NASA HW4 - 金哲安(B12902118)

Short Answers (15 pt)

1.

Block –> deny traffic and don’t let the client know it has been dropped (which is usually advisable for untrusted networks)

Reject –> deny traffic and let the client know about it. (only tcp and udp support rejecting packets, which in case of TCP means a `RST` is returned, for UDP `ICMP UNREACHABLE` is returned).

For internal networks it can be practical to use reject, so the client does not have to wait for a time-out when access is not allowed. When receiving packets from untrusted networks, you usually don’t want to communicate back if traffic is not allowed.

2.

Traffic can be matched on in[coming] or out[going] direction, our default is to filter on incoming direction. In which case you would set the policy on the interface where the traffic originates from.

In visual terms: [Source] -> IN -> [Firewall] -> OUT -> [Destination].

For example, if you want to allow https traffic coming from any host on the internet, you would usually set a policy on the WAN interface allowing port 443 to the host in question.

If you want to block https traffic going out to a client on the local area net, you can set a policy on the LAN interface to the client in question blocking port 443.

3.

Interface net:

All networks assigned to the physical interface, this will include networks of virtual addresses assigned as well ([Interface] is explained in the interfaces topic). Normally used to allow traffic from or to clients connected to a specific interface.

Interface address:

All addresses configured on an interface, this includes all virtual (alias) addresses as well.

References

- https://docs.opnsense.org/manual/firewall.html
- https://docs.opnsense.org/manual/firewall_generic.html

OPNsense (85 pt)

1.

1. On macOS, download `OPNsense-25.1-ufs-efi-vm-aarch64.qcow2.bz2` from https://github.com/maurice-w/opnsense-vm-images/releases
2. `bunzip2 OPNsense-25.1-ufs-efi-vm-aarch64.qcow2.bz2`
3. `qemu-img convert -f qcow2 -O vdi OPNsense-25.1-ufs-efi-vm-aarch64.qcow2 OPNsense.vdi`
4. On VirtualBox, create a new virtual machine and start it with the settings:
    - Name and Operating System
        - Name: `OPN1`
        - ISO Image: <not selected>
        - Type: BSD
        - Subtype: FreeBSD
        - Version: FreeBSD (ARM 64-Bit)
    - Hardware
        - Base Memory: 4096 MB
        - Processors: 8
    - Hard Disk
        - Use an Existing Hard Disk File
            - `OPNsense.vdi`
5. Login to the virtual machine with:
    - Username: `root`
    - Password: `opnsense`
6. Type `3`
7. Type `y`
8. `b12902118`
9. `b12902118`

2.

1. On VirtualBox `Tools` > `Network` > `Host-only Networks`, create a Host-only Network if none exist with settings:
    - Name: `HostNetwork`
    - Mask: `255.255.255.0`
    - Lower Bound: `192.168.56.1`
    - Upper Bound: `192.168.56.199`

    This will simulate LAN.
2. On VirtualBox `Tools` > `Network` > `NAT Networks`, create a NAT Network if none exist with settings:
    - Name: `NatNetwork`
    - IPv4 Prefix: `10.0.2.0/24`
    - Enable DHCP

    This will simulate WAN

3. Shut down the virtual machine and then on VirtualBox, select machine `OPN1` > `Settings` > `Network`. Set `Adapter 1` > `Attached to:` to `Host-only Network`. Select `Adapter 2`, create a new interface by selecting `Enable Network Adapter` > `Attached to:` to `NAT Network`.
4. Start the virtual machine again
5. Login to the virtual machine with:
    - Username: `root`
    - Password: `b12902118`
6. Type `2`
7. Press `Enter`
8. `192.168.56.2`
9. `24`
10. Press `Enter`
11. Press `Enter`
12. Press `Enter`
13. Press `Enter`
14. Press `Enter`
15. Press `Enter`
16. Press `Enter`
17. On Google Chrome, connect to `https://192.168.56.2` and login with username: `root`, password: `opnsense`
18. Wait until the page refreshes
19. Click `Next`
20. Click `Next`
21. Click `Next`
22. Uncheck `Block private networks from entering via WAN` and `Block non-Internet routed networks from entering via WAN`
23. Click `Next`
24. Click `Next`
25. Click `Next`
26. Click `Reload`
27. Go to `Interfaces` > `Devices` > `VLAN` and click the plus sign
28. Add a new VLAN with the following configurations:
    - Device: `vlan0.11`
    - VLAN tag: `11`
    - Description: `VLAN 11`
29. Click the plus sign again and add a new VLAN with the following configurations:
    - Device: `vlan0.12`
    - VLAN tag: `12`
    - Description: `VLAN 12`
30. Click the plus sign again and add a new VLAN with the following configurations:
    - Device: `vlan0.99`
    - VLAN tag: `99`
    - Description: `VLAN 99`
31. Click `Apply`

