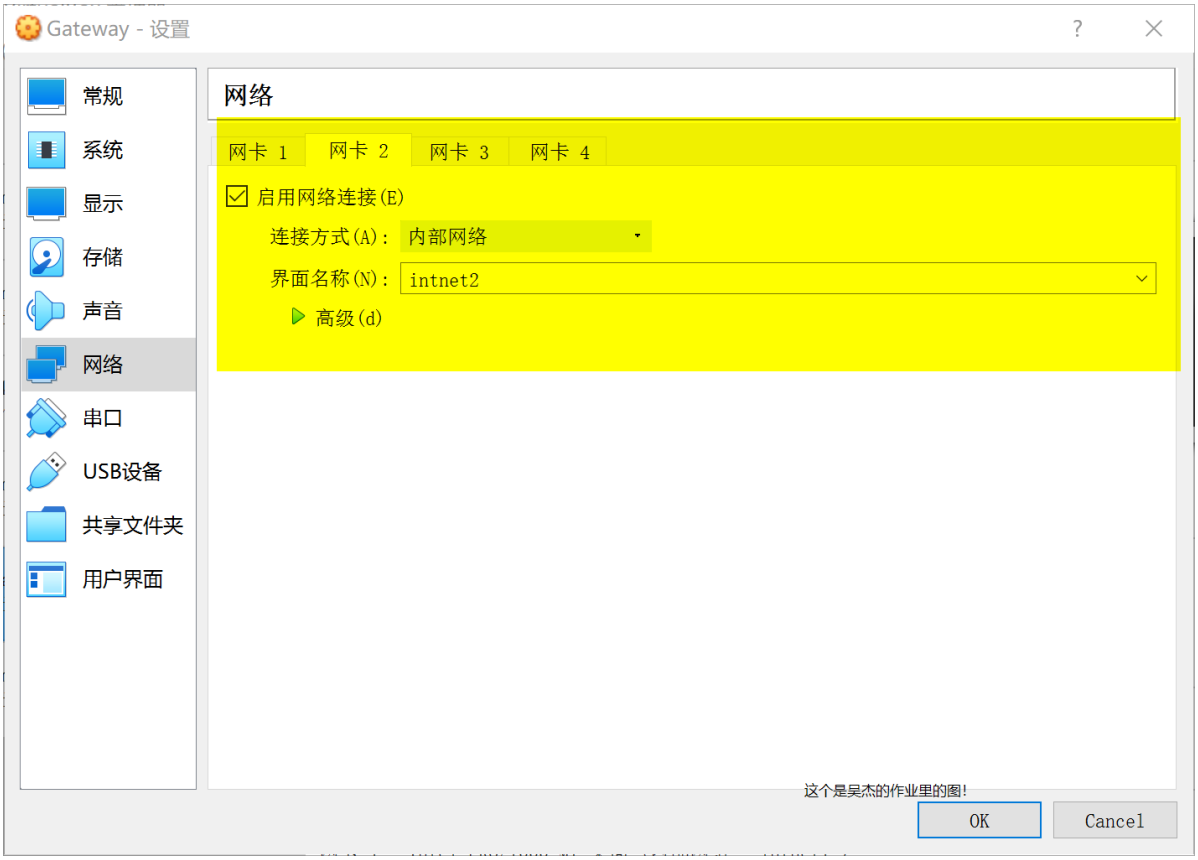


Figure 27: intnet2_gw.png

6.4 设置NatNetwork网络

6.4.1 选用NAT网络的原因

由于要求**所有节点均可以访问互联网**，因此需要保证**网关**与**攻击者**都能上网，内部网络机器通过网关上网。

因此有几种可能的方式：

- 桥接宿主机网卡：不可行，这样**网关**与**攻击者**无法互相访问。
- NAT地址转换：可行，但由于NAT地址转换会给每个虚拟机单独配置NAT转换器，**网关**与**攻击者**需要再添加一个内部网络才能互相访问，实际在互联网中并不是这样的。
- NAT网络：可行，且共用网关和攻击者共用NAT转换器，可以实现**网关**与**攻击者**的互相访问。

6.4.2 创建NAT网络

首先进入全局设定：

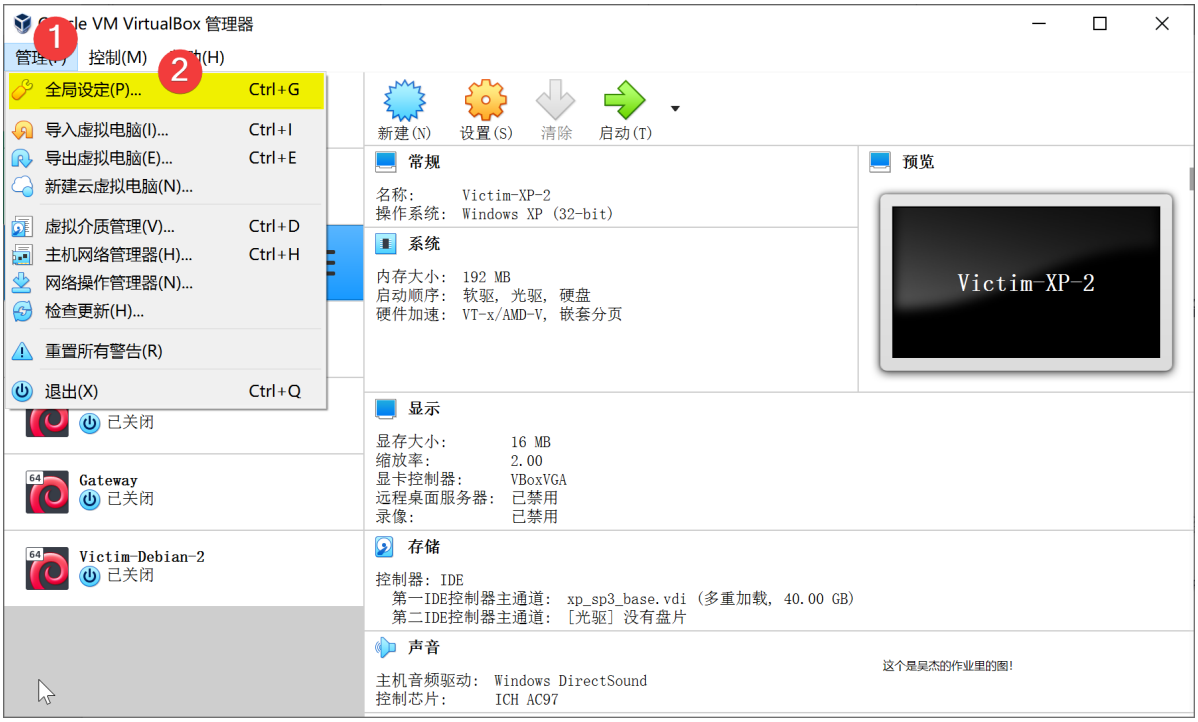


Figure 28: global_settings.png

新建一个NAT网络:

