Настраиваем интерфейсы между r1 и r2, r2 и r3

R1 | R2 | R3

```
DEVICE=ens34
IPADDR=192.168.12.1
PREFIX=24
ONBOOT=yes
~
~
~
~
~
```

```
[root@R1 ~]# ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: ens33: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 00:0c:29:fb:63:98 brd ff:ff:ff:ff:ff:ff
    inet 192.168.0.201/24 brd 192.168.0.255 scope global noprefixroute ens33
       valid_lft forever preferred_lft forever
    inet6 fe80::20c:29ff:fefb:6398/64 scope link
       valid_lft forever preferred_lft forever
3: ens34: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 00:0c:29:fb:63:a2 brd ff:ff:ff:ff:ff:ff
    inet 192.168.12.1/24 brd 192.168.12.255 scope global noprefixroute ens34
       valid_lft forever preferred_lft forever
    inet6 fe80::20c:29ff:fefb:63a2/64 scope link
       valid_lft forever preferred_lft forever
[root@R1 ~]#
```

Проверяем связность между r1 и r2

```
[root@R2 ~]# vim /etc/sysconfig/network-scripts/ifcfg-ens34
[root@R2 ~]# ifdown ens34
Device 'ens34' successfully disconnected.
[root@R2 ~]# ifup ens34
Connection successfully activated (D-Bus active path: /org/freedesktop/NetworkManager/ActiveConnection/3)
[root@R2 ~]# ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: ens33: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 00:0c:29:5c:58:4a brd ff:ff:ff:ff:ff:ff
    inet 192.168.0.202/24 brd 192.168.0.255 scope global noprefixroute ens33
       valid_lft forever preferred_lft forever
    inet6 fe80::20c:29ff:fe5c:584a/64 scope link
       valid_lft forever preferred_lft forever
3: ens34: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 00:0c:29:5c:58:54 brd ff:ff:ff:ff:ff:ff
    inet 192.168.12.2/24 brd 192.168.12.255 scope global noprefixroute ens34
       valid_lft forever preferred_lft forever
    inet6 fe80::20c:29ff:fe5c:5854/64 scope link
       valid_lft forever preferred_lft forever
4: ens35: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 00:0c:29:5c:58:5e brd ff:ff:ff:ff:ff:ff
[root@R2 ~]# ping 192.168.12.1
PING 192.168.12.1 (192.168.12.1) 56(84) bytes of data.
64 bytes from 192.168.12.1: icmp_seq=1 ttl=64 time=0.524 ms
64 bytes from 192.168.12.1: icmp_seq=2 ttl=64 time=0.376 ms
64 bytes from 192.168.12.1: icmp_seq=3 ttl=64 time=0.262 ms
^C
--- 192.168.12.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2004ms
rtt min/avg/max/mdev = 0.262/0.387/0.524/0.108 ms
[root@R2 ~]#
```

Проверяем связность между r2 и r3

```
[root@R3 ~]# ping 192.168.23.1
PING 192.168.23.1 (192.168.23.1) 56(84) bytes of data.
64 bytes from 192.168.23.1: icmp_seq=1 ttl=64 time=0.706 ms
64 bytes from 192.168.23.1: icmp_seq=2 ttl=64 time=0.360 ms
64 bytes from 192.168.23.1: icmp_seq=3 ttl=64 time=0.399 ms
```

Создадим интерфейс dummy

```
[root@R1 ~]# modprobe -v dummy
insmod /lib/modules/3.10.0-1160.el7.x86_64/kernel/drivers/net/dummy.ko.xz
```

чтобы модуль dummy загружался при старте системы, создадим файл dummy.conf и добавим строчку

dummy

```
[root@R1 ~]# vim /etc/modules-load.d/dummy.conf
[root@R1 ~]#
```

Проверим что dummy появляется после ребута

```
Using username "root".
Last login: Sat Aug 20 14:10:42 2022 from 192.168.0.214
[root@R1 ~]# ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: ens33: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 00:0c:29:fb:63:98 brd ff:ff:ff:ff:ff:ff
    inet 192.168.0.201/24 brd 192.168.0.255 scope global noprefixroute ens33
       valid_lft forever preferred_lft forever
    inet6 fe80::20c:29ff:fefb:6398/64 scope link
       valid_lft forever preferred_lft forever
3: ens34: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 00:0c:29:fb:63:a2 brd ff:ff:ff:ff:ff:ff
    inet 192.168.12.1/24 brd 192.168.12.255 scope global noprefixroute ens34
       valid_lft forever preferred_lft forever
    inet6 fe80::20c:29ff:fefb:63a2/64 scope link
       valid_lft forever preferred_lft forever
4: dummy0: <BROADCAST,NOARP> mtu 1500 qdisc noop state DOWN group default qlen 1000
    link/ether de:58:0f:18:61:0e brd ff:ff:ff:ff:ff:ff
[root@R1 ~]#
```

