Homework 4
Web Services

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Outline

- HTTP Server (40%)
  - Virtual Hosts (5%)
  - HTTPS & HTTP2 (15%)
  - Hide Server Information (5%)
  - PHP / PHP-FPM (5%)
  - Access Control (10%)

- Database (30%)
  - MySQL (10%)
  - PhpMyAdmin (5%)
  - DB Maintenance (Migration) (15%)
- Kernel Module (30%)
  - Kernel Module (15%)
  - Websocketd (15%)

HTTP Server

Virtual Host (5%)

- Setup a <u>name-based</u> virtual host.

- Show different contents based on different domain / IP.

    - Your Domain Name: <u>{ID}.nycu.cs</u>

    - Your IP: <u>10.113.0.{ID}</u>

        - {ID} is your wireguard ID
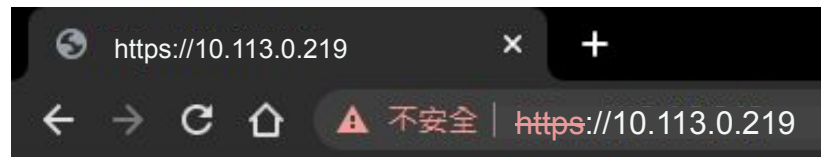
Hint:

You can use hosts file to map ip to your domain.

- On FreeBSD, CentOS: */etc/hosts*

- On Windows: *C:\Windows\System32\drivers\etc\hosts*

Virtual Host (5%)

- Please show the following contents according to different URLs.

nycu-sa-hw4-vhost

nycu-sa-hw4-ip

We will judge your work by 10.113.0.{ID} and {ID}.nycu.cs.
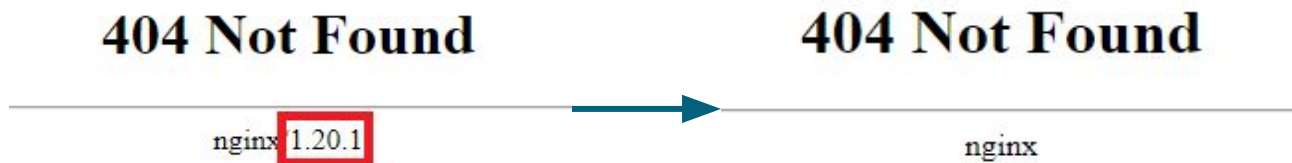Be sure to adjust your configurations accordingly.

HTTPS & HTTP/2 (15%)

- On virtual host {ID}.nycu.cs

  - Enable HTTPS

    - Please <u>sign your own certificate</u> on your domain.

  - Redirect all HTTP requests to HTTPS. (5%)

  - Enable HSTS (HTTP Strict Transport Security) (5%)

  - Enable HTTP/2 with HTTPS (5%)

Hide Server Information (5%)

- On virtual host {ID}.nycu.cs
  - Do not show the server <u>version</u> on error pages.

  - Hide Nginx/Apache <u>version</u> in header.

PHP / PHP-FPM (5%)

- On virtual host {ID}.nycu.cs

  - Create https://{ID}.nycu.cs/info-{ID}.php with PHP info page.

  - Set up PHP 8 (or higher).

  - Hide PHP version information in header.

    - But the version needs to be displayed in the PHP info page.

PHP / PHP-FPM (5%)

