HOMEWORK 1

Network Environment Setting

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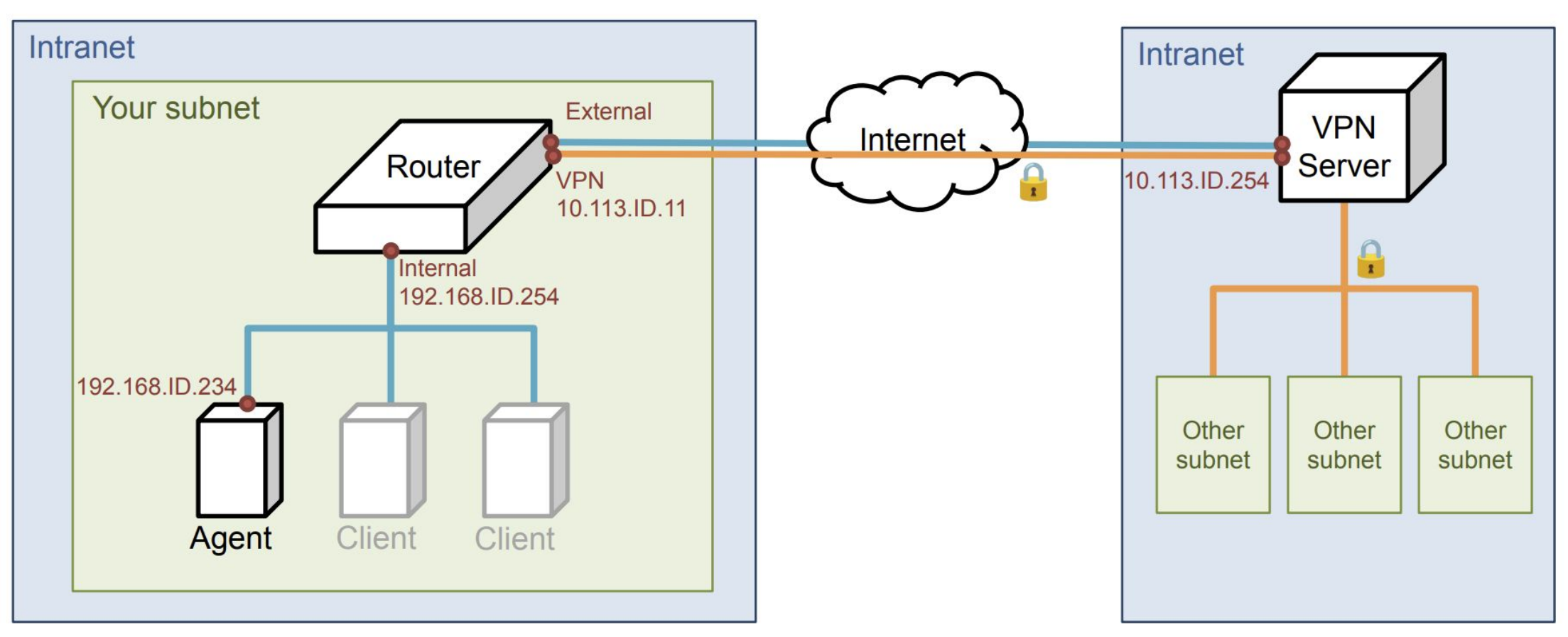
Purpose

- The goal is to build an intranet that provides several services including DHCP, NAT, VPN, DNS, Mail, LDAP, WWW, etc.
- Know what you should know about the configuration and management of these services.

Overview

- Create an intranet which contains several VMs:
  - Router
    - The only VM is directly connected to the outside world (Internet).
    - Provides NAT and DHCP.
    - Can connect to all VMs inside your subnet.
    - Can connect to the VPN server and the whole 10.113.0.0/16 intranet.
  - Agent
    - Simulates a simple VM inside your subnet to help TAs and OJ verify results.
  - Client (Optional)
    - Simulates a simple VM inside your subnet to help you verify results.