32. Go to `Assignments`
33. Assign a new interface with the following settings:
    - Device: `vlan0.11 VLAN11 (Parent: em0, Tag:11)`
    - Description: `VLAN 11`
34. Assign a new interface with the following settings:
    - Device: `vlan0.12 VLAN12 (Parent: em0, Tag:12)`
    - Description: `VLAN 12`
35. Assign a new interface with the following settings:
    - Device: `vlan0.99 VLAN99 (Parent: em0, Tag:99)`
    - Description: `VLAN 99`
36. Change WAN interface device to `em1` and click save
37. Go to `Interfaces` > `[VLAN11]` and click `Enable Interface`
38. Select `Static IPv4` for IPv4 Configuration Type
39. Type `10.30.11.1` and `24` for IPv4 Address and click `Save`
40. Click `Apply changes`
41. Go to `Interfaces` > `[VLAN12]` and click `Enable Interface`
42. Select `Static IPv4` for IPv4 Configuration Type
43. Type `10.30.12.1` and `24` for IPv4 Address and click `Save`
44. Click `Apply changes`
45. Go to `Interfaces` > `[VLAN99]` and click `Enable Interface`
46. Select `Static IPv4` for IPv4 Configuration Type
47. Type `10.30.99.1` and `24` for IPv4 Address and click `Save`
48. Click `Apply changes`
49. Go to `Interfaces` > `[WAN]` and click `Enable Interface`
50. Select `DHCP` for IPv4 Configuration Type
51. Select `DHCPv6` for IPv6 Configuration Type and click `Save`
52. Click `Apply changes`
    VM interfaces:

- WAN: `NAT Network`
  - IP and subnet: assigned by DHCP, `10.0.2.5/24`
- LAN: `Host-only Network`
  - IP and subnet: `192.168.56.2/24`

3.

1. Go to `Services` > `ISC DHCPv4` > `[VLAN11]`
2. Check `Enable DHCP server on the VLAN11 interface`
3. Set Range: `10.30.11.100` - `10.30.11.199`
4. Set DNS servers: `8.8.8.8`, `8.8.4.4`
5. Click `Save`
6. Go to `Services` > `ISC DHCPv4` > `[VLAN12]`
7. Check `Enable DHCP server on the VLAN12 interface`
8. Set Range: `10.30.12.100` - `10.30.12.199`
9. Set DNS servers: `8.8.8.8`, `8.8.4.4`

10. Click `Save`
11. Go to `Services` > `ISC DHCPv4` > `[VLAN99]`
12. Check `Enable DHCP server on the VLAN1199 interface`
13. Set Range: `10.30.99.100` - `10.30.99.199`
14. Set DNS servers: `8.8.8.8`, `8.8.4.4`
15. Click `Save`
16. Go to `Firewall` > `Rules` > `[VLAN11]` and click the plus sign to add a rule with the following settings:
    - Action: `Pass`
    - Interface: `VLAN11`
    - Direction: `In`
    - Protocol: `UDP`
    - Source: `any`
    - Destination: `VLAN11 net`
    - Destination Port:
        - From: `(other)` > `67`
        - To: `(other)` > `68`
    - Description: `Allow DHCP for VLAN11`
17. Click Save & Apply Changes.
18. Repeat the same steps 17 and 18 but for `[VLAN12]` and `[VLAN99]`
19. Repeat the same steps 17 and 18 but for blocking `[LAN]` and `[WAN]`

4.

