Auditing a Corporate Log Server

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GIAC Gold Certification

GIAC Systems and Network Auditor (GSNA)

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17 September 2006

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1 Abstract

This paper was written to fulfill requirements for GIAC Gold for the GSNA[1] (GIAC Systems and Network Auditor) Certification.

This paper details an audit of a corporate log server. The goal of the audit is to measure if implemented security controls are adequate on the server and to validate the configuration, since prevention is always better than cure.

The ever increasing number of computer devices located in a corporation produce a vast amount of log data. This log data contains information related to specific events that have occurred on a system. Collection and storage of these logs is important for reasons like traceability, statistics and identifying security events. Increasingly compliance requirements, laws, and industry regulations dictate the storage, and analysis of security events.

The audited log server collects log data from multiple sources including firewalls, VPN, routers and other security related systems, stores them and permits analysis and monitoring.

The remainder of this paper is divided into 5 parts:
It starts with the **Introduction** which explains the background material like risk and log management. The **Identification** describes the audited device, in this case the log server and surrounding infrastructure. The **Risk Analysis** defines the terms risk, threat, vulnerability and impact. Three risks to the log server are isolated and analyzed in detail. The next part – **Testing** – compiles a list of tests to determine the vulnerabilities chosen in the preceding part. The **Audit** performs the tests developed in the previous chapter.

The methodology used to evaluate the risk was derived from the function that risk is a multiplication of the threat likelihood and the threat impact. The vulnerabilities with the biggest impacts were chosen and analyzed. The tests showed that the identified risks were addressed appropriately with some minor recommendations for improvements.

1 GIAC Systems and Network Auditor (GSNA): http://www.giac.org/certifications/audit/gsna.php

2 Introduction

This introductory section defines risk and risk management and gives an introduction to computer security log management.

2.1 Definition of risk

In the NIST Special Publication 800-30[2] 'Risk Management Guide for Information Technology Systems', risk is defined as follows:

> ***Risk** is a function of the **likelihood** of a given **threat-source's** exercising a particular potential **vulnerability**, and the resulting **impact** of that adverse event on the organization.*

Let's explain each of these terms[3]:

Risk:	Risk is the potential impact (positive or negative) to an asset. It's a combination of the likelihood that a particular vulnerability will be either intentionally or unintentionally exploited by a threat-source and the magnitude of the potential harm that could result. *Example*: loss of confidentiality
Threat:	A threat is an unwanted event that may result in harm to an asset. *Examples*: natural threats (earthquake), human threats (attacker)
Vulnerability:	A vulnerability is a weakness or flaw in a system that can be accidentally triggered or intentionally exploited. *Example*: unpatched operating system
Impact:	Impact is the magnitude of the potential loss or seriousness of the event. *Example*: violation of an organization's mission, reputation or interest

The determination of risk for a particular threat/vulnerability can be derived by multiplying the threat likelihood (e.g., probability) and the threat impact:

Derived Risk = Threat likelihood * Threat Impact

If either the threat likelihood or the threat impact is zero, there is no risk. Example: If there is an unpatched server which is not connected to the network, the threat impact may be high, but the threat likelihood is zero, thus no risk.

2.2 Introduction to Computer Security Log Management

The NIST[4] Special Publication 800-92 'Guide to Computer Security Log Management'[5] guide defines a log as follows:

> *A log is a record of the events occurring within an organization's systems and networks. Logs are composed of log entries; each entry contains information related to a specific event that has occurred within a system or network.*

2 NIST Special Publication 800-30: Risk Management Guide for Information Technology Systems http://csrc.nist.gov/publications/nistpubs/800-30/sp800-30.pdf
3 Ideas from the NIST SP800-30 Risk Management Guide
4 NIST - National Institute of Standards and Technology (http://www.nist.gov/)
5 NIST Special Publication 800-92: Guide to Computer Security Log Management, section ES-1 (http://www.csrc.nist.gov/publications/drafts/DRAFT-SP800-92.pdf)

Logs serve many functions in today's computer systems, such as troubleshooting problems, investigating malicious activity and recording the actions of users and systems. In the remainder of this document, computer security events are discussed even though there are many other events one can log.

In today's corporate networks a wide variety of networked servers and devices are generating an ever-increasing number of computer security logs. This has created the need for a process to manage those logs. Managing logs means defining a process for the generation, transmission, storage, analysis and deletion of the logs. The log server plays the central role in all those processes.

2.3 The Need for Log Management

Organizations are facing larger quantities, volumes and variety of computer security logs, and also need to address requirements to analyze and retain certain logs to comply with federal legislation and regulations, including FISMA[6], HIPAA[7], Basel II[8] and the Sarbanes-Oxley Act (SOX)[9]. There is a report from the Enterprise Strategy Group[10] called 'Security Information Lifecycle: Data Retention of Event Logs for Compliance'[11] which states the data retention requirements for different regulations. It ranges from 3 years for FISMA, 5 years for SOX, 6 years for HIPAA to 7 years for Basel II. The log retention requirements for the different regulations is somewhat controversial as to what kind of logs have to be archived. SOX requires in section 103[12] retention of at least 7 years: "... prepare, and maintain for a period of not less than 7 years, audit work papers, and other information related to any audit report, in sufficient detail to support the conclusions reached in such report." The Basel II guidelines call for the retention of log data over a period of three to seven years.

As a result, many organizations have a greater need for computer security log management. Log management assists in ensuring that computer security records are stored in sufficient detail for an appropriate period of time.

In addition to the laws and regulations, there are many other ways an organization can benefit of log management. Log reviews can help in the following areas:

- identifying security events
- identifying policy violations
- identifying fraudulent activity
- identifying operational problems
- performance auditing
- forensic analysis
- establishing baselines
- identifying operational trends

6 FISMA - Federal Information Security Management Act (http://csrc.nist.gov/sec-cert/)
7 HIPAA - Health Insurance Portability and Accountability Act (http://www.cms.hhs.gov/HIPAAGenInfo/)
8 Basel II Capital Accord: http://en.wikipedia.org/wiki/Basel_II
9 Sarbanes-Oxley Act: http://en.wikipedia.org/wiki/Sarbanes-Oxley_Act
10 Enterprise Strategy Group: http://www.enterprisestrategygroup.com/
11 Eric Ogren. Security Information Lifecycle: Data Retention of Event Logs for Compliance (http://www.enterprisestrategygroup.com/_documents/Report/Attachment1ID613.pdf)
12 SOX section 103: http://fl1.findlaw.com/news.findlaw.com/hdocs/docs/gwbush/sarbanesoxley072302.pdf

2.4 The Challenges in Log Management

The biggest challenge is the vast amount of ever increasing log data. It's a balance of keeping the right amount of data and still being able to analyze them.

Log Generation
Every organization has many different operating systems, security devices like firewalls, routers and other applications which each generate their own logs in their own format. These different log formats make the analysis and storage process challenging. Each device produces log data in it's (sometimes proprietary) format. For example Linux uses syslog (explained later) and Windows uses the event log service. The diversity of formats creates issues in the log transfer and the log analysis. Proprietary log formats have to be exported to a format where they can be easily sent to the log server. The log server then has to normalize the data for further analysis and correlation between the different devices. The normalization process brings logs into a consistent format.

Log Protection
Logs have to be protected from viewing and altering by unauthorized people, as they can contain confidential data. They not only have to be protected on the log server but also on the transmission from the generating device to the log server. Once an attacker has gained access to a system, he will try to hide his presence on the system by altering the system logs. This can be prevented by sending the logs in real time to the log server (also referred to as secondary logging).

Log Analysis
The log analysis, particularly the correlation of entries from multiple log sources to the same event is a major challenge. This last step of the log management process is one of the most important, but considered boring by most administrators. A serious analysis is a very time consuming task which requires knowledge in many different areas such as networking protocols (TCP/IP), operating systems (Linux, Windows) and applications (Checkpoint, Apache). It also takes the right tools for correlating entries from multiple log sources.

2.5 Audit Methodology

A methodology defines the methods, procedures, and techniques used to conduct an audit. The audit methodology used for this audit is a compliance-driven audit process to assess the risk of a given system and to compare it to best practices standards like the NIST Guideline on Network Security Testing[13].

