管理虚拟网络

概述

- Linux网桥基本概念
- qemu-kvm支持的网络
- 向虚拟机添加虚拟网络连接
- 虚拟网络配置
  - 基于NAT的虚拟网络
  - 基于网桥的虚拟网络
  - 用户自定义的隔离的虚拟网络
- 多物理网卡绑定
- 配置VLAN
- 通过网络过滤提高安全性

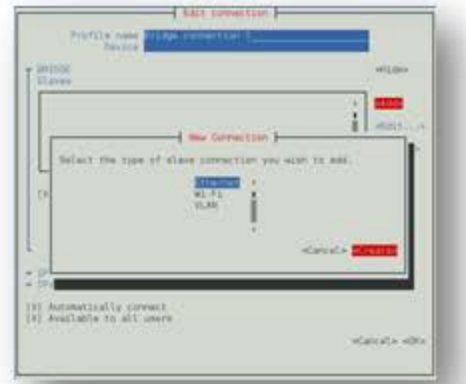
Linux网桥基本概念

- 数据链路的设备，基于MAC地址进行转发
- Redhat/CentOS配置网桥常用方法：
  - 命令行修改网络脚本文件（推荐）
  - Network Manager
    - nmtui：NetworkManager的文本用户接口
    - nmcli：NetworkManager的命令行工具

```
# nmcli con add type bridge ifname br0
Connection 'bridge-br0' (6ad5bba6-98a0-4f20-839d-c997ba7668ad) successfully added.

# nmcli con show
NAME        UUID                                  TYPE            DEVICE
bridge-br0  79cf6a3e-0310-4a78-b759-bda1cc3eef8d  bridge          br0
eth0        4d5c449a-a6c5-451c-8206-3c9a4ec88bca  802-3-ethernet  eth0
```

  - 图形界面管理工具
  - 使用命令行的brctl



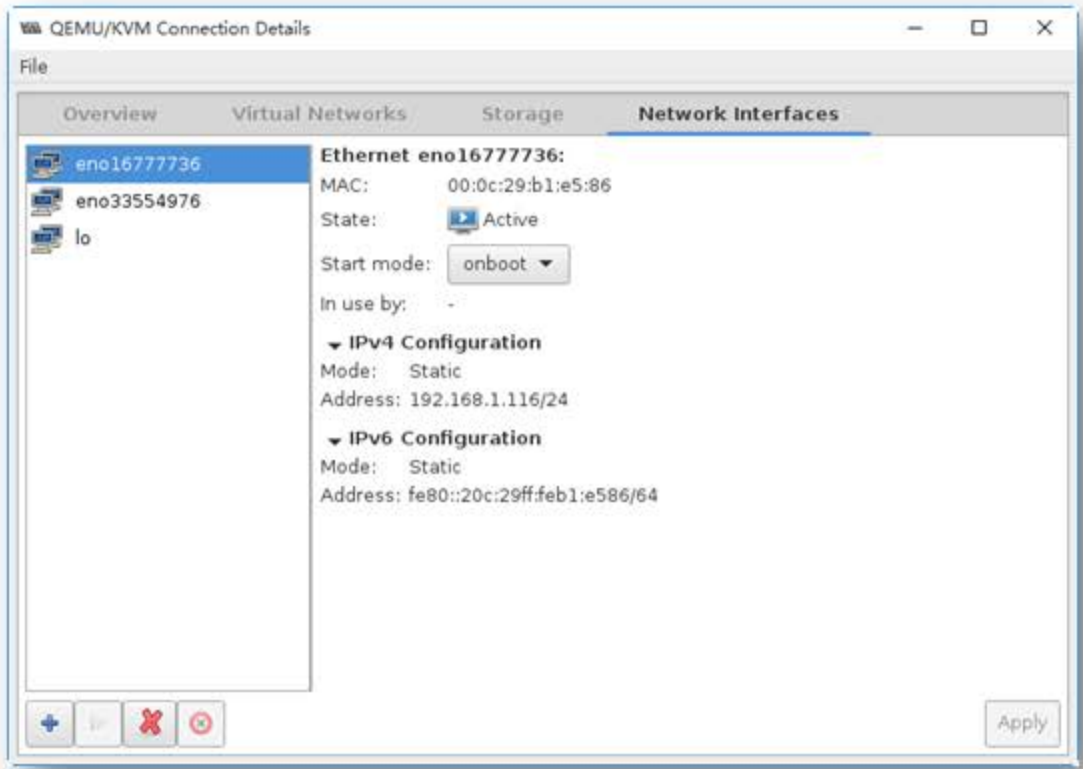
qemu-kvm支持的网络

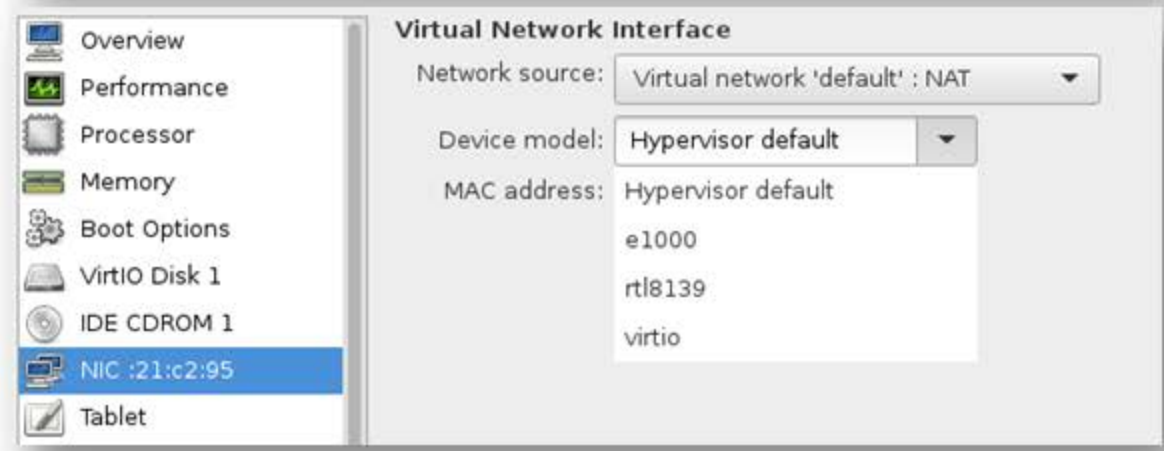
- 虚拟机的网络模式：
  - 基于NAT（Network Addresss Translation）的虚拟网络
  - 基于网桥（Bridge）的虚拟网络
  - 用户自定义的隔离的虚拟网络
  - 直接分配网络设备（包括VT-d和SR-IOV）
- 虚拟机的网卡：
  - RTL8139、e1000、....
  - virtio

```
# /usr/libexec/qemu-kvm -net nic,model=?
qemu: Supported NIC models:
ne2k_pci,i82551,i82557b,i82559er,rtl8139,e1000,pcnet,virtio
```