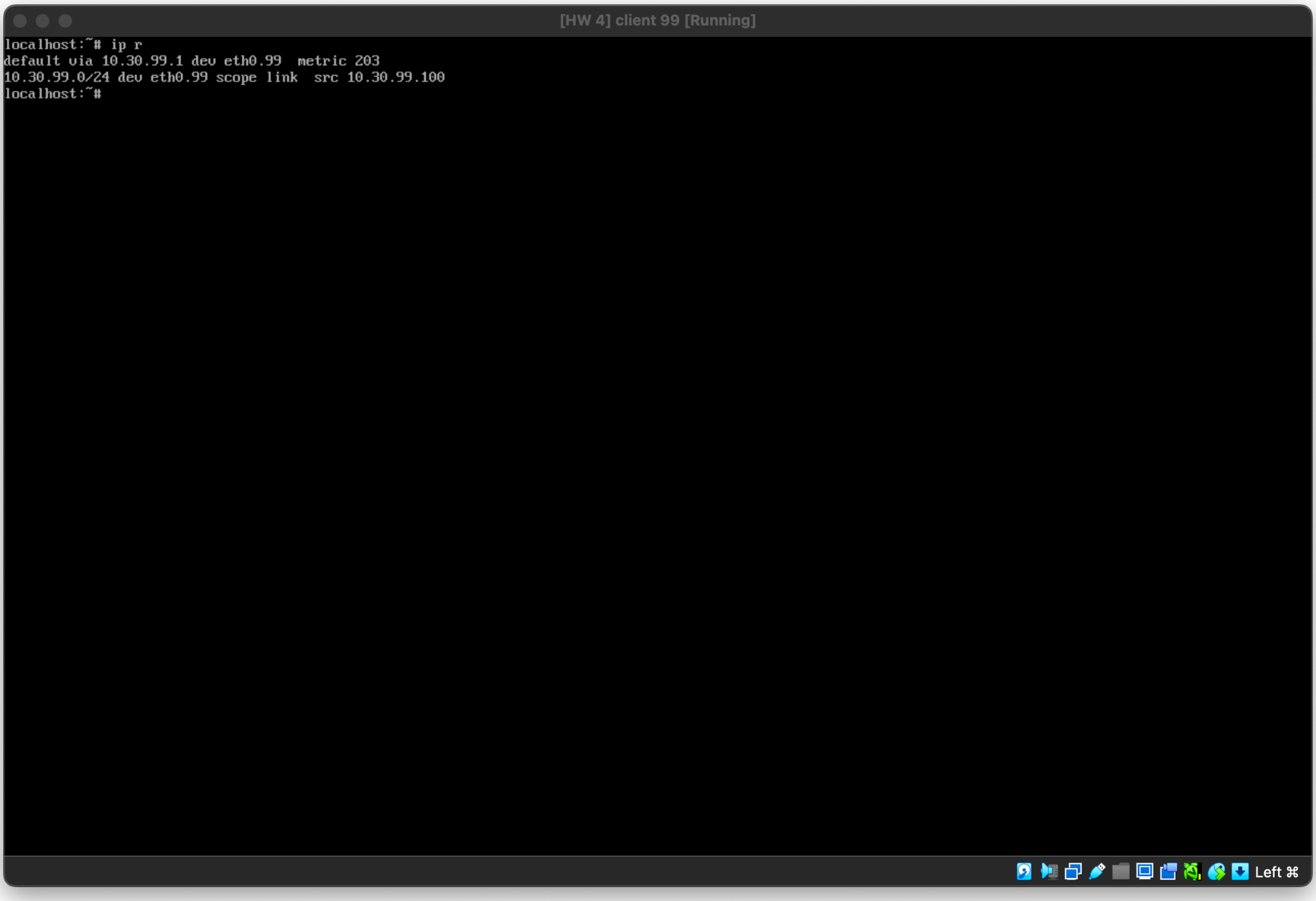
1. Go to `Firewall` > `Aliases`
2. Click the plus sign
3. Type `ADMIN_PORTS` for Name
4. Type `22,80,443,` for Content
5. Click `Save`
6. Click the plus sign
7. Type `CSIE_WS` for Name
8. Type `ws1.csie.org,ws2.csie.org,ws3.csie.org,ws4.csie.org,ws5.csie.org,ws6.csie.org,ws7.csie.org,` for Content
9. Click `Save`
10. Click the plus sign
11. Type `GOOGLE_DNS` for Name
12. Type `8.8.8.8,8.8.4.4,` for Content
13. Click `Save`
14. Click `Apply`