The audit methodology consists of four phases (see Illustration 1):

13 NIST, Special Publication 800-42: Guideline on Network Security Testing: http://csrc.nist.gov/publications/nistpubs/800-42/NIST-SP800-42.pdf

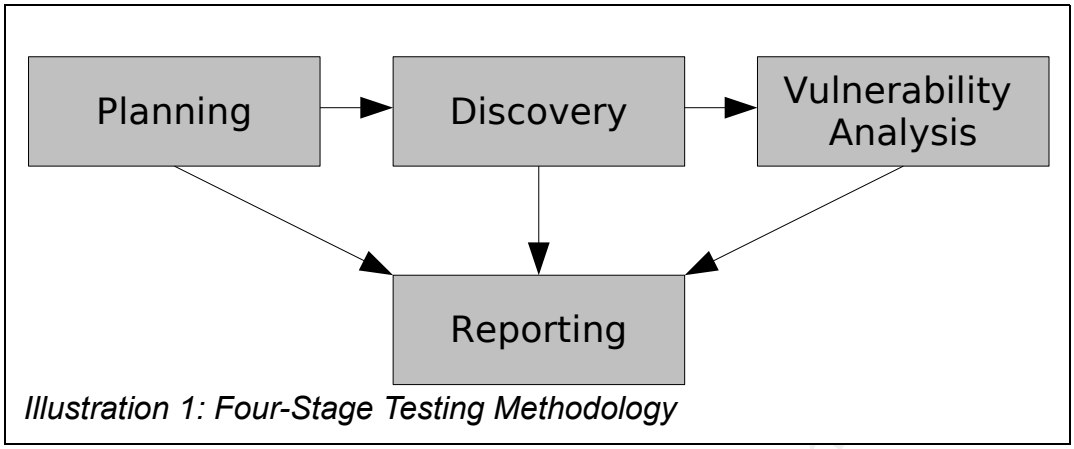


Illustration 1: Four-Stage Testing Methodology

In the **planning phase**, the target is identified and the business risks and regulatory challenges are evaluated in order to assess their significance to the business (Chapter 3 – Identification). Further, the management approval is finalized and the testing goals set. The vulnerabilities with the biggest impacts are chosen and analyzed (Chapter 4 – Risk Analysis).

The **discovery phase** starts the actual testing (Chapters 5 and 6 – Testing and Audit). Here, we try to get as much information about our target network(s)/host(s) as possible from DNS interrogation, searching web server(s) for information, network scanning, packet capture, and different kind of enumeration techniques like NetBIOS and Banner grabbing.

In the **vulnerability analysis phase** the results from the discovery phase are compared against vulnerability databases, and the design and operating effectiveness of the controls are tested (Chapter 6 – Audit).

The **reporting phase** occurs in all other three phases. It's where the findings are evaluated, the opinions of the audit are formed and the findings are reported (Chapter 7 – Conclusion).

3 Identification

The subject of this audit is a corporate log server. This chapter covers the scope of the audit – the corporate log server – and the log infrastructure. It's the planning phase in the four-stage testing methodology.

3.1 Scope: The Corporate Log Server

This section defines the scope of the audit. A clear scope is very important for a successful audit. The scope of the audit is to check if the server is configured correctly and if the controls are appropriate.

The corporate log server is a Red Hat Enterprise Linux machine. It acts as the collector and receiver of all log data.

3.1.1 The log collection

The log collection process is the part where the actual log data is transferred and collected on the log server. The communication between the log generating devices and the log server occurs over the organization's regular networks. There are many different ways this can be achieved. In our environment there are two different mechanisms in use:

- scp (secure file transfer over SSH)
- syslog[14]

14 RFC 3164 - The BSD syslog Protocol (http://tools.ietf.org/html/3164)

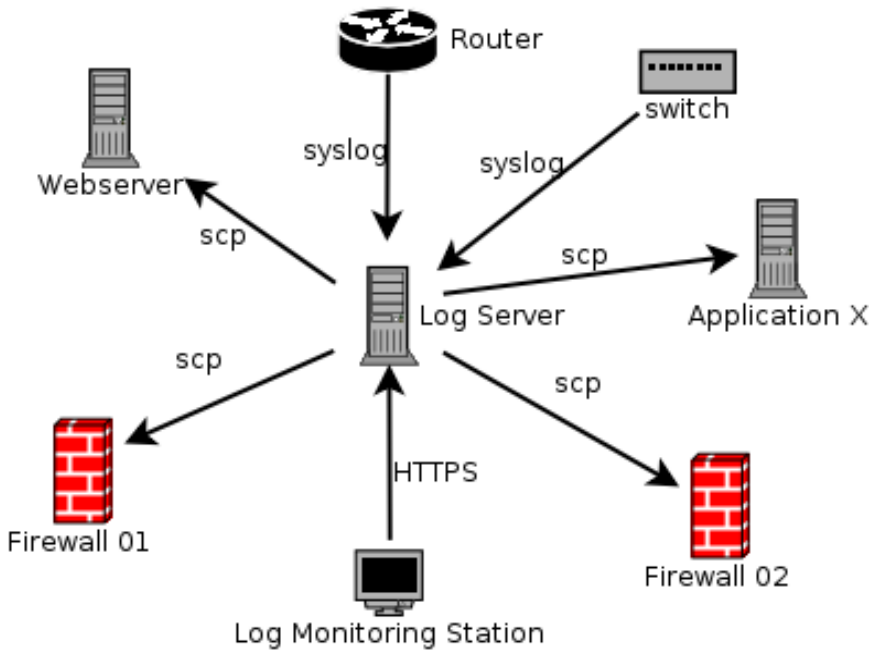


Illustration 2: Overall Architectural Log Collection Diagram

The arrows in the illustration show the connection establishment. Syslog generating devices will send their logs directly to the log server. With scp it works the other way around; the log server connects to the log generating devices to collect the log data in a regular interval.

scp
scp (**S**ecure **Cop**y) is a program which is part of the OpenSSH[15] package. SSH (**S**ecure **Sh**ell) provides a way to make a secure connection between two systems. scp uses such a connection to copy files over a network. Additionally, it allows an automated login (passwordless) with the help of certificates. The transfer is initiated daily by the log server which makes a connection to the log generating device and copies the relevant log data. This means that the logs are not available in real-time. The big plus over the syslog transfer is that it is encrypted (provides confidentiality and integrity with SSL certificates).

Syslog
Syslog is described in the Request for Comments (RFC) 3164. It consists of log generators and one or more syslog server(s) which act as the collector for the log data. Syslog uses a standardized log format, which simplifies the storage of many different log sources.

The big disadvantage is the usage of the User Datagram Protocol (UDP)[16] protocol for the transfer of the logs (by default on UDP port 514). UDP does not provide the reliability and ordering as TCP does. Syslog does not provide any basic security controls and does not preserve the confidentiality, integrity or availability of the logs. The advantage of syslog over scp is that it's operating in near real-time.

15 OpenSSH is a free version of the SSH connectivity tools (http://www.openssh.org/)
16 UDP - User Datagram Protocol (http://en.wikipedia.org/wiki/User_Datagram_Protocol)

Due to the provided confidentiality and integrity of scp, the company is using the SSH transfers wherever possible. Syslog transfers are only deployed if the generating device does not support a secure way of transport.

3.1.2 The log processing

Once the log files are on the log server, some of them have to be normalized and/or converted to a format where the logs can be further processed, e.g. to be able to create statistics. Normalizing log and security events enables comparisons of dissimilar systems. It's this process which brings logs into a consistent format. For example the log data from two different firewall manufacturers are normalized so they can be compared easily. Some log processing programs also require normalized log entries as they don't understand the log format of every firewall manufacturer. The original log data is always stored and is sometimes used for detailed analysis where the normalization process reduces and eliminates some information for simplification reasons.

The generated statistics are useful for the analysis as they offer an overview of many log entries in just a glance. Wading through thousands of log lines is a very cumbersome task and yields often only minimal results.

3.1.3 The log presentation (web interface)

The log server provides a web interface to present the formatted logs. It's running an Apache web server with PHP support over HTTPS. The web interface is protected by usernames and passwords implemented using .htaccess files[17]. .htaccess files provide a way to limit access to the web server on a per-directory basis by giving each user a username and password to authorize themselves. Each user has an account and is assigned to a corresponding group. Each group has a different menu and can only access the logs it is supposed to see.

There are many different scripts in use for the graphical presentation. Some of them have been written by the administrators, some are open source tools like RRDtool[18] and awstats[19], which generate graphical statistics. Here are two example graphics created for the graphical analysis using RRDtool and MRTG[20]:

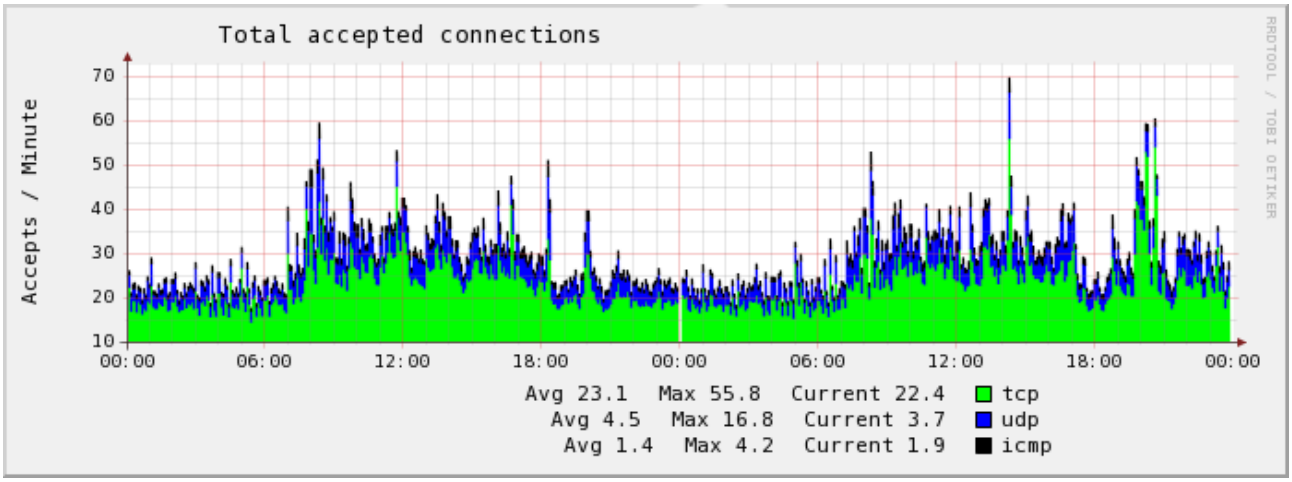


Illustration 3: Firewall Accepts / Minute: 48 hours view

17 Apache: .htaccess files (http://httpd.apache.org/docs/2.0/howto/htaccess.html)
18 RRDtool is a Round Robin Database tool (http://oss.oetiker.ch/rrdtool/)
19 AWStats is a free tool that generates web, streaming, ftp or mail server statistics, graphically. (http://awstats.sourceforge.net/)
20 MRTG - The Multi Router Traffic Grapher (http://oss.oetiker.ch/mrtg/)

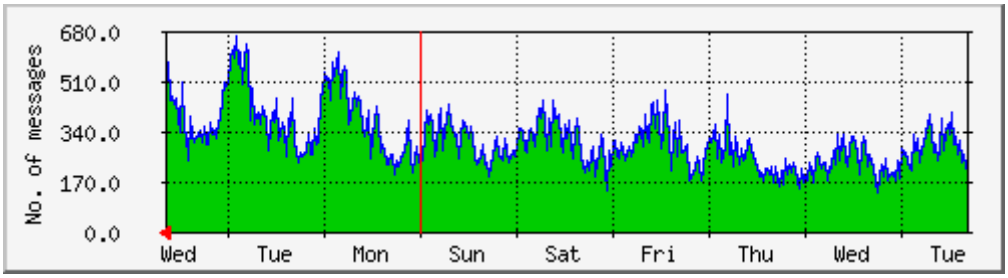


Illustration 4: Number of Messages: 8 days view

3.1.4 Server operation

There are many different kind of log data collected. The sensitivity of those logs differ, they can range from confidential to informational only. Amongst the more important logs are those from VPN (Virtual Private Network Access log), HTTP access logs, firewalls and routers.

For sensitivity reasons the log server is set up and operated by the security team. The security team does not operate other servers, firewalls, routers or any other devices. This has the goal of ensuring the separation of duties. The analysis and reporting of the log data is also conducted by the security team members.

3.1.5 Server configuration

The log server is running on a HP ProLiant DL380 machine with a dual CPU, 2GB of RAM, 1.4TB of hard disk, redundant power supplies and fans. The system was set up according to the company Linux guidelines from the central Linux install server. It's a Red Hat Enterprise Linux WS release 4 (Nahant Update 3) version. The following network daemons are enabled:

- SSH (TCP port 22)
- Apache (TCP port 443)
- Syslog (UDP port 514)
- NTP (TCP/UDP port 123)
- Veritas NetBackup (TCP 13722, 13724, 13782 and 13783)

All log processing scripts and programs are running under an unprivileged user account. Access to the server is strictly limited to the security team.

3.2 The Log Infrastructure

The log management is composed of three tiers:

- the log generation
- the centralized log consolidation and storage
- the log monitoring and alerting

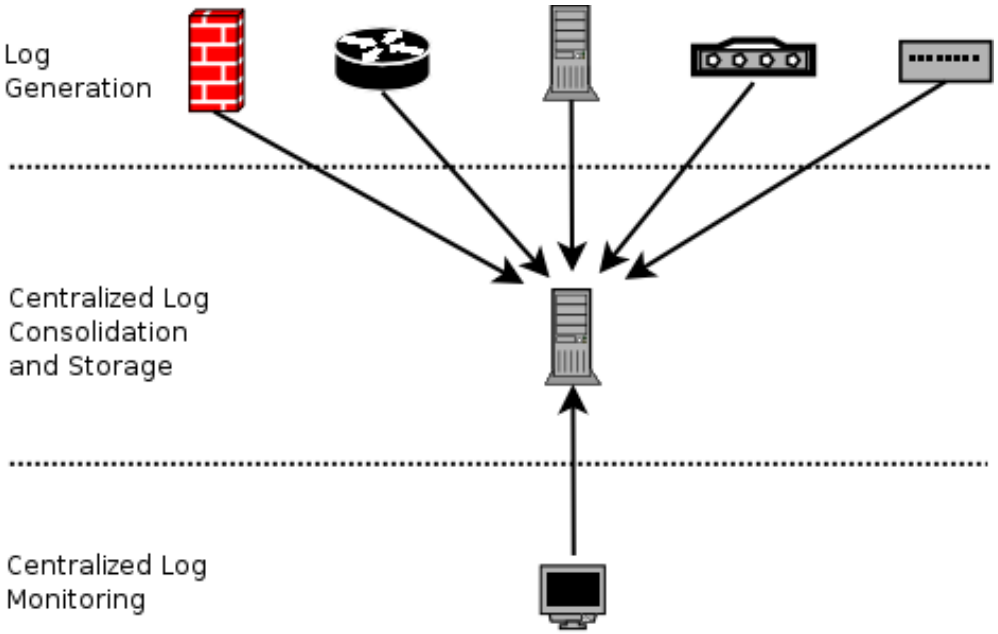


Illustration 5: Log Management Infrastructure Tiers

Looking at Illustration 5 the log generation tiers contains the log generating devices like firewalls, routers and servers. The second layer contains the log server. It's role is to collect log data from multiple sources, normalize and store (archive) them to be accessed later through the log monitoring station (third layer – machine at the bottom). The monitoring station does not copy the logs from the log server, it accesses the (graphical) reports (and logs) through the web interface which is running on the log server.

4 Risk Analysis

This part deals with risk management – a part of planning phase. It is the process of identifying risk, assessing risk, and taking steps to reduce risk to an acceptable level. The objective of risk management is to give the management a good basis for decision making by supporting documentation resulting from the performance of risk management. It allows the IT managers to spend the right amount of protective measures to protect the IT systems and to achieve their organization's missions. The overall goal is to minimize the negative impact to an organization and to spend the right amount to protect the organization.

4.1 Three identified risks

Three risks with the most serious impacts were selected and will be described here with their impacts on the system and the primary vulnerabilities that could lead to these three impacts. There are many more risks to the system. The three risks should give a demonstration of the audit methodology. There are also many different vulnerabilities for each risk with the same or similar impact.

4.1.1 Risk 1: Unauthorized access of logs (loss of confidentiality)

Unauthorized access is possible through gaining access to the server and/or log data without the express permission of the owner. Transmitting the log data in the clear or using a weak encryption algorithm could also lead to a loss of confidentiality.

Unauthorized access of logs can happen through several ways:

- web interface (vulnerability in web application)
- hacked password (e.g. sniffed or guessed password)
- running unnecessary services (e.g. telnet)
- use of weak or no encryption during transmission (sniffing of clear text log transfer)

Impact
Unauthorized access to log data could lead to a loss of confidentiality. Log files can contain confidential data like user names, passwords and many other access and usage statistics. A potential attacker could also get useful information about network topology and vulnerabilities which could ease further attacks.

This can result in legal issues if laws and regulations are not followed. There are several laws like SOX which instruct how to handle log data. For more information please see chapter '2.3 The Need for Log Management'.

Vulnerabilities which could lead to this risk

- vulnerabilities in the web interface
- weak or no encryption during transfer of log data
- weak or no encryption for remote login
- weak or no encryption for accessing the web interface

Controls
A number of controls are implemented to mitigate the risks.

- Access to the system is limited to system administrators via password protected access
- The majority of transfers are encrypted file transfers to reduce the likelihood of

sniffing clear text log transfers
- Remote administration access is only allowed with encrypted protocols like SSH
- Access to the web server (web interface) only over HTTPS with strong cyphers

4.1.2 Risk 2: Unauthorized modification of logs

The modification of log data consists of reading, modifying or deleting the content of log files. The unnoticed modification of data might be the most destructive as it can lead to wrong conclusions in the analysis and thereby to wrong accusations and decisions.
A modification can be the deletion of one or more lines in a log file or the erasure of some or all log files. The purposeful alteration of specific log entries (e.g. changing IP addresses or user names) can be very difficult to detect.

Impact
The integrity and availability may be compromised by altering the logs. Unauthorized full access to log data can have several consequences. The alteration of specific log entries can lead to false conclusions like overlooking important events. Through the manipulation of evidence malicious activity may go unnoticed and the identity of a malicious party may be concealed.

