Construction of a Web Server with a Database Facility Using Open Source Software

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This report is about using an open source operating system for constructing a web server. We chose the FreeBSD open source operating system. The following covers the installation and configuration of this operating system including MySQL database, Apache2.0 server and PHP5.0 script applications.

Keywords: Web Server, FreeBSD, Database, Open Source Software

1. Introduction

This report explains my research of information technology at Tsuyama National College of Technology for six months. I conducted research work and professional development for information technologies including server construction, database technology, Java language, etc. This report is about using an open source operating system for constructing a web server with a database facility. We chose the FreeBSD open source operating system. The report covers the installation and configuration of this operating system including MySQL database, Apache2.0 server, PHP5.0 script "phpMyAdmin" applications; all of open source software1).

2. FreeBSD and its Installation

FreeBSD2) is an open source operating system derived from BSD, the version of UNIX developed at the University of California, Berkeley. FreeBSD is widely used to support the core infrastructure of many companies worldwide. Because it can be built with a small footprint, it is also seeing increased use in embedded applications. The licensing terms of FreeBSD do not require the distribution of changes and enhancements to the system unlike the licensing terms of Linux. Thus, we can distribute our developed result at ease3).

2.1 FreeBSD Installation4)

We are able to select from two boot methods that use a CD-ROM or a floppy disk on a stand-alone machine. We have opted for booting from the CD-ROM because of its high-speed and stable process. The bootable CD-ROM is made from the ISO images that can be downloaded from many FreeBSD mirror sites2). After setting the BIOS for booting from CD-ROM, we set the bootable CD-ROM and are able to start up from it.

After the Installer start, a keyboard setting is required. Many keyboard types exist, such as English and Japanese versions, so we have to configure the keyboard setting for better convey potential. Below is a Japanese version of the keyboard settings. We chose Country Selection, 110 Japan (Fig.1), then Japanese 106.

```
Countries in Asia
Select a country or region

Cambodia
China
Cyprus
Georgia
Hong Kong
India
Indonesia
Iran
Iraq
Israel
Japan
Jordan
Kazakhstan
Korea (Democratic People's Republic of)
Korea (Republic of)
Kuwait
```

Fig.1 The Country Selection

We have to create partitions on FreeBSD. An FDISK partition area is created for operation and installation of FreeBSD. Here is the hard disk capacity of the entire FreeBSD area. This can be set using the Custom Installation. We select Custom from the Main menu and

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then select Partition menu.

Partition: hard disk partitioning

We are not using other operating systems, so we create the partitions at once. If we want to delete slice first, we will be continuing to Delete Slice.

Delete Slice -- Deleting old partition: shortcut - ［D］

Create Slice -- Creating new partition for FreeBSD: Shortcut-［C］

We have to select the Bootable Set to the disc from start to Standard Install. We selected a standard MBR（no boot manager）because the boot manager is not necessary in our case.

We next set Label allocated disk partitions. Here, we selected "AUTO". If AUTO is selected, there is no need for later processing. The hard disk partitioning is terminated.

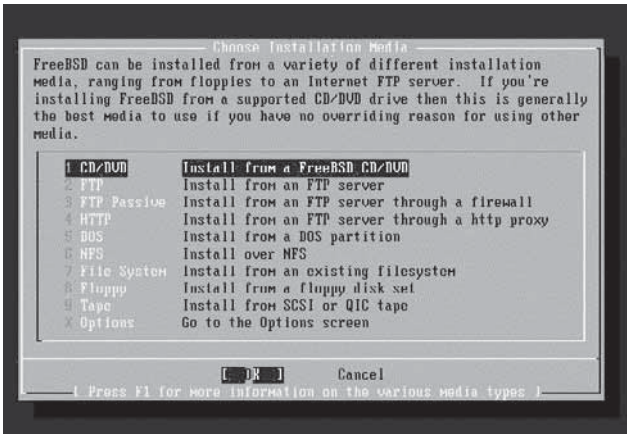
Then we deploy a distributed file selection Actual use and disk space according to the clued-up installation choices.

Distributions: distribution to be installed

Select Developer menu: Ports are unnecessary, so "No" is chosen. Select Window System, and then enter "X EXIT". The choice is terminated.

We chose the media used during the installation.

