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# Securing a Multi-User Solaris 8 SPARC System

## Software/Hardware Preparation

### **Scenario**

This paper describes the process for securing a Sparc based server with Solaris 8 operating system for remote access. The users often travel and work from home, and they need to have access to this machine over the Internet for transferring files and connecting to other machines in the internal network computing resources. The users should be able to connect to this machine, store and transfer files, run their own applications in the home directories, and launch X-based applications from other X-terminals (the system is an X client).

Security will be implemented considering that the system will be a general multi-user system. The focus of this paper is on protecting sensitive information that may travel over the internet using OpenSSH and TCP Wrappers. In addition, measures are taken to *protect* the system by minimizing the potential holes and protecting the file system to prevent unauthorized access, and configuring the system to prevent and minimize the damages from denial of service attacks by internal and external threats while maintaining the availability of necessary services, manageability and system performance.

### **Hardware Preparation:**

Two Sparc-based machine is required to carry out the steps presented in this paper:

- **One Sparc based machine to be used as a UNIX system to be used as an access point over ssh.**
- **One Sparc based machine to be used as a development platform to download, verify and compile necessary software components to be installed in the above system with an Internet connection (http and ftp for viewing the manuals in the web and to download necessary software) .**

Both machines are UltraSparc 10 with 256Mb RAM, and 10 Gb internal SCSI hard disk. A CD-Rom drive and an 8mm tape drive are used to install Solaris 8 operating system and transfer files from the development machine to the production machine.

### **Software Preparation**

Solaris 8 Operating System CDs and Solaris 8 Operating System Update 07/01 are needed carry out the steps presented in the following sections. Follow the steps for each hardware platforms: development and production ssh server.

#### Development System

1. Install Solaris 8 operating system with the Development Cluster option.
2. In addition the operating system CDs (disk 1 and 2) required to install the operating system, the following software should be obtained to follow the steps presented in this paper; download, or prepare the following software in the specified format (in a suitable directory). If the link does not work, go to <http://www.sunfreeware.com> and other web sites to locate the appropriate links updated versions of these software:

### **GCC Compiler**

Precompiled binaries can be obtained and installed to compile TCP Wrappers 7.6 and OpenSSH 3.0p1. The Solaris Software Companion CD included with Solaris 8 operating system Update 07/01 provides a convenient mechanism to install the compilers and other necessary software components such as flex, bison, binutils, gmake and other library files.

### **TCP Wrappers 7.6**

Purpose: This software is a wrapper program used to monitor and control the access to TCP based services such as telnet, ftp, etc. Even though it can be used to improve the security posture significantly, it is still vulnerable to IP spoofing attacks. To improve the security of remote access to these services, this paper recommends that it is used to manage OpenSSH connections. See next section for the description of OpenSSH.

Source download: <ftp://ftp.porcupine.org/pub/security/index.html>

Source file name: tcp\_wrappers\_7.6.tar.gz

### **OpenSSH 3.0p1**

This software is used to replace insecure network services such as rlogin, rcp, ftp, etc. These services pose vulnerability because they transmit sensitive access information unencrypted. OpenSSH provides an asymmetric encryption based authentication mechanism to authenticate the hosts. In addition, proper router and firewall configuration, and the use of Intrusion Detection Systems (IDS) can further improve the security.

Source download: <http://www.openssh.com/portable.html>

Solaris precompiled binary download (v2.9): <http://www.sunfreeware.com>

Source file name: openssh-3.0p1.tar.gz

### **FixModes**

Purpose: A solaris permissions hardening scripts. It removes group and world writable permissions. The changes are made to all files and directories that are

listed in in /var/sadm/install/contents with the exception of those listed in exceptions.h file.

Source and Precompiled download

<http://www.sun.com/blueprints/tools/FixModes.html>

Source file name: FixedModes.tar.Z

### **Solaris 8 Security Patches**

Install recommended and security patches from SunSolve Online (<http://sunsolve.sun.com>).

File name: 8\_Recommended.zip

3. Install GCC compiler. Insert the CD onto the development system, and double-click “installer”, follow the graphical user interface to install the following group of applications.

- Development/Languages
- Development/Libraries
- Development/Tools

The gcc compiler binary is located in */opt/sfw/bin* by default.

4. Set the PATH environment variable.

```
# PATH = $PATH:/opt/sfw/bin:/usr/ccs/bin
# export PATH
```

Now, the development machine is ready for compiling the TCP wrappers, OpenSSH and Fixmodes.

## **Solaris OS Installation (Target Production Host)**

### **Installation Precaution**

First, install the operating system on the production server without connecting to the network, as the production system could possibly be compromised during the installation.

### **Minimization**

Added software components often translate into more labor and complexity to secure and maintain the software. Minimizing the software components down to bare necessities is not an easy task either because most software application vendors do not precisely state which packages are required to run their application. For the initial installation procedure in this paper, “Solaris Operating System Minimization for Security”, November 2000 from Sub BluePrints Online was used to identify the necessary packages that needs to be installed and many of the unnecessary packages that can be removed.

Starting at the OK> prompt, reboot the system using the cd-rom.

```
OK> boot cdrom
```

1. Select a language: 0
2. Network: yes
3. Use DHCP: No – It will be a Internet ready server.
4. Hostname: <enter hostname>
5. IP Address: <enter ip>
6. Part of Subnet: Yes
7. Subnet mask: <enter subnet>
8. IP v6: <yes if IP v6 support is required>
9. Configure Kerberos Security: No
10. Name Service: none
11. Time zone: Geographic Region
12. Select appropriate region
13. Select Date and Time
14. Select “Initial Installation”
15. Select Geographic Regions, and select only the languages that are necessary.
16. “U.S.A. (en\_US\_ISO8859-1)”
17. Select “Core System Support”
18. Require 64-bit support? yes
19. If yes, click select to include Solaris 64bit support.