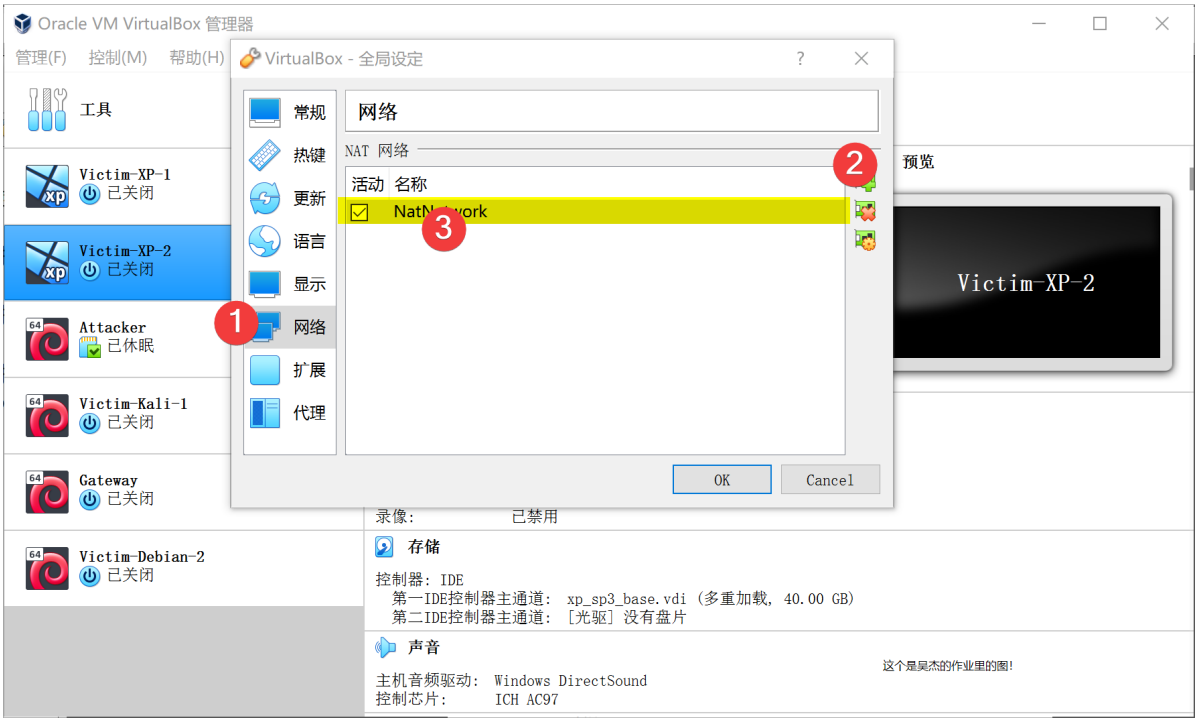


Figure 29: new_natnetwork.png

设定一个子网，不与其他网络重复，同时开启DHCP：

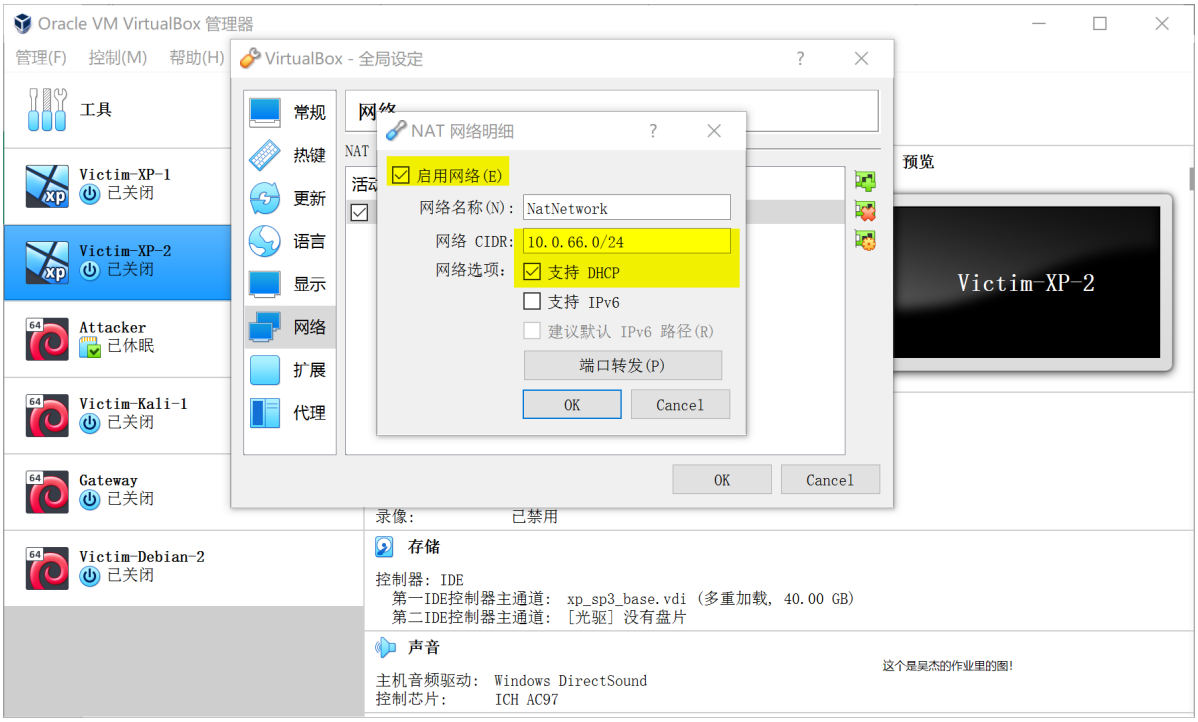


Figure 30: init_natnetwork.png

6.4.3 配置Attacker

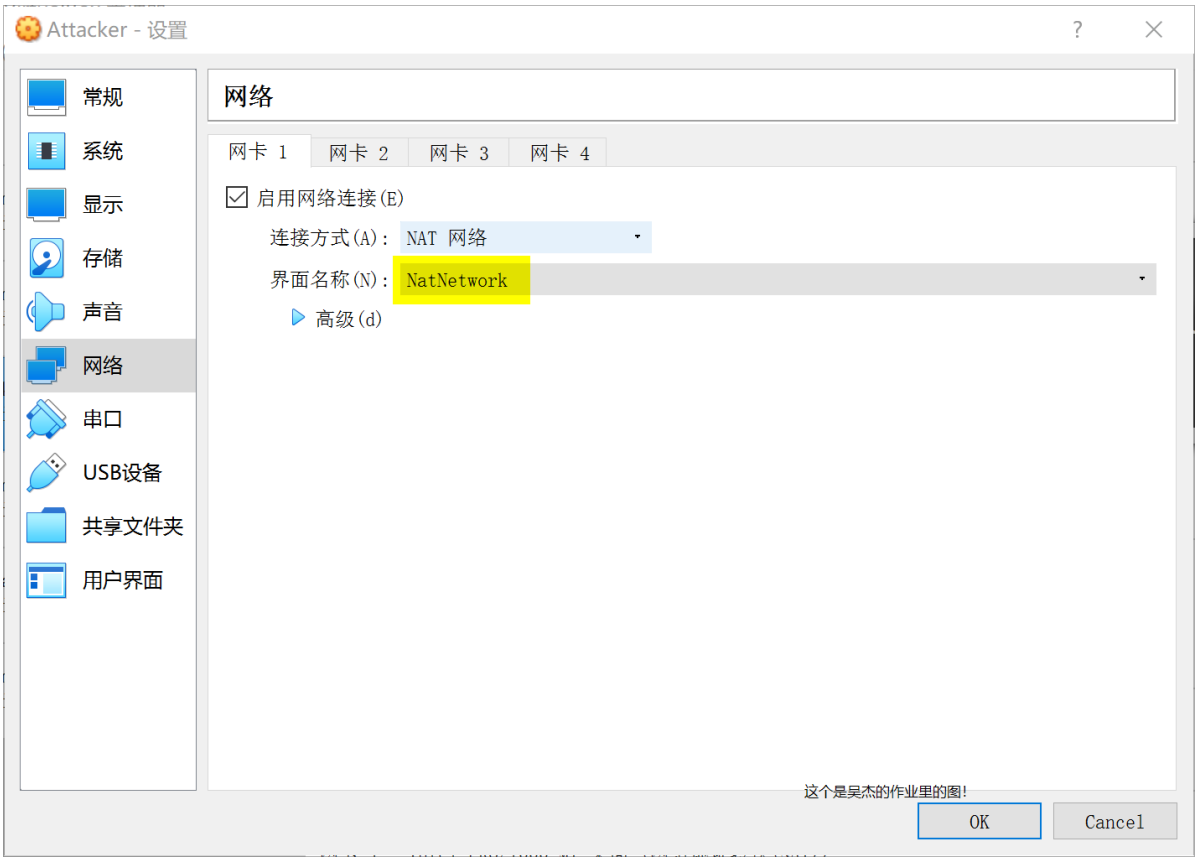


Figure 31: set_attacker_network.png

6.4.4 配置网关

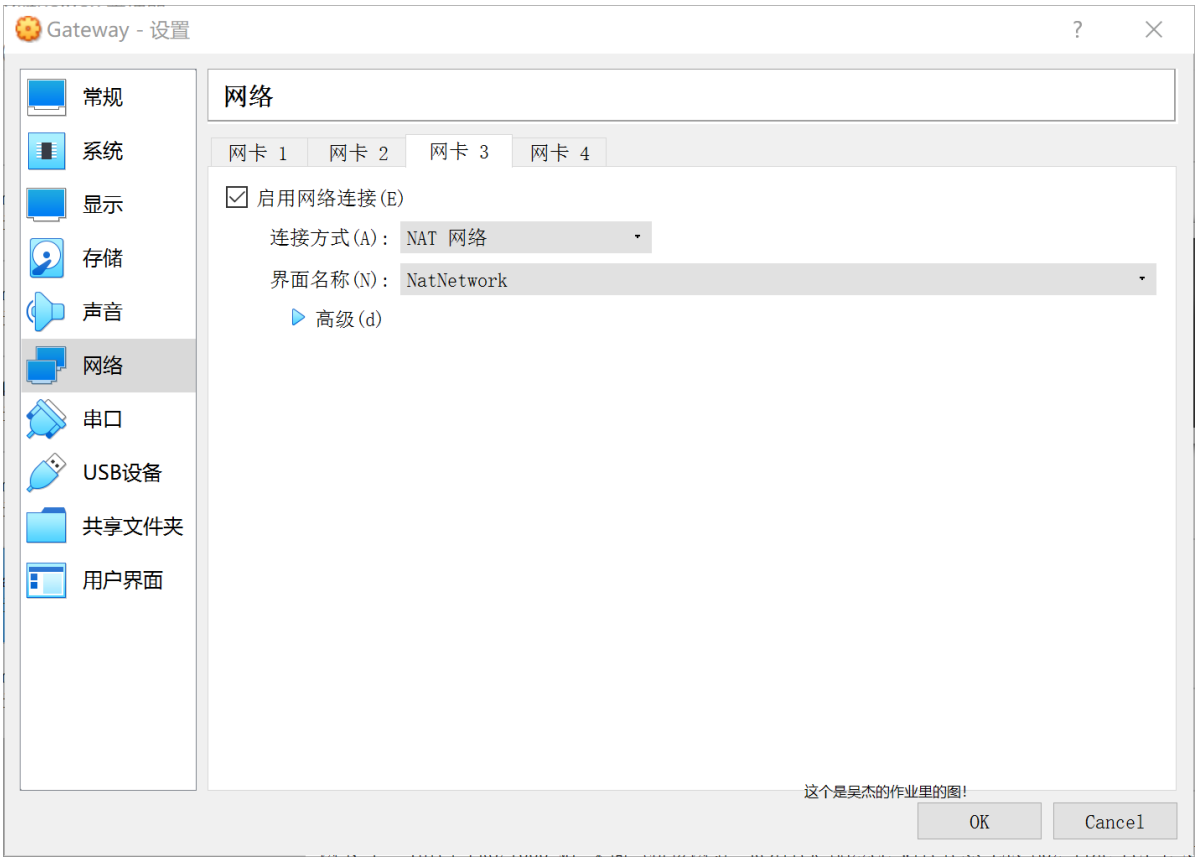


Figure 32: gw_natnetwork.png

6.5 添加DCHP服务 （但是似乎不需要）

现在已经创建了**内部网络1**、**内部网络2**与**NAT网络**。

但是**内部网络1**、**内部网络2**只是简单的虚拟交换机链接，并无DHCP服务器，因此需要添加。

执行以下命令，为**内部网络1**、**内部网络2**添加DCHP服务：

```
VBoxManage dhcpserver add --netname intnet1 --ip 192.168.59.1 --netmask 255.255.255.0 --lowerip 192.168.59.2 --upperip 192.168.59.100 --enable

VBoxManage dhcpserver add --netname intnet2 --ip 192.168.60.1 --netmask 255.255.255.0 --lowerip 192.168.60.2 --upperip 192.168.60.100 --enable
```

添加后使用`VBoxManage.exe list dhcpservers`命令查看结果：

```
D:\Program Files\Oracle\VirtualBox>VBoxManage.exe list dhcpservers
```

```
NetworkName:    HostInterfaceNetworking-VirtualBox Host-Only Ethernet Adapter
Dhcpd IP:       192.168.56.100
LowerIPAddress: 192.168.56.101
UpperIPAddress: 192.168.56.254
NetworkMask:    255.255.255.0
Enabled:        Yes
Global Configuration:
    minLeaseTime:     default
    defaultLeaseTime: default
    maxLeaseTime:     default
    Forced options:   None
    Suppressed opts.: None
        1/legacy: 255.255.255.0
Groups:               None
Individual Configs:   None

NetworkName:    NatNetwork
Dhcpd IP:       10.0.2.3
LowerIPAddress: 10.0.2.4
UpperIPAddress: 10.0.2.254
NetworkMask:    255.255.255.0
Enabled:        Yes
Global Configuration:
    minLeaseTime:     default
    defaultLeaseTime: default
    maxLeaseTime:     default
    Forced options:   None
    Suppressed opts.: None
        1/legacy: 255.255.255.0
        3/legacy: 192.168.41.1
        6/legacy: 172.16.228.9
Groups:               None
Individual Configs:   None

NetworkName:    intnet1
```

```
Dhcpd IP:       192.168.59.1
LowerIPAddress: 192.168.59.2
UpperIPAddress: 192.168.59.100
NetworkMask:    255.255.255.0
Enabled:        Yes
Global Configuration:
    minLeaseTime:     default
    defaultLeaseTime: default
    maxLeaseTime:     default
    Forced options:   None
    Suppressed opts.: None
        1/legacy: 255.255.255.0
Groups:               None
Individual Configs:   None

NetworkName:    intnet2
Dhcpd IP:       192.168.60.1
LowerIPAddress: 192.168.60.2
UpperIPAddress: 192.168.60.100
NetworkMask:    255.255.255.0
Enabled:        Yes
Global Configuration:
    minLeaseTime:     default
    defaultLeaseTime: default
    maxLeaseTime:     default
    Forced options:   None
    Suppressed opts.: None
        1/legacy: 255.255.255.0
Groups:               None
Individual Configs:   None
```

可以看到，内部网络已经成功添加DHCP服务器，但Nat网络（NatNetwork）的DCHP服务器其实是Vbox的NAT模式自带的那个DHCP服务器，这样重名可能会有一些问题，所以修改一下自己新建的服务器名称和IP：

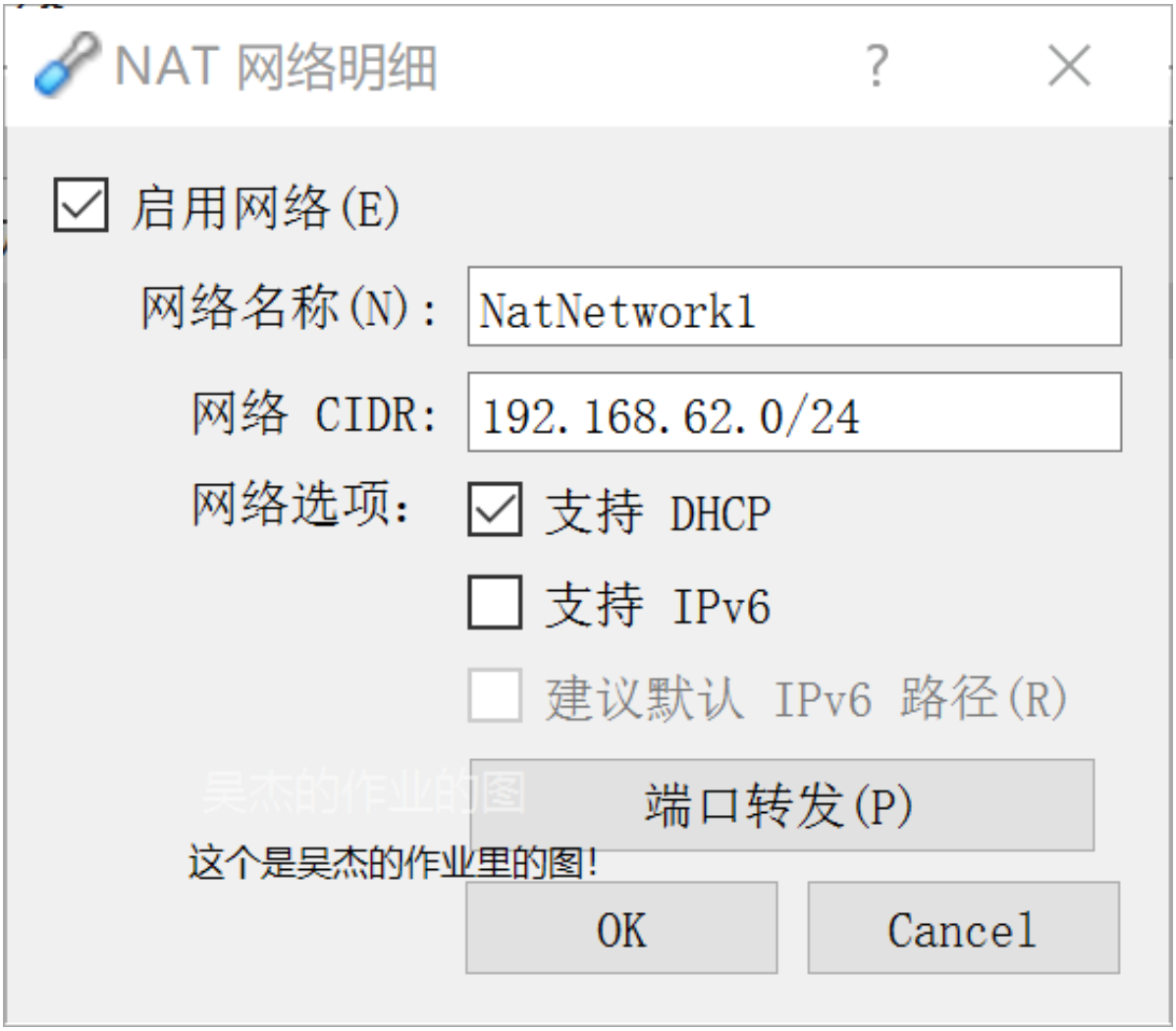


Figure 33: modify_natnetwork.png

随后运行命令，添加DHCP服务器：

```
VBoxManage dhcpserver add --netname NatNetwork1 --ip 192.168.61.1 --
netmask 255.255.255.0 --lowerip 192.168.61.2 --upperip 192.168.61.100 --enable
```