演示：考察默认的虚拟网络的配置

- 查看宿主机的网络配置
- 查看虚拟机的网络配置

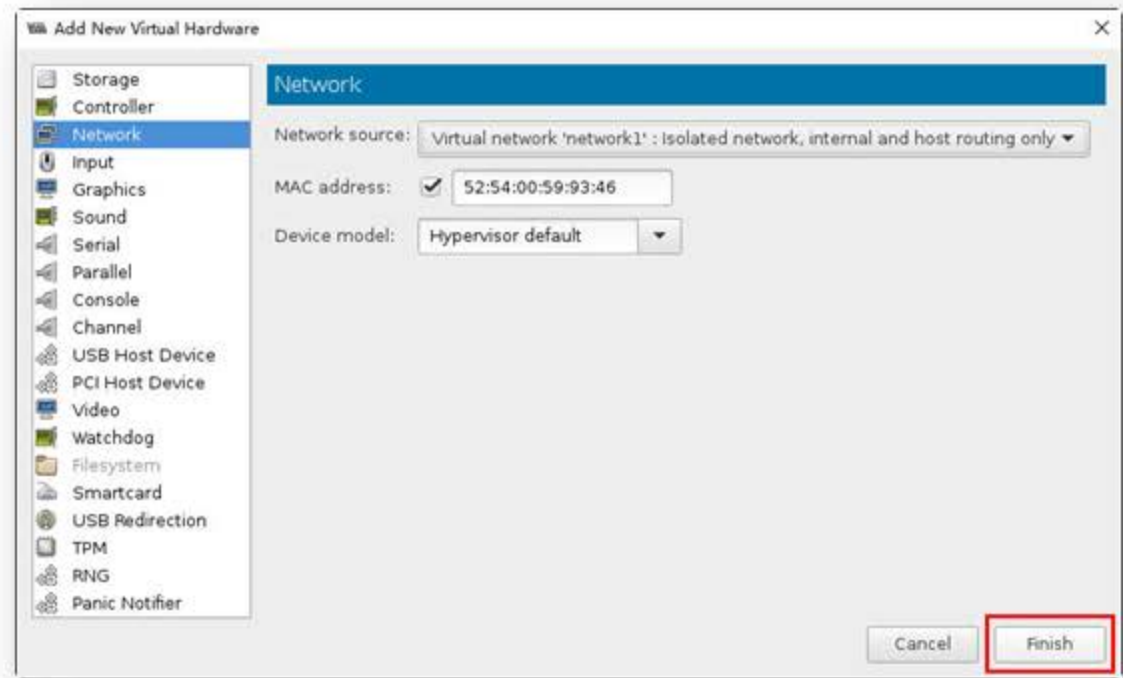




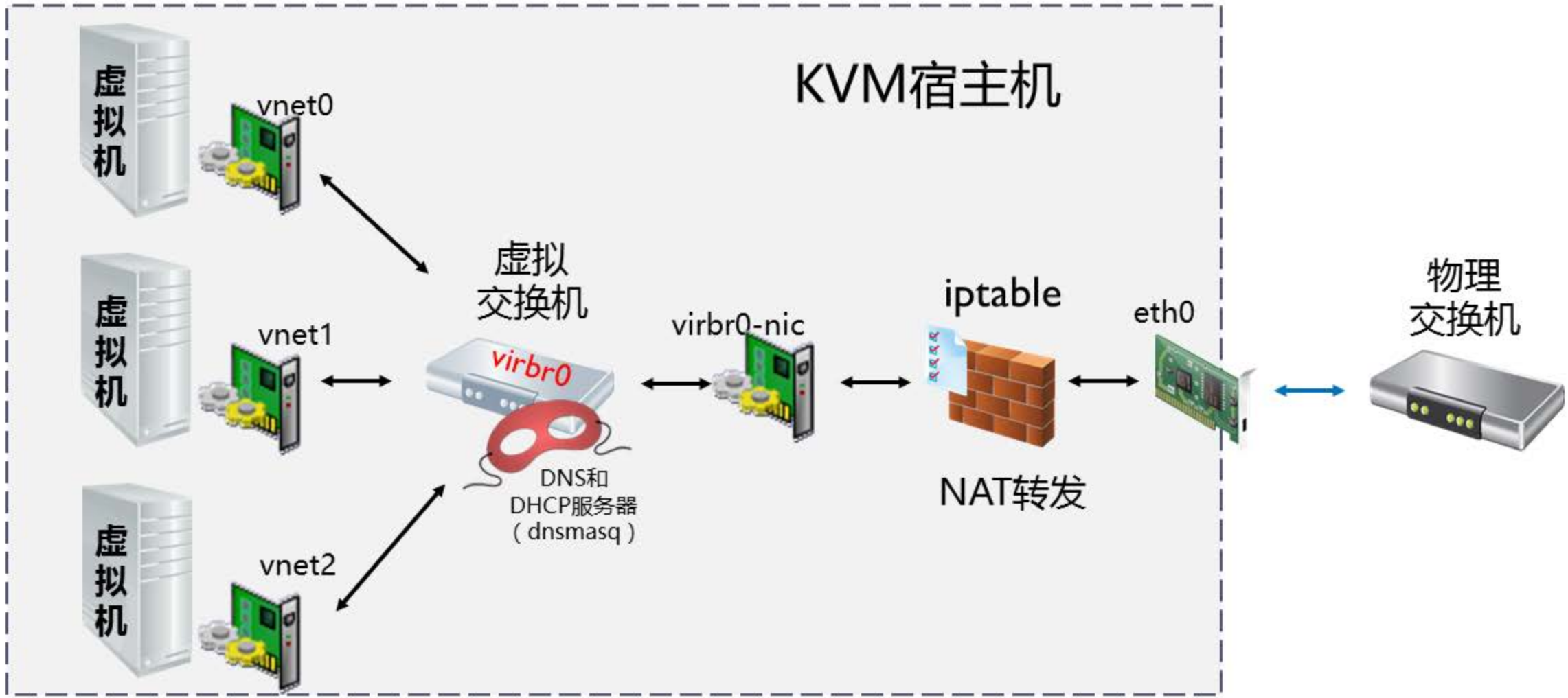
向虚拟机添加虚拟机网络

```
<interface type='network'>
  <mac address='52:54:00:59:93:46'/>
  <source network='network1'/>
  <model type='rtl8139'/>
  <address type='pci' domain='0x0000' bus='0x00' slot='0x08' function='0x0'/>
</interface>
```