Assign space for each of the following partitions:

- The minimum required operating system components will take less than 50 mb of the root partition, but the extra space provides protection against root partition being filling up, and crashing the system. Some may say it’s too much.

```
/ 512 Gb
```

- Assign enough space to holds log files.

```
/var 512 Mb
```

- Assign space for user home directories.

```
/export 6 Gb
```

- Assign space for installing applications

```
/usr 1.5 Gb
```

```
/opt 1 Gb
```

- Assign swap space double the size of RAM

```
swap 512 Mb
```

## **Add other packages such as NTP and zlib.**

Using this command,

```
# pkgadd -d /cdrom/Solaris_8/Product <Package Name>
```

Install the following additional packages:

### **TermInfo Database and System Accounting Package**

```
SUNWter  
SUNWaccr  
SUNWaccu  
SUNWzlib  
SUNWwice
```

### **NTP**

```
SUNWntpu  
SUNWntpr
```

### **For OpenSSH X Tunneling**

```
SUNWxcu4  
SUNWxcu4x  
SUNWxwplt  
SUNWxwplx  
SUNWxwrtl  
SUNWxwrtx  
SUNWswmt  
SUNWxwice  
SUNWxwicx
```

Then, install 109667-03 patch that fixes several serious NTP bugs, and configure at least three time servers by editing `/etc/inet/ntp.conf`:

```
server <time server ip 1> prefer  
server <time server ip 2>  
server <time server ip 3>
```

“prefer” argument should assigned to the time server that is believed to be most accurate, but the other two server can check against the preferred time server when it significantly deviates from the other two time servers.

If external ntp server is outside the firewall, NTP port 123 should be open.

## Security Patches

Install recommended and security patches from SunSolve Online (<http://sunsolve.Sun.COM/pub-cgi/show.pl>). Once the patch cluster is downloaded from the site, verify the checksum of the downloaded files using a MD5 utility.

File name: 8\_Recommended.zip (As of 12/11/2001)

Unzip 8\_Recommended.zip file, and run *install\_cluster* script.

It is important that security patches are applied before taking other system hardening measures because some patches may overwrite the changes that are made. In addition, the application of some patches will result in the installation of previously removed software components. The patches can be selectively applied, but it is easier at this stage to install the patch cluster, and then remove the unnecessary packages identified in the next section.

## Removal of Unnecessary Packages

Appendix A contains the list of packages that can be removed from the system. The source of this list was taken from <http://www.enteract.com/~lspitz/jump-remove.txt>, and this list was compiled from JASS security toolkit from Sun Microsystems web site (<http://www.sun.com/blueprints/tools>). The list in Appendix A developed for Netscape iPlanet Webserver, but this list is used here because this example will require even less number of packages than iPlanet Webserver.

```
# /usr/sbin/pkgrm <package name>
```

When additional applications are installed later, identify all required packages for the Internet application to run as specified by the vendor. Remember to identify and apply the latest security patches after necessary Operating System packages are installed.

## Configure Gateway

Create `/etc/defaultrouter` file that contains the IP address of the router.

```
# echo XXX.XXX.XXX.XXX > /etc/defaultrouter
```

Create `/etc/notrouter` to disable router capabilities.

```
# touch /etc/notrouter
```

## Configure Name Service

Because the machine was off-line during the installation, name service was not configured. At this point `resolve.conf` should be created, and it should contain

```
domain <company>.com
nameserver <ip of the dns>
search <company>.com
```

/etc/nsswitch.conf should contain

```
hosts: files dns
```

so that /etc/hosts file has the priority just in case DNS is compromised.

## **Console Security**

For the maximum security of a host, it should be placed where physical access to the system is restricted. At the minimum, it needs to be locked, and it should only be accessible by the administrator who is maintaining the host.

Also, the system should be protected against the power outage, and occasional surges. The server should be connected to a UPS (uninterruptable power supply) and appropriate surge protector.

The server should stay unavailable until the administrator restores the system. This measure may increase the downtime, but when the machine is shutdown, the administrator gets the first chance to troubleshoot the system.

```
# eeprom security-mode=full
# eeprom security-password=
```

**Note:** “Sun Operating System Security “, April 2001 states that EEPROM password can not be recovered, and SunService needs to be contacted for a new EEPROM. Some EEPROMs in Sparc machines can be reset by physically powering off, powering back on, and holding [STOP] [N] keys simultaneously until EEPROM prompts for a new password.

To monitor password login guessing add the following line to an initialization script.

```
# eeprom security-badlogins=0
```

Later, typing

```
# eeprom security-#badlogins
```

will reveal the number of bad logins.

In addition, disable the keyboard abort sequence by uncommenting the following line in /etc/default/kbd file

```
KEYBOARD_ABORT=disable
```

This measure will prevent users from using Stop-A sequence to gain access to boot prompt.



## **Login and Password**

Edit /etc/default/login file to set the login policy.

```
# The root user can only log in directly from the
# system console. PermitRootLogin parameter in
# OpenSSH server configuration will actually limit the
# ability to log on as root over the network.
CONSOLE = /dev/console

# Set the initial PATH settings for root to ensure that
# PATH initially points to the right directories.
# The administrator will have to use su when they are using
# ssh to login over the network.
SUPATH = /usr/sbin:/usr/bin

# Set the initial shell file creation mode so that the user
# created files are not writable by group, and not accessible
# at all by other users
UMASK = 027

# log failed login attempts
SYSLOG_FAILED_LOGIN = 0
```

Make sure the umask is not overridden to a value less strict than 027 in the following files:

```
/etc/.login
/etc/profile
$HOME/.cshrc
$HOME/.login
$HOME/.profile
```

where \$HOME is the home directory for each users (verify as users are added to the system).

Set the password policy by editing /etc/default/passwd file. Set the maximum time period for a passwd to 13 weeks so that user passwords will change every 3 months or so, and the minimum time period to 1 week to prevent users from changing password multiple times in a short period time to set the password back to the original password. The password length makes the passwords more difficult to guess to prevent not only manual guesses, but also to make it harder for a hacker to crack password hashes in case he/she was able to obtain them.

```
# /etc/default/passwd file
MINWEEKS = 1
MAXWEEKS=13
PASLENGTH=8
```

## **Boot Scripts**

Disable the following boot script using the convention used by Hal Pomeranz's Solaris "Security Step-by-Step". Rename these files by attaching ".NO" in the beginning so that the new file name would be ".NO<previous filename>".