5.

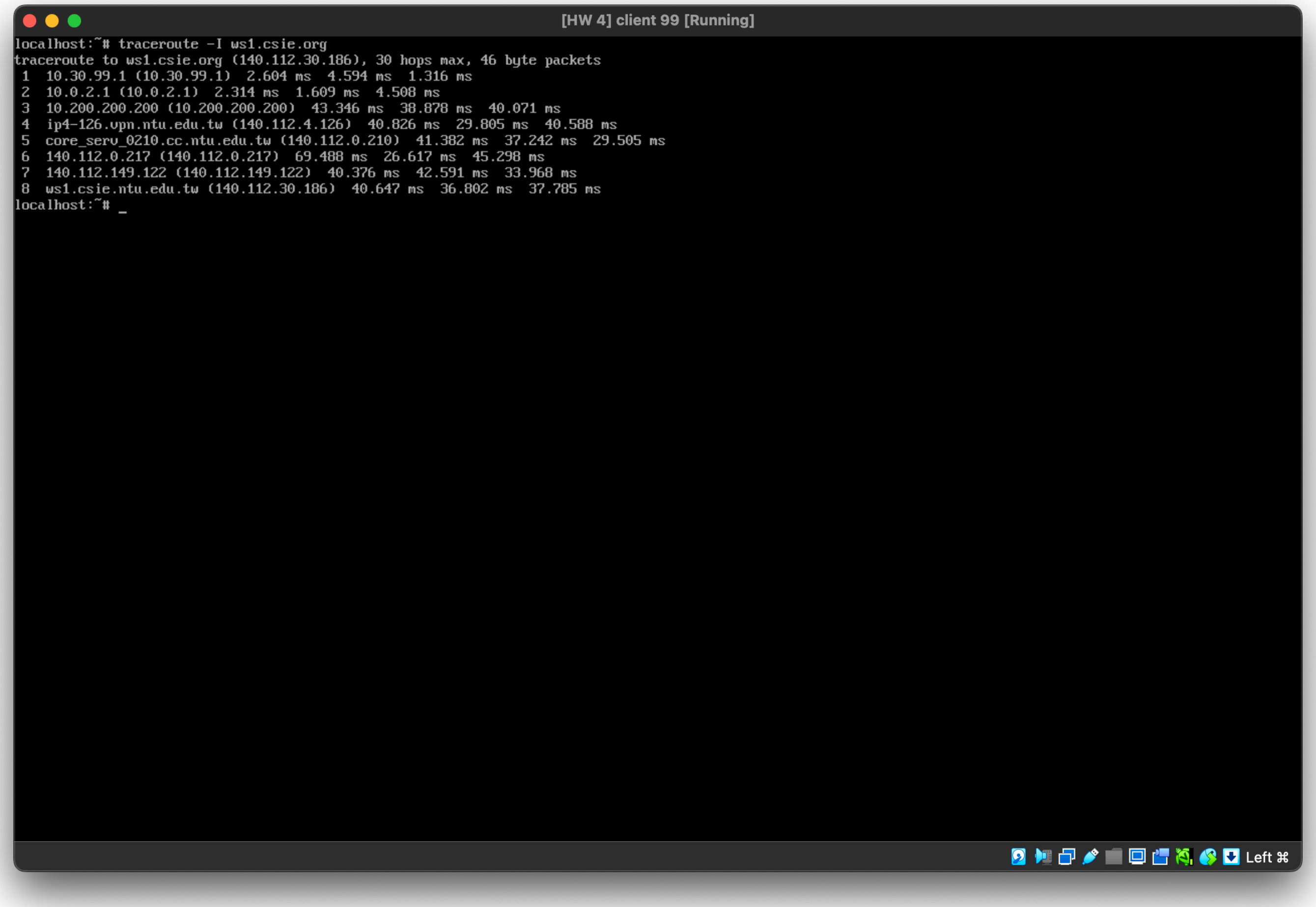
1. Go to `System` > `Settings` > `Administration`
2. At `Secure Shell`, check `Enable Secure Shell`
3. Check `Permit root user login`