Topology (1)


Intranet
Your subnet
External
Router
VPN
10.113.ID.11
Internal
192.168.ID.254
192.168.ID.234
Agent
Client
Client
Internet
Intranet
VPN
Server
10.113.ID.254
Other
subnet
Other
subnet
Other
subnet

Definitions

- Internet
  - The IP addresses that are not in our intranet.
- Intranet
  - 10.113.0.0/16, a private network for you to do your homework.
- OJ
  - Online Judge system, https://nasaoj.cs.nycu.edu.tw/
- ID
  - See the profile page on OJ.
- Your subnet
  - 192.168.{ID}.0/24, a subnet of intranet controlled by yourself.
- VPN server
  - A WireGuard server which connects subnets together.

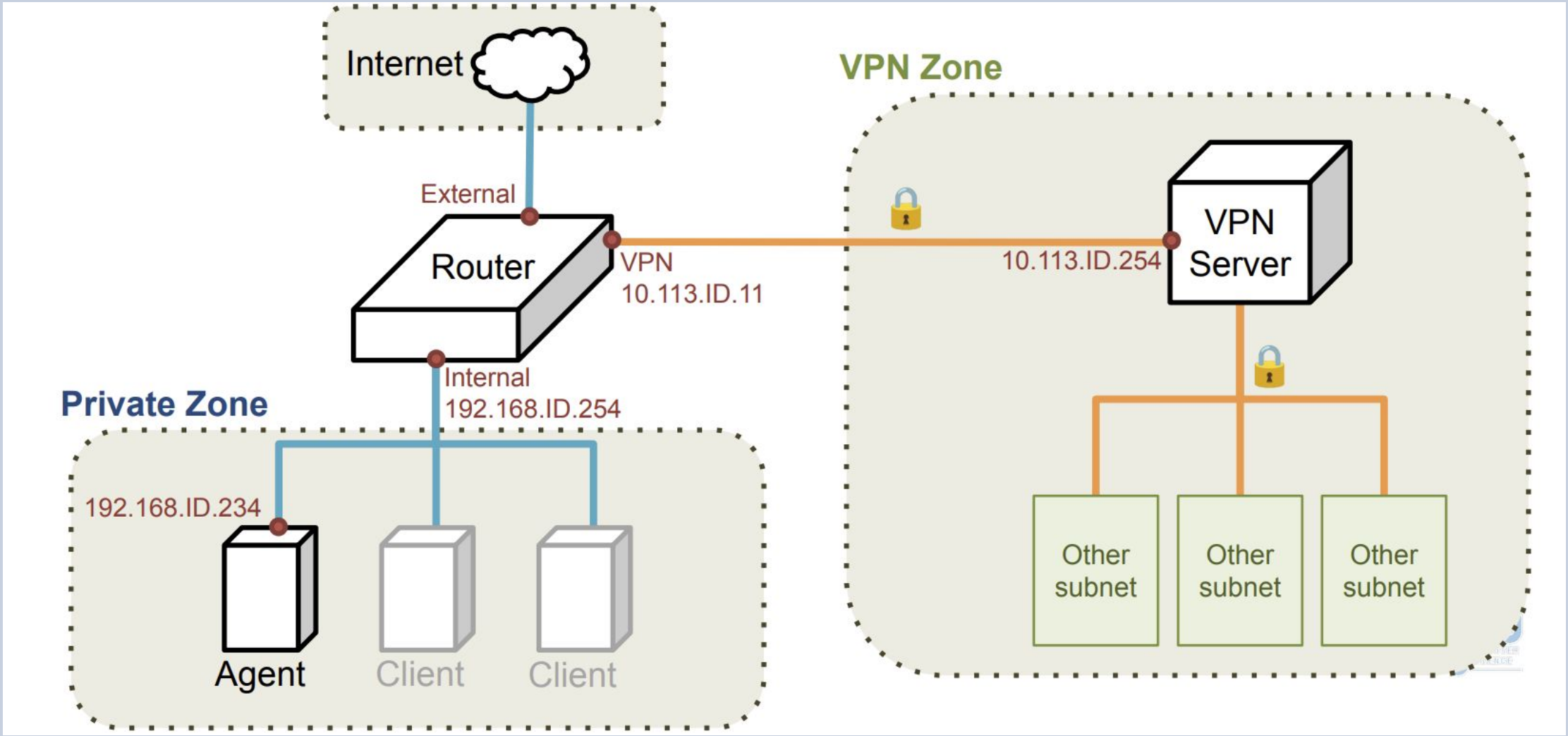
Requirements (1/4)