- Disable NFS because NFS traffic flows in cleartext.

```
/etc/rc2.d/S73nfs.client -> /etc/rc2.d/.NOS73nfs.client
/etc/rc3.d/S15nfs.server -> /etc/rc3.d/.NOS15nfs.server
/etc/rc2.d/K28nfs.server -> /etc/rc2.d/.NOK28nfs.server
/etc/rc2.d/S74autofs -> /etc/rc2.d/.NOS74autofs
```

- RPC (Remote Procedure Call) uses IP address and UID for authentication, and is not generally secure. This installation does not require RPC.

```
/etc/rc2.d/S71rpc -> /etc/rc2.d/.NOS71rpc
/etc/rc2.d/S76nsd -> /etc/rc2.d/.NOS76nsd
```

- This machine is not a e-mail server. E-mails can be sent out from this machine without a mail server daemon running.

```
/etc/rc2.d/S88sendmail -> /etc/rc2.d/.NOS88sendmail
```

- This machine is not configured to use ldap

```
/etc/rc2.d/S71ldap.client -> /etc/rc2.d/.NOS71ldap.client
```

- Solaris auto-configuration services are not needed.

```
/etc/rc2.d/S30sysid.net -> /etc/rc2.d/.NOS30sysid.net
/etc/rc2.d/S71sysid.sys -> /etc/rc2.d/.NOS71sysid.sys
/etc/rc2.d/S72autoinstall -> /etc/rc2.d/.NOS72autoinstall
```

### **Filesystem Mount Options**

Security of the system can be enhanced by using read-only and nosuid mount option. No suid files should be present outside root (/) or /usr partition. In the target host, software application that require suid attributes in /opt partition should be avoided. /var directories and /export/home needs to have "write" access, but suid files should not be executed from those directories.

Edit /etc/vfstab so that the following directories and partitions will mount with the following options:

<b>mount point</b>	<b>mount option</b>
/	-
/usr	ro (read only)
/var	nosuid (suid does not work)
/export/home	nosuid (suid does not work)
/opt	nosuid, ro (read only)

Later, when additional software needs to be installed under /usr or /opt partition, temporarily change the mount option to rw, shutdown and restart the system. /usr directory can only be unmounted by shutting down the system.

Until reboot, additional software (OpenSSH) can still be installed because read-only has not taken effect. In addition, OpenSSH requires its configuration directory to be writable, and it will reside in /etc/ssh directory.

### **Legal Notifications**

/etc/motd file will be displayed in the incoming ssh connections. This file needs to contain warning messages that the activities in the system will be monitored for unauthorized and inappropriate use.

### **Vendor Default Accounts**

The following users except should be either locked or assigned “no password” so that they could not be used to log in. They also need to be assigned an unusable shell:

```
daemon
bin
sys
adm
lp
nobody
nobody4
uucp
nuucp
listen
```

```
# passwd -l <username> will assign “*LK*” in the password field.
```

```
# passwd -e <username>
```

```
when prompted to enter the new shell type,
```

```
New shell: /bin/false
```

### **Auditing**

Enable the login of failed login attempts (via /usr/bin/login) by creating an empty loginlog file.

```
# touch /var/adm/login
```

```
# chmod 600 /var/adm/login
```

```
# chown root:sys /var/adm/loginlog
```

Repeat the above procedure for /var/log/authlog file

In addition, add the following line to /etc/syslog.conf. This step is required to enable the logging of unsuccessful login attempts.

```
auth.info    /var/log/authlog
```

Edit /etc/lib/newsyslog script to configure log rotation. See Appendix C for the updated newsyslog script. Appendix C rotates syslog, authlog, and loginlog logs, and sets secure permissions on those files that they may not be exploited.

Consider configuring syslog.conf that a central loghost that will store the logs by adding the following line to the syslog.conf file. This provides a back-up in case the system is compromised, and the attacker has deleted the log information on the host.

```
auth.warning ifdef (`LOGHOST`, /var/log/authlog, @loghost)
```

Configure the loghost to accept the logs from this host.

### **Sendmail**

Sendmail server was disabled at the next reboot because the sendmail server boot script has been renamed in the previous section. However, it needs to be able to send mail.

Download sendmail file from <http://www.sun.com/blueprints/tools/> to the development box, and place it in /etc/default directory in the production system.

The content of this configuration file is included with this report in Appendix B. The installation of this configuration file allows the periodic flushing (15 min) of the mail queues. This is an undocumented approach that can be used instead of adding “sendmail -q” implemented in the cron job in Solaris 8<sup>1</sup>. `MODE=""` setting /etc/default/sendmail enables this.

### **Network Settings**

The following lines should be added at the end of /etc/init.d/inetinit to protect the system from common TCP/IP based attacks on cache, spoofing, and other DoS (Denial of Service) attacks.

```
# Reduce the arp cache, and routing table entry timeout
# to 1 minute by running the following commands.
# In a congested network, increase the interval
#(specified in milliseconds) if a drastic
# performance degradation is observed.
```

```
ndd -set /dev/arp arp_cleanup_interval 60000
ndd -set /dev/ip ip_ire_arp_interval 60000
```

```
# disable responses to echo multicasts/broadcasts
```