php version >= 8

PHP Version 8.0.13

System	FreeBSD xizhen 13.0-RELEASE FreeBSD 13.0-RELEASE #0 releng/13.0-n244733-ea31abc261f: Fri Apr 9 04:24:09 UTC 2021 root@releng1.nyi.freebsd.org:/usr/obj/usr/src/amd64.amd64/sys/GENERIC amd64
Build Date	Nov 21 2021 01:14:15
Build System	FreeBSD 130amd64-quarterly-job-03 13.0-RELEASE-p5 FreeBSD 13.0-RELEASE-p5 amd64
Configure Command	'./configure' '--with-layout=GNU' '--with-config-file-scan-dir=/usr/local/etc/php' '--disable-all' '--with-libxml' '--with-password-argon2=/usr/local' '--program-prefix=' '--enable-mysqlnd' '--enable-fpm' '--with-fpm-user=www' '--with-fpm-group=www' '--enable-embed' '--enable-dtrace' '--prefix=/usr/local' '--localstatedir=/var' '--mandir=/usr/local/man' '--infodir=/usr/local/share/info/' '--build=amd64-portbld-freebsd13.0' 'build_alias=amd64-portbld-freebsd13.0' 'PKG_CONFIG=pkgconf' 'CFLAGS=-O2 -pipe -fstack-protector-strong -fno-strict-aliasing ' 'CPP=cpp' 'CXXFLAGS=-O2 -pipe -fstack-protector-strong -fno-strict-aliasing '
Server API	FPM/FastCGI
Virtual Directory Support	disabled
Configuration File (php.ini) Path	/usr/local/etc
Loaded Configuration File	/usr/local/etc/php.ini
Scan this dir for additional .ini files	/usr/local/etc/php
Additional .ini files parsed	(none)
PHP API	20200930
PHP Extension	20200930
Zend Extension	420200930
Zend Extension Build	API420200930,NTS
PHP Extension Build	API20200930,NTS
Debug Build	no
Thread Safety	disabled
Zend Signal Handling	enabled
Zend Memory Manager	enabled
Zend Multibyte Support	disabled
IPv6 Support	enabled
DTrace Support	available, disabled
Registered PHP Streams	php, file, glob, data, http, ftp
Registered Stream Socket Transports	tcp, udp, unix, udg
Registered Stream Filters	string.rot13, string.toupper, string.tolower, convert.*, consumed, dechunk

This program makes use of the Zend Scripting Language Engine:
Zend Engine v4.0.13, Copyright (c) Zend Technologies

no php version in header

Access Control (5%)

- On virtual host <u>10.113.0.{ID}</u>

  - There is a <u>secret</u> webpage on <u>http://10.113.0.{ID}/private</u>.

    - Deny access with domain {ID}.nycu.cs.

  - When accessing the web page from <u>10.113.0.254</u>, the user is required to provide credentials (HTTP Basic Authentication).

    - Username: admin

    - Password: Your {IP} without dots. (e.g. 10113015)

  - When the webpage is accessed from <u>any other location</u> or accessed with <u>domain</u>:

    - 403 Forbidden or 404 Not Found.

    - <u>Even from localhost</u>, you still have to return 403 or 404.

Access Control (5%)


nycu-sa-hw4-private

Database

MySQL (10%)

- Create a "mortal" account (3%)
  - Username: *judge*
  - Password: Your {IP} without dots. (e.g. 101130221)
  - Can login from any host.
- Secure MySQL (4%)
  - Allow root login ONLY from localhost.
    - Password: Your {IP} without dots. (e.g. 101130221)
  - Remove test database.
- Create a database called *judge* (3%)
  - ONLY *root* have FULL privileges.
  - User *judge* have <u>SELECT privilege</u> and ONLY on this database.

PhpMyAdmin (5%)

- Build a PhpMyAdmin webside on https://{ID}.nycu.cs/phpmyadmin/.
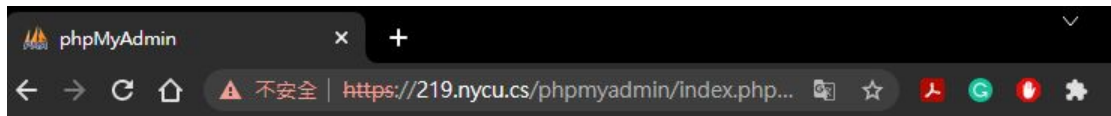
DB Maintenance (15%)

- There is a cold backup in our SA server.