- Router
  - Any OS is acceptable.
  - This VM MUST have these network interfaces:
    - External: Internet facing
      - Provides NAT on this interface. Packets from your subnet can go to the Internet through this interface.
      - IP: No limitation.
    - Internal: To your subnet (192.168.{ID}.0/24)
      - Provides DHCP on this interface. IP offered by DHCP should from 192.168.{ID}.111 to 192.168.{ID}.222 .
      - IP: 192.168.{ID}.254
    - VPN: To WireGuard server and intranet (10.113.0.0/16)
      - Connected to the WireGuard server.
      - Everyone in the intranet can access your public services through this interface.
      - IP: 10.113.{ID}.11
    - Enable sshd service on port 22.

Requirements (2/4)

- Agent
  - Get this VM OVA file below, don’t install this VM by yourself.
    - Download from https://bit.ly/na2025agent
    - This VM will get IP 192.168.{ID}.234 by DHCP (Hint: MAC binding).
  - OJ will log in to “Agent” to judge your VMs’ settings.

Topology (2)


Internet
External
Router
VPN
10.113.ID.11
VPN Zone
10.113.ID.254
VPN
Server
Internal
192.168.ID.254
Private Zone
192.168.ID.234
Agent
Client
Client
Other
subnet
Other
subnet
Other
subnet

Requirements (3/4)

- Routing
  - All inbound and outbound traffic in and out your subnet should go through Router.
  - Traffic from Private zone to Internet should be NAT masqueraded.
  - Traffic from Private zone to VPN zone should not be NAT masqueraded.
  - Traffic from VPN zone to Private zone should go to its destination.

Requirements (4/4)

- Firewall
  - Consider you are providing services to the Internet, so several firewall configurations must be taken for security.
  - Configure firewall rules on Router.
  - Rules:
    - By default, all connections from Internet and VPN zone to Private zone should be rejected.
    - By default, all connections from Private zone to VPN zone should be rejected.
    - SSH connections from anywhere to “Agent” are allowed.
    - SSH connections from VPN zone to “Router” are not allowed.
    - ICMP connections from anywhere to anywhere are allowed.
    - Allow HTTP (80)/HTTPS (443) from Private zone to VPN zone.

Grading

Automated grading (Online Judge), 100pts

- Enable Router’s sshd service. (5%)
- Trace Route from Agent to Internet. (15%)
- Trace Route from Agent to VPN zone. (15%)
- IP offered by DHCP should be 192.168.{ID}.111-222 (20%)
- Agent get IP 192.168.{ID}.234 by DHCP (15%)
- Check Firewall rules for Router (15%)
- Check Firewall rules for Agent (15%)

Hints

- How to check if Internet connection is fine?
  - Ping 8.8.8.8 from different VMs.
  - Ping www.google.com from different VMs.
- How to check WireGuard is connected? (Please make sure your private key is correct.)
  - Ping 10.113.$ID.254 (intranet gateway).
- In the final project, you need to deploy these service on cloud.

Attention

- Your work will be tested by Online Judge system.
  - You can submit multiple judge requests. However, OJ will cool down for 10 minutes after each judge.
  - We will take the last submitted score instead of the highest score.
  - Late submissions will not be accepted.
- Make sure everything is fine after reboot.
- Backup your VM before judging every time.
  - We may do something bad when judging.
- Due date: 2025/03/13 Thu. 23:59:59