添加结果：

```
NetworkName:    NatNetwork1
Dhcpd IP:       192.168.62.3
LowerIPAddress: 192.168.62.4
UpperIPAddress: 192.168.62.254
NetworkMask:    255.255.255.0
```

```
Enabled:        Yes
Global Configuration:
    minLeaseTime:     default
    defaultLeaseTime: default
    maxLeaseTime:     default
    Forced options:   None
    Suppressed opts.: None
        1/legacy: 255.255.255.0
        3/legacy: 192.168.62.1
        6/legacy: 172.16.228.9
Groups:               None
Individual Configs:   None
```

但是进系统之后发现**网卡3、网卡4**的IP是无法DHCP获取的，估计是**网关**系统里写成静态的了，所以调换一下顺序，**网卡3**和**网卡4**分别给**内部网络1**和**内部网络2**，这样**NAT网卡**就能正确DHCP、上网了。

如下图：

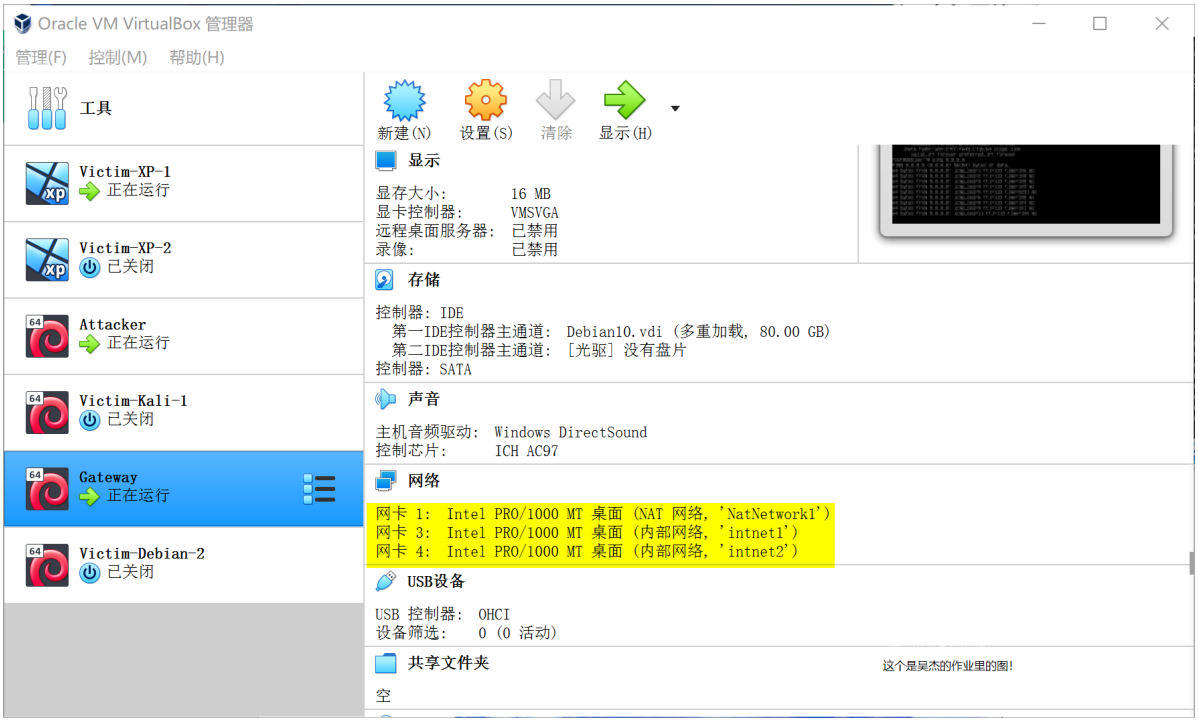


Figure 34: modify_gw_interface.png

随后把之前添加的DHCP删除：

```
D:\Program Files\Oracle\VirtualBox>VBoxManage.exe dhcpserver remove --network=intnet1

D:\Program Files\Oracle\VirtualBox>VBoxManage.exe dhcpserver remove --network=intnet2
```