4. Check `Permit password login`
5. Click `Save`
6. Go to `Firewall` > `Rules` > `VLAN99`
7. Add a new rule:
    - Action: `Pass`
    - Interface: `VLAN99`
    - Protocol: `TCP`
    - Source: `VLAN99 net`
    - Destination: `This Firewall`
    - Destination Port Range: `SSH`
    - Description: `Allow SSH to OPNsense`
8. Add a new rule:
    - Action: `Pass`
    - Interface: `VLAN99`
    - Protocol: `any`
    - Source: `VLAN99 net`
    - Destination: `This Firewall, GOOGLE_DNS, CSIE_WS`
9. Click `Apply Changes`

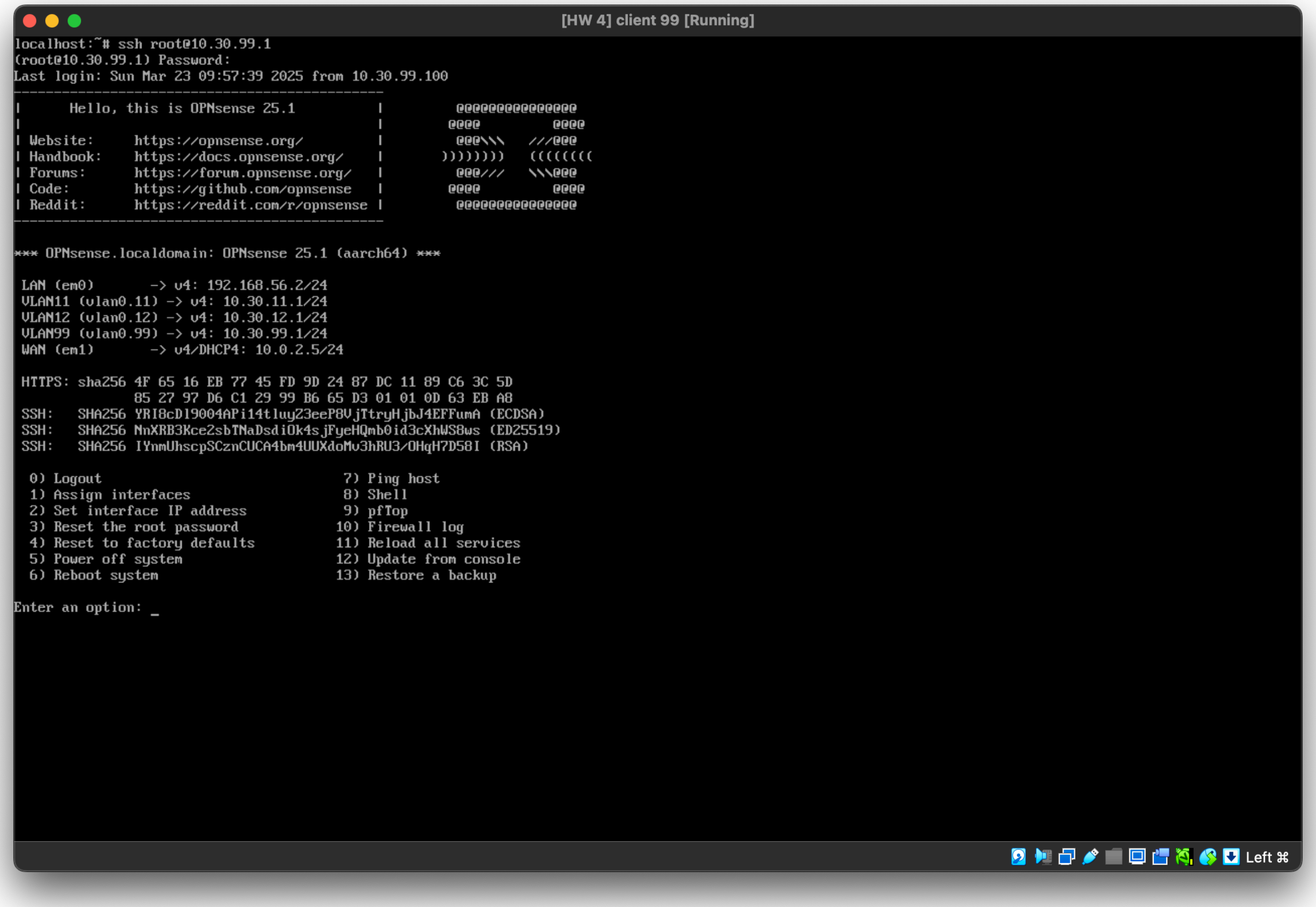
Screenshots:



```
localhost:~# ip r
default via 10.30.99.1 dev eth0.99  metric 203
10.30.99.0/24 dev eth0.99 scope link  src 10.30.99.100
localhost:~#
```



```
localhost:~# traceroute -I ws1.csie.org
traceroute to ws1.csie.org (140.112.30.186), 30 hops max, 46 byte packets
 1  10.30.99.1 (10.30.99.1)  2.604 ms  4.594 ms  1.316 ms
 2  10.0.2.1 (10.0.2.1)  2.314 ms  1.609 ms  4.508 ms
 3  10.200.200.200 (10.200.200.200)  43.346 ms  38.878 ms  40.071 ms
 4  ip4-126.vpn.ntu.edu.tw (140.112.4.126)  40.826 ms  29.805 ms  40.588 ms
 5  core_serv_0210.cc.ntu.edu.tw (140.112.0.210)  41.382 ms  37.242 ms  29.505 ms
 6  140.112.0.217 (140.112.0.217)  69.488 ms  26.617 ms  45.298 ms
 7  140.112.149.122 (140.112.149.122)  40.376 ms  42.591 ms  33.968 ms
 8  ws1.csie.ntu.edu.tw (140.112.30.186)  40.647 ms  36.802 ms  37.785 ms
localhost:~# _
```



```
localhost:~# ssh root@10.30.99.1
(root@10.30.99.1) Password:
Last login: Sun Mar 23 09:57:39 2025 from 10.30.99.100
----------------------------------------------