Назначаем настройки интерфейсу dummy0 через vim /etc/sysconfig/network-scripts/ifcfg-dummy0

В конфиге указываем TYPE=dummy

Проводим аналогичные действия на машине r2 и r3

Устанавливаем FRR на все машины

```
  68  FRRVER="frr-stable"
  69  curl -O https://rpm.frrouting.org/repo/$FRRVER-repo-1-0.el7.noarch.rpm
  70  sudo yum install ./$FRRVER* -y
  71  sudo yum install frr frr-pythontools -y
```

```
[root@R3 ~]# vim /etc/frr/daemons
```

Включаем демона ospf

ospfd=yes

Включаем автозагрузку демона

systemctl enable frr

Заходим в vtysh и включаем анонсирование подсетей с помощью протокола ospf

```
R1(config-router)# network 192.168.12.0/24 area 0
R1(config-router)# network 1.1.1.1/32 area 0
R1(config-router)# ex
```

```
R2(config)# router ospf
R2(config-router)# network 192.168.12.0/24 area 0
R2(config-router)# network 192.168.23.0/24 area 0
R2(config-router)# network 2.2.2.2/32 area 0
R2(config-router)# exit
```

```
R3(config)# router ospf
R3(config-router)# network 192.168.23.0/24  area 0
R3(config-router)# network 3.3.3.3/32 area 0
R3(config-router)# exit
```

Соседство нам мешает установить файрволл, отключаем его и убираем из автозагрузки

systemctl disable firewalld
systemctl stop firewalld

Делаем это на всех машинах.

Соседство установилось. Маршруты получены.

```
R1# sh ip ro
Codes: K - kernel route, C - connected, S - static, R - RIP,
       O - OSPF, I - IS-IS, B - BGP, E - EIGRP, N - NHRP,
       T - Table, A - Babel, F - PBR, f - OpenFabric,
       > - selected route, * - FIB route, q - queued, r - rejected, b - backup
       t - trapped, o - offload failure

K>* 0.0.0.0/0 [0/100] via 192.168.0.1, ens33, 00:21:49
O   1.1.1.1/32 [110/10] via 0.0.0.0, dummy0 onlink, weight 1, 00:13:40
C>* 1.1.1.1/32 is directly connected, dummy0, 00:21:48
O>* 2.2.2.2/32 [110/110] via 192.168.12.2, ens34, weight 1, 00:03:23
O>* 3.3.3.3/32 [110/210] via 192.168.12.2, ens34, weight 1, 00:03:13
K>* 169.254.0.0/16 [0/1004] is directly connected, dummy0, 00:21:48
C>* 192.168.0.0/24 is directly connected, ens33, 00:21:49
O   192.168.12.0/24 [110/100] is directly connected, ens34, weight 1, 00:14:22
C>* 192.168.12.0/24 is directly connected, ens34, 00:21:48
O>* 192.168.23.0/24 [110/200] via 192.168.12.2, ens34, weight 1, 00:03:23
```

Проверяем доступность узлов

```
[root@R1 ~]# ping 3.3.3.3
PING 3.3.3.3 (3.3.3.3) 56(84) bytes of data.
^C
--- 3.3.3.3 ping statistics ---
7 packets transmitted, 0 received, 100% packet loss, time 6023ms

[root@R1 ~]# ping 2.2.2.2
PING 2.2.2.2 (2.2.2.2) 56(84) bytes of data.
64 bytes from 2.2.2.2: icmp_seq=1 ttl=64 time=0.313 ms
64 bytes from 2.2.2.2: icmp_seq=2 ttl=64 time=0.301 ms
^C
--- 2.2.2.2 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1003ms
rtt min/avg/max/mdev = 0.301/0.307/0.313/0.006 ms
[root@R1 ~]#
```

До R3 не можем достучаться. Нужно включить ip forwarding на R2. Чтобы форвардинг был включен после ребута, нужно включить эту опцию в конфиг