---

<sup>1</sup> Alex Noordergraaf and Keith Watson, Sun BluePrints OnLine, April2001

```

# that can produce a large number of packets
nnd -set /dev/ip6 ip6_respond_to_echo_multicast 0
nnd -set /dev/ip ip_respond_to_echo_broadcast 0

# disable responses to timestamps (unicast and broadcast)
nnd -set /dev/ip ip_respond_to_timestamp_broadcast 0
nnd -set /dev/ip ip_respond_to_timestamp 0

# Verify address mask broadcast is turned off
nnd -set /dev/ip ip_respond_to_address_mask_broadcast 0

# Attacker might forge redirect errors to fool the
# system that a new router is in place.
nnd -set /dev/ip ip_ignore_redirects 1
nnd -set /dev/ip ip6_ignore_redirects 1

# router functions
nnd -set /dev/ip ip_send_redirects 0
nnd -set /dev/ip6 ip6_send_redirects 0
nnd -set /dev/ip ip_forwarding 0
nnd -set /dev/ip6 ip6_forwarding 0
nnd -set /dev/ip hme0:ip_forwarding 0

# a measure against connection exhaust attack.
# indirectly shorten the connection timeout setting
# much more resource is required (default = 128).

nnd -set /dev/tcp tcp_conn_req_max_q 1024

# a measure against SYN flood attack. Default is
# 1024.
nnd -set /dev/tcp tcp_conn_req_max_q0 4096

Edit /etc/default/inetinit to that improved TCP algorithm is utilized to prevent TCP
sequence prediction.
TCP_STRONG_TSS = 2

and, add the following to the end of /etc/init.d/inetinit to enable the above change.
nnd -set /dev/tcp tcp_strong_iss 2

```

## **Other Miscellaneous Configuration Files**

.rhosts and hosts.equiv files

Lock down the .rhosts and hosts.equiv files and hosts.equiv files

```

# echo "-" > /.rhosts
# echo "-" > /etc/hosts.equiv
# chmod 600 /.rhosts
# chmod 600 /etc/hosts.equiv
# chown root:sys /.rhosts
# chown root:sys /etc/hosts.equiv

```

`/etc/pam.conf`

In addition, remove those rlogin or other r-command (rsh and rlogin) related references from pam.conf file such as the following lines.

```
rlogin auth sufficient /usr/lib/security/pam_rhosts_auth.so.1
rsh auth required /usr/lib/security/pam_rhosts_auth.so.1
```

`/etc/system`

Set noexec\_user\_stack and noexec\_user\_stack\_log to the following values to protect against the buffer overflow attack:

```
set noexec_user_stack = 1
```

- disables the users from executing code on the system stack.

```
set noexec_user_stack_log =1
```

- logs any attempts to execute code on the stack.

Set maxuprc parameter to 128 on this multi-user machine to limit the number of processes per non super-user to limit resource consumption.

```
set maxuprc=128
```

Core file can be used to recover passwords or other restricted information. The following setting essentially disables the core generation

```
set sys:coredumpsize=0
```

## ***Install OpenSSH and TCP Wrappers***

### Further Preparation on the Development System

Make sure that “make” and “ar” tools are available in the PATH variable.

```
rename “/opt/sfw/bin/gmake” to “/opt/sfw/bin/make”.
# mv /opt/sfw/bin/gmake /opt/sfw/bin/make
```

Set the PATH variable to include the path to “ar” and “make”.

```
# PATH = $PATH:/usr/ccs/bin:/opt/sfw/bin
# echo $PATH
```

```
/usr/sbin:/usr/bin:/usr/ccs/bin:/opt/sfw/bin
```

```
# which ar
```

```
/usr/ccs/bin/ar
# which make
/opt/sfw/bin/
```

Set CC variable to “gcc”.

```
# CC = /opt/sfw/bin/gcc
# export CC
```

## TCP Wrappers

From the development system, unpack TCP Wappers gzipped tar ball.

```
# gzip -d tcp_warppers_ipv6_7.6.tar.gz
# tar xf tcp_wrappers_ipv6_7.6.tar.gz
```

Uncomment the REAL\_DAEMON\_DIR path from the Makefile.

```
# SysV.4 Solaris 2.x OSF AIX
REAL_DAEMON_DIR=/usr/sbin
```

Modify the FACILITY variable so all logs will be handled by the authentication log facility

```
# The LOG_XXX names below are taken from the
/usr/include/syslog.h file.
```

```
# FACILITY= LOG_AUTH    # LOG_AUTH is better place to send log
```

Run

```
# make sunos5
```

Copy the following files in the current directory to the specified location in the development machine:

- libwrap.a file to /usr/local/lib
- tcpd.h file to /usr/local/include

## OpenSSH

To install OpenSSH on the development system, OpenSSL is required. The version used here is v0.96b.

ungzip and untar the source code distribution package.

```
run config
# sh config
...
# make
...
```

```
# make install
```

```
...
```

The software is installed under the following directories.

/usr/local/bin/	executable binary utilities
/usr/local/lib/ssl	static and shared crypto/ssl libraries
/usr/local/ssl	documentation and other tools.

Unpack openssh3.0p1.tar.gz file, and cd into openssh-3.0p1 directory.

```
# gzip -c openssh3.0p1 | tar -xf
# cd openssh-3.0p1
```

set CFLAGS environmental variable to `-I/usr/local/include` so that TCP Wrapper header (tcpd.h) files can be accessed, and set LDFLAGS variable to `-L/usr/local/lib`.

```
# CFLAGS="-I/usr/local/ssl/include"
# LDFLAGS = "-L/usr/local/lib"
# sh configure -prefix=/usr/local
-sysconfdir=/etc/ssh
-with-tcp-wrappers
-without-rsh
-with-pam
```

- `-prefix` decides the top directory where OpenSSH directories are laid down.
- `-sysconfdir` decides where OpenSSH files are stored. It is stored in the root partition because `/usr` partition will be mounted “read-only”, and the configuration should be writable even though it has to be protected.
- `-with-tcp-wrappers` includes `libwrap.a` (TCP Wrapper library) so that ssh can be configured using `/etc/hosts.allow` and `/etc/hosts.deny`.
- `-without-rsh` flag will not let the system use rsh when ssh fails.
- `-with-pam` enables PAM support.

Refer to the following web-site for more available configuration options.