Media: "Choose Install Media" menu boot. This is a CD-ROM installation procedure, "a CD/DVD" menu is selected（Fig.2）. At this point, we select the end of the installation.



```
Choose Installation Media
FreeBSD can be installed from a variety of different installation
media, ranging from floppies to an Internet FTP server.  If you're
installing FreeBSD from a supported CD/DVD drive then this is generally
the best media to use if you have no overriding reason for using other
media.

  1 CD/DVD       Install from a FreeBSD CD/DVD
  2 FTP          Install from an FTP server
  3 FTP Passive  Install from an FTP server through a firewall
  4 HTTP         Install from an FTP server through a http proxy
  5 DOS          Install from a DOS partition
  6 NFS          Install over NFS
  7 File System  Install from an existing filesystem
  8 Floppy       Install from a floppy disk set
  9 Tape         Install from SCSI or QIC tape
  X Options      Go to the Options screen

                 [  OK  ]      Cancel
[ Press F1 for more information on the various media types ]
```

Fig.2 Choose Install Media

We go into practice final confirmation expansion after the partition labeling. We select Commit by selecting "Yes", and then the installation process will begin.

After a while FreeBSD's hard disk installation is complete at a state of minimum requirement. So the "Requested User Configuration" menu is running. Select the "Yes" and press Enter, a "Configuration" menu begins. Here, we will explain environment settings and other important settings.

Now the minimum installation completed. However, it is necessary to set the "root" password. "root" is an administrator user to be able to manage all environments. Therefore, we have to set carefully the root password. Others can modify the system for the firm if the password is set aside.

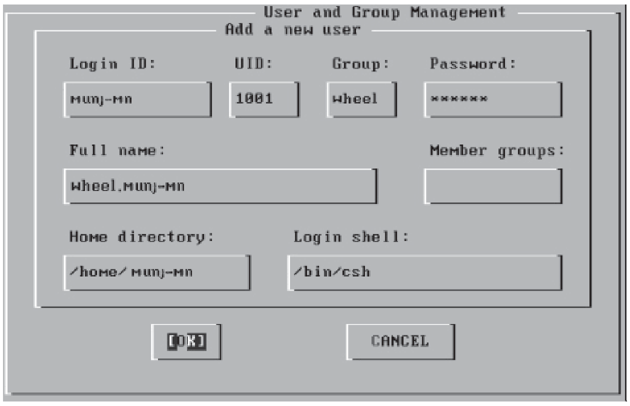
2.2 FreeBSD Configuration

（1）User Configuration Management

It is undesirable to access the entire root system environment by a normal user account. So we have to use a general account user. Here, we added general user registration. Using "User Add" we are able to add a new user to select the system（Fig.3, Table 1）.

Table 1　Adding new user to FreeBSD

Fields	Values	Notes
Login ID	munj-mn	User's login name
Group	wheel	User's group you can create new user group
Password	xxxxxxx	User's login password
Home directory	/home/munj-mn	
Login shell	/bin/csh	



User and Group Management

Add a new user

Login ID: munj-mn

UID: 1001

Group: wheel

Password: *******

Full name: wheel.munj-mn

Member groups:

Home directory: /home/ munj-mn

Login shell: /bin/csh

Fig.3 Adding new user to FreeBSD

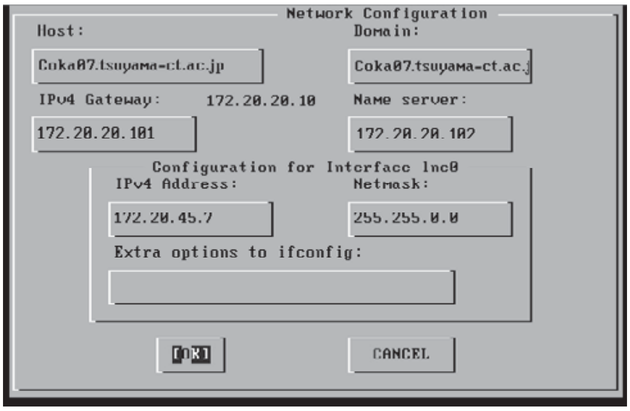
In the console settings we select "Saver" and choose "Daemon".

For time zone settings, the following is selected. The first time a local setting is required, select "NO". The set ends with a CMOS clock to set the world standard time, or the time in Japan. Here, we choose the local time by answering "Yes" for "Asia", "Japan" and the "Confirmation". This is the end of the time zone selection.