На R2 редактируем файл

vim /etc/sysctl.conf

Добавляем строку

```
net.ipv4.ip_forward = 1
```

Проверяем доступность

```
[root@R1 ~]# ping 3.3.3.3
PING 3.3.3.3 (3.3.3.3) 56(84) bytes of data.
64 bytes from 3.3.3.3: icmp_seq=1 ttl=63 time=0.616 ms
64 bytes from 3.3.3.3: icmp_seq=2 ttl=63 time=0.498 ms
64 bytes from 3.3.3.3: icmp_seq=3 ttl=63 time=0.690 ms
64 bytes from 3.3.3.3: icmp_seq=4 ttl=63 time=0.554 ms
```

На R3 устанавливаем пакеты, необходимые для создания NFS сервера

```
[root@R3 home]# yum group install "File and Storage Server"
```

Стартуем демона и включаем автозагрузку

systemctl enable nfs-server

systemctl start nfs-server

На R3 создаём 2 папки, которые будем экспортировать
/home/nfs_1
/home/nfs_2

Заходим в файл exports и прописываем какие директории и кому мы будем анонсировать, и какие доступы будут у nfs клиента
vim /etc/exports

R1 R2 R3

```
/home/nfs_1 192.168.12.1(rw,sync,no_root_squash)
/home/nfs_2 192.168.12.1(rw,sync,no_root_squash)
~
~
~
~
```

Перезапускаем сервер

systemctl restart nfs-server

На R1 с помощью команды mount примонтируем в /mnt/nfs_shre расшаренные директории

```
[root@R1 nfs_share]# mount -t nfs 192.168.23.2:/home/nfs_1 /mnt/nfs_share
[root@R1 nfs_share]# ll
total 0
[root@R1 nfs_share]# pwd
/mnt/nfs_share
[root@R1 nfs_share]# cd /
[root@R1 /]# ll /mnt/nfs_share/
total 0
[root@R1 /]# df -kh
Filesystem                Size  Used Avail Use% Mounted on
devtmpfs                  898M     0  898M   0% /dev
tmpfs                     910M     0  910M   0% /dev/shm
tmpfs                     910M  9.6M  901M   2% /run
tmpfs                     910M     0  910M   0% /sys/fs/cgroup
/dev/mapper/centos-root    22G  1.6G   21G   8% /
/dev/sda1                1014M  151M  864M  15% /boot
tmpfs                     182M     0  182M   0% /run/user/0
192.168.23.2:/home/nfs_1   22G  1.6G   21G   8% /mnt/nfs_share
[root@R1 /]# cd /mnt
[root@R1 mnt]# mkdir nfs_share2
[root@R1 mnt]# mount -t nfs 192.168.23.2:/home/nfs_2 /mnt/nfs_share2
[root@R1 mnt]# df -kh
Filesystem                Size  Used Avail Use% Mounted on
devtmpfs                  898M     0  898M   0% /dev
tmpfs                     910M     0  910M   0% /dev/shm
tmpfs                     910M  9.6M  901M   2% /run
tmpfs                     910M     0  910M   0% /sys/fs/cgroup
/dev/mapper/centos-root    22G  1.6G   21G   8% /
/dev/sda1                1014M  151M  864M  15% /boot
tmpfs                     182M     0  182M   0% /run/user/0
192.168.23.2:/home/nfs_1   22G  1.6G   21G   8% /mnt/nfs_share
192.168.23.2:/home/nfs_2   22G  1.6G   21G   8% /mnt/nfs_share2
[root@R1 mnt]#
```

Создадим файл abc.txt и проверим, появился ли он на R3
R1

```
[root@R1 nfs_share]# touch abc.txt
[root@R1 nfs_share]# ll
total 0
-rw-r--r--. 1 root root 0 Aug 20 18:06 abc.txt
[root@R1 nfs_share]# ll
total 0
```

R3

```
[root@R3 /]# cd /home
[root@R3 home]# ll
total 0
drwxr-xr-x. 2 root root 21 Aug 20 18:06 nfs_1
drwxr-xr-x. 2 root root  6 Aug 20 15:47 nfs_2
[root@R3 home]# cd nfs_1
[root@R3 nfs_1]# ll
total 0
-rw-r--r--. 1 root root 0 Aug 20 18:06 abc.txt
[root@R3 nfs_1]#
[root@R3 nfs_1]#
```

Установим на R2 nfs-utils и попробуем примонтировать директории nfs_1 и nfs_2

```
[root@R2 mnt]# mount -t nfs 192.168.23.2:/home/nfs_1 /mnt/nfs_1
mount.nfs: access denied by server while mounting 192.168.23.2:/home/nfs_1
[root@R2 mnt]#
```