<ftp://ftp.ca.openbsd.org/pub/OpenBSD/OpenSSH/portable/INSTALL>

```
# make
```

```
...
```

The performance of ssh may improve when PRNGD 0.9.19 is installed. It is a random number generator pool that can generate random numbers required to generate keys, but the author is not certain about its security implications where and how these random numbers might be stored on the system. See <http://www.mail-archive.com/openssl-announce@openssl.org/msg00024.html> for details.

Transfer the following files in the current directory (where the source code resides) to the specified location in the target host:



- sshd to the production machine's /usr/local/sbin directory.
- sftp-server to the production machine's /usr/local/libexec directory.
- ssh\_prng\_cmds, ssh\_config, sshd\_config to /etc/ssh directory  
/etc/ssh/sshd\_config is the sshd configuration file. See Appendix D for sshd\_config file and ssh\_config file. The comments in the Appendix briefly describe the purpose of individual settings. See OpenSSH man pages for more detailed information about OpenSSH daemon configuration.
- ssh-keygen, sftp, slogin, ssh, scp files to /usr/local/bin directory.

## Configuring TCP Wrappers and the SSH Daemon

Create /etc/hosts.allow, and /etc/hosts.deny.

/etc/host.allow should contain what machines are allowed to access.

The following file gives ssh connection from the class C subnet.

```
#hosts within a class C network
sshd : 139.121.66.0/255.255.255.0
#x11 forwarding allowed for internal network
sshd -x11: 139.121.66.0/255.255.255.0
```

```
#additional hosts from external network
sshd : 143.120.65.26
sshd : 143.120.65.27
sshd -x11: 139.121.55.0/255.255.255.0
```

/etc/hosts.deny file looks like

```
# mail failed attempt to
ALL:ALL: /usr/bin/mailx -s "%s: connection attempt from %a"
root@localdomain.com
```

Then, edit the sshd\_config file in /etc.

- Turn the X-forwarding on by changing X11Forwarding from no to yes.
- Disable Root Login over the network by changing PermitRootLogin from yes to no.
- Review the Appendix D, and verify that the settings are identical.
- Edit the line that starts with "Subsystem sftp..." to  
"Subsystem sftp /usr/local/libexec/sftp-server"

**Note:** From the potential ssh client machines, edit /etc/ssh/ssh\_config (the client configuration file) and set the following parameters to the corresponding values.

```
ForwardAgent yes
ForwardX11 yes
```

Generate the server key and hostkey using ssh-keygen.

```
# ssh-keygen -t rsa1 -f /etc/ssh/ssh_host_key -N ""
# ssh-keygen -t rsa -f /etc/ssh/ssh_host_rsa_key -N ""
# ssh-keygen -t dsa -f /etc/ssh/ssh_host_dsa_key -N ""
```

Create a script (/etc/init.d/sshd) with the following content:

```
case "$1" in
'start')
    if [ -x /usr/local/sbin/sshd -a -f /etc/ssh/sshd_config ]; then
        /usr/local/sbin/sshd -f /etc/ssh/sshd_config

# sshd daemon is called with sshd_config file. Make sure these files
# exist.

        fi
        ;;
'stop')
    kill 'cat /etc/ssh/sshd.pid'

# Make sure that sshd_config file has a line
# "PidFile /etc/ssh/sshd.pid" or
# the PidFile has to match the path to sshd.pid file

        ;;
*)
    echo "Usage: $0 { start | stop }"
        ;;
esac
exit 0

# ln -s /etc/init.d/sshd /etc/rc3.d/S70sshd
```

So that sshd will start at reboot.

To verify that sshd is listening,

```
# telnet localhost 22
```

```
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.
SSH-1.99-OpenSSH_3.0p1
```

## Disable Inetd

At this point, network services such as telnet, ftp and other unnecessary network services are still enabled through inetd daemon. ssh has already been installed and configured with

TCP wrapper, so inetd service should be disabled by killing inetd process and renaming /etc/sbin/inetd binary to /etc/sbin/inetd.bak-and /etc/inetd.conf to /etc/inetd.conf.bak.

```
# ps -ef | grep inetd
```

```
root 159  1 0 Oct 16 ?    0:00 /usr/sbin/inetd -s
```

and

```
# kill -9 159
```

```
# mv /etc/sbin/inetd /etc/sbin/inetd.bak
```

```
# mv /etc/inetd.conf /etc/inetd.conf.bak
```

Edit /etc/init.d/inetsvc script, and comment out the following line that initiates inetd daemon.

```
# /usr/sbin/inetd -s &
```

### **Filesystem Permissions**

When the operating system and the necessary software is installed, lock down the filesystem permissions to further tighten the security.

Solaris 8 contains many binaries with group-write bits set. A tool written by Casper Dik removes group and world-write permissions from the files listed in /var/sadm/install/contents.

Download fix-modes from <ftp://ftp.fwi.uva.nl/pub/solaris/fix-modes.tar.gz> to the development system. Uncompress and compile the file, and copy “secure-modes” and “fix-modes” files to the target machine. Put them in /usr/local/fix-modes/, and restrict their permissions to 700 root:root.

Run fix-modes by typing the following:

```
# sh fix-modes
```

For those files that are somehow not listed in that file, run the following command to identify those files with group or world write permissions. To find out if any files in the system contain group or world writable permissions, type

```
# find / -type f \( -perm -u+w -o -perm -g+w \) -ls > /tmp/group_writable
```

and view the output file.

Also, take a note of all the setuid and setgid files.

```
# find / -type f \( -perm -u+s -o -perm -g+s \) -ls > /tmp/seguid_setgid
```

and view the output file.

Set-uid, and set-gid files, especially when combined with group or world writable permissions, can become a serious security threat. Run the following command to identify the set-uid and world writable files.

```
# find . -type f -perm -4002 -ls
```

Remove set-uid and world-writable *permissions* immediately upon identification.

```
# chmod -s <filename>
# chmod -w <filename>
```

### **Testing and Backup**

The production system is now set up. Connect this system to the network for testing purpose. If the test is unsatisfactory, remove the network connection, and resolve the problem.