Appendix: VM Network

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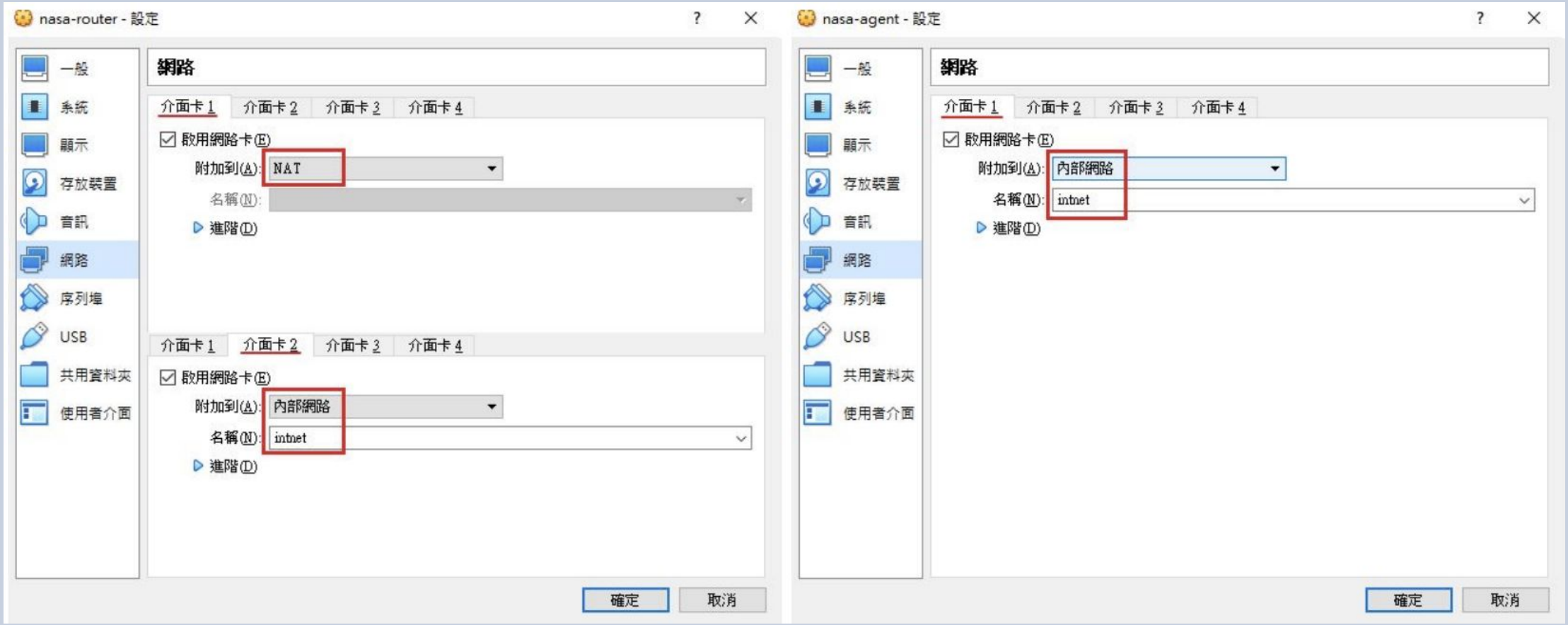
Appendix: VM Network

- We assume that you use Virtualbox. You can choose other VM hypervisor. However, the network structure should satisfy the requirements.
- About the network interfaces type (take Virtualbox as an example):
  - You can use NAT for the External interface of Router; Internal Network for the Internal interface of Router.
  - For other VMs, you should only assign an interface with the type of Internal Network. That is, all the network traffics from these VMs should go through the Internal interface of Router.

Appendix: VM Network

- VirtualBox



Appendix: How to use WireGuard

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Wireguard – Get key

- Install WireGuard
- Configurate VPN connection
  - Download the configuration file
  - Apply it to connect VPN server