Vulnerabilities which could lead to this risk
- careless handling of passwords by employees (e.g. choosing weak passwords, writing them down)
- vulnerability in OS
- vulnerability in a daemon (e.g. SSHD, Apache) or application (PHP web interface)
- misconfiguration by the system administrator
- vulnerability in report generating programs

Controls (to mitigate the risk)
- The use of strong passwords and good password processes
- The regular patching of the system
- The safe configuration as a default setting (e.g. no guest accounts)
- All unused services and daemons are disabled

4.1.3 Risk 3: Loss of logs

The complete or partial loss of logs can be intentional or unintentional. The intentional removal of some or all log data through a malicious person can have the goal to conceal a malicious activity and the identity of this malicious activity. The unintentional loss can occur through natural threats (earthquakes, floods) or human threats (malicious person) if there is no backup or if it was destroyed through the same means.

In his book 'Auditing Business Continuity', Rolf von Roessing states in the preface that:

> *Around 85% of Business Continuity Plans fail when first tested. [...] Over 50% of Business Continuity Plans are never tested.*[21]

Impact
The most obvious impact is the missing analysis of the log data for all the listed benefits under 2.2 like identifying policy violations. The loss will most probably be a violation of laws and regulations which state what and how long the data has to be archived.

21 Rolf von Roessing. Auditing Business Continuity. ISBN #1-931332-15-0

Vulnerabilities which could lead to this risk

- hardware failure (e.g. hard disk failure, power outage) which leads to data corruption
- missing backup
- broken backup process or mechanism
- intentional or unintentional deletion of logs (improper handling)

Controls

- Maintaining a valid backup is a critical component to be able to recover in case of an emergency
- A backup process which is tested regularly
- The deployment of redundant hardware
- Physical access control

4.1.4 Exposure

This is a general note to the exposure of all of the above risks. Since the log server is in the internal network of the company – protected by (correctly configured) firewalls – it is not directly accessible from the Internet. This reduces the exposure significantly. There is still a significant threat from external sources of attack through rogue access points, VPNs, modems, etc. The '2005 FBI Computer Crime Survey'[22] has some statistics regarding the relation of inside/outside attacks:

> *Overall, there were over twice as many unauthorized access incidents coming from outside the organization than there were from within, [...]*

The national Computer Emergency Response Team for Australia (AusCERT) has some similar numbers. In their '2006 Australian Computer Crime and Security Survey'[23] they state:

> *Consistent with previous years' trends, most of these attacks were again sourced externally (83%) compared to internally (only 29%).*

Regardless of the location of the log server, there is a direct and indirect exposure:

Direct exposure
A direct exposure is limited to internal attackers only. Direct attacks can involve attacks over the internal networks or physical attacks.

Indirect exposure
Indirect exposure can happen through specially crafted log entries. Most log entries are text elements which contain a certain known set of characters. If an attacker can control what an application will write into the log file, he may exploit analyzing programs, which may fail badly if they are not handling unexpected characters well. These log entries will pass all protective measures like firewalls easily, as they are assumed to be trusted content. This form of attack is called “Second Order Code Injection Attacks”[24].

22 2005 FBI Computer Crime Survey, pp. 8
http://www.digitalriver.com/v2.0-img/operations/naievigi/site/media/pdf/FBIccs2005.pdf
23 AusCERT. 2006 Australian Computer Crime and Security Survey. ISBN: 1-86499-849-0
(http://www.auscert.org.au/images/ACCSS2006.pdf)
24 Next Generation Security Software Ltd. Second Order Code Injection Attacks
http://www.ngssoftware.com/papers/SecondOrderCodeInjection.pdf

5 Testing

In the preceding chapter three major risks were described including their impacts and vulnerabilities. The corresponding tests for each risk will now be developed to identify the presence of vulnerabilities. For each test the criteria for determining whether the test passes or fails is explained.

The primary reason for testing the security of an operational system is to identify potential vulnerabilities so they can be fixed. As the number of reported vulnerabilities is growing daily, the testing for new vulnerabilities and misconfigurations is getting more and more important.

The audit will be conducted with the presence of the system administrator responsible for the operation and maintenance of the log server. Any commands that require root level access will be entered by the administrator and observed/noted by the auditor. Both the system administrator and the auditor have agreed to this testing methodology.

5.1 Risk 1: Unauthorized access of logs (loss of confidentiality)

Control 1
Control objective: Verify that encryption is being used during transmission of the log data
Control activity: Make sure the server is configured to use encryption for the log transfer.

Test 1: Inspect the scp (SSH) transfer. The SSH daemon must answer on port TCP 22 and the transfer must be encrypted (not readable).
 	
• Connect to port 22 (default SSH port) with nc[25] to verify the daemon is running.
 	
`$ nc log_server 22`
 	
• Use Ethereal[26] to capture the log transfer. Ethereal is a popular network protocol analyzer.
 	
As the root user start Ethereal. In the menu 'Capture' click on 'Interfaces...'. A dialog will appear with all interfaces. Choose the interface on which the SSH traffic will be on and click on the 'Prepare' button. Write the following in the field 'Capture Filter':
`tcp port 22`
This will limit the dumped traffic to the TCP port 22 which is the default port for SSH. Now start a log transfer and click 'Stop' once the transfer has occurred. Verify that after the initial key exchange you'll only see encryption requests and responses.
 	
The test passes if the SSH daemon answers on port 22 with a version string and there are no clear text log messages.

Test 2: Inspect the syslog transfer. Syslog traffic is sent in clear over UDP port 514. This makes it easy to intercept, spoof and fill the log server with bogus syslog entries. It is unnecessary to intercept syslog traffic since it will be unencrypted by default. Instead it will be verified if the syslog server

25 Netcat is a networking utility which reads and writes data across network connections (http://netcat.sourceforge.net/)

26 Ethereal is a network protocol analyzer (http://www.ethereal.com/)

Control 1

can be filled with bogus entries.
 	
We're going to use a small program written in the c programming language called syslog_deluxe[27]. Once the source code is downloaded, we have to compile it:
 	
`$ gcc -o syslog_deluxe syslog_deluxe.c`
 	
This creates the binary executable `syslog_deluxe`. Execute it as root with the following parameters:
 	
`# syslog_deluxe src_hostname dst_hostname`
 	
This will send one syslog entry as specified in the source code (facility: LOG_DAEMON; priority: LOG_INFO). If the syslog server just received such an entry, bogus entries can create a Denial of Service (DoS). The test fails if the `syslog_deluxe` program successfully creates syslog entries.

Control 2
Control objective: Verify that the log server does not support weak encryption algorithms for the web access.
Control activity: Verify that the web server is configured to use strong encryption algorithms only.

Test 1: Inspect the Apache configuration for allowed cyphers. The test succeeds if only strong ciphers are allowed. Strong protocols are considered to be SSL3.x and TLS, SSL < 3 is not considered strong. Strong ciphers are starting at 128 bits.
 	
Apache allows with the 'SSLProtocol' directive to set the allowed protocols. The configuration has to look something like this (disable all, enable TLSv1 and SSLv3):
 	
`SSLProtocol -all +TLSv1 +SSLv3`
 	
The ciphers are set with the 'SSLCipherSuite' directive. Apache has four parameter settings, HIGH (>168 bits), MEDIUM (128 bits) and LOW (<56 bits) cipher suites; and NULL (no encryption). There are a couple of other settings like aNULL and EXPORT which have to be disabled. Example configuration:
 	
`SSLCipherSuite HIGH:MEDIUM:!aNULL:+SHA1:+MD5:+HIGH:+MEDIUM`
 	
There are some other directives to force the usage of a SSL/TLS connection:
 	
`SSLEngine on`
`SSLOptions +StrictRequire`
`<Directory />`
`  SSLRequireSSL`
`</Directory>`
 	
Reference: A series of three articles dedicated to configuring Apache 2.0 with SSL/TLS support[28] on SecurityFocus by Artur Maj.

27 syslog_deluxe.c - This program sends a spoofed syslog message (http://packetstormsecurity.org/Exploit_Code_Archive/syslog_deluxe.c)

28 Apache 2 with SSL/TLS: Step-by-Step, Part 1: http://www.securityfocus.com/print/infocus/1818

Control 2

Test 2: Verify the used encryption algorithms (using `openssl`). No connection with weak cyphers (protocol < 3; ciphers < 128 bits) are allowed.
 	
With the help of the OpenSSL[29] package we check manually what cyphers the web server supports. Let's try to connect with SSLv2 / SSLv3 and weak algorithms.
 	
`$ openssl s_client -connect log_server:443 -ssl2 -cipher 'LOW:NULL:aNULL:EXP'`
`$ openssl s_client -connect log_server:443 -ssl3 -cipher 'LOW:NULL:aNULL:EXP'`
 	
If there's an error message like the following, the test succeeded:
`CONNECTED(00000003)`
`10243:error:1407F0E5:SSL routines:SSL2_WRITE:ssl handshake failure:s2_pkt.c:428:`
 	
A successful connection means the server accepted one of those low encryption algorithms and the test failed.