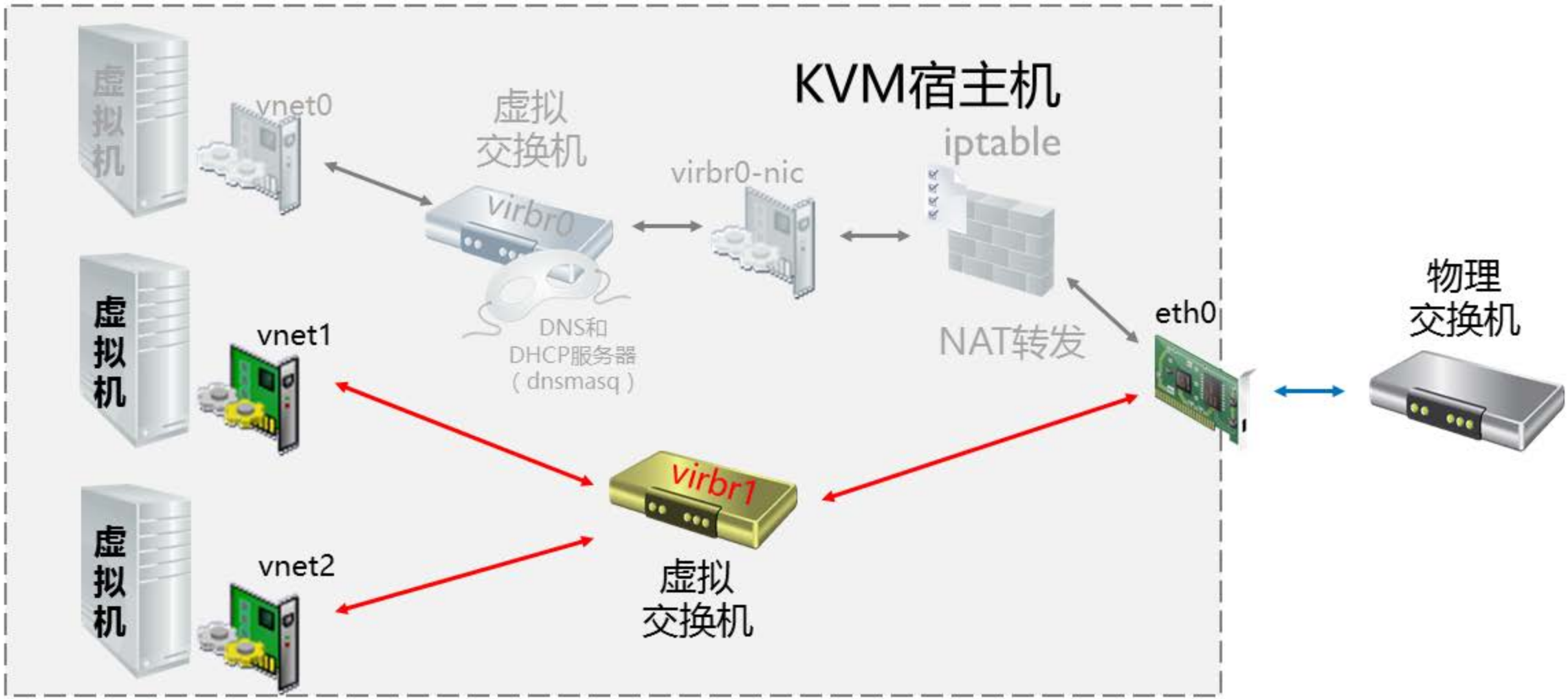
```
virsh # domiflist crm
virsh # domifaddr crm
virsh # domif-getlink crm vnet5
virsh # domifstat crm vnet5
```



KVM安装时默认的网络配置-NAT模式



增加桥接连接模式



通过virsh更改虚拟网卡的连接

1. 原虚拟机的配置如下

```
<interface type='bridge'>
      <mac address='52:54:00:4a:c9:5e'/>
      <source bridge='virbr0'/>
      <model type='virtio'/>
</interface>
```

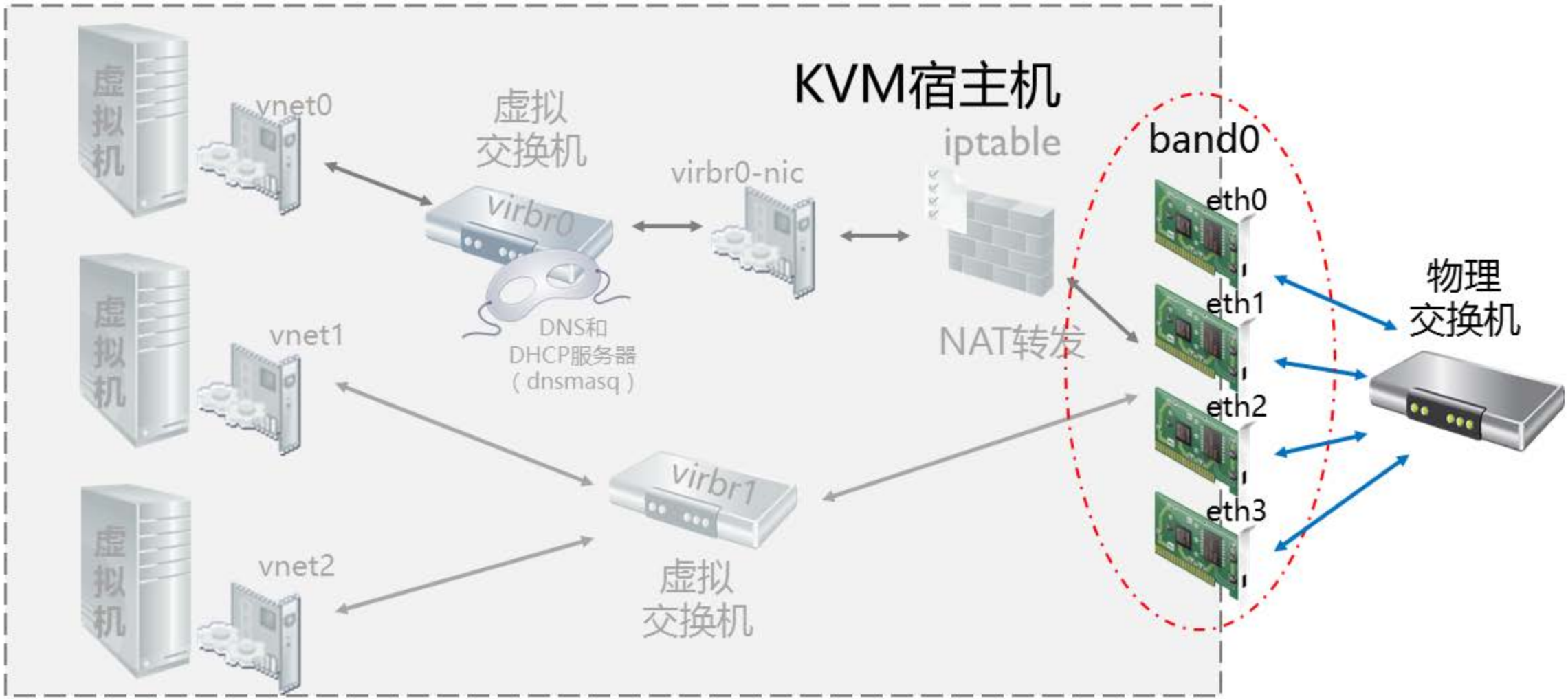
2. 准备更新用户的XML文件

```
# vi /tmp/br1.xml
<interface type='bridge'>
      <mac address='52:54:00:4a:c9:5e'/>
      <source bridge='virbr1'/>
      <model type='virtio'/>
</interface>
```