Testing (from the production machine)

1. Reboot the machine. Verify that the console prompts for the password.
2. Verify that the changes made in Network Settings section are in effect.

e. g) Run the following

```
# ndd /dev/arp arp_cleanup_interval
```

instead of

```
ndd -set /dev/arp arp_cleanup_interval 60000
```

and verify that the settings are in effect.

Substitute the other devices (/dev/tcp, /dev/ip, etc) and parameters described in network settings section to verify that the settings are in effect.

3. Verify the following daemons are not running

```
rpcbind
cachefs
sendmail
inetd
automountd
nfsd
```

**Example:**

```
# ps -ef | grep inetd
```

```
root 165 1 0 19:01:37 ? 0:00 /usr/sbin/inetd -s
```

4. Verify that syslogd is running from step 3.

5. Verify that the NFS, RPC, and inetd related ports are NOT open by running the following command (use `-an` option instead of `-a` to verify the port numbers):

```
# netstat -a

* ftp ..... LISTEN
* telnet ..... LISTEN
* sunrpc ..... LISTEN
* nfsd ..... LISTEN
* time ..... LISTEN
...
```

6. Verify that port 22 is open from the previous step. Port 22 is used by OpenSSH.
7. Verify that `/usr` and `/opt` partitions are not writable, and `suid` files do not work under `/var`, `/usr`, `/opt`, and `/export/home` directories.

### From another machine

8. Verify that other ssh enabled machines can connect to this machine via `ssh`, `sftp`, and `scp`. The successful first connection will prompt for the confirmation that the server host key will be trusted.
9. Verify that this host can not be accessed via `telnet`, `ftp`, `rlogin`, `rsh` and `rftp`.

### Backup

Upon successful testing, bring the machine down to the single user mode, mount fixed drives, and mount a tape drive. The backup procedure is directly taken and applied from Solaris Security Step by Step v2.0.

```
# reboot -- -s
# fsck
# mount -a
# mt /dev/rmt/0 rewind
```

Identify all the partitions

```
# df -F ufs -n

# for dir in / /var /usr /opt /export/home
do
    /usr/sbin/ufsdump 0f /dev/rmt/0n $dir
done
mt /dev/rmt/0 rewoffl
```

Make at least two back-up copies, and store them separately in secure locations.

At this point, there should be reasonable protection implemented for this machine, and others that needs to make connection to this machine.

## **Maintenance**

Now, the system should be reasonably secure. Periodically (daily), check <http://sunsolve.sun.com> to get the list of updated patches, and apply them if applicable. In addition, periodically back up the system, and consider options to analyze the backups (especially the root partition which is still writable) to verify the system integrity.

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## References

1. Solaris Operating Environment Security Updated for Solaris 8 Operating Environment, Alex Noordergraaf and Keith Watson, Sun BluePrints OnLine, April 2001
2. Solaris Operating Environment Minimization for Security: A Simple, Reproducible and Secure Application Installation Methodology Updated for Solaris 8 Operating Environment, Alex Noordergraaf, Sun BluePrints OnLine, November 2000
3. Solaris Operating Environment Network Settings for Security Updated for Solaris 8 Operating Environment, Keith Watson and Alex Noordergraaf, Sun Blueprints OnLine, December 2000
4. Solaris Security Step By Step v2.0, SANS Institute, 2001
5. [http://www.sans.org/y2k/practical/Jeff\\_Campione\\_GCUX.htm](http://www.sans.org/y2k/practical/Jeff_Campione_GCUX.htm)  
Solaris 8 Installation Checklist, Jeff Campione, 2000
6. <http://www.usenix.org/sage/sysadmins/solaris/solaris/checklist.html>  
Hardening Solaris
7. Auditing in the Solaris 8 Operating Environment, William Osser and Alex Noordergraaf, Sun BluePrints OnLine – February 2001
8. <http://www.cert.org/security-improvement/implementations/i041.08.html>  
Configuring and using syslogd to collect logging messages on systems running Solaris 2.X
9. <http://www.mail-archive.com/openssl-announce@openssl.org/msg00024.html>  
Advisory describing PRNG (Pseudo Random number generator in OpenSSL).
10. <http://lelandsystems.stanford.edu/services/ssh/sysadmin/>  
Installing Secure Shell (SSH) for Unix System Administrators
11. <ftp://ftp.ca.openbsd.org/pub/OpenBSD/OpenSSH/portable/INSTALL>  
OpenSSH Installation Instruction
12. Building and Deploying OpenSSH for Solaris Operating Environment, Jason Reid and Keith Watson, Sun BluePrints OnLine, July 2001

13. Hacking Exposed: Network Security Secrets and Solutions, 3<sup>rd</sup> Edition, [Joel Scambray](#), [George Kurtz](#), [Stuart McClure](#), September 27, 2001

14. SSH, The Secure Shell: The Definitive Guide, Daniel J. Barrett & Richard E. Silverman, O'Reilly and Associates Inc., 2001

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## Appendix A.

58 packages that can be removed from Solaris 8 Core Installation

system	SUNWadmr	System & Network Administration
Root		
system	SUNWatfsr	AutoFS, (Root)
system	SUNWatfsu	AutoFS, (Usr)
system	SUNWauda	Audio Applications
system	SUNWaudd	Audio Drivers
system	SUNWauddx	Audio Drivers (64-bit)
system	SUNWcg6	GX (cg6) Device Driver
system	SUNWcg6x	GX (cg6) Device Driver (64-bit)
system	SUNWdfb	Dumb Frame Buffer Device Drivers
system	SUNWdtcor	Solaris Desktop /usr/dt
filesystem anchor		
system	SUNWfcip	Sun FCIP IP/ARP over
FibreChannel Device Driver		
system	SUNWfcipx	Sun FCIP IP/ARP over
FibreChannel Device Driver		(64 b it)
system	SUNWfcp	Sun FCP SCSI Device Driver
system	SUNWfcpx	Sun FCP SCSI Device Driver (64-
bit)		
system	SUNWfctl	Sun Fibre Channel Transport
layer		
system	SUNWfctlx	Sun Fibre Channel Transport
layer (64-bit)		
system	SUNWftpr	FTP Server, (Root)
system	SUNWftpu	FTP Server, (Usr)
system	SUNWi15cs	X11 ISO8859-15 Codeset Support
system	SUNWilcs	X11 ISO8859-1 Codeset Support
system	SUNWkey	Keyboard configuration tables
system	SUNWluxdx	Sun Enterprise Network Array sf
Device Driver (64-bit)		
system	SUNWluxop	Sun Enterprise Network Array
firmware and utilities		
system	SUNWluxox	Sun Enterprise Network Array
libraries (64-bit)		
system	SUNWm64	M64 Graphics System
Software/Device Driver		
system	SUNWm64x	M64 Graphics System
Software/Device Driver		(64-bit)
system	SUNWmdi	Sun Multipath I/O Drivers
system	SUNWmdix	Sun Multipath I/O Drivers (64-
bit)		