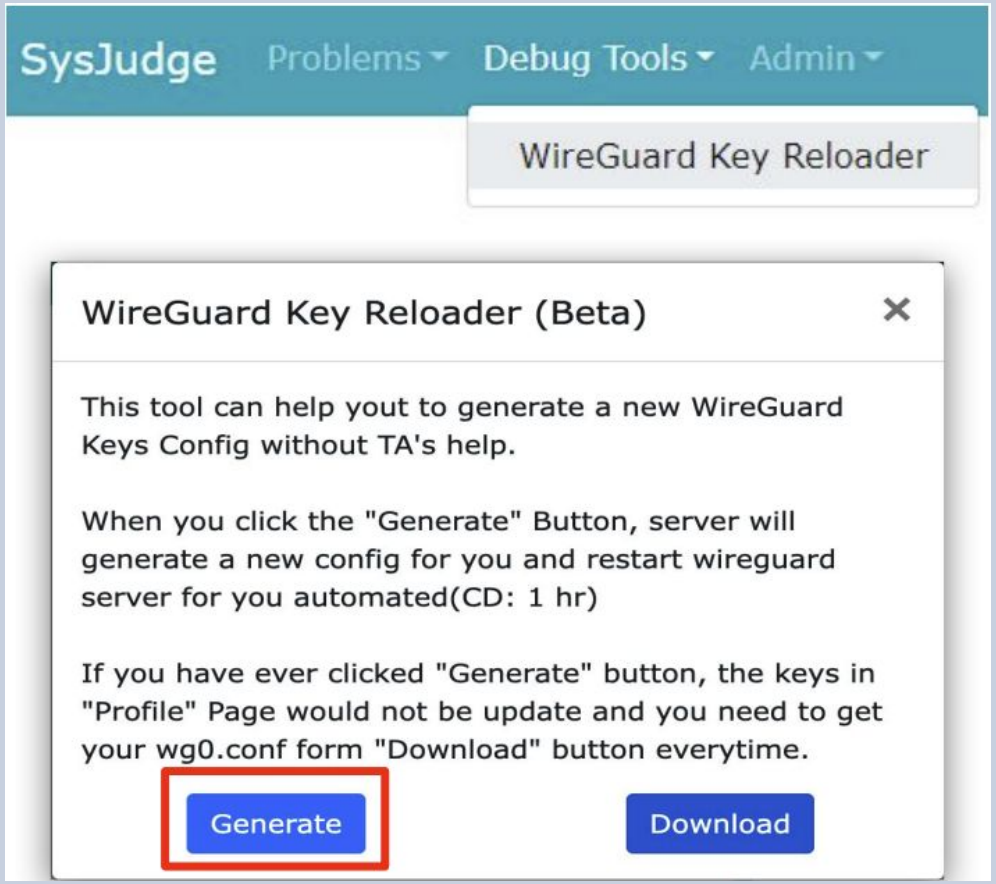
Wireguard – Configuration

- 4 IPs are provided
- You can use them to set up additional test VMs in VPN zone

```
[Interface]
PrivateKey = 6DjdaOxdYgR8yBPXTXV7Dn7pFc6iWeBiPEpvTrXI1Ek=
Address = 10.113.51.11/32

# [Interface]
# PrivateKey = GEvJ2Idm6qIF4EJTsx8ij7qymk4FOTFbSp8DgOIehm8=
# Address = 10.113.51.12/32

# [Interface]
# PrivateKey = qCZ3Eyw287d+Vp7vJTRUBiEd/hZtTajODzMSw7e4dko=
# Address = 10.113.51.21/32

# [Interface]
# PrivateKey = OLGWjXai3TPYQRMnSm0OZIuPWcinX2cFwcRXbQDRymE=
# Address = 10.113.51.22/32

[Peer]
PublicKey = j8LQIh3EB/4OsPcqzqoljMpxue4Pkib2EUPah7z25B8=
AllowedIPs = 10.113.0.0/16, 192.168.0.0/16
Endpoint = 140.113.168.131:51051
PersistentKeepalive = 15
```

Wireguard – Regenerate key

- If you cannot connect to Wireguard
  - Regenerate key and configuration file
  - Download and apply it