Then Network Configuration is required. We set Networking using the Network Services Menu to select from the Interface. Network Configuration is shown in Table 2 and Fig.4. This is an example used in a private network only.

Table 2 Network configurations values

Fields	Values	note
Host:	coka07	Enter to host name
Domain:	center.tsuyama-ct.ac.jp	Enter to domain name
IPv4 Gateway:	172.20.20.101	Internet gateway's IP
Server Name:	172.20.20.102	Name server's IP
IPv4 Address	172.20.45.7	Own IP
Netmask	255.255.0.0	This is a B class



Host: Coka07.tsuyama-ct.ac.jp

Domain: Coka07.tsuyama-ct.ac.j

IPv4 Gateway: 172.20.20.10

172.20.20.101

Name server: 172.20.20.102

Configuration for Interface lnc0

IPv4 Address: 172.20.45.7

Netmask: 255.255.0.0

Extra options to ifconfig:

Fig.4 Network configuration

3. Installation of Server Applications

We have installed all of the open source server applications: MySQL[5) 5.1.22-rc, Apache[6) 2.0, PHP[7) 5.2.4 (latest versions). The installation was done by using following standard commands[8,9).

```
% cd - changing directory
% tar zxvf - extract archive
% cp or mv - coping or moving file
% vi - opening file with editing
% ./configure - setting to configure of
 installation
% make - making file list
% su - changing general user to root
# make install - making install
# chmod - changing mode of file and
 directory permission
```

3.1 MySQL Installation

First, we added the following user and group by using Sysinstall tool.

```
User: mysql
Group: mysql
```

Next, we extracted the source of mysql5.1.22-rc.

```
%tar zxvf mysql5.1.22-rc.tar.gz
```

Then, we created a Make file to compile by configure script, and then made and installed it as follows.

```
% cd mysql5.1.22-rc
% ./configure - with-charset=utf8
 - with-exrta-charsets=all-with-mysqld-user
 -mysql-prefix=/usr/local/mysql
 -localstatedir=/pub/mysql/data
% make
% su
# make install
```

We made a Configuration file.

```
# cp [Mysql source directory]/support-files/
my-large.cnf.sh/etc/my.cfg
```

Then we added this line to our cnf file.

```
Datadir=/pub/mysql/data
```

At the end, we initialized MySQL.

```
# /usr/local/mysql/bin/mysql_install_db-user
=mysql
# chown -R mysql /usr/local/mysql
# chgrp -R mysql /usr/local/mysql
# /usr/local/mysql/bin/mysqld_safe
 -user=mysql&
# /usr/local/mysql/bin/mysqladmin -u root
 password xxxxxxxx
```

Note: xxxxxxxx - this is mysql root password, we are able to set to this password.

3.2 Apache 2.0 Installation

First, we extracted the source of httpd-2.0.61.

```
% tar zxvf httpd-2.0.61.tar.gz
```

Then, we created a Make file to compile by configure script, and then made and installed it.

```
% cd httpd-2.0.61
% ./configure - enabled so-module=so
% make
% su
# make install
```

We have to install two libraries for character manipulation. First the libxml installation was done as follows.

```
% tar zxvf libxml
% cd libxml
% ./configure
% make
% su
# make install
```

Second we installed libiconv （conversion code library）.

```
% tar zxvf libiconv-1.11
% cd libiconv-1.11
% ./configure
% make
% su
# make install
```

3.3 PHP 5.2.4 Installation

First, we extracted the source of php-5.2.4.

```
% tar zxvf php-5.2.4.tar.gz
```

Then, we created a Make file to compile by configure script, and then made and installed it as follows.

```
% cd php-5.2.4
%./configure -with-mysql=/usr/local/mysql
 -with-apxs2=/usr/local/apache2/bin/apxs-wit
h-tsdrm
 -pth -enabled -mbsrting -enabled mbstr
 -trans -enc -enabled -trans -sid -enable
 -versioning - with -dom -with zlib -dir -
% make
% su
# make install
# cp php.ini-dist /usr/local/lib/php.ini
```

We changed the path for Sendmail in php.ini.

```
# vi php.inin-dist /usr/local/lib/php.ini
# sendmail_path = /usr/sbin/sendmail-t
```