3. 通过XML文件来修改网卡参数

```
# virsh update-device vm1 /tmp/br1.xml
Device updated successfully
```

多物理网卡绑定


KVM宿主机
虚拟机
虚拟机
虚拟机
vnet0
vnet1
vnet2
虚拟交换机
virbr0
virbr0-nic
DNS和
DHCP服务器
(dnsmasq)
iptable
NAT转发
band0
eth0
eth1
eth2
eth3
物理交换机
virbr1
虚拟交换机

实验：配置多网卡绑定的KVM桥接模式

- 绑定网卡
  1. 启用Bonding
  2. 配置物理网卡
  3. 配置绑定接口
  4. 重新启动服务
  5. 测试
- 配置网桥

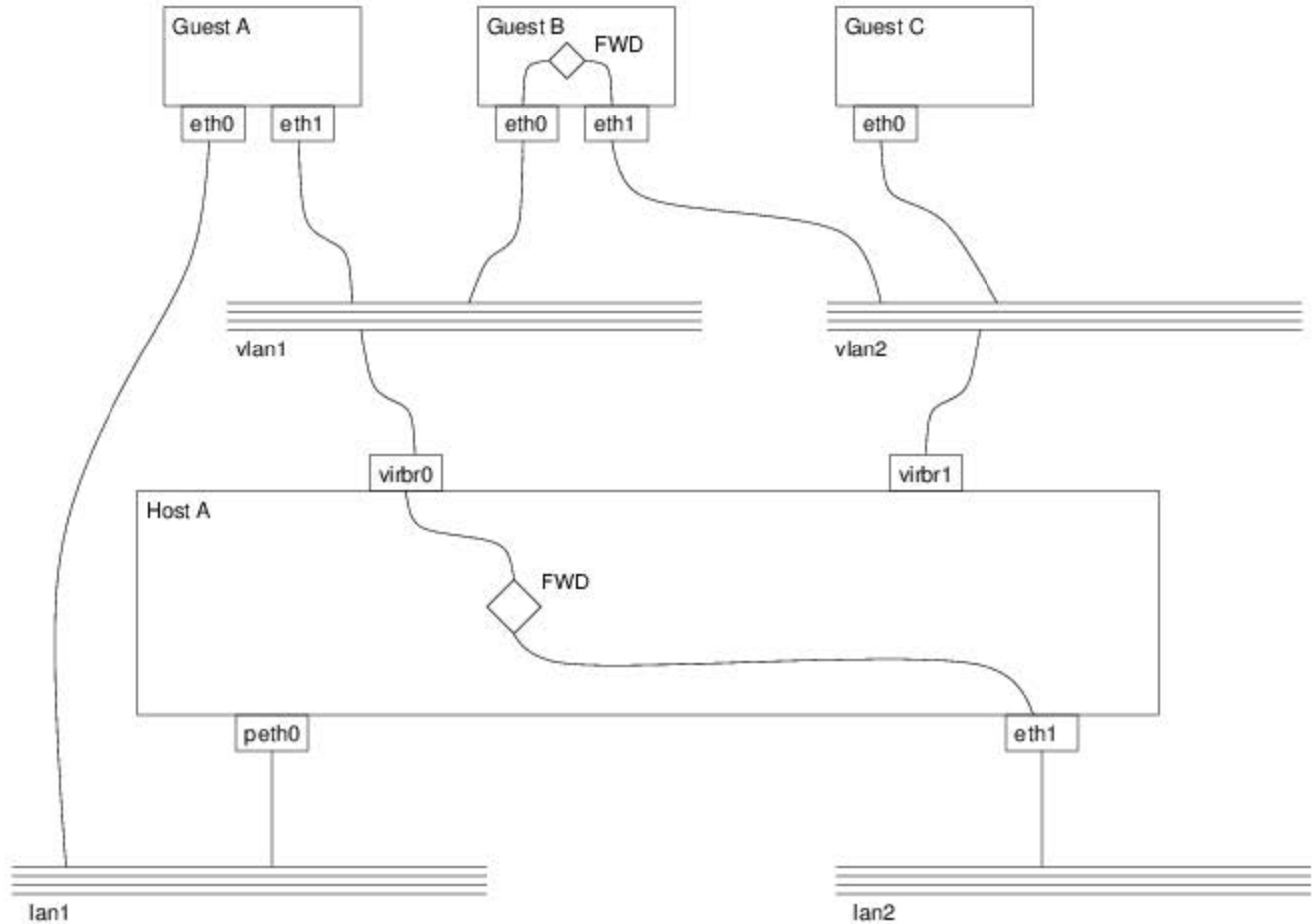
```
# vi ifcfg-bond0
DEVICE=bond0
ONBOOT=yes
NM_CONTROLLED=no
USERCTL=no
BONDING_OPTS="mode=1 miimon=100"
BOOTPROTO=static
IPADDR=192.168.200.11
NETMASK=255.255.255.0
```

```
mode=0 (Balance Round Robin)
mode=1 (Active backup)
mode=2 (Balance XOR)
mode=3 (Broadcast)
mode=4 (802.3ad)
mode=5 (Balance TLB)
mode=6 (Balance ALB)
```

```
# brctl show
bridge name     bridge id               STP enabled     interfaces
virbr0          8000.5254008dc0c2       yes             virbr0-nic
virbr1          8000.000c2942ae81       no              bond0
                                                        vnet0
                                                        vnet1
                                                        vnet2
```