|      Hello, this is OPNsense 25.1          |         @@@@@@@@@@@@@@@
|                                            |        @@@@         @@@@
| Website:      https://opnsense.org/        |         @@@\\\   ///@@@
| Handbook:     https://docs.opnsense.org/   |       ))))))))   ((((((((
| Forums:       https://forum.opnsense.org/  |         @@@///   \\\@@@
| Code:         https://github.com/opnsense  |        @@@@         @@@@
| Reddit:       https://reddit.com/r/opnsense |         @@@@@@@@@@@@@@@
----------------------------------------------

*** OPNsense.localdomain: OPNsense 25.1 (aarch64) ***

 LAN (em0)       -> v4: 192.168.56.2/24
 VLAN11 (vlan0.11) -> v4: 10.30.11.1/24
 VLAN12 (vlan0.12) -> v4: 10.30.12.1/24
 VLAN99 (vlan0.99) -> v4: 10.30.99.1/24
 WAN (em1)       -> v4/DHCP4: 10.0.2.5/24

 HTTPS: sha256 4F 65 16 EB 77 45 FD 9D 24 87 DC 11 89 C6 3C 5D
               85 27 97 D6 C1 29 99 B6 65 D3 01 01 0D 63 EB A8
 SSH:   SHA256 YRI8cDl9004APi14tluyZ3eeP8VjTtryHjbJ4EFFumA (ECDSA)
 SSH:   SHA256 NnXRB3Kce2sbTNaDsdiOk4sjFyeHQmb0id3cXhWS8ws (ED25519)
 SSH:   SHA256 IYnmUhscpSCznCUCA4bm4UUXdoMv3hRU3/OHqH7D58I (RSA)

  0) Logout                              7) Ping host
  1) Assign interfaces                   8) Shell
  2) Set interface IP address            9) pfTop
  3) Reset the root password            10) Firewall log
  4) Reset to factory defaults          11) Reload all services
  5) Power off system                   12) Update from console
  6) Reboot system                      13) Restore a backup

Enter an option: _
```