Test 3: Use SSLDigger[30] (Foundstone) to check for accepted ciphers. SSLDigger is a tool to assess the strength of SSL servers by testing the ciphers supported. This test is basically an extension of test 2, this time using an automated tool. Once SSLDigger is running, type the web address of the server in the “Address” location bar and hit “Go”. The results will be displayed on the screen and can be saved to an HTML file. The same criteria apply as for test 1 & 2: protocol >= 3; ciphers >= 128 bits.

5.2 Risk 2: Unauthorized modification of logs

Control 3
Control objective: Verify that no unneeded services and daemons are running.
Control activity: Check the system configuration files and verify running services.
Test 1: Use the tool chkconfig to see what services are running. Only the services which are needed for the operation of the server are allowed. The tool chkconfig queries runlevel information for system services. On a Linux system each service can be started or stopped in different runlevels. A runlevel is a mode of operation, they are ranging from 0 to 6, with 0 halting the system and 6 rebooting. The following command lists all services which chkconfig knows about, and whether they are stopped or started in each runlevel: `# chkconfig --list`
Test 2: Check the `/etc/xinet.d/` directory for running xinetd[31] services. Only the xinetd services which are needed for the operation of the server are allowed.

Apache 2 with SSL/TLS: Step-by-Step, Part 2: http://www.securityfocus.com/print/infocus/1820
Apache 2 with SSL/TLS: Step-by-Step, Part 3: http://www.securityfocus.com/print/infocus/1823

29 The OpenSSL Project is a toolkit implementing the Secure Sockets Layer (SSL v2/v3) and Transport Layer Security (TLS v1) protocols (http://www.openssl.org/)

30 SSLDigger™ is a tool to assess the strength of SSL servers by testing the ciphers supported. (http://www.foundstone.com/resources/proddesc/ssldigger.htm)

31 xinetd - the extended Internet services daemon (http://www.xinetd.org/)

Control 3

In the directory `/etc/xinet.d/` are the configuration scripts for each service. Each service has a directive called 'disable'. It has to be set to 'yes' for those services which are not necessary ('`disable = yes`').

Test 3: Use the ps and netstat tools to verify that no unneeded processes are running. It passes the test if only the processes which are needed for the operation of the server are running.

The program ps reports a snapshot of the current processes. It allows us to verify all running processes. The following command lists all running processes:

```
$ ps aux
```

Options:
-a – the -a option lists the processes of all users
-u – the -u option tells ps to provide detailed information about each process
-x – the -x option adds the processes that have no controlling terminal, such as daemons

Netstat can print a wealth of information, we're interested in the network connections. The following listing shows all open TCP and UDP ports including their process IDs:

```
$ netstat -lnp --tcp --udp
```

Options:
-l – show only listening sockets
-n – numeric only; don't use name lookups (DNS)
-p – show the PID and name of the program to which each socket belongs
--tcp – show TCP connections
--udp – show UDP connections

Test 4: Use nmap[32] to verify that no unneeded ports are open. Nmap is a very popular network port scanner which allows us to see what ports are open. In the previous test we verified the open ports from the inside, now we're verifying the open ports from the outside. The test passes if only allowed services are running, i.e. only allowed ports are open. Those are SSH (TCP 22), NTP (TCP/UDP 123), syslog (UDP 514), HTTPS (TCP 443) and the NetBackup ports (TCP 13722, 13724, 13782 and 13783).

The following scans all TCP ports:

```
# nmap -sS -O -v -P0 -sV -p1-65535 log_server
```

Options:
-sS – TCP SYN scan
-O – enable OS detection
-v – increase verbosity level
-P0 – treat all hosts as online – skip host discovery (no ping)

32 Nmap ("Network Mapper") is a free open source utility for network exploration or security auditing (http://www.insecure.org/nmap/)

Control 3
-sV — probe open ports to determine service/version info -p1-65535 — specifies the port range, in this case all TCP ports After scanning the TCP ports, we're scanning all UDP ports: `# nmap -sU -P0 -p1-65535 log_server` Options: -sU — UDP scan

Control 4
Control objective: Identify common vulnerabilities in the OS.
Control activity: Use a vulnerability scanner to check for missing patches and misconfigurations.
Test 1: Use Nessus[33] to scan the system for remote vulnerabilities. The test passes if no security holes are found. Nessus is a very popular remote vulnerability scanner with an easy to use graphical interface. The installation process is not described here, there is a good introduction on SecurityFocus 'Introduction to Nessus'[34]. Once the Nessus client is running and the user has logged in, several configuration options have to be set. The following options have to be adjusted: • In the 'Plugins' tab, select the '**Enable dependencies at runtime**' checkbox to enable the plugins that are dependent on the set of plugins which were selected. • In the 'Plugins' tab, click the '**Enable all**' button to select all plugins • In the 'Scan Options' tab, enter the following in the 'Port range' text box: **0-65535** • In the 'Scan Options' tab, uncheck the '**Safe checks**' checkbox • In the 'Scan Options' tab, under 'Port scanner', verify that the '**Nmap (NSSL wrapper)**' is checked, so that Nessus will use Nmap for the port scan. • In the 'Target' tab, enter the following in the 'Target(s)' text box: **log_server** • In the 'Prefs.' tab, enable the 'UDP Scan' check box • In the 'Prefs.' tab, enable the 'SSL' check box Once those settings are set, the scan can be started by clicking the 'Start the scan' button at the bottom. When the scan is finished, there will be an option to save the results. It is recommended to save it in the native NBE format for re-importation by any Nessus client. There are several other output methods like 'HTML with Pies and Graphs' which is useful for a presentation.

Control 5
Control objective: Verify that the OS is up to date with security patches.
Control activity: Verify OS patch level.

33 Nessus is a remote security scanner (http://www.nessus.org/)
34 Introduction to Nessus: http://www.securityfocus.com/print/infocus/1741
Nessus, Part 2: Scanning: http://www.securityfocus.com/print/infocus/1753
Nessus, Part 3: Analysing Reports: http://www.securityfocus.com/print/infocus/1759

Control 5

Test 1: Use the Red Hat tool `up2date` to check the patch level. All current patches must have been applied.

The Red Hat Update Agent (`up2date`) is a program for managing and updating RPM packages on Red Hat Linux systems. We're assuming the Red Hat system has been set up correctly to use the Red Hat Network (RHN)[35] for the update process. To check if there are any new packages available, type:

```
$ up2date --dry-run
```

This will give an output of all available downloads with dependencies. The test succeeds if there are no new packages available.

Control 6:

Control objective: Verify user accounts and their privileges

Control activity: Inspect the user accounts, their rights and their password strength.

Test 1: Check `/etc/passwd` for UID == 0. The only account allowed to have UID 0 is root.

Use the awk[36] command to list accounts with UID 0:

```
$ awk -F: '($3==0){print $1}' /etc/passwd
```

Test 2: Check `/etc/shadow` for password less accounts. No enabled user account is allowed to have a null password.

Use the awk command to list any accounts that have empty password fields:

```
# awk -F: '($2==“”){print $1}' /etc/shadow
```

Test 3: Examine the `/etc/passwd` file for any unnecessary user accounts. No unneeded user accounts are allowed on the system.

```
$ cat /etc/passwd
```

Test 4: Use the John the Ripper[37] password cracker to verify the password strength. The purpose is to detect weak system passwords. However, there is no hard limit what a weak password is. The following characteristics are commonly seen as a weak password:

- any word in a dictionary
- passwords shorter or equal than 6 characters
- names, birthdays or any other characteristics which could lead to this person

This test passes if John doesn't find the password within 1 hour with the default options, which are "single crack" mode first, then using a word list with rules, and finally "incremental" mode. Single crack mode will use the login names, "GECOS" / "Full Name" fields, and users' home directory names as candidate passwords, also with a large set of mangling rules applied. In wordlist mode you supply john a word list and you can optionally enable word mangling rules to as some simple modifications like numbers at the end. Incremental mode is the most powerful cracking mode. It tries all possible passwords (brute force).

35 Red Hat Network is a systems management platform (http://www.redhat.com/rhn/)
36 AWK is a general purpose computer language that is designed for processing text-based data (http://en.wikipedia.org/wiki/Awk)
37 John the Ripper is a password cracker (http://www.openwall.com/john/)

Control 6:

First, we need to get a copy of the password file. John provides the '`unshadow`' utility to obtain the traditional Unix password file, as root type:
 	
`# unshadow /etc/passwd /etc/shadow > mypasswd`
 	
To let John use its default order of cracking modes, type:
 	
`$ john mypasswd`
 	
John will display the cracked passwords on the screen.

5.3 Risk 3: Loss of logs

Control 7
Control objective: Verify that the backup procedure is in place and is working correctly.
Control activity: Inspect the backup mechanism.
Test 1: Perform a restore of several test files to ensure that backup can be restored. All tested files must be able to restore completely. First, some arbitrary files have to be deleted. Then we're going to use the NetBackup graphical user interface (NetBackup Administration Console), a Java-based, graphical-user interface to restore the file (`jnbSA`) command. There is also a character-based, menu interface that is started by running the `bpadm` command. Start the NetBackup Administration Console: `# /usr/openv/netbackup/bin/jnbSA` Log in with your user name and password. In the 'Restore files' tab, select the directory we've just deleted in the file tree. Now click on the “Restore...” button. In the “Restore Files” dialog, verify that “Restore everything to its original location” is checked, then click “Start Restore”. When the restore is finished, the status will go to “Successful”. Now try to verify that the restore completed successfully.