  - Dump the data from server and restore to your database: *judge*. (10%)

  - The server information:

    - IP: 10.113.0.254 :3306

    - DB: OJ{ID} (e.g. OJ221)

    - Account: {ID} (e.g. 221) / Password: {IP} without dots (e.g. 101130221)

- Store the dump data temp file at *home/judge/PrivKey.sql* (5%)

Kernel Module

Kernel Module (15%)

- Write a kernel module for add a device driver `/dev/sockn`.

- When you run <u>`echo "hello" > /dev/sockn`</u> (or any other writing action), `/dev/sockn` must save the message into the buffer of sockn kernel module. Please overwrite old buffer data.

- When you run <u>`cat /dev/sockn`</u> (or any other reading action) , you will get:
  - Line 1: the value of `sysctl vm.uma.socket.stats.current`, is the amount of socket
  - Line 2 and following: the message saved in the buffer of sockn.

Kernel Module (15%)

```
$ cat /dev/sockn
16
$ echo "hello" > /dev/sockn
$ cat /dev/sockn
16
hello
$ echo "world" > /dev/sockn
$ cat /dev/sockn
16
world
```

Kernel Module (15%)

- You can download the C source code of sockn kernel module from

  https://nasa.cs.nctu.edu.tw/sa/2021/sockn.c

- You have to build the kernel module and load it, pleass refer to

  https://docs.freebsd.org/en/books/arch-handbook/driverbasics/

  and other FreeBSD doc.

Kernel Module (15%)

- Scoring
  - Kernel module "`sockn`" is loaded and `/dev/sockn` exists (5%)
  - `/dev/sockn` works well. (10%)

WebSocket (15%)

- A WebSocket is a persistent connection between a client and server.

- Use websocket to keep logging your output of `/dev/sockn`.

  - Show new output of `/dev/sockn` every second.

  - The format of each websocket message is <u>a,b</u>

    - <u>a</u>: The first line of the output from `/dev/sockn`

    - <u>b</u>: The second line of the output from `/dev/sockn`

WebSocket (15%)

- Create a new domain **{ID}_ws.nycu.cs** without HSTS.

  - ws://{ID}_ws.nycu.cs/wsconnect on port 80 (5%)

- Add websocket proxy on **{ID}.nycu.cs**

  - wss://{ID}.nycu.cs/wsconnect on port 443 (5%)

Hint: websocketd

WebSocket (15%)

- Create a webpage (5%)

  http://{ID}_ws.nycu.cs/wsdemo.html

  to connect to
  - ws://{ID}_ws.nycu.cs/wsconnect on port 80
  - wss://{ID}.nycu.cs/wsconnect on port 443
- And show your results side by side on that webpage. (See next slide)
- Bonus: Add a line chart to show changes of the amount of sockets (first line of /dev/sockn). (+5%)

Hint: You might need to trust your self-signed certificate to see wss on your browser.

WebSocket (15%) (Example)

Start

ws: wss:

https://imgur.com/a/Az70egl

Hints

1. You can use **Apache** or **Nginx** to complete this homework.

2. Although you can not test your setup in 10.113.0.x network, you can use ip from another interface or port forwarding.

3. If you find your system too slow, please consider adding more RAM to it.

4. If wss or https did not work, make sure you have trusted the self-signed certificate.

Homework 4

1. BACKUP your server before judge EVERY TIME.

2. We may do some things bad when judging.

3. TAs reserve the right of final explanations.

4. Start scoring at 2021/11/27 00:00

5. Deadline: 2021/12/20 23:59

Help me! TA!

- TA time: 3 GH at EC 324 (PC Lab) or by appointment (mail us).

- Questions about this homework

  - Ask them on https://groups.google.com/g/nctunasa

  - We <u>MIGHT</u> give out hints on google group

    - Be sure to join the group :D

  - Do not use E3 to email us.

Good Luck!