Figure 35: remove_dhcp_servers.png

完成后进入XP1：

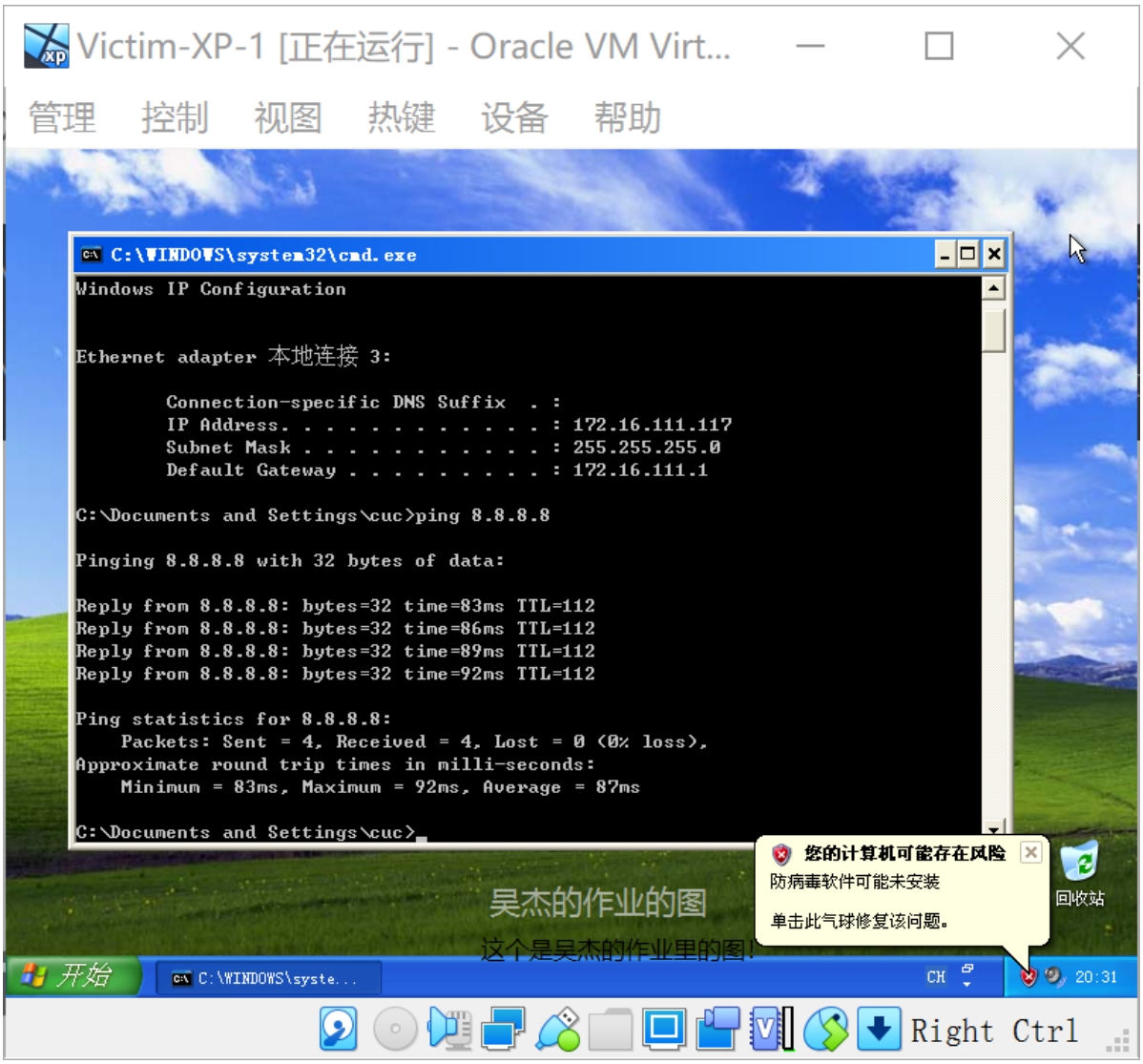


Figure 36: xp1_cmd_dhcp.png

可以看到已经获取到ip，并且也可以上网了，所以应该是这个网关是有dhcpd的。

7 网络测试

7.1 靶机可以直接访问攻击者主机

7.1.1 XP1

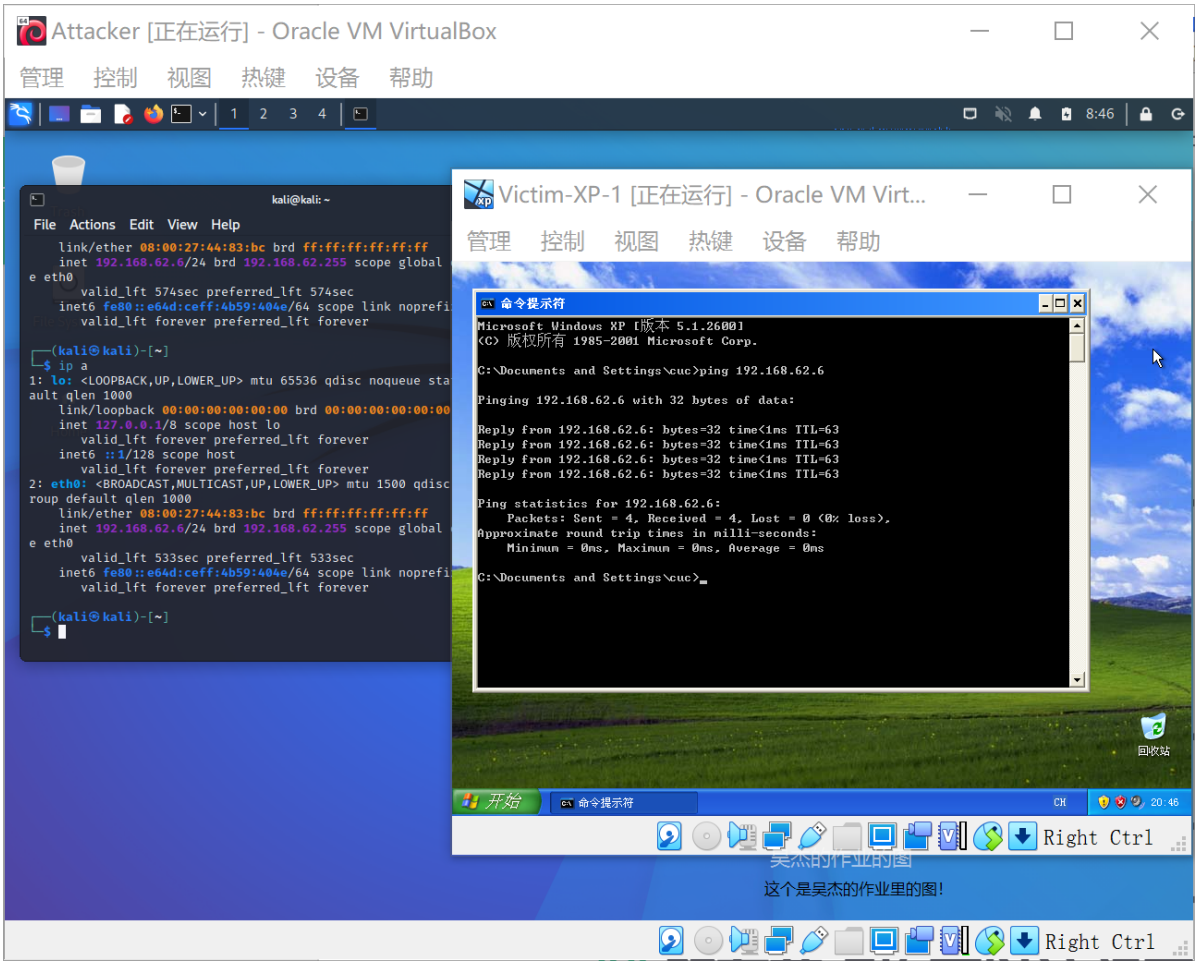


Figure 37: xp1_ping_attacker.png

7.1.2 Kali1

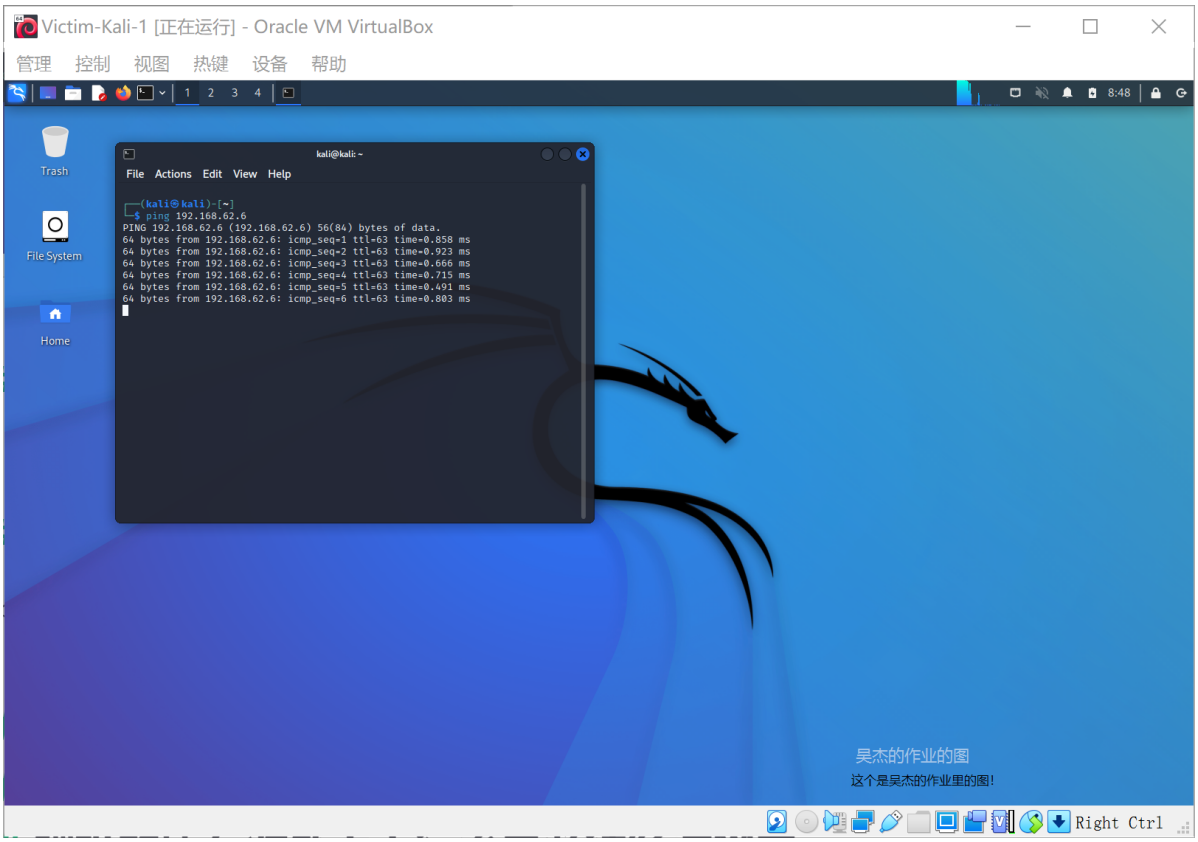


Figure 38: kali1_ping_attacker.png

7.1.3 XP2

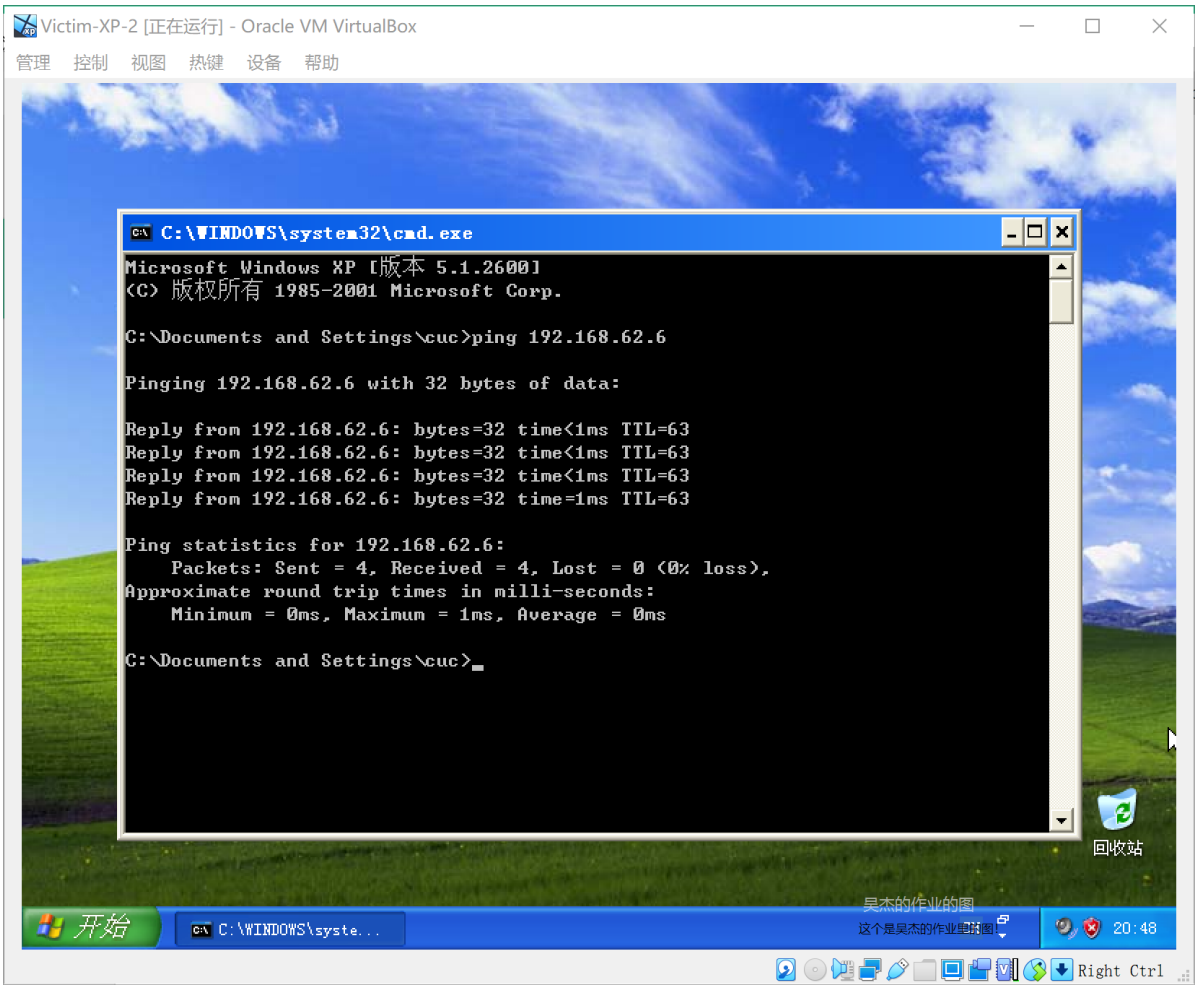


Figure 39: xp2_ping_attacker.png