Control 8
Control objective: Prevent hardware outages.
Control activity: Determine if the environment is appropriate.
Test 1: Verify that both power supplies are working. Both power supplies must be working. Pull one power plug and check if the server is continuing to run with the second power supply. Then pull the plug of the second power supply. The test succeeds if the server continues running with only one power supply plugged in.
Test 2: Verify that the UPS (uninterruptible power supply) is working. An uninterruptible power supply (UPS) is a device or system that maintains a continuous supply of electric power to an equipment that must not be shut down unexpectedly. We

Control 8
are verifying that the UPS system is inspected and tested in a regular interval. To succeed this test the UPS system has to be inspected once a year including a test to see if it is working as expected.

Control 9
Control objective: Prevent physical access for unauthorized people
Control activity: Determine if physical security is adequate
Test 1: This test succeeds if the physical protection mechanisms in use is adequate for the server room. The following has to inspected: • The doors to the computer room must be locked. • It must be inspected who has access to the rooms. • There must be a documentation and formal process who is allowed to access those rooms. • The entrance has to have an access log which logs the date, time, room number and the name of the employee who accessed the room.

6 Audit

In this part the actual audit is conducted – it's the discovery and vulnerability analysis part of the testing methodology. The elaborated tests in the preceding chapter will be executed here. Each test will be explained in detail, the findings will be discussed and – depending on the result – a recommendation will be given. But first let's elaborate how to prepare for carrying out an audit.

6.1 Audit Planning / setting up an audit

Before the real audit work can be started, there are some important preparation steps to be taken which, when left out, can have severe consequences (e.g. accusation of unauthorized scanning). Probably the most important step in the audit planning part is to get written permission from the appropriate staff member(s) (or authorities), usually the CIO or any other management level employee with the right to authorize the audit.

Before every audit, the scope is defined. Without a clear scope, the auditor and/or the audit requester won't be satisfied with the result. The scope of this audit has been detailed in chapter '3.1 Scope'.

Further, you have to prepare yourself for the audit with the right computer equipment and tools. Be familiar with the used scanners and test them in a lab before using them on production systems. You also have to do research on the internal policy documents and industry best practices.

As a last step, set up a time for the audit and inform the necessary people like system and network administrators and the management when it's going to happen. Be ready to respond to questions and stay on site during the audit – don't start the scans and then walk away, as systems might crash and administrators might need help and answers.

Control 1 - Verify that encryption is being used during transmission of the log data

Test 1** (Control 1)* ***Result: pass

Testing procedure

This test consists of two parts, the verification of the SSH daemon and the TCP dump verification. First, we connect to port 22 (default SSH port) with nc to verify that the daemon is running:

```
$ nc log_server 22
SSH-2.0-OpenSSH_3.9p1
```

This shows that the SSH daemon is responding on port 22. It is returning it's version string (SSH-2.0-OpenSSH_3.9p1). Unfortunately this string does not let us verify that it's running the latest version including the latest patches as linux distributions are patching their software without giving them a new version identification.

The second test involves using Ethereal to dump the log transfer traffic over SSH. The following screen shot shows the dump in Ethereal:

Test 1 *(Control 1)* **Result: pass**

Protocol	Info
TCP	56678 > ssh [SYN] Seq=0 Len=0 MSS=1460 TSV=10381454 TSER=0 WS=2
TCP	ssh > 56678 [SYN, ACK] Seq=0 Ack=1 Win=5792 Len=0 MSS=1460 TSV=2362312219 TSER=10381454 WS=2
TCP	56678 > ssh [ACK] Seq=1 Ack=1 Win=5840 Len=0 TSV=10381454 TSER=2362312219
SSH	Server Protocol: SSH-2.0-OpenSSH_3.9p1
TCP	56678 > ssh [ACK] Seq=1 Ack=23 Win=5840 Len=0 TSV=10381460 TSER=2362312226
SSH	Client Protocol: SSH-2.0-OpenSSH_4.2p1 Debian-8
TCP	ssh > 56678 [ACK] Seq=23 Ack=32 Win=5792 Len=0 TSV=2362312241 TSER=10381476
SSHv2	Client: Key Exchange Init
TCP	ssh > 56678 [ACK] Seq=23 Ack=744 Win=7216 Len=0 TSV=2362312242 TSER=10381477
SSHv2	Server: Key Exchange Init
SSHv2	Client: Diffie-Hellman GEX Request
SSHv2	Server: Diffie-Hellman Key Exchange Reply
SSHv2	Client: Diffie-Hellman GEX Init
SSHv2	Server: Diffie-Hellman GEX Reply
SSHv2	Client: New Keys
TCP	ssh > 56678 [ACK] Seq=1279 Ack=928 Win=8640 Len=0 TSV=2362312346 TSER=10381541
SSHv2	Encrypted request packet len=48
TCP	ssh > 56678 [ACK] Seq=1279 Ack=976 Win=8640 Len=0 TSV=2362312347 TSER=10381581
SSHv2	Encrypted response packet len=48
SSHv2	Encrypted request packet len=64
TCP	ssh > 56678 [ACK] Seq=1327 Ack=1040 Win=8640 Len=0 TSV=2362312388 TSER=10381582
SSHv2	Encrypted response packet len=1264
SSHv2	Encrypted request packet len=240
TCP	ssh > 56678 [ACK] Seq=2591 Ack=1280 Win=8640 Len=0 TSV=2362312398 TSER=10381632
SSHv2	Encrypted response packet len=192
SSHv2	Encrypted request packet len=384
TCP	ssh > 56678 [ACK] Seq=2783 Ack=1664 Win=10064 Len=0 TSV=2362312455 TSER=10381690
SSHv2	Encrypted response packet len=32
SSHv2	Encrypted request packet len=64
SSHv2	Encrypted response packet len=48
SSHv2	Encrypted request packet len=448
SSHv2	Encrypted response packet len=48

Illustration 6: Ethereal screen shot showing session initiation and transfer

The screen shot shows us the three-way TCP connection handshake and the initial key exchange. Eventually, all traffic is sent encrypted.

Findings
SSH daemon is running and only encrypted packets are seen in traffic dump.

Recommendation
None

Test 2 *(Control 1)* **Result: fail**

Testing procedure
This test checks if bogus syslog entries can be inserted on the log server.

After downloading the source code of syslog_deluxe, we have to compile it:

```
$ gcc -o syslog_deluxe syslog_deluxe.c
```

This created the binary executable `syslog_deluxe`. Let's now execute it as root with the following parameters:

```
# syslog_deluxe 192.168.1.99 log_server
```

This sends one syslog entry as specified in the source code (facility: LOG_DAEMON; priority: LOG_INFO) with the source IP address of 192.168.1.99 to the log server. Let's check if the log server just got a new syslog message. On the log server, execute the

***Test 2** (Control 1)*	***Result: fail***

following command to print the last line of the default syslog log file:
 	
`$ tail -1 /var/log/messages`
`Jun  7 13:37:48 192.168.1.99 telnetd[4489]: connection from ...`
 	
We just got a new syslog entry from the bogus IP address 192.168.1.99.	

Findings The syslog daemon running on the log server accepts any kind of syslog messages. This means, any kind of entries can be inserted and may create a Denial of Service (DoS) attack through filling the disk space or just making the log analysis a very difficult task.	
Recommendation Protecting a syslog server using UDP for the transmission is very hard due to the nature of the protocol which does not provide reliability. One may restrict the source IPs of the syslog packets on the server. This will limit most fake entries but will still allow to enter bogus entries if an attacker fakes the source IP to one of the allowed IP addresses. The only secure way to transport syslog is to use a reliable syslog server like syslog-ng[38] which uses TCP. Additionally, traffic should be encrypted to provide integrity and confidentiality. This can be achieved for example with stunnel[39], which allows you to encrypt TCP connections inside SSL.	

Control 2 - Verify that the log server does not support weak encryption algorithms for the web access.

***Test 1** (Control 2)*	***Result: fail***

Testing procedure
This test is inspecting the Apache SSL configuration. We're going to see what cyphers are configured in the Apache configuration files.
 	
The main configuration file is `/etc/httpd/conf/httpd.conf`. The SSL configurations are set in the following file, though: `/etc/httpd/conf.d/ssl.conf`. Here are the relevant entries:
 	
`SSLEngine on`
`SSLCipherSuite ALL:!ADH:!EXPORT56:RC4+RSA:+HIGH:+MEDIUM:+EXP`
 	
This line allows the all cipher suites except ADH and EXPORT56. There are no other SSL settings in the `ssl.conf` file.	