6.

1. Go to `Firewall` > `Rules` > `[VLAN11]`
2. Add a new rule:
    - Action: `Block`
    - TCP/IP Version: `IPv4+IPv6`
    - Interface: `VLAN11`
    - Protocol: `any`
    - Source: `VLAN11 net`
    - Destination: `This Firewall, VLAN99 net`
    - Description: `Block VLAN11 to firewall and VLAN99`
3. Go to `Firewall` > `Rules` > `[VLAN12]`
4. Add a new rule:
    - Action: `Block`
    - TCP/IP Version: `IPv4+IPv6`
    - Interface: `VLAN12`
    - Protocol: `any`
    - Source: `VLAN12 net`
    - Destination: `This Firewall, VLAN99 net, VLAN11 net`
    - Description: `Block VLAN12 to firewall, VLAN99, and VLAN11`
5. Go to `Firewall` > `Aliases`
6. Click the plus sign to create a new alias:
    - Name: `BlockedWebsites`
    - Type: `URL Table (IPs)`
    - Content: `https://www.csie.ntu.edu.tw/~euom/colorful_websites.txt`
    - Update Frequency: `1` Day `0` Hours
7. Click `Save` and `Apply`
8. Go to `Firewall` > `Rules` > `[VLAN11]`
9. Click the plus sign to create a new rule:
    - Action: `Block`
    - TCP/IP Version: `IPv4+IPv6`
    - Interface: `VLAN11`
    - Protocol: `any`
    - Source: `VLAN11 net`
    - Destination: `BlockedWebsites`
10. Click `Save` and `Apply Changes`.
11. Repeat the steps 8, 9, 10 but for `VLAN12`
12. Go to `System` > `Settings` > `Cron`
13. Click the plus sign and configure:
    - Minute: `0`
    - Hour: `2`
    - Day of the Month: `*`
    - Month: `*`
    - Day of the Week: `*`
    - Command: `Update and reload firewall aliases`

   - Description: `Update and reload firewall aliases`
14. Click `Save` and `Apply`
15. Go to `Firewall` > `Settings` > `Schedules`
16. Click the plus sign to create a new schedule:
    - Name: `Schedule1`
    - Month: `Mon`
    - Time: ```9``00``` - ```12``00```
17. Click `Add Time` and `Save`
18. Go to `Firewall` > `Rules` > `[VLAN11]`
19. Click the plus sign to create a new rule:
    - Action: `Block`
    - TCP/IP Version: `IPv4+IPv6`
    - Interface: `VLAN11`
    - Protocol: `any`
    - Source: `VLAN11 net`
    - Destination: `any`
    - Schedule: `Schedule1`
20. Click the plus sign to create a new rule:
    - Action: `Pass`
    - TCP/IP Version: `IPv4+IPv6`
    - Interface: `VLAN11`
    - Protocol: `any`
    - Source: `VLAN11 net`
    - Destination: `any`
21. Click `Save` and `Apply Changes`.
22. Repeat the steps 18, 19, 20, 21 but for `VLAN12`

References

b12902066 (宋和峻)

7.

1. Go to `System` > `Configuration` > `Backups`
2. Click `Donwload configuration`
3. Rename the configuration file to `b12902118.xml`