7.1.4 Debian2

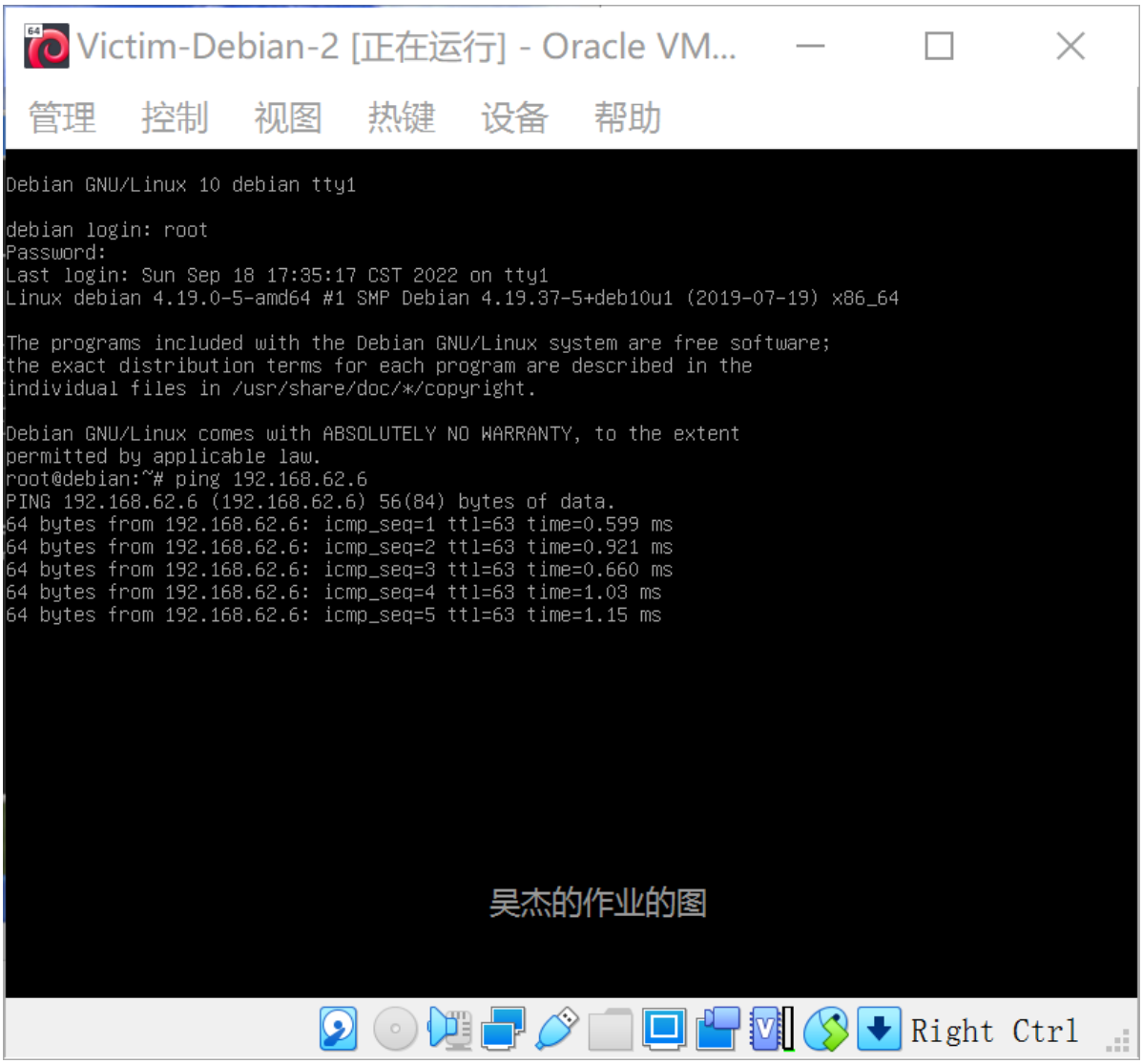


Figure 40: debian2_ping_attacker.png

7.2 攻击者主机无法直接访问靶机

7.2.1 XP1

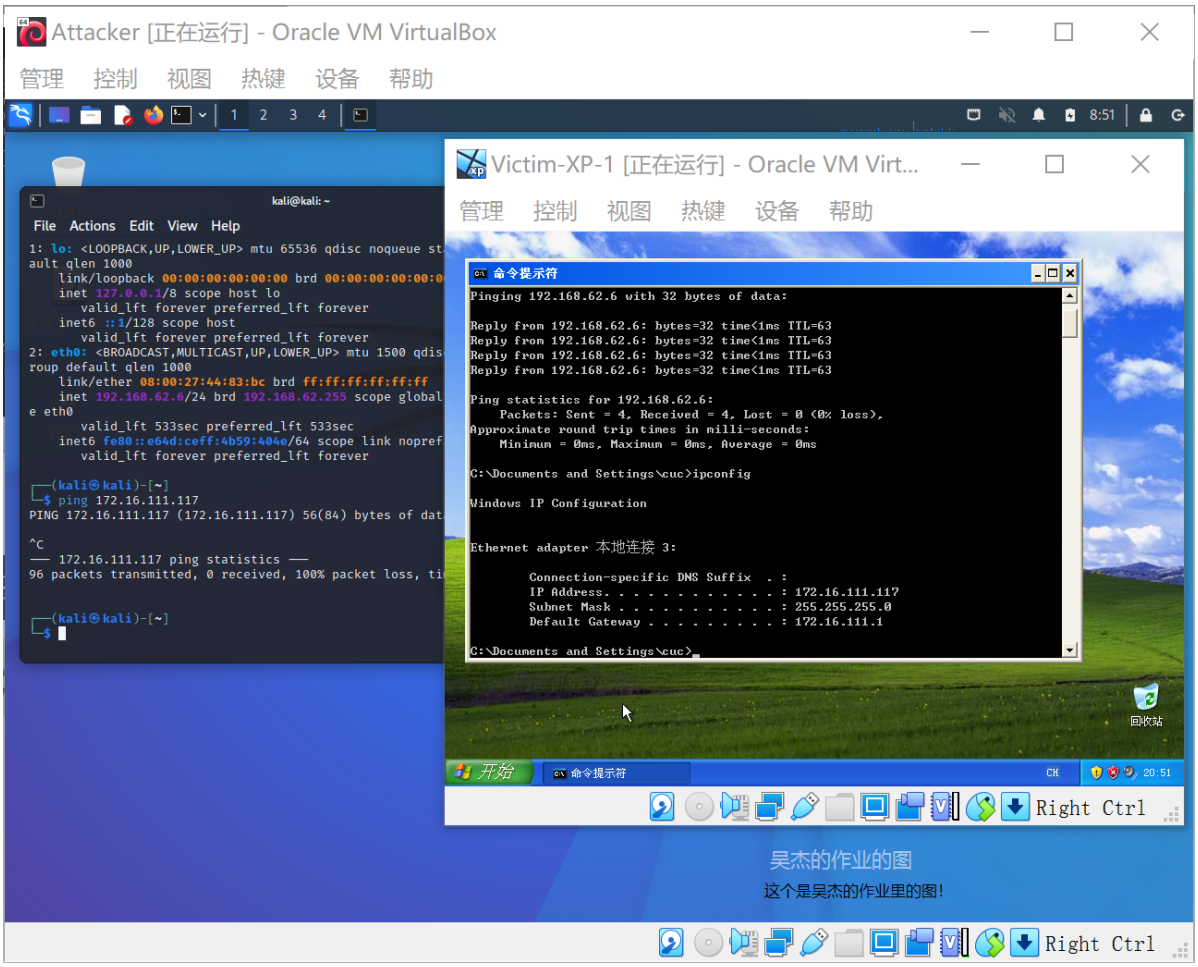


Figure 41: attacker_ping_xp1.png

7.2.2 XP2

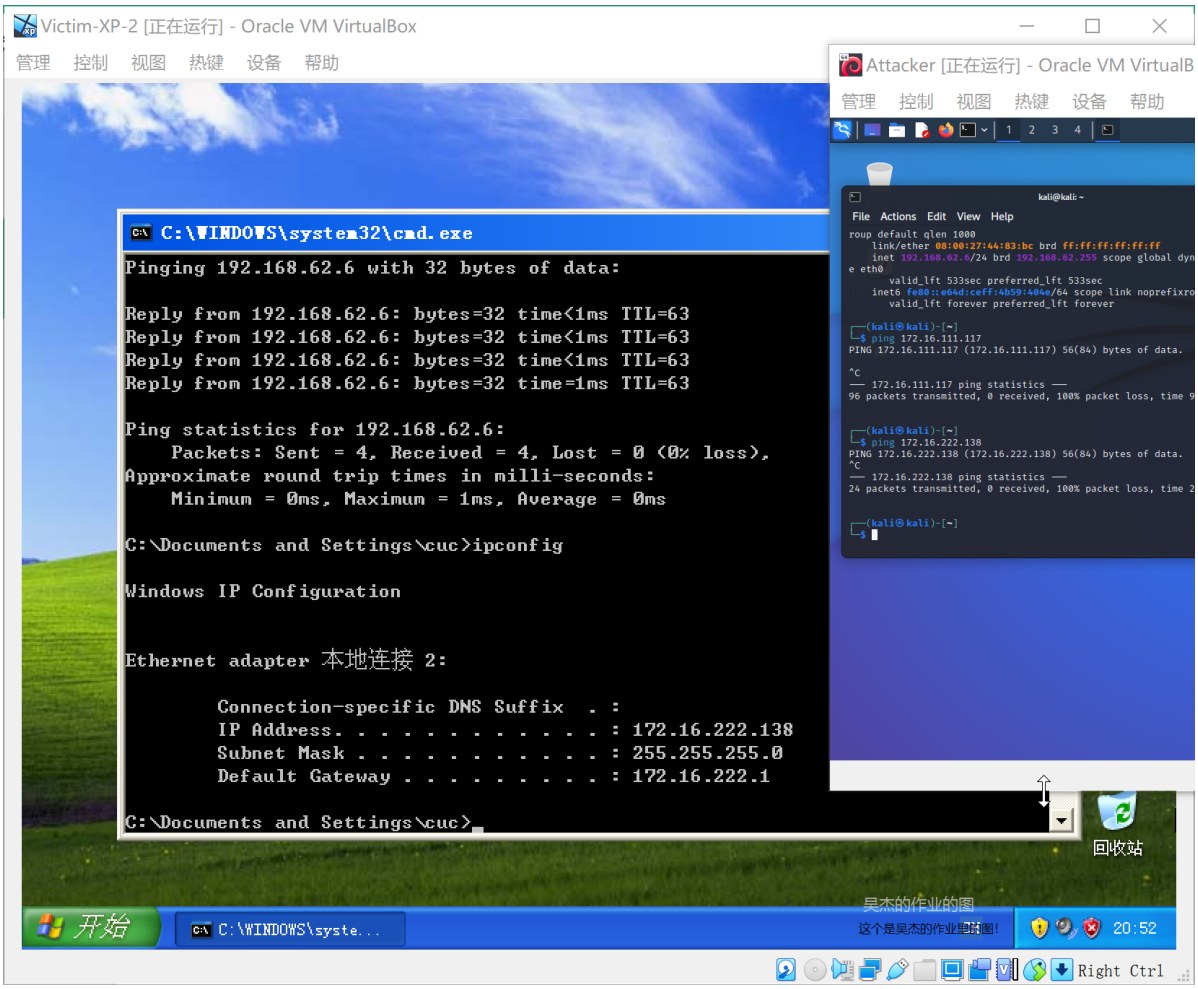


Figure 42: attacker_ping_xp2.png

7.3 网关可以直接访问攻击者主机和靶机

7.3.1 攻击者主机

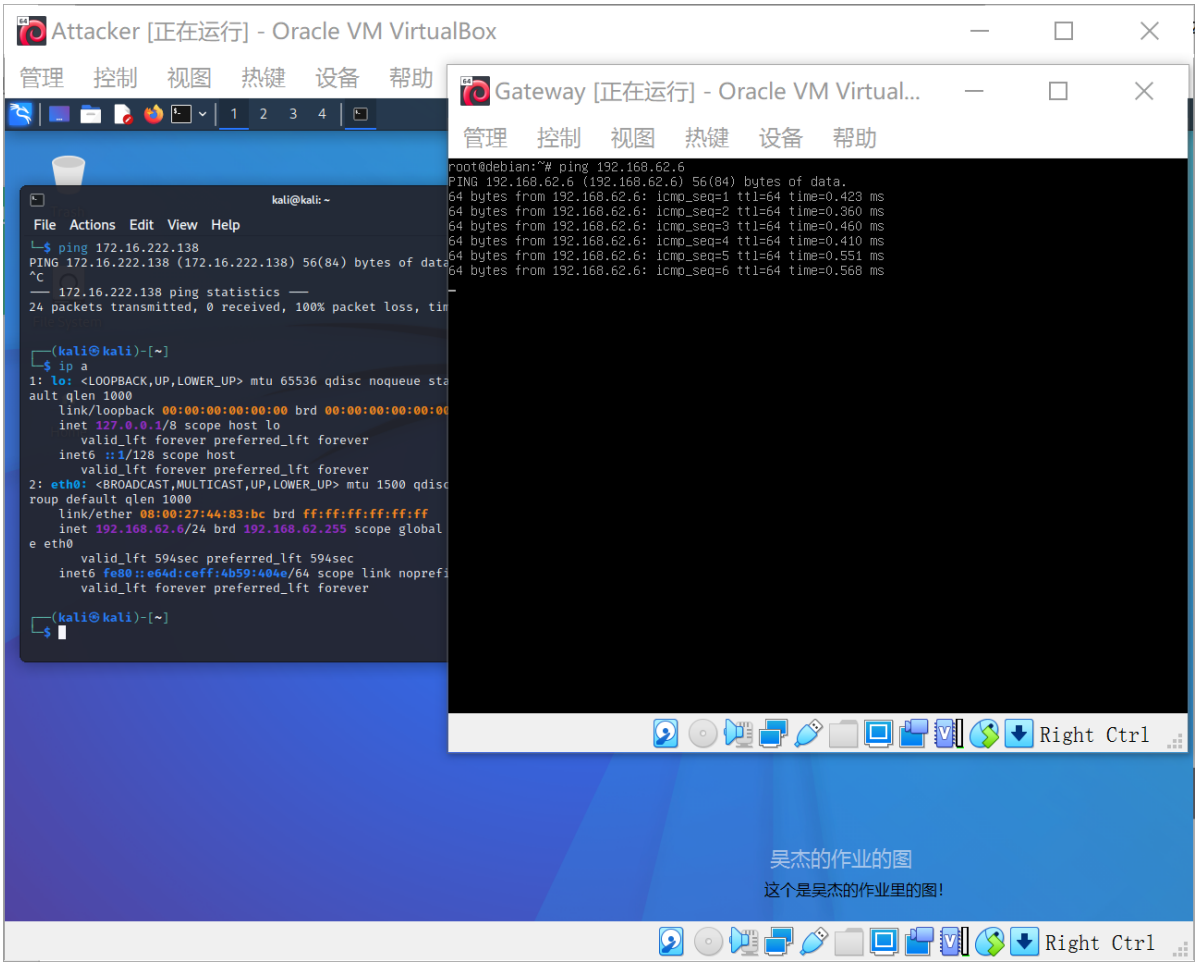


Figure 43: gw_ping_attacker.png

7.3.2 XP1

需要先关闭XP防火墙才能PING:

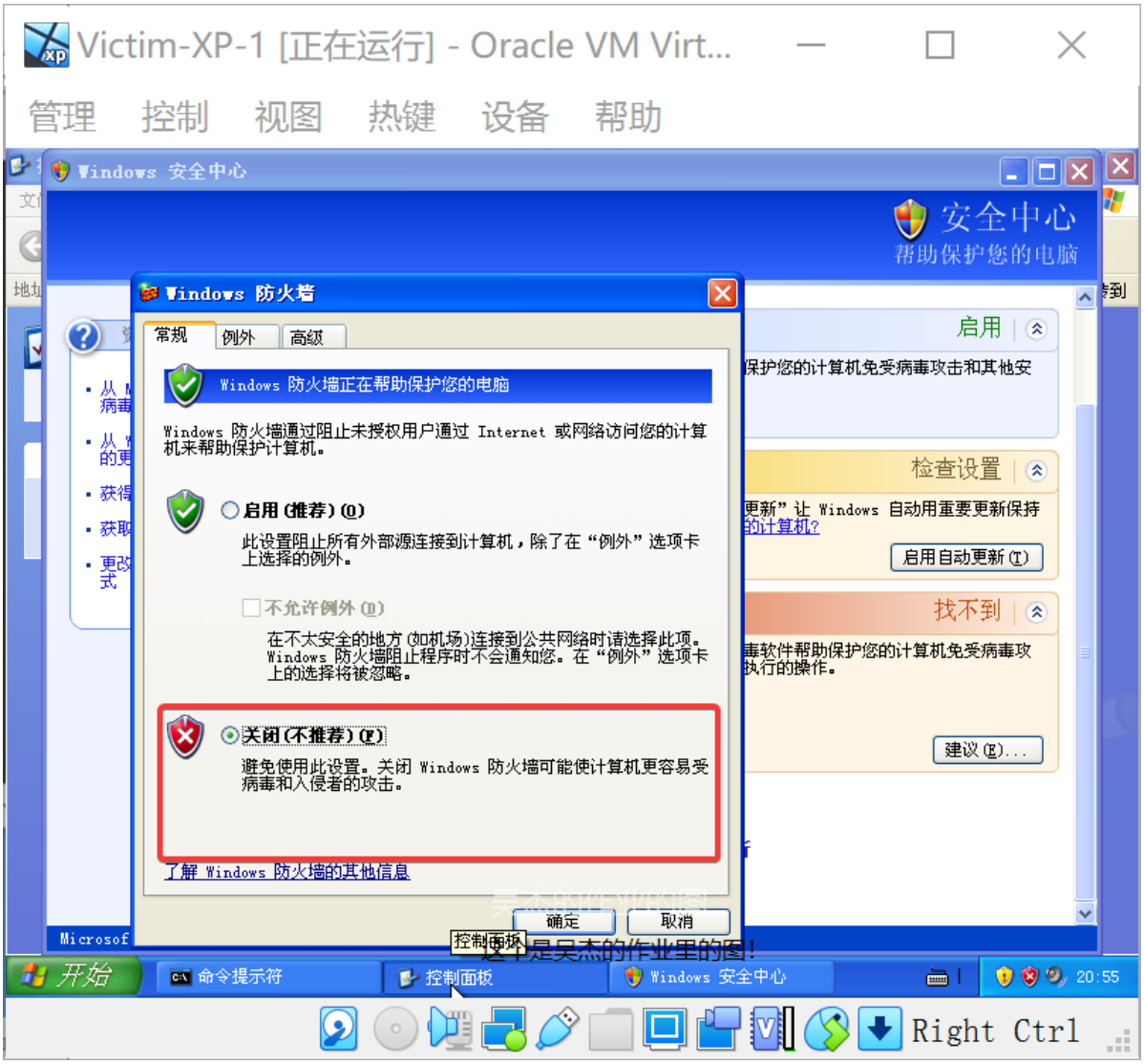


Figure 44: disable_xp1_firewall.png

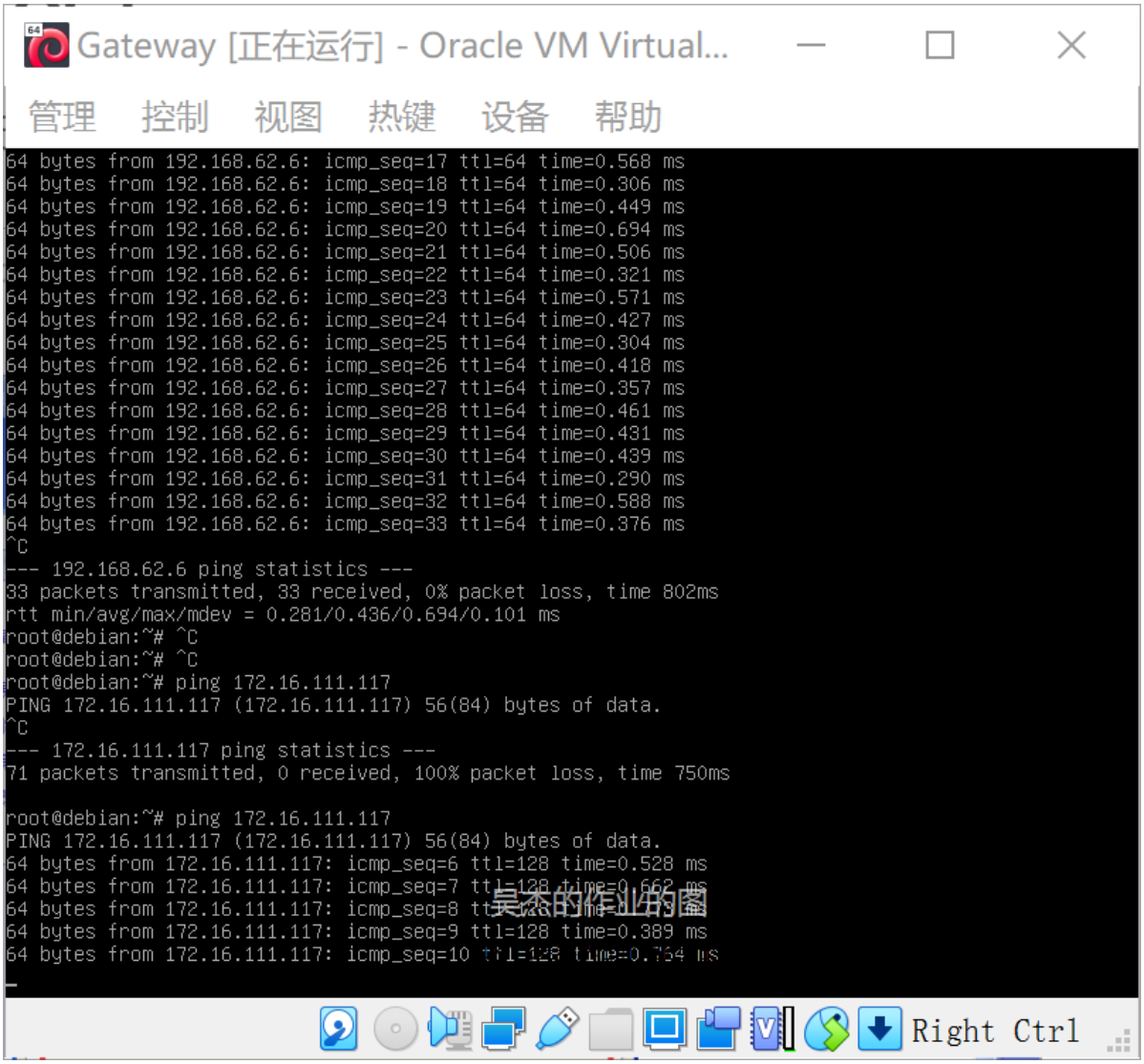


Figure 45: gw_ping_xp1.png

7.4 靶机的所有对外上下行流量必须经过网关

以**XP1**为例子，尝试ping `baidu.com`:

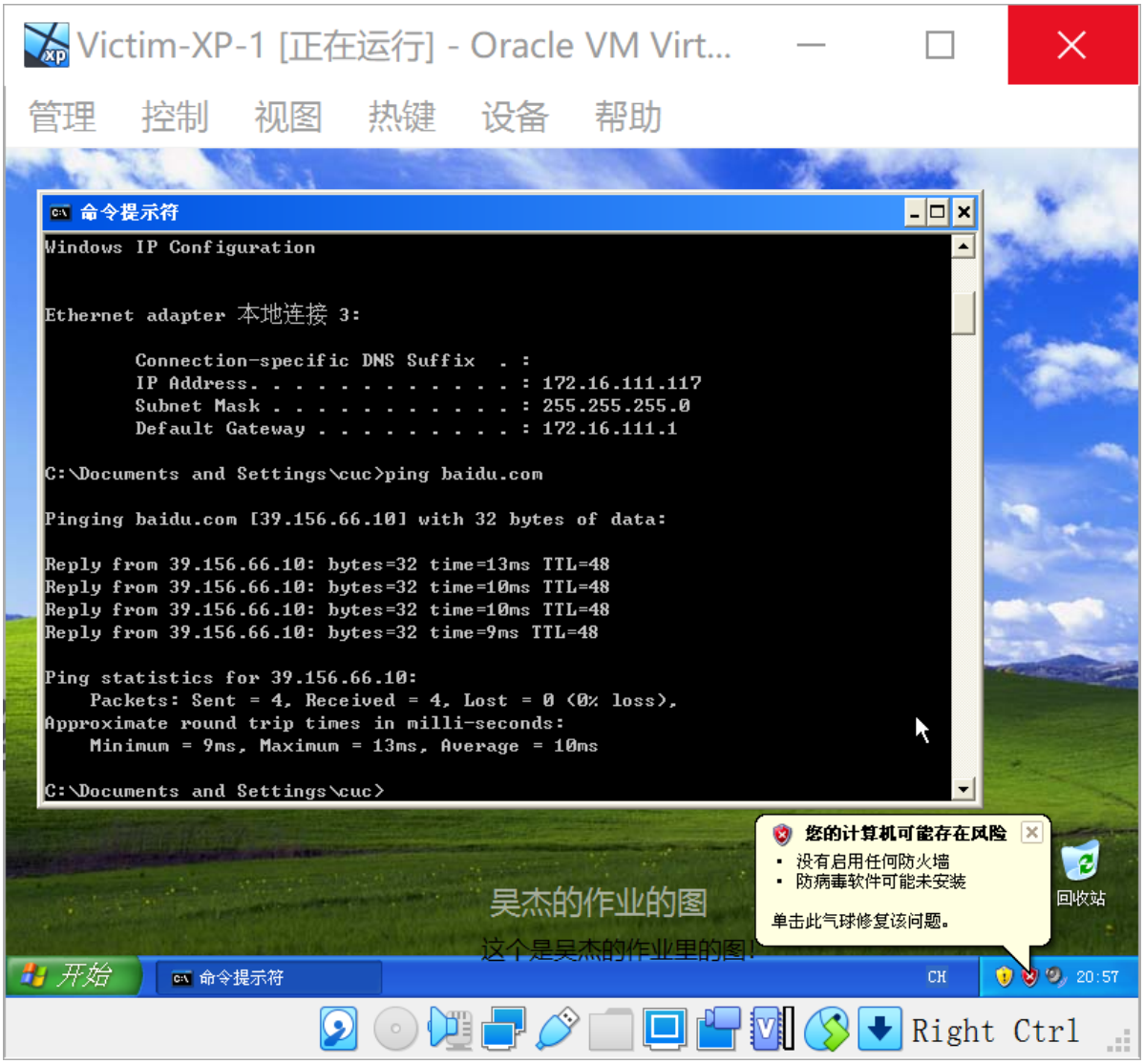


Figure 46: xp1_ping_baidu_with_gw.png

在网关上进行抓包:

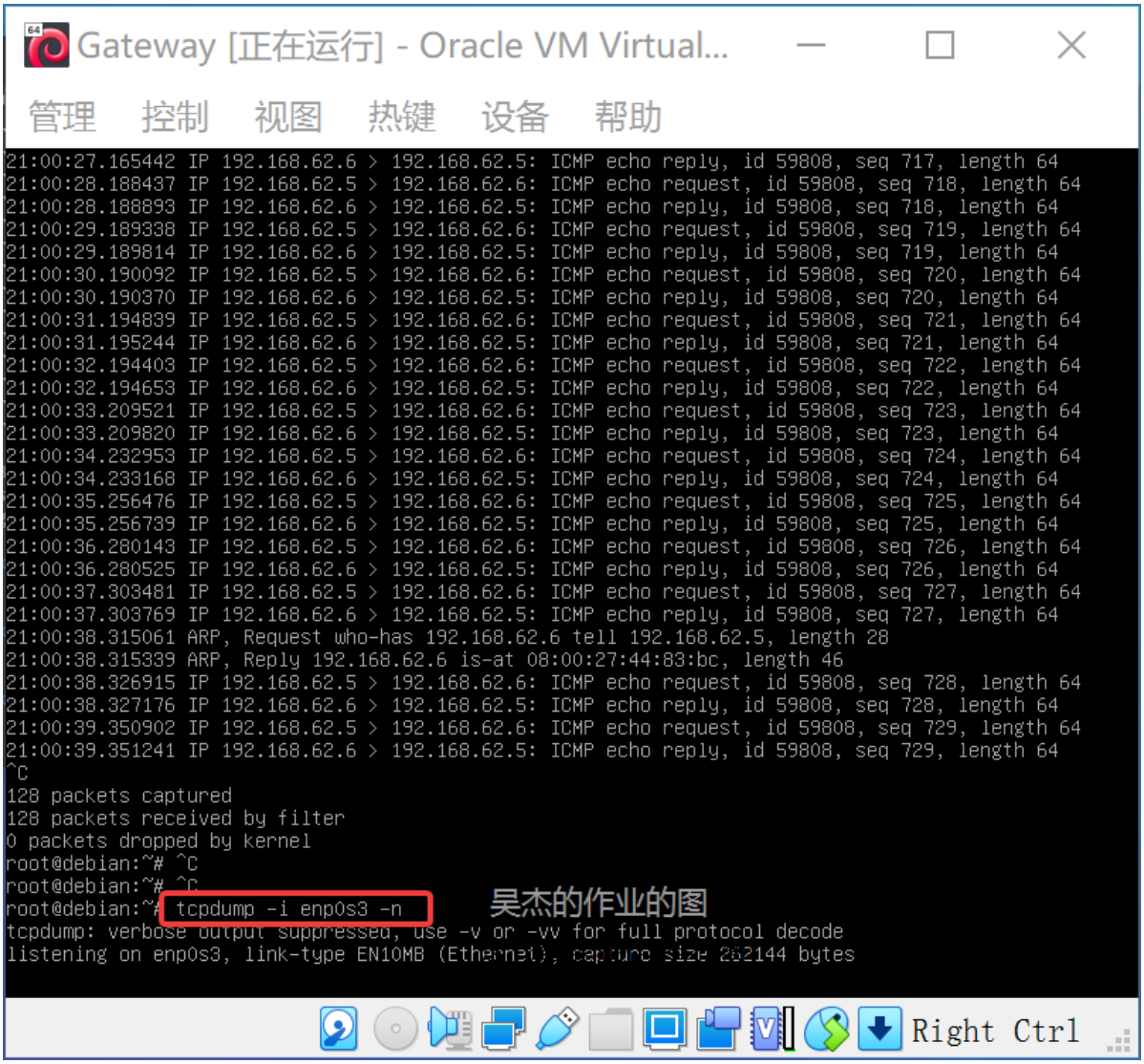


Figure 47: tcpdump_on.png

随后再次进行ping，可以看到`tcpdump`的结果：

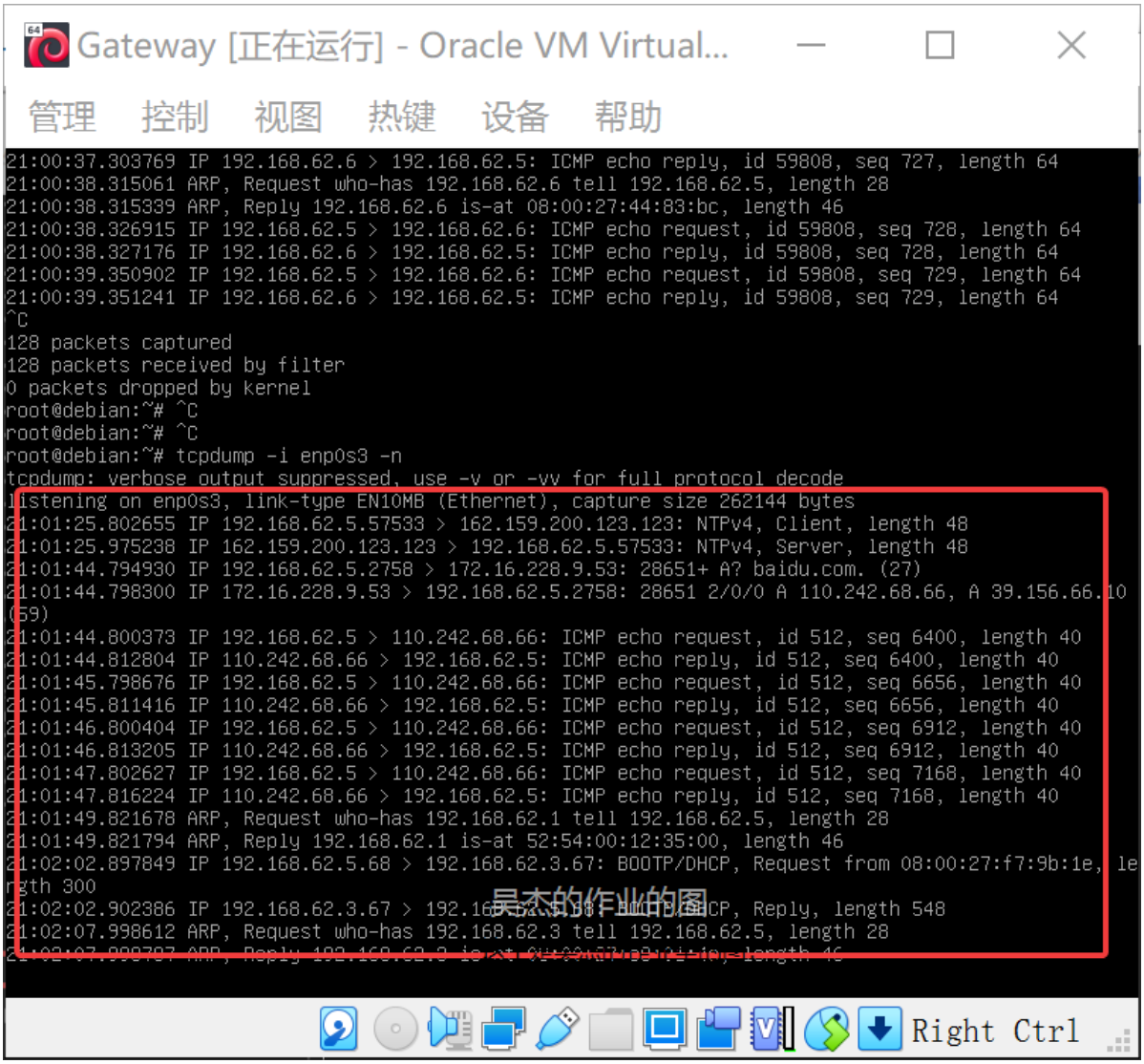


Figure 48: tcpdump_result.png

与ping `baidu.com`的包一致，说明经过网关。

7.5 所有节点均可以访问互联网

7.5.1 攻击者

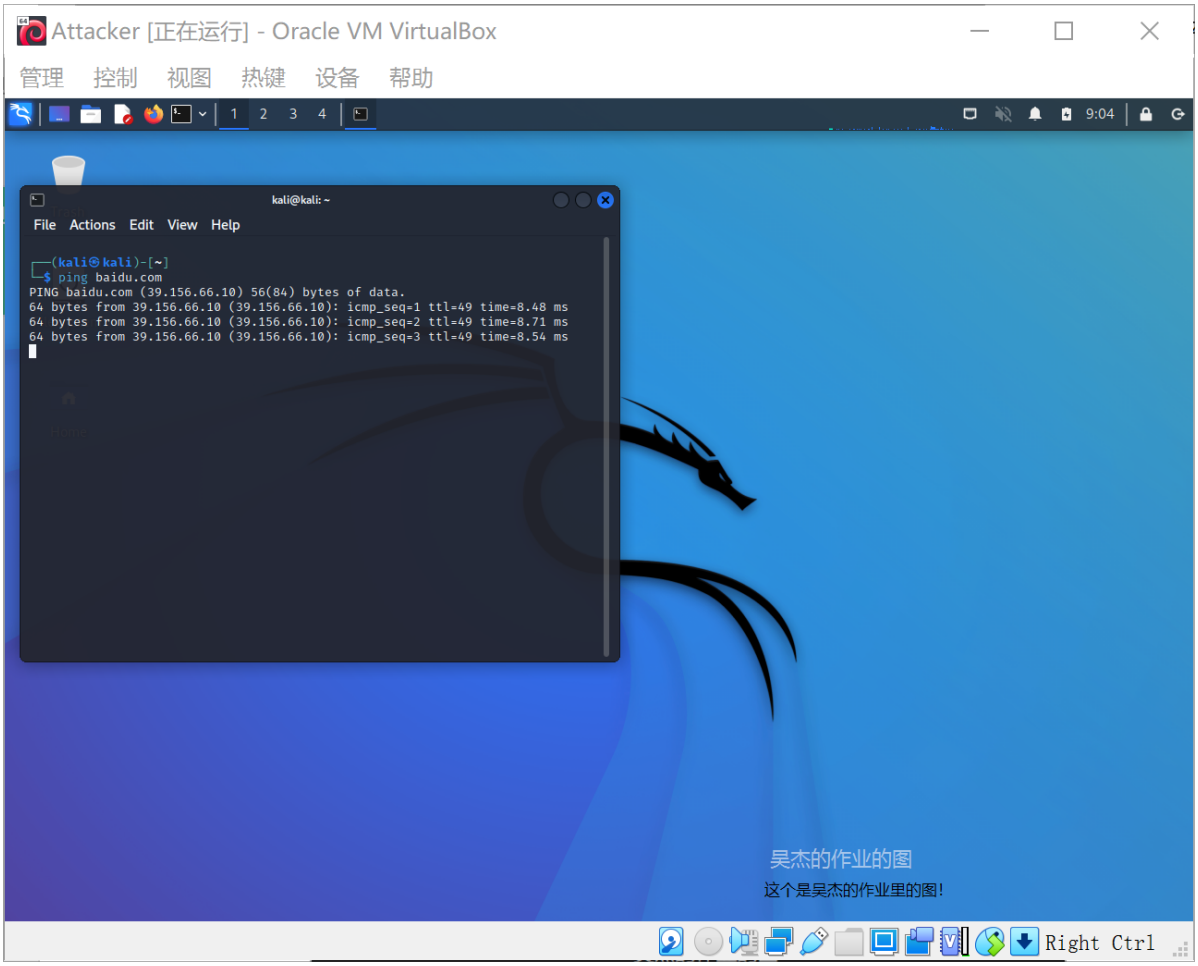


Figure 49: attacker_baidu.png

7.5.2 网关

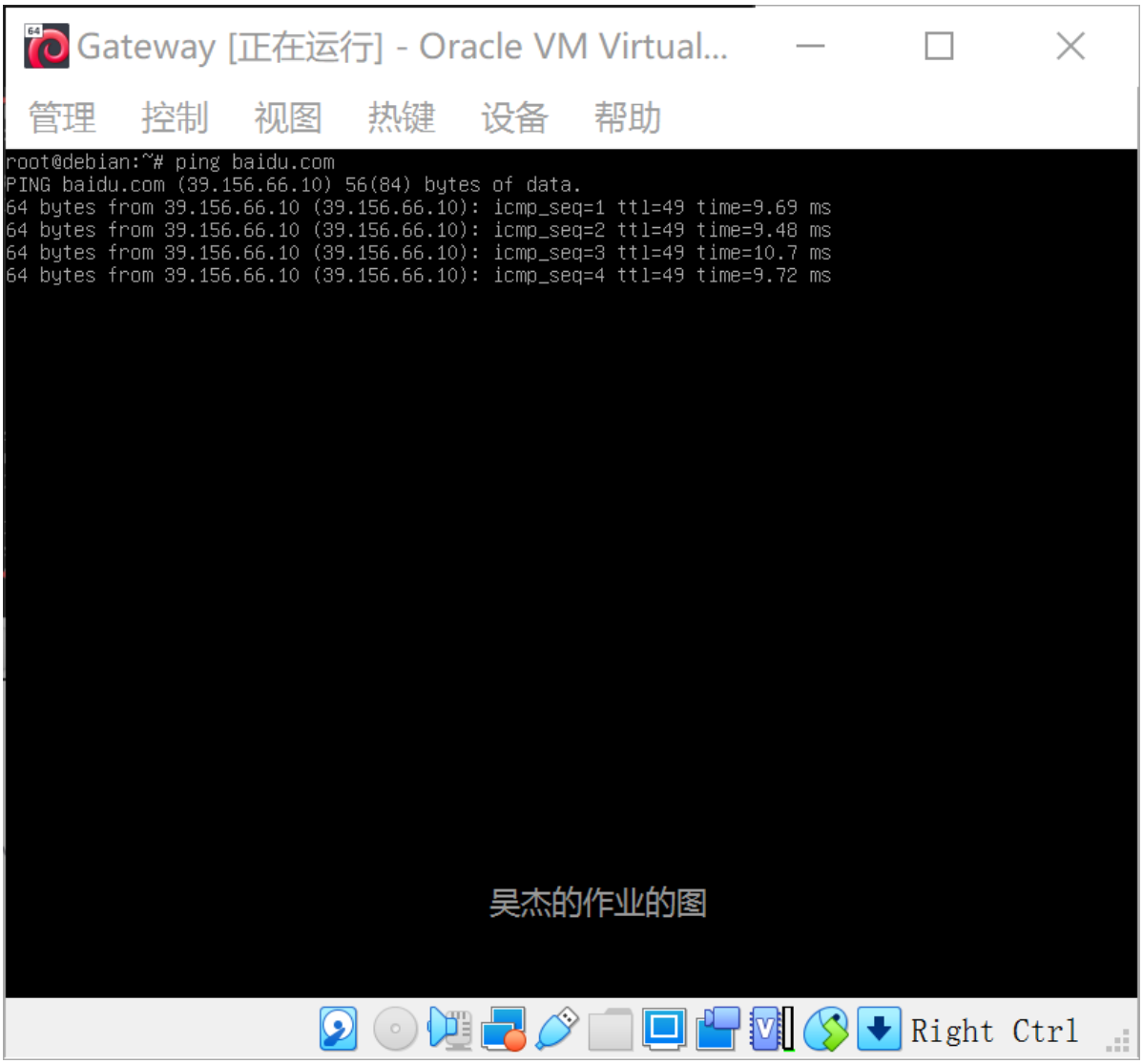