Appendix:
How to use Online Judge

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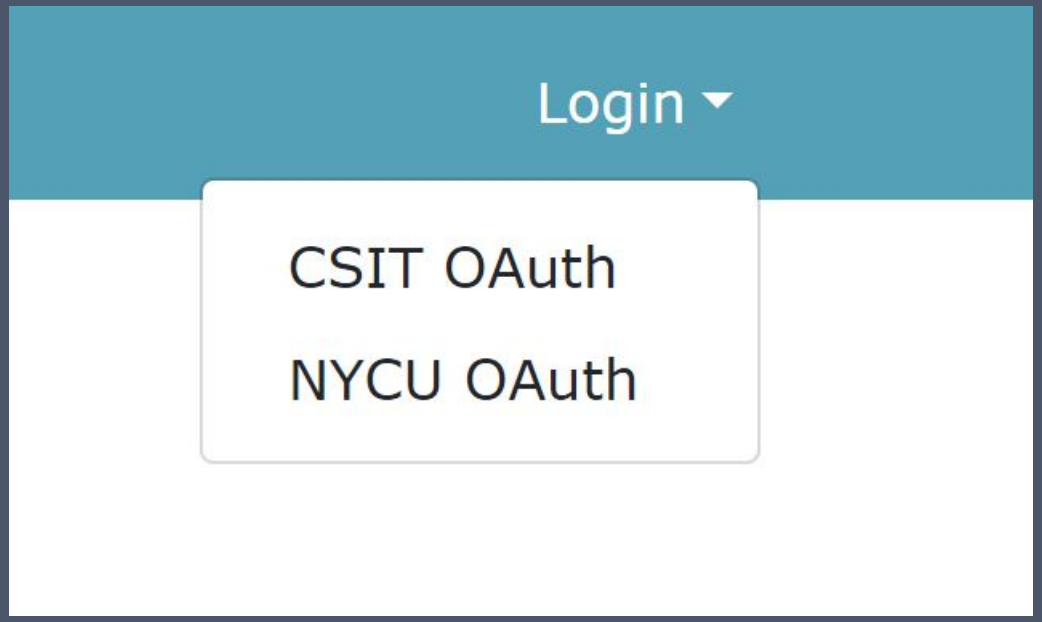
Online Judge

https://nasaoj.cs.nycu.edu.tw

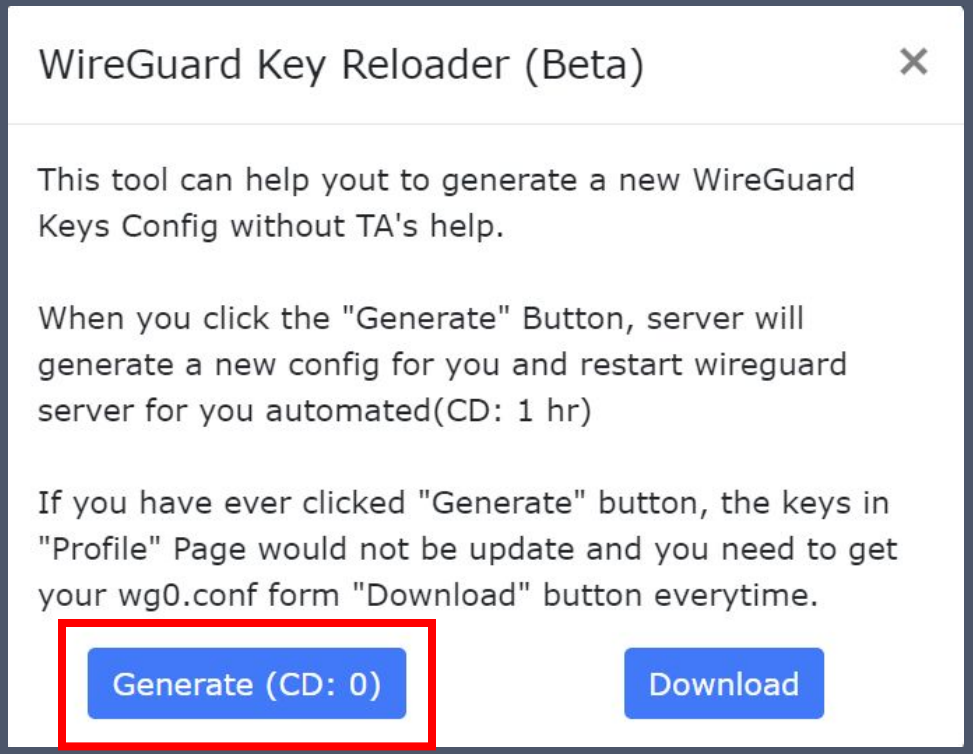
Login

Log in NASA Online Judge via either OAuth methods



Troubleshooting WireGuard® Issues

Use key reloader to regenerate configuration to solve VPN-related issues



Help

- Join NCTUNASA google group
  - If you have any question, you can post your problem in this group, TAs and Students will help you.
  - https://groups.google.com/g/nctunasa
- UNIX 常見指令教學
  - https://it.cs.nycu.edu.tw/unix-basic-commands
- How To Ask Questions The Smart Way
  - https://github.com/ryanhanwu/How-To-Ask-Questions-The-Smart-Way