Получаем ошибку access denied. Потому что в файле /etc/exports мы прямо указали что доступ к папкам будет только у машины 192.168.12.1

После ребута R1 mount nfs шары отвалился

```
Using username "root".
Last login: Sat Aug 20 15:29:15 2022 from 192.168.0.214
[root@R1 ~]# cd /mnt/nfs_share
[root@R1 nfs_share]# ll
total 0
[root@R1 nfs_share]# df -kh
Filesystem               Size  Used Avail Use% Mounted on
devtmpfs                 898M     0  898M   0% /dev
tmpfs                    910M     0  910M   0% /dev/shm
tmpfs                    910M  9.6M  901M   2% /run
tmpfs                    910M     0  910M   0% /sys/fs/cgroup
/dev/mapper/centos-root   22G  1.6G   21G   8% /
/dev/sda1               1014M  151M  864M  15% /boot
tmpfs                    182M     0  182M   0% /run/user/0
[root@R1 nfs_share]#
```

Чтобы директории маунтились сразу при загрузке, воспользуемся fstab

vim /etc/fstab

R1 R2 R3

```
#
# /etc/fstab
# Created by anaconda on Tue Aug 16 21:38:54 2022
#
# Accessible filesystems, by reference, are maintained under '/dev/disk'
# See man pages fstab(5), findfs(8), mount(8) and/or blkid(8) for more info
#
/dev/mapper/centos-root /                       xfs     defaults        0 0
UUID=f6eb14ad-e7e7-4c41-afde-96628b55b5ea /boot                   xfs     defaults        0 0
/dev/mapper/centos-swap swap                    swap    defaults        0 0
192.168.23.2:/home/nfs_1 /mnt/nfs_share nfs defaults,_netdev 0 0
192.168.23.2:/home/nfs_2 /mnt/nfs_share2 nfs defaults,_netdev 0 0
~
~
~
~
```

После ребута R1 директории так и не примаунтились автоматически.

```
Using username "root".
System is booting up. See pam_nologin(8)
Last login: Sat Aug 20 19:50:56 2022 from 192.168.0.214
[root@R1 ~]# df -kh
Filesystem               Size  Used Avail Use% Mounted on
devtmpfs                 898M     0  898M   0% /dev
tmpfs                    910M     0  910M   0% /dev/shm
tmpfs                    910M  9.6M  901M   2% /run
tmpfs                    910M     0  910M   0% /sys/fs/cgroup
/dev/mapper/centos-root   22G  1.6G   21G   8% /
/dev/sda1               1014M  151M  864M  15% /boot
tmpfs                    182M     0  182M   0% /run/user/0
```

Решим задачу с помощью редактирования /etc/rc.local

vim /etc/rc.local

R1 | R2 | R3

```
#!/bin/bash
# THIS FILE IS ADDED FOR COMPATIBILITY PURPOSES
#
# It is highly advisable to create own systemd services or udev rules
# to run scripts during boot instead of using this file.
#
# In contrast to previous versions due to parallel execution during boot
# this script will NOT be run after all other services.
#
# Please note that you must run 'chmod +x /etc/rc.d/rc.local' to ensure
# that this script will be executed during boot.

touch /var/lock/subsys/local
while ! ping -cl 192.168.23.2
do
sleep 1
done
mount -t nfs 192.168.23.2:/home/nfs_1 /mnt/nfs_share
mount -t nfs 192.168.23.2:/home/nfs_2 /mnt/nfs_share2
exit 0
~
~
~
~
~
```

Как видим после перезагрузки скрипт срабатывает уже после того, как поднялся сетевой интерфейс, и таким образом mount проходит успешно.

R1 | R2 | R3

```
Using username "root".
Last login: Sat Aug 20 20:18:58 2022 from 192.168.0.214
[root@R1 ~]# df -kh
Filesystem                Size  Used Avail Use% Mounted on
devtmpfs                  898M     0  898M   0% /dev
tmpfs                     910M     0  910M   0% /dev/shm
tmpfs                     910M  9.6M  901M   2% /run
tmpfs                     910M     0  910M   0% /sys/fs/cgroup
/dev/mapper/centos-root    22G  1.6G   21G   8% /
/dev/sda1                1014M  151M  864M  15% /boot
192.168.23.2:/home/nfs_1   22G  1.6G   21G   8% /mnt/nfs_share
192.168.23.2:/home/nfs_2   22G  1.6G   21G   8% /mnt/nfs_share2
tmpfs                     182M     0  182M   0% /run/user/0
[root@R1 ~]#
```