Findings The configuration showed that all cipher suites except ADH and EXPORT56 are allowed. This is not a very strong setting. There are also some configurations missing like the allowed SSL protocols.	
Recommendation It is recommended that the configuration is adjusted to include the following settings: Only allow TLSv1 and SSLv3 protocols: `SSLProtocol -all +TLSv1 +SSLv3`	

38 syslog-ng - flexible and scalable audit trail processing tool: http://www.balabit.com/products/syslog_ng/
39 Stunnel - Universal SSL Wrapper: http://www.stunnel.org/

Test 1** (Control 2)* ***Result: fail

Use only HIGH (>168 bits) and MEDIUM (128 bits) cipher suites; exclude aNULL (no encryption):

```
SSLCipherSuite HIGH:MEDIUM:!aNULL:+SHA1:+MD5:+HIGH:+MEDIUM
```

Force the usage of a SSL/TLS connection:

```
SSLEngine on
SSLOptions +StrictRequire
<Directory />
    SSLRequireSSL
</Directory>
```

Test 2** (Control 2)* ***Result: fail

Testing procedure

Now we're testing the SSL connection manually with the openssl tool from the OpenSSL package. Our goal is to find out if weak cyphers are supported.

The following command tries to open a connection with the SSLv2 protocol and either a LOW, NULL, aNULL or EXP cipher suite:

```
$ openssl s_client -connect log_server:443 -ssl2 -cipher 'LOW:NULL:aNULL:EXP'
CONNECTED(00000003)
...
```

The connection works – with a weak cipher suite. Now let's try the same ciphers with SSLv3:

```
$ openssl s_client -connect log_server:443 -ssl3 -cipher 'LOW:NULL:aNULL:EXP'
CONNECTED(00000003)
...
```

Again, the connection works. To verify that not any ciphers are accepted, we'll try to connect with the SSLv2 protocol and NULL or aNULL ciphers:

```
$ openssl s_client -connect log_server:443 -ssl2 -cipher 'NULL:aNULL'
error setting cipher list
16781:error:1410D0B9:SSL routines:SSL_CTX_set_cipher_list:no cipher
match:ssl_lib.c:1176:
```

This time the connection doesn't work anymore. The server doesn't support those ciphers.

Findings

The log server supports weak cipher suites, including LOW (<56 bits) and the protocol SSLv2.

Recommendation

It is recommended to switch to strong ciphers and only allow SSLv3 and TLSv1 protocols.

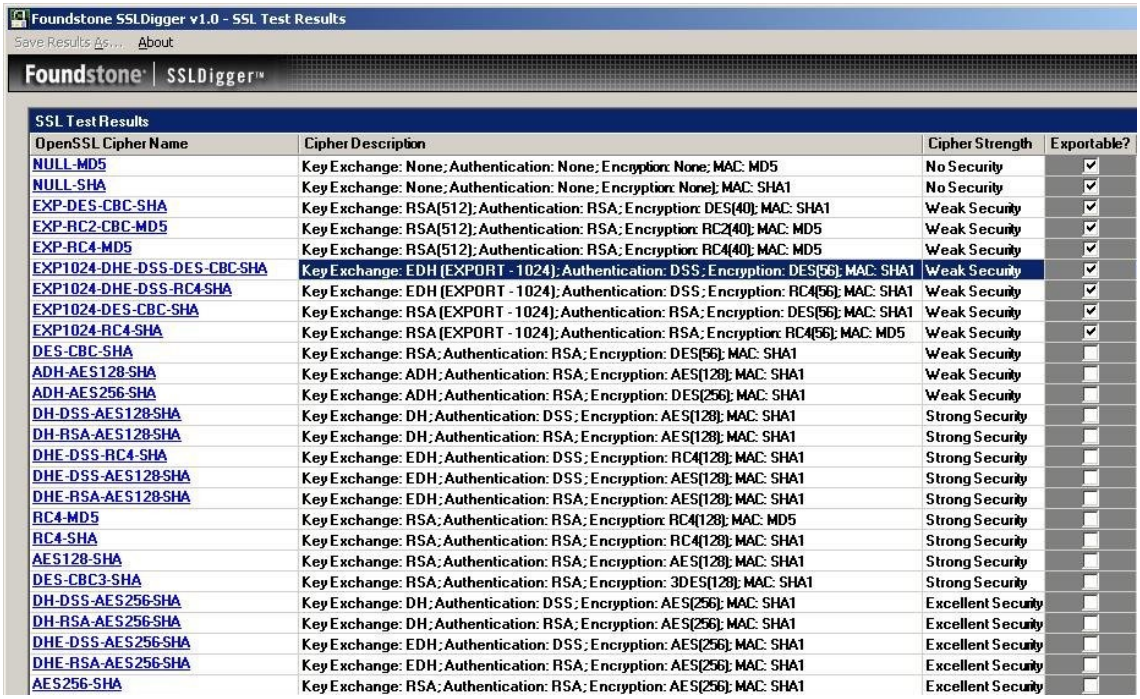
Test 3** (Control 2)* ***Result: pass

Testing procedure

With the help of SSLDigger we're going to assess the strength of the SSL configuration of the log server.

Test 3 *(Control 2)* **Result: pass**

Download the tool from the Foundstone website[40]. Unzip the archive and install it by double clicking on the SSLDigger.msi file. Once installed start the tool and enter the URL of the log server in the “Address” location bar and hit “Go”. You'll see something like this:



OpenSSL Cipher Name	Cipher Description	Cipher Strength	Exportable?
NULL-MD5	Key Exchange: None; Authentication: None; Encryption: None; MAC: MD5	No Security	☑
NULL-SHA	Key Exchange: None; Authentication: None; Encryption: None; MAC: SHA1	No Security	☑
EXP-DES-CBC-SHA	Key Exchange: RSA(512); Authentication: RSA; Encryption: DES(40); MAC: SHA1	Weak Security	☑
EXP-RC2-CBC-MD5	Key Exchange: RSA(512); Authentication: RSA; Encryption: RC2(40); MAC: MD5	Weak Security	☑
EXP-RC4-MD5	Key Exchange: RSA(512); Authentication: RSA; Encryption: RC4(40); MAC: MD5	Weak Security	☑
EXP1024-DHE-DSS-DES-CBC-SHA	Key Exchange: EDH (EXPORT - 1024); Authentication: DSS; Encryption: DES(56); MAC: SHA1	Weak Security	☑
EXP1024-DHE-DSS-RC4-SHA	Key Exchange: EDH (EXPORT - 1024); Authentication: DSS; Encryption: RC4(56); MAC: SHA1	Weak Security	☑
EXP1024-DES-CBC-SHA	Key Exchange: RSA (EXPORT - 1024); Authentication: RSA; Encryption: DES(56); MAC: SHA1	Weak Security	☑
EXP1024-RC4-SHA	Key Exchange: RSA (EXPORT - 1024); Authentication: RSA; Encryption: RC4(56); MAC: MD5	Weak Security	☑
DES-CBC-SHA	Key Exchange: RSA; Authentication: RSA; Encryption: DES(56); MAC: SHA1	Weak Security	☐
ADH-AES128-SHA	Key Exchange: ADH; Authentication: RSA; Encryption: AES(128); MAC: SHA1	Weak Security	☐
ADH-AES256-SHA	Key Exchange: ADH; Authentication: RSA; Encryption: DES(256); MAC: SHA1	Weak Security	☐
DH-DSS-AES128-SHA	Key Exchange: DH; Authentication: DSS; Encryption: AES(128); MAC: SHA1	Strong Security	☐
DH-RSA-AES128-SHA	Key Exchange: DH; Authentication: RSA; Encryption: AES(128); MAC: SHA1	Strong Security	☐
DHE-DSS-RC4-SHA	Key Exchange: EDH; Authentication: DSS; Encryption: RC4(128); MAC: SHA1	Strong Security	☐
DHE-DSS-AES128-SHA	Key Exchange: EDH; Authentication: DSS; Encryption: AES(128); MAC: SHA1	Strong Security	☐
DHE-RSA-AES128-SHA	Key Exchange: EDH; Authentication: RSA; Encryption: AES(128); MAC: SHA1	Strong Security	☐
RC4-MD5	Key Exchange: RSA; Authentication: RSA; Encryption: RC4(128); MAC: MD5	Strong Security	☐
RC4-SHA	Key Exchange: RSA; Authentication: RSA; Encryption: RC4(128); MAC: SHA1	Strong Security	☐
AES128-SHA	Key Exchange: RSA; Authentication: RSA; Encryption: AES(128); MAC: SHA1	Strong Security	☐
DES-CBC3-SHA	Key Exchange: RSA; Authentication: RSA; Encryption: 3DES(128); MAC: SHA1	Strong Security	☐
DH-DSS-AES256-SHA	Key Exchange: DH; Authentication: DSS; Encryption: AES(256); MAC: SHA1	Excellent Security	☐
DH-RSA-AES256-SHA	Key Exchange: DH; Authentication: RSA; Encryption: AES(256); MAC: SHA1	Excellent Security	☐
DHE-DSS-AES256-SHA	Key Exchange: EDH; Authentication: DSS; Encryption: AES(256); MAC: SHA1	Excellent Security	☐
DHE-RSA-AES256-SHA	Key Exchange: EDH; Authentication: RSA; Encryption: AES(256); MAC: SHA1	Excellent Security	☐
AES256-SHA	Key Exchange: RSA; Authentication: RSA; Encryption: AES(256); MAC: SHA1	Excellent Security	☐