And we modified the httpd.conf file.

```
# cd /usr/local/apache2/conf
# vi httpd.conf
```

＊ Adding a module （second row in front of the line）

```
Loadfile /usr/local/mysql/lib/mysql/libmysql
client.so
loadModule php_5 modules/libphp5.so
```

* Setting up directory index

```
directoryIndex index.php, index.html, index.
htm
Add the following lines AddType
AddType application/x-httpd - php.php
AddType application/x-httpd-php-source.phps
```

At the end of the PHP installation, we installed and configured "phpMyAdmin". The phpMyAdmin is a tool written in PHP intended to handle the administration of MySQL over the Web[10]. We extract the source, and then open the configuration file in order to set the MySQL username and password.

```
% tar zxvf phpmyadmin.tar.gz
% cd phpmyadmin
% vi [phpmyadmin source directory]/config.in
c.php
```

* Setting to mysql username and password

```
$cfg['Servers'][$i]['user'] = 'root';
       //mysql user name for example: root
$cfg['Servers'][$i]['password'] ='xxxxxxxxx'
      //your mysql user password;
```

3.4 Some System Configurations

Because the FreeBSD is installed with the minimum function that can be used, we have to make several system configurations for system security, significant alterations, record of logs and so on. Here we report some system configurations by using the Sysinstall tool and vi editor.

（1） Setting up FTP log

The Select configure --> networking --> inetd from Main menu in the Sysinstall. Then you can see inetd.conf file with editor （Fig.5）. If you want to disable a service, comment it out by prefixing the line with '#'. If we want to enable a service, then remove the '#' at the beginning of the line.

```
# $FreeBSD: src/etc/inetd.conf,v 1.70.2.2 2006/09/07 20:03:25 obrien Exp $
#
# Internet server configuration database
#
# Define *both* IPv4 and IPv6 entries for dual-stack support.
# To disable a service, comment it out by prefixing the line with '#'.
# To enable a service, remove the '#' at the beginning of the line.
#
ftp     stream  tcp     nowait  root    /usr/libexec/ftpd       ftpd -l
#ftp    stream  tcp6    nowait  root    /usr/libexec/ftpd       ftpd -l
#ftp    stream  tcp     nowait  root    /usr/libexec/lukemftpd  ftpd -l -r
#ftp    stream  tcp6    nowait  root    /usr/libexec/lukemftpd  ftpd -l -r
#ssh    stream  tcp     nowait  root    /usr/sbin/sshd          sshd -i -4
#ssh    stream  tcp6    nowait  root    /usr/sbin/sshd          sshd -i -6
#telnet stream  tcp     nowait  root    /usr/libexec/telnetd    telnetd
#telnet stream  tcp6    nowait  root    /usr/libexec/telnetd    telnetd
#shell  stream  tcp     nowait  root    /usr/libexec/rshd       rshd
#shell  stream  tcp6    nowait  root    /usr/libexec/rshd       rshd
#login  stream  tcp     nowait  root    /usr/libexec/rlogind    rlogind
#login  stream  tcp6    nowait  root    /usr/libexec/rlogind    rlogind
#finger stream  tcp     nowait/3/10 nobody /usr/libexec/fingerd fingerd -s
#finger stream  tcp6    nowait/3/10 nobody /usr/libexec/fingerd fingerd -s
#
/etc/inetd.conf: unmodified: line 1
```

Fig.5　Setting to FTP log

（2） Configuration of rc.conf file

rc.conf file contains about FreeBSD operating system information for the main configuration. It is impossible to explain this in detail here, so we will mention one example of configuration to set FreeBSD to a hostname and a global IP address （Fig.6）.