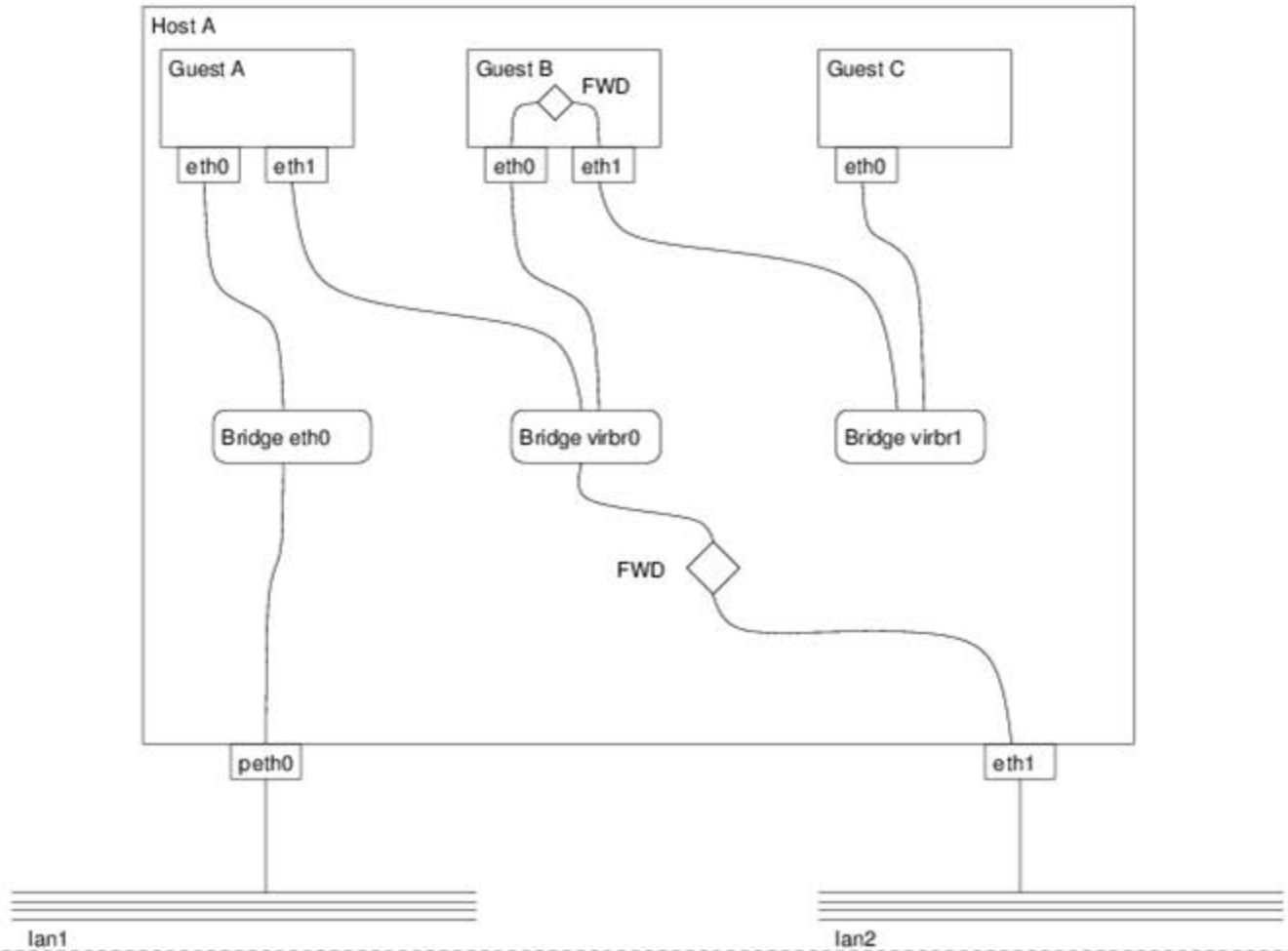
综合应用示例：逻辑视图

http://libvirt.org/archnetwork.html

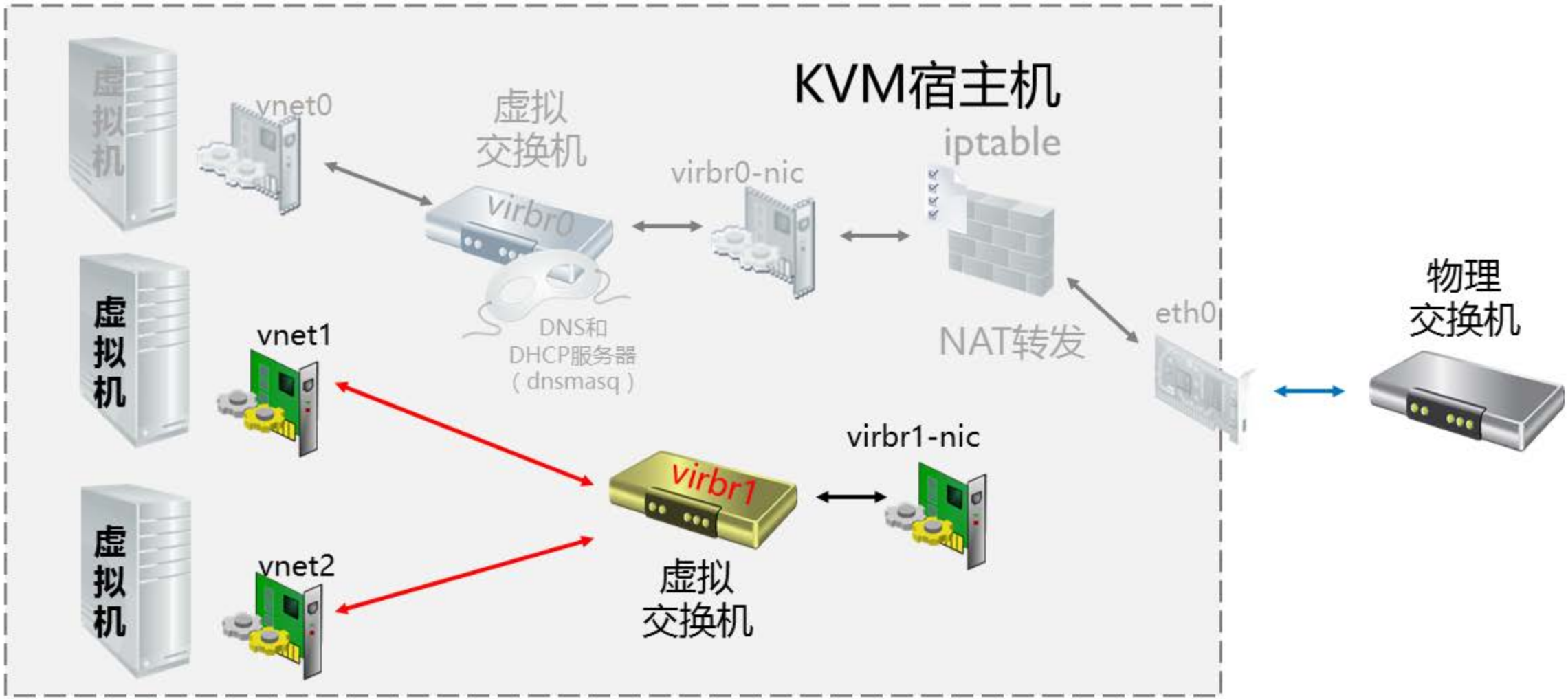


综合应用示例：物理视图

http://libvirt.org/archnetwork.html



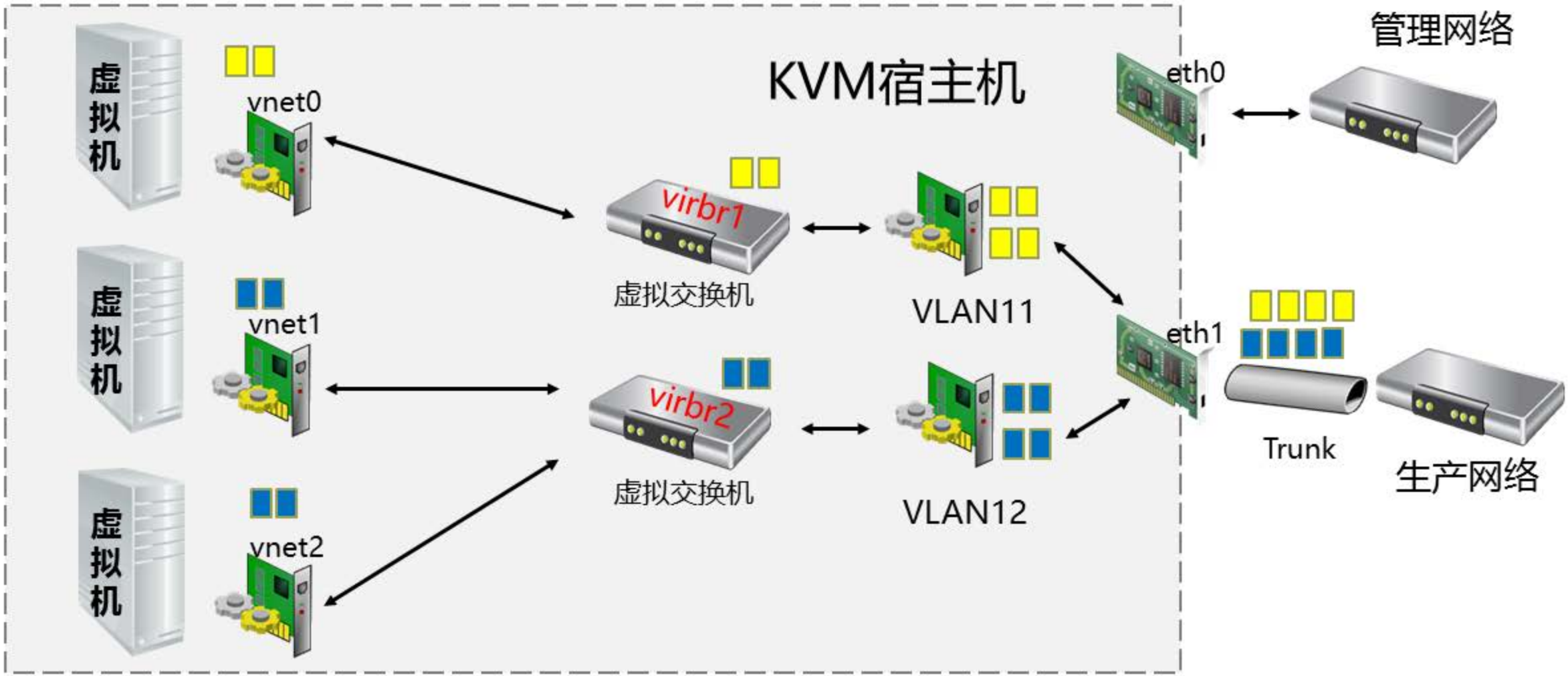
隔离网络



配置VLAN

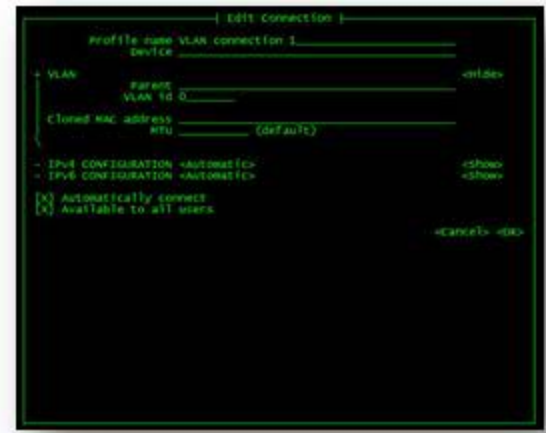
- KVM下VLAN配置概述
- 在Linux中配置VLAN
- KVM使用VLAN

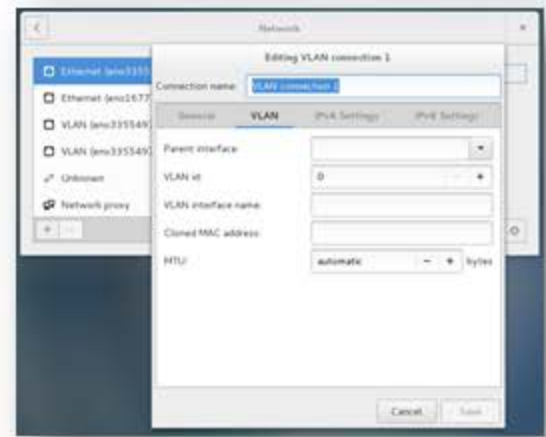
KVM下VLAN配置概述



在Linux中配置VLAN

- Redhat/CentOS 7 已经没有vconfig命令了
- Redhat/CentOS配置VLAN常用方法：
  - 命令行修改网络脚本文件（推荐）
  - Network Manager
    - nmtui：NetworkManager的文本用户接口
    - nmcli：NetworkManager的命令行工具
  - 图形界面工具
  - 命令行的ip命令






```
# ip link add link eth0 name eth0.8 type vlan id 8
# ip -d link show eth0.8
4: eth0.8@eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc
noqueue state UP mode DEFAULT
     link/ether 52:54:00:ce:5f:6c brd ff:ff:ff:ff:ff:ff promiscuity 0
     vlan protocol 802.1Q id 8 <REORDER_HDR>
```