system	SUNWnamow	Northern America OW Support
system (Root)	SUNWnistr	Network Information System,
system (Usr)	SUNWnisu	Network Information System,
system Ethernet Driver	SUNWpcelx	3COM EtherLink III PCMCIA
system	SUNWpcmci	PCMCIA Card Services, (Root)
system	SUNWpcmcu	PCMCIA Card Services, (Usr)
system	SUNWpcmcx	PCMCIA Card Services (64-bit)
system	SUNWpcmem	PCMCIA memory card driver
system	SUNWpcser	PCMCIA serial card driver
system	SUNWpl5u	Perl 5.005_03
system	SUNWpsdpr	PCMCIA ATA card driver
system	SUNWrmodu	Realmode Modules, (Usr)
system Driver	SUNWses	SCSI Enclosure Services Device
system Driver (64-bit)	SUNWsesx	SCSI Enclosure Services Device
system	SUNWsndmr	Sendmail root
system	SUNWsndmu	Sendmail user
system	SUNWsolnm	Solaris Naming Enabler
system	SUNWssad	SPARCstorage Array Drivers
system bit)	SUNWssadx	SPARCstorage Array Drivers (64-
system files (64-bit)	SUNWtleux	Thai Language Environment user
system (Usr)	SUNWudf	Universal Disk Format 1.50,
system	SUNWudfr	Universal Disk Format 1.50
system bit)	SUNWudfrx	Universal Disk Format 1.50 (64-
system	SUNWusb	USB Device Drivers
system	SUNWusbx	USB Device Drivers (64-bit)
system Start runtime support	SUNWwsr2	Solaris Product Registry & Web
system	SUNWxwdv	X Windows System Window Drivers
system (64-bit)	SUNWxwdvx	X Windows System Window Drivers
system	SUNWxwmod	OpenWindows kernel modules
system (64-bit)	SUNWxwmox	X Window System kernel modules

## Appendix B. /etc/default/sendmail

```
#
# Copyright (c) 2001 by Sun Microsystems, Inc.
# All rights reserved.
#
# $Id: sendmail,v 1.1 2001/03/04 07:26:16 kaw Exp $
#
# INTRODUCTION
#
# This configuration file defines sendmail operating modes, queue
# intervals, and any additional options. Install this configuration
# file to affect changes to sendmail operations. For further
# information regarding sendmail security, see the Sun Blueprints(tm)
# OnLine article entitled "Solaris Operating Environment Security -
# updated for 8".
#
#     http://www.sun.com/blueprints/0401/security-updt1.pdf
#
# The latest version of this configuration file is available for the
# Blueprints OnLine tools area at:
#
#     http://www.sun.com/blueprints/tools/
#
# This configuration file only works for the Solaris 8 Operating
# Environment release.
#
# INSTALLATION
#
#     # cp <file> /etc/default/sendmail
#     # chmod 644 /etc/default/sendmail
#     # chown root:sys /etc/default/sendmail
#
# Keith A. Watson <keith.watson@sun.com>
#
#
# MODE
#
# This variable defines the mode in which sendmail will operate. Only
# the background mode ("-bd") and the queue mode ("") make sense in
# this context. sendmail will listen for SMTP connections and process
# queued mail in background mode. In queue mode, it will ONLY process
# queued mail.
# The default mode is "-bd" if this variable is not defined.
#
MODE=""

#
# QUEUEUINTERVAL
#
# The queue interval defines how long sendmail waits before attempting
# to process any mail in the queue. Use the following characters to
# define the time:
```

```
#
#   's' seconds
#   'm' minutes
#   'h' hours
#   'd' days
#   'w' weeks
#
# For example:
#   "15m" == 15 minutes
#   "1h"  == 1 hour
#   "3d"  == 3 days
#
# The default queue interval is "15m" (15 minutes) if this variable is
# not defined.
#
QUEUEINTERVAL="15m"

#
# OPTIONS
#
# This variable defines any additional options to sendmail.
# There is no default value for this variable.
#
OPTIONS=""
```