Figure 50: gw_baidu.png

7.5.3 XP1

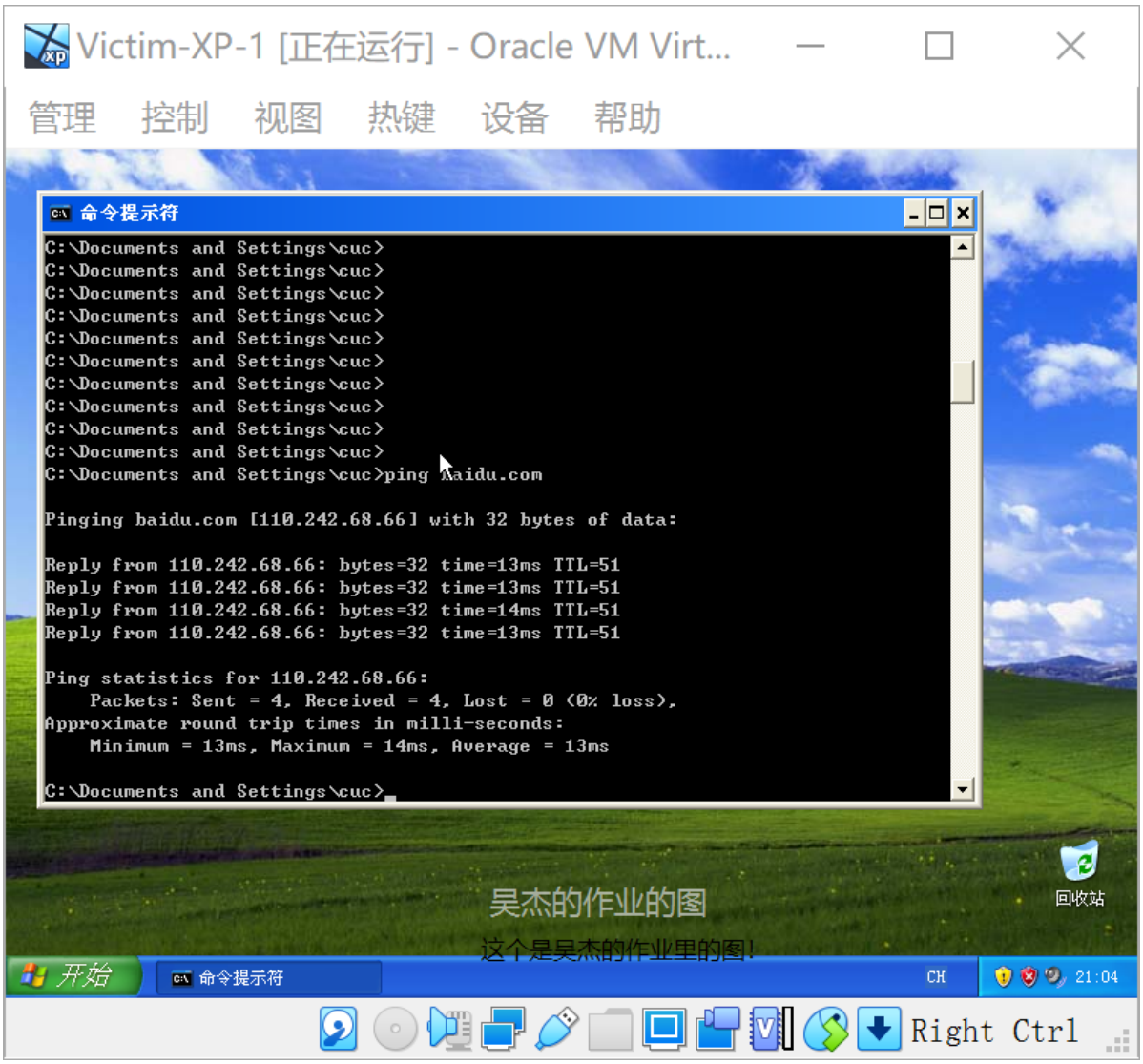


Figure 51: xp1_baidu.png

7.5.4 Kali1

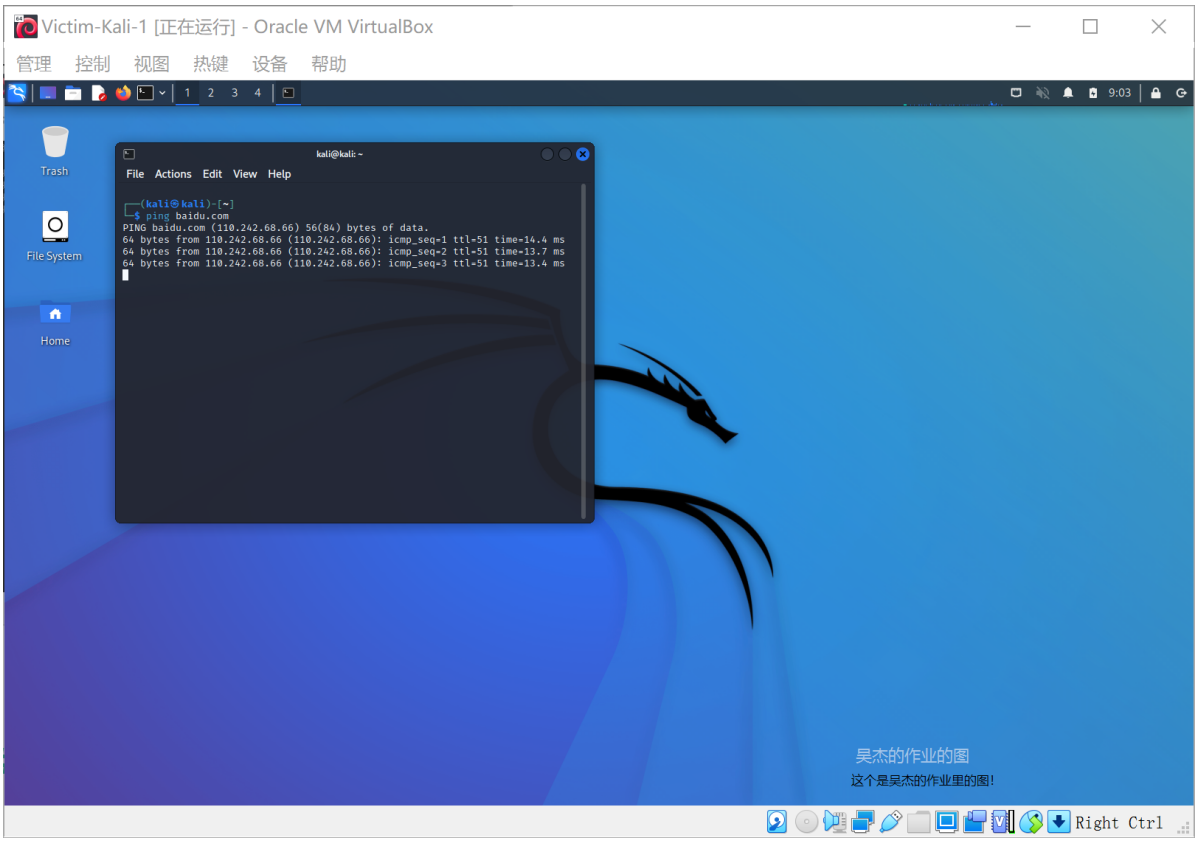


Figure 52: kali1_baidu.png

7.5.5 XP2

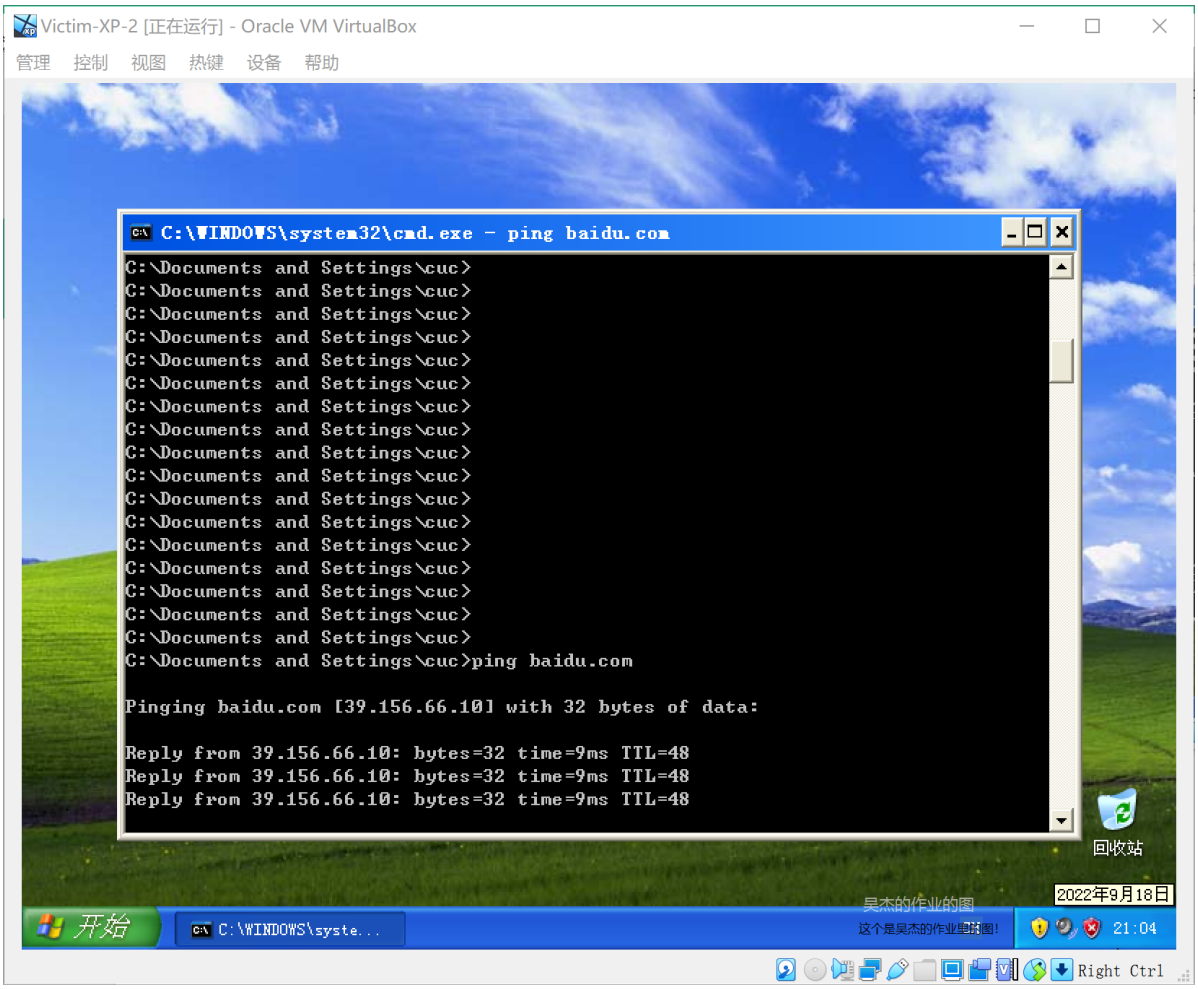


Figure 53: xp2_baidu.png

7.5.6 Debian2

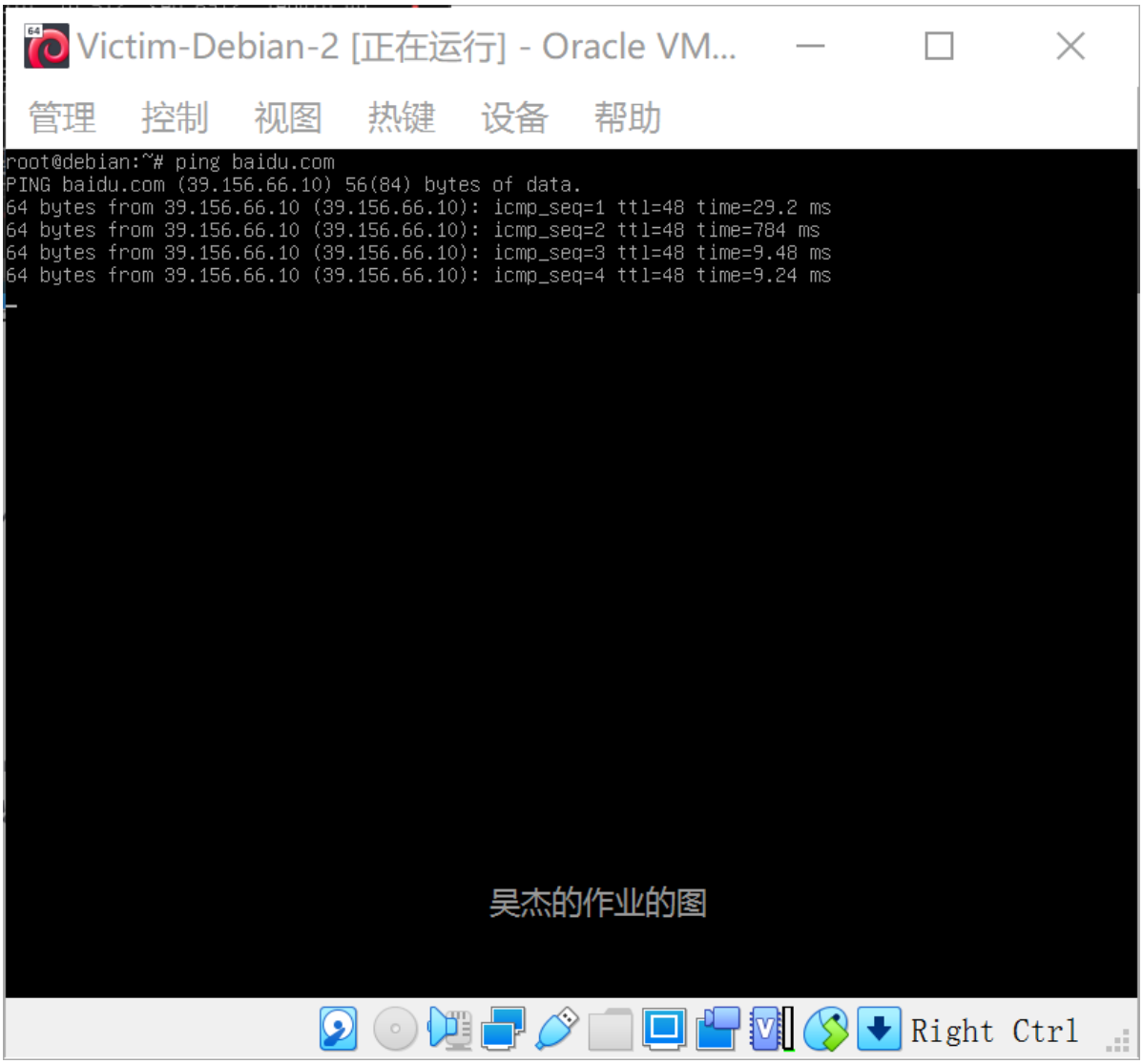


Figure 54: debian2_baidu.png