演示：创建VLAN

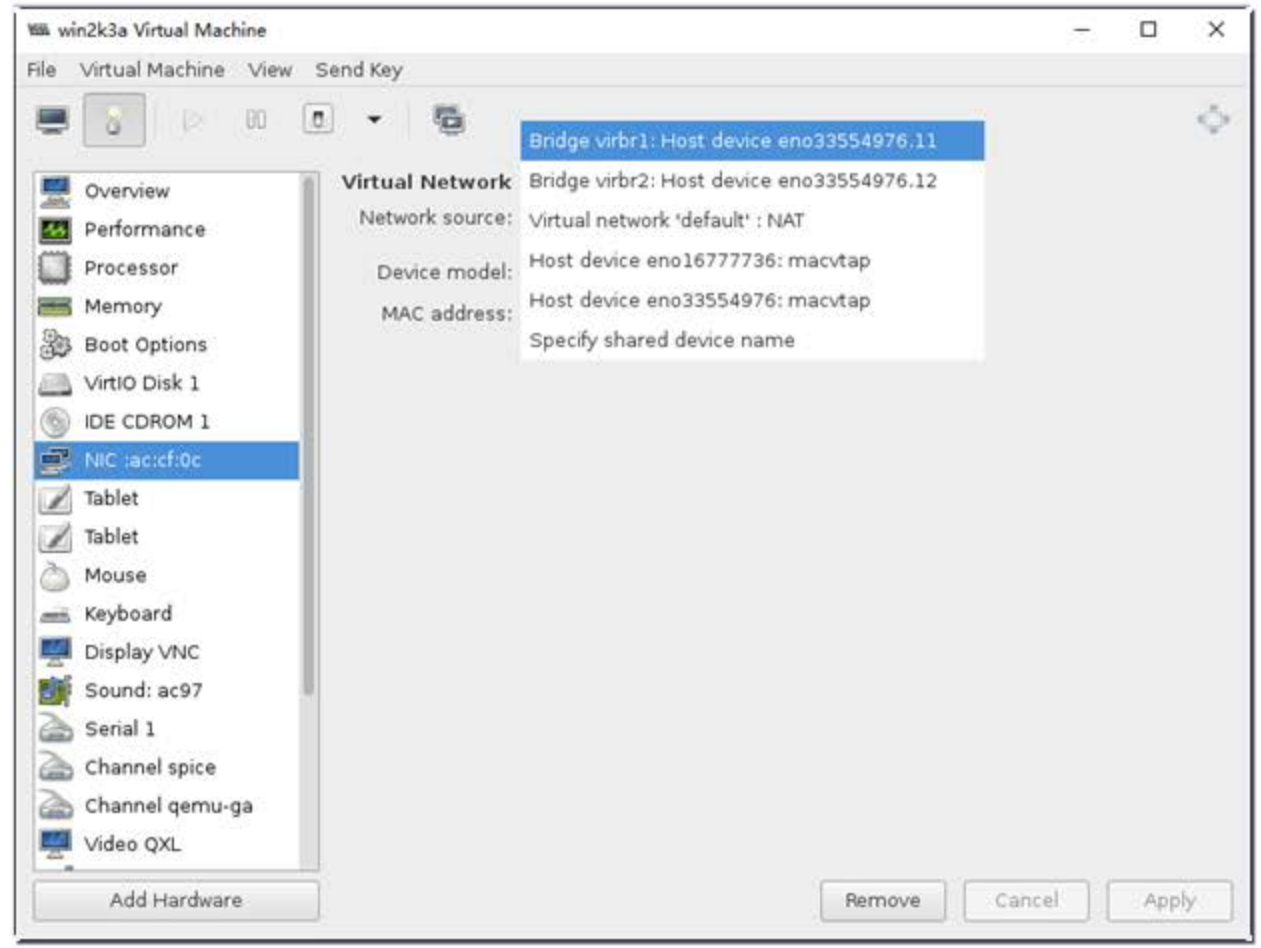
- 方法1：通过nmcli来创建VLAN
- 方法2：通过命令行修改网络脚本文件
- 方法3：通过virt-manager来创建

```
# nmcli connection show
NAME                UUID                                  TYPE            DEVICE
Vlan eno33554976.11 04186f9a-64da-e1fb-48ff-e2f3b18264db  vlan            eno33554976.11
Vlan eno33554976.12 7369ff99-43dd-fba1-6ff8-d63c153547d1  vlan            eno33554976.12
virbr0-nic          93318350-4af3-425c-9460-a5533f13d8a4  generic         virbr0-nic
virbr0              9eb91425-e5c2-4438-8af1-09ae9e81a3af  bridge          virbr0
eno33554976         8de27733-0c72-2949-b490-8a0d853a42d4  802-3-ethernet  eno33554976
eno16777736         51ca47f2-49c8-47af-a26c-f82d4ea6a120  802-3-ethernet  eno16777736
```

演示：KVM中使用VLAN

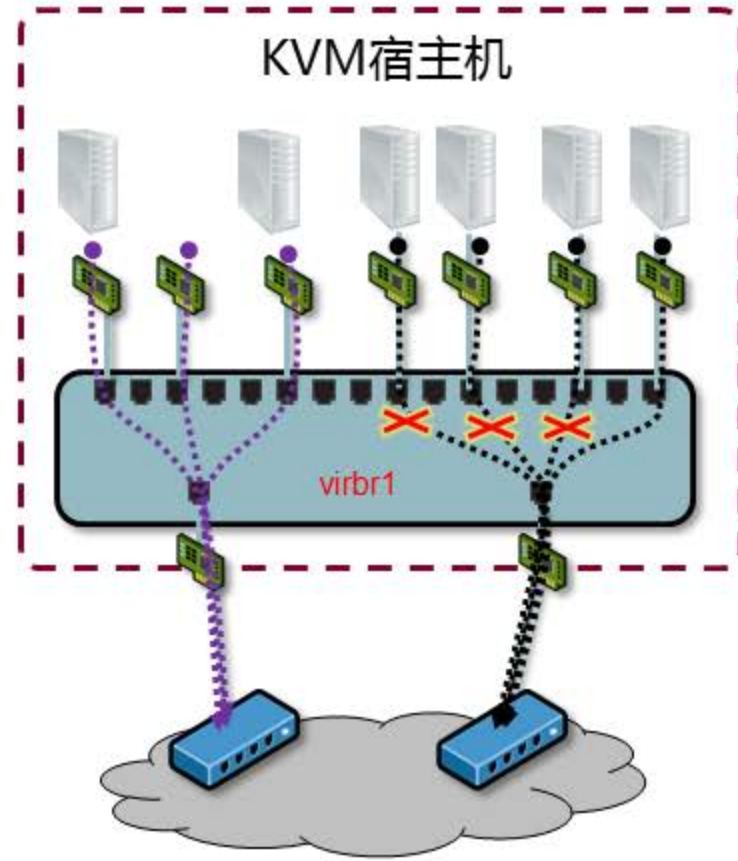
```
# vi ifcfg-virbr1
DEVICE=virbr1
TYPE=Bridge
BOOTPROTO=static
IPADDR=172.16.11.11
NETMASK=255.255.255.0
ONBOOT=yes
DELAY=0


# vi ifcfg-eno33554976.11
DEVICE=eno33554976.11
VLAN=yes
ONBOOT=yes
BOOTPROTO=none
BRIDGE=virbr1
```