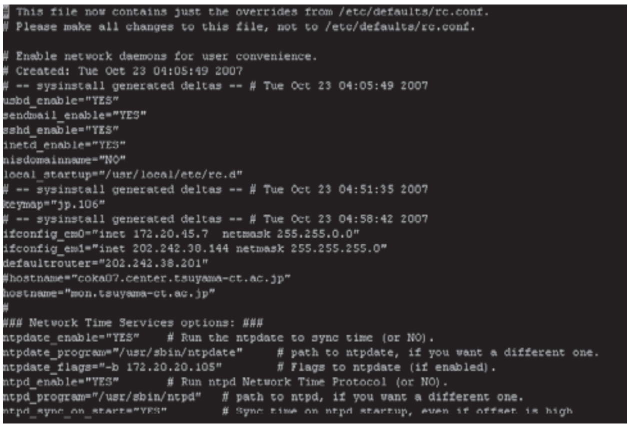
1. Open /etc/rc.conf file using text editor such as vi:

```
# vi /etc/rc.conf
```

2. Set to following lines

```
ifconfig_em0="inet 172.20.45.7 netmask 255.2
55.0.0
ifconfig_em1="inet 202.242.38.144 netmask 25
5.255.255.0"
defaultruoter="202.242.38.201"
#hostname="coka07.center.tsuyama-ct.ac.jp"
```

```
hostname="mon.tsuyama-ct.ac.jp"
```



```
# This file now contains just the overrides from /etc/defaults/rc.conf.
# Please make all changes to this file, not to /etc/defaults/rc.conf.

# Enable network daemons for user convenience.
# Created: Tue Oct 23 04:05:49 2007
# -- sysinstall generated deltas -- # Tue Oct 23 04:05:49 2007
usbd_enable="YES"
sendmail_enable="YES"
sshd_enable="YES"
inetd_enable="YES"
nisdomainname="NO"
local_startup="/usr/local/etc/rc.d"
# -- sysinstall generated deltas -- # Tue Oct 23 04:51:35 2007
keymap="jp.106"
# -- sysinstall generated deltas -- # Tue Oct 23 04:58:42 2007
ifconfig_em0="inet 172.20.45.7  netmask 255.255.0.0"
ifconfig_em1="inet 202.242.38.144 netmask 255.255.255.0"
defaultrouter="202.242.38.201"
#hostname="coka07.center.tsuyama-ct.ac.jp"
hostname="mon.tsuyama-ct.ac.jp"
#
### Network Time Services options: ###
ntpdate_enable="YES"    # Run the ntpdate to sync time (or NO).
ntpdate_program="/usr/sbin/ntpdate"     # path to ntpdate, if you want a different one.
ntpdate_flags="-b 172.20.20.105"        # Flags to ntpdate (if enabled).
ntpd_enable="YES"       # Run ntpd Network Time Protocol (or NO).
ntpd_program="/usr/sbin/ntpd"   # path to ntpd, if you want a different one.
ntpd_sync_on_start="YES"        # Sync time on ntpd startup, even if offset is high
```

Fig.6 Setting up to hostname and global IP address

(3) Automatically start up MySQL server at system initial boot time

Make sure that MySQL server starts automatically whenever FreeBSD comes up after reboot. FreeBSD provided this facility via /etc/rc.conf file (system configuration information). This file lists which services should be started up at system initial boot time. The rc.conf file contains the global system configuration information referenced by the startup scripts, while rc.conf.local contains the local system configuration.

We configured FreeBSD to start up MySQL Server at system initial boot time as following.

1. Open /etc/rc.conf file using text editor such as vi:

```
# vi /etc/rc.conf
```

2. Append following line, so it will be enabled that MySQL server starts automatically after each reboot:

```
Mysql enabled="YES"
```

3. Save file and exit to shell prompt.

4. Conclusion

From July through December 2007 I conducted research work and professional development at Tsuyama National College of Technology in Japan. During this time, I completed the following tasks.

* Installing and configuring the FreeBSD open source operating system

* Installing packages and applications necessary for a fully operational web server with a database facility using MySQL, Apache and PHP

* Installing fully operational Dynamic web services based on PHP, Java script, etc.

These were experimental efforts and were very successful. During these six months, I have gained extensive knowledge in Java programming, database (MySQL), PHP script language and so on.

Acknowledgment

I would like to express my gratitude for both the opportunity to expand my technical knowledge and also for the many wonderful memories I will carry with me always. In particular, I would like to thank President Takeji Abe, Professor Masanori Fukuda, Professor Tadashi Okada, the Mayor of Shoo town Mr. Takashi Nishida and all of the staff of Tsuyama National College of Technology.

Furthermore, I wish all of the students of Tsuyama National College of Technology every success in their studies.

I sincerely hope that Tsuyama National College of Technology in Japan and Mongolian University of Science and Technology in Uvurkhangai will continue their cooperation and build a bright future for us all.

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