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## Appendix C. /usr/lib/newsyslog rotation script

```
#
#ident @Z%newsyslog      1.3      97/03/31 SMI
#
LOG=messages
cd /var/adm
test -f $LOG.2 && mv $LOG.2 $LOG.3
test -f $LOG.1 && mv $LOG.1 $LOG.2
test -f $LOG.0 && mv $LOG.0 $LOG.1
mv $LOG $LOG.0
cp /dev/null $LOG
chmod 644 $LOG
#

LOG=syslog
if test -d $LOGDIR
then
    cd $LOGDIR
    if test -s $LOG
    then
        test -f $LOG.6 && mv $LOG.6 $LOG.7
        test -f $LOG.5 && mv $LOG.5 $LOG.6
        test -f $LOG.4 && mv $LOG.4 $LOG.5
        test -f $LOG.3 && mv $LOG.3 $LOG.4
        test -f $LOG.2 && mv $LOG.2 $LOG.3
        test -f $LOG.1 && mv $LOG.1 $LOG.2
        test -f $LOG.0 && mv $LOG.0 $LOG.1
        mv $LOG $LOG.0
        cp /dev/null $LOG
        chmod 644 $LOG
        sleep 40
    fi
fi

LOG=authlog
if test -d $LOGDIR
then
    cd $LOGDIR
    if test -s $LOG
    then
        test -f $LOG.6 && mv $LOG.6 $LOG.7
        test -f $LOG.5 && mv $LOG.5 $LOG.6
        test -f $LOG.4 && mv $LOG.4 $LOG.5
        test -f $LOG.3 && mv $LOG.3 $LOG.4
        test -f $LOG.2 && mv $LOG.2 $LOG.3
```

```

        test -f $LOG.1 && mv $LOG.1 $LOG.2
        test -f $LOG.0 && mv $LOG.0 $LOG.1
        mv $LOG $LOG.0
        cp /dev/null $LOG
        chmod 644 $LOG
        sleep 40
    fi
fi
LOG=loginlog
if test -d $LOGDIR
then
    cd $LOGDIR
    if test -s $LOG
    then
        test -f $LOG.6 && mv $LOG.6 $LOG.7
        test -f $LOG.5 && mv $LOG.5 $LOG.6
        test -f $LOG.4 && mv $LOG.4 $LOG.5
        test -f $LOG.3 && mv $LOG.3 $LOG.4
        test -f $LOG.2 && mv $LOG.2 $LOG.3
        test -f $LOG.1 && mv $LOG.1 $LOG.2
        test -f $LOG.0 && mv $LOG.0 $LOG.1
        mv $LOG $LOG.0
        cp /dev/null $LOG
        chmod 644 $LOG
        sleep 40
    fi
fi
fi

/usr/bin/chown -f root:sys /var/log/syslog*
/usr/bin/chmod -f 0640 /var/log/syslog*

/usr/bin/chown -f root:sys /var/log/authlog*
/usr/bin/chmod -f 0640 /var/log/authlog*

/usr/bin/chown -f root:sys /var/log/loginlog*
/usr/bin/chmod -f 0640 /var/log/loginlog*

```

## Appendix D. SSH Configuration Files

### D.1 `sshd_config` (Server Configuration)

```
# This is the sshd server system-wide configuration file.  See sshd(8)
# for more information.
Port 22

# PidFile is used to store the process ID for the OpenSSH daemon.
# The daemon is killed using the information in this file when
# the system shuts down
PidFile /etc/ssh/sshd.pid

Protocol 2,1

# Listen on all available addresses.
ListenAddress 0.0.0.0

# HostKey for protocol version 1
HostKey /etc/ssh/ssh_host_key

# HostKeys for protocol version 2
HostKey /etc/ssh/ssh_host_rsa_key
HostKey /etc/ssh/ssh_host_dsa_key

# The server uses another key
# for encrypting client/server communication
KeyRegenerationInterval 3600
ServerKeyBits 1024

# Use Authentication Logging facility
SyslogFacility AUTH
# Amount of information logged.
# Use DEBUG to maximize the amount of information
# being logged when troubleshooting
LogLevel INFO

# The user has 10 minutes to log-on.
LoginGraceTime 600

# Root user's ability to log in over the network should be
# disabled.
PermitRootLogin No

# Make sure that the
# user home directories, SSH configuration directory (~/.ssh),
# and the key files under SSH configuration directory are owned
# by the user or root, and is not group and writable.
# The user won't be able to log in if the above criteria are not
# satisfied when StrictModes is set to yes.
StrictModes yes

# enable RSAAuthentication and Public Key authentication
```

```
RSAAuthentication yes
PubkeyAuthentication yes
AuthorizedKeysFile      %h/.ssh/authorized_keys

# rhosts authentication should not be used
RhostsAuthentication no

# Don't read the user's ~/.rhosts and ~/.shosts files
IgnoreRhosts yes

# disable host based authentication using .(s)rhosts
# and /etc/(s)hosts.equiv all together.
RhostsRSAAuthentication no
HostbasedAuthentication no

# Uncomment if you don't trust ~/.ssh/known_hosts for
#IgnoreUserKnownHosts yes

# Enable to log in with the passwords /etc/passwd and /etc/shadow.
# over SSH tunnel.
PasswordAuthentication yes

# Root user should not be able to log in over the network.
PermitEmptyPasswords no

# Used for s/key. s/key is not used.
ChallengeResponseAuthentication no

# enable encrypted X tunnel for secure X.
X11Forwarding yes

# the display variable is set automatically by sshd
# It will start from 10.
X11DisplayOffset 10

# print /etc/motd file when the user logs on
PrintMotd yes

# Verify the connections are alive in every interval.
# Disconnect if the connection is bad.
# defined by the system TCP/IP configuration.
KeepAlive yes

# enable secure ftp
Subsystem      sftp      /usr/local/libexec/sftp-server
```

## **D.2 ssh\_config (Client Configuration)**

```
# This is ssh client systemwide configuration file.
# See ssh(1) for more information.
# This file provides defaults for users, and the values can
# be changed in per-user configuration files or on the command line.

# Enable forward agent and X11
ForwardAgent yes
```



```
ForwardX11 yes

# Authentication mechanisms. Do not use rhosts.
RhostsAuthentication no
RhostsRSAAuthentication no
RSAAuthentication yes
PasswordAuthentication yes

# When SSH fails, do not fall back on Rsh
FallBackToRsh no
# Do not use rsh
UseRsh no
#
BatchMode no
# When connecting other machines over ssh
# ask the users if the unidentified or changed
# host key should be entered into the server database.
# Rely on the users to make the right decision for
# manageability of host databases.
StrictHostKeyChecking ask
CheckHostIP yes

# user identity and key files/databases/configuration
IdentityFile ~/.ssh/identity
IdentityFile ~/.ssh/id_dsa
IdentityFile ~/.ssh/id_rsa
# ssh port
Port 22
#
Protocol 2,1
Cipher blowfish
EscapeChar ~
```

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