网络过滤 Network filtering

- 什么是网络过滤
- 内置的默认规则
- 应用案例分析

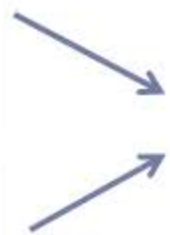


什么是网络过滤 Network filtering

- 官方链接 http://libvirt.org/formatnwfilter.html
- 通过ebtable引擎来实现
- 是一种网络流量的过滤规则，管理对虚拟机网络流量的接受和转发
- 由于虚拟机不能控制过滤规则，所以对虚拟机的访问控制具有强制性
- 通过XML文件存储配置，libvirt动态调整ebtable配置
- 即可以针对特定虚拟机进行配置，也可以多个虚拟机共享配置

```
<interface type='bridge'>
  <mac address='52:54:00:24:4c:ee'/>
  <source bridge='br0'/>
  <model type='virtio'/>
  <filterref filter='limit'/>
</interface>
```

```
<interface type='bridge'>
  <mac address='12:34:56:78:90:12'/>
  <source bridge='br1'/>
  <model type='rtl8139'/>
  <filterref filter='limit'/>
</interface>
```



```
# virsh nwfilter-dumpxml limit
<filter name='limit' chain='root'>
  <uuid>1c3384c7-093a-5689-2cf3-320ef716ba2e</uuid>
  <rule action='accept' direction='inout' priority='400'>
    <icmp connlimit-above='2'/>
  </rule>
  <rule action='accept' direction='inout' priority='500'>
    <tcp/>
  </rule>
  <filterref filter='clean-traffic'/>
  <rule action='drop' direction='inout' priority='1000'>
    <all/>
  </rule>
</filter>
```

virsh中与网络过滤器有关的命令

```
virsh # help filter
 Network Filter (help keyword 'filter'):
nwfilter-define   define or update a network filter from an XML file
nwfilter-dumpxml  network filter information in XML
nwfilter-edit     edit XML configuration for a network filter
nwfilter-list     list network filters
nwfilter-undefine undefine a network filter
```

过滤规则示例

```
# virsh nwfilter-dumpxml limit
<filter name='limit' chain='root'>
  <uuid>1c3384c7-093a-5689-2cf3-320ef716ba2e</uuid>
  <rule action='accept' direction='inout' priority='400'>
    <icmp connlimit-above='2'/>
  </rule>
  <rule action='accept' direction='inout' priority='500'>
    <tcp/>
  </rule>
  <filterref filter='clean-traffic'/>
  <rule action='drop' direction='inout' priority='1000'>
    <all/>
  </rule>
</filter>
```

Chain类型：

- 所有过滤规则都被组织到一个过滤链中
- 数据包经过这些过滤链，被选择进入虚拟机或是被DROP。
- 链都有不同的优先级，root链的优先级最高
- 所有的数据包必须先要经过root链后，才可能继续到其他过滤过则中匹配。
- 目前已经存在的链：root、mac、stp、vlan、arp、rarp、ipv4、ipv6
- priority优先级的设定：所有的链都被连接到root链中。优先级的值越小，优先级别越高。用户可以定义自己的优先级数值，取值范围在[-1000,1000]。

演示：考察默认规则

```
virsh # nwfilter-list
 UUID                                   Name
--------------------------------------------------------------------
 17411a8d-a462-426c-a93a-3e6d93d195c8   allow-arp
 13f1a780-c05b-49ba-9937-c671e6fb6bdf   allow-dhcp
 1d291a19-0dc0-4b3a-af7a-b6cc19cb6d85   allow-dhcp-server
 6fb77a9d-5a7e-4de6-be45-123b5023ab20   allow-incoming-ipv4
 8bc2ad0f-df9a-4134-9f9f-f343fc9ff5f7   allow-ipv4
 db78d3a7-c303-4834-b194-d0f0ce23a0d9   clean-traffic
 703cf08e-157b-4bd0-9320-79e3c53f7961   no-arp-ip-spoofing
 6ff7b9ba-b188-423a-b890-f282cc9f090e   no-arp-mac-spoofing
 556589d0-f316-42a7-8147-98daa7120c1e   no-arp-spoofing
 222b3bb3-2a3f-42b3-9835-979bceedab6f   no-ip-multicast
 9cef3d10-2236-46e2-990b-20e8387c18d9   no-ip-spoofing
 63a231cd-8e52-4ac0-9836-acb909e70614   no-mac-broadcast
 ef3a7804-8249-4290-9118-42473c5d69fb   no-mac-spoofing
 f59a14d8-b3d4-40bf-a0e6-213571192cda   no-other-l2-traffic
 1efb813a-5916-46fb-a01f-e84d44e0d546   no-other-rarp-traffic
 8e7b6bc8-9968-48ea-af02-ed84929eb6ba   qemu-announce-self
 d903fee5-0af4-4238-ade5-960d76d58e33   qemu-announce-self-rarp
```

```
virsh # nwfilter-dumpxml clean-traffic
<filter name='clean-traffic' chain='root'>
  <uuid>db78d3a7-c303-4834-b194-d0f0ce23a0d9</uuid>
  <filterref filter='no-mac-spoofing'/>
  <filterref filter='no-ip-spoofing'/>
  <rule action='accept' direction='out' priority='-650'>
    <mac protocolid='ipv4'/>
  </rule>
  <filterref filter='allow-incoming-ipv4'/>
  <filterref filter='no-arp-spoofing'/>
  <rule action='accept' direction='inout' priority='-500'>
    <mac protocolid='arp'/>
  </rule>
  <filterref filter='no-other-l2-traffic'/>
  <filterref filter='qemu-announce-self'/>
</filter>
```

禁止VM外发MAC欺骗、ARP欺骗以及IP地址欺骗……

演示：考察KVM网络过滤与ebtables的关系

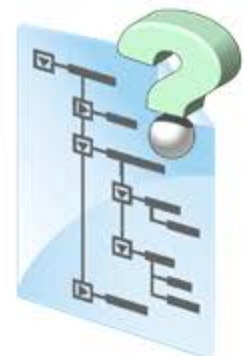
- 对比启动配置有网络过滤的虚拟机前后ebtables的变化

```
# ebtables -t nat -L
Bridge table: nat
Bridge chain: PREROUTING, entries: 0, policy: ACCEPT
Bridge chain: OUTPUT, entries: 0, policy: ACCEPT
Bridge chain: POSTROUTING, entries: 0, policy: ACCEPT
```

```
# virsh dumpxml win2k3a | more   只看与网络有关的
<interface type='network'>
  <mac address='52:54:00:ac:cf:0c'/>
  <source network='default' bridge='virbr0'/>
  <target dev='vnet0'/>
  <model type='virtio'/>
  <filterref filter='clean-traffic'/>
  <alias name='net0'/>
</interface>
```

思考：仅允许虚拟机发出“干净”的数据包

- 防止虚拟机进行MAC、IP和ARP欺骗
- 仅打开TCP 22和80端口
- 允许虚拟机向外ping，但不是允许其他机器ping此虚拟机
- 允许DNS解析流量



总结

- Linux网桥基本概念
- qemu-kvm支持的网络
- 向虚拟机添加虚拟网络连接
- 虚拟网络配置
  - 基于NAT的虚拟网络
  - 基于网桥的虚拟网络
  - 用户自定义的隔离的虚拟网络
- 多物理网卡绑定
- 配置VLAN
- 通过网络过滤提高安全性