Illustration 7: SSLDigger scanning for supported ciphers

Once the scan is complete, it will display the results. Here is what SSLDigger found:

Ciphers supported:

No security:	0
Weak security:	4
Strong security:	5
Excellent security:	2

OpenSSL Name	*Display Name*	*Strength*
EXP-DES-CBC-SHA	Key Exchange: RSA(512); Authentication: RSA; Encryption: DES(40); MAC: SHA1	Weak Security
EXP-RC2-CBC-MD5	Key Exchange: RSA(512); Authentication: RSA; Encryption: RC2(40); MAC: MD5	Weak Security
EXP-RC4-MD5	Key Exchange: RSA(512); Authentication: RSA; Encryption: RC4(40); MAC: MD5	Weak Security
DES-CBC-SHA	Key Exchange: RSA; Authentication: RSA; Encryption: DES(56); MAC: SHA1	Weak Security
DHE-RSA-AES128-SHA	Key Exchange: EDH; Authentication: RSA; Encryption: AES(128); MAC: SHA1	Strong Security
RC4-MD5	Key Exchange: RSA; Authentication: RSA; Encryption: RC4(128); MAC: MD5	Strong Security

40 SSLDigger™ : http://www.foundstone.com/resources/proddesc/ssldigger.htm

***Test 3** (Control 2)*		***Result: pass***
OpenSSL Name	***Display Name***	***Strength***
RC4-SHA	Key Exchange: RSA; Authentication: RSA; Encryption: RC4(128); MAC: SHA1	Strong Security
AES128-SHA	Key Exchange: RSA; Authentication: RSA; Encryption: AES(128); MAC: SHA1	Strong Security
DES-CBC3-SHA	Key Exchange: RSA; Authentication: RSA; Encryption: 3DES(128); MAC: SHA1	Strong Security
DHE-RSA-AES256-SHA	Key Exchange: EDH; Authentication: RSA; Encryption: AES(256); MAC: SHA1	Excellent Security
AES256-SHA	Key Exchange: RSA; Authentication: RSA; Encryption: AES(256); MAC: SHA1	Excellent Security

The total number of ciphers used in testing was 26. SSLDigger grades the overall security with a B.

Findings
SSLDigger found 4 weak supported ciphers.

Recommendation
As in the previous tests, it is recommended to only support strong ciphers and disable all weak cipher suites.

Control 3 - Verify that no unneeded services and daemons are running

Test 1** (Control 3)* ***Result: pass

Testing procedure
This test verifies what services are running. First, we're checking which runlevel is set as default:

```
# grep initdefault /etc/inittab
id:3:initdefault:
```

This means that by default, the server is booting into runlevel 3. We need this information to see what services are running in this specific runlevel. Now let's see which services are running:

```
# chkconfig --list
syslog          0:off   1:off   2:on    3:on    4:on    5:on    6:off
mdmonitor       0:off   1:off   2:on    3:on    4:on    5:on    6:off
readahead_early 0:off   1:off   2:off   3:off   4:off   5:on    6:off
atd             0:off   1:off   2:off   3:off   4:off   5:off   6:off
gpm             0:off   1:off   2:off   3:off   4:off   5:off   6:off
iptables        0:off   1:off   2:on    3:on    4:on    5:on    6:off
cpuspeed        0:off   1:on    2:on    3:on    4:on    5:on    6:off
dc_server       0:off   1:off   2:off   3:off   4:off   5:off   6:off
apmd            0:off   1:off   2:on    3:on    4:on    5:on    6:off
cups            0:off   1:off   2:off   3:off   4:off   5:off   6:off
anacron         0:off   1:off   2:on    3:on    4:on    5:on    6:off
httpd           0:off   1:off   2:on    3:on    4:on    5:on    6:off
netdump         0:off   1:off   2:off   3:off   4:off   5:off   6:off
crond           0:off   1:off   2:on    3:on    4:on    5:on    6:off
acpid           0:off   1:off   2:off   3:on    4:on    5:on    6:off
NetworkManager  0:off   1:off   2:off   3:off   4:off   5:off   6:off
ntpd            0:off   1:off   2:on    3:on    4:on    5:on    6:off
```

Test 1** (Control 3)* ***Result: pass

```
readahead       0:off   1:off   2:off   3:off   4:off   5:on    6:off
snmptrapd       0:off   1:off   2:off   3:off   4:off   5:off   6:off
haldaemon       0:off   1:off   2:off   3:off   4:off   5:off   6:off
arpwatch        0:off   1:off   2:on    3:on    4:on    5:on    6:off
messagebus      0:off   1:off   2:off   3:on    4:on    5:on    6:off
xinetd          0:off   1:off   2:on    3:on    4:on    5:on     6:off
saslauthd       0:off   1:off   2:off   3:off   4:off   5:off   6:off
irqbalance      0:off   1:off   2:off   3:on    4:on    5:on    6:off
psacct          0:off   1:off   2:off   3:off   4:off   5:off   6:off
autofs          0:off   1:off   2:off   3:on    4:on    5:on    6:off
dc_client       0:off   1:off   2:off   3:off   4:off   5:off   6:off
smartd          0:off   1:off   2:off   3:off   4:off   5:off   6:off
sshd            0:off   1:off   2:on    3:on    4:on    5:on    6:off
kudzu           0:off   1:off   2:off   3:on    4:on    5:on    6:off
rhnsd           0:off   1:off   2:on    3:on    4:on    5:on    6:off
netplugd        0:off   1:off   2:off   3:off   4:off   5:off   6:off
diskdump        0:off   1:off   2:off   3:off   4:off   5:off   6:off
ipmi            0:off   1:off   2:off   3:off   4:off   5:off   6:off
snmpd           0:off   1:off   2:off   3:off   4:off   5:off   6:off
network         0:off   1:off   2:on    3:on    4:on    5:on    6:off
rawdevices      0:off   1:off   2:off   3:on    4:on    5:on    6:off
```

Findings

Only the necessary services are running in runlevel 3.

Recommendation

There are some services like atd, gpm and cups which are installed but not running, as they are disabled in all runlevels. It is recommended that only services which are needed to run are installed. Those services should be uninstalled.

Test 2** (Control 3)* ***Result: pass

Testing procedure

Test 2 checks the `xinet.d` configuration. There are two ways to verify the running `xinet.d` services. The command '`chkconfig --list`' also lists services started by `xinet.d`. The other method is the manual verification of the configuration scripts the directory `/etc/xinet.d/` for each service. Each service has a directive called 'disable'.

```
# chkconfig -list
xinetd based services:
        vnetd:          on
        rsync:          off
        cups-lpd:       off
        time-udp:       off
        echo-udp:       off
        krb5-telnet:    off
        daytime-udp:    off
        kshell:         off
        bpjava-msvc:    on
        time:           off
        bpcd:           on
        echo:           off
        chargen:        off
        klogin:         off
```

Test 2** (Control 3)* ***Result: pass

```
        vopied:         on
        eklogin:        off
        daytime:        off
        chargen-udp:    off
```

Let's double check this result with the manual verification.

```
# grep -H disable /etc/xinetd.d/*
/etc/xinetd.d/bpcd:             disable         = no
/etc/xinetd.d/bpjava-msvc:      disable         = no
/etc/xinetd.d/chargen:          disable         = yes
/etc/xinetd.d/chargen-udp:      disable         = yes
/etc/xinetd.d/cups-lpd:         disable         = yes
/etc/xinetd.d/daytime:          disable         = yes
/etc/xinetd.d/daytime-udp:      disable         = yes
/etc/xinetd.d/echo:             disable         = yes
/etc/xinetd.d/echo-udp:         disable         = yes
/etc/xinetd.d/eklogin:          disable         = yes
/etc/xinetd.d/klogin:           disable         = yes
/etc/xinetd.d/krb5-telnet:      disable         = yes
/etc/xinetd.d/kshell:           disable         = yes
/etc/xinetd.d/rsync:            disable         = yes
/etc/xinetd.d/time:             disable         = yes
/etc/xinetd.d/time-udp:         disable         = yes
/etc/xinetd.d/vnetd:            disable         = no
/etc/xinetd.d/vopied:           disable         = no
```

Findings

The two tests showed the same results and only the allowed services are running.

Recommendation

None

Test 3** (Control 3)* ***Result: pass

Testing procedure

This test verifies in yet another way what processes/services are running.

```
# ps aux
USER       PID %CPU %MEM    VSZ   RSS TTY      STAT START   TIME COMMAND
root         1  0.0  0.0   2676   512 ?        S    Mar22   0:26 init [3]
root         2  0.0  0.0      0     0 ?        S    Mar22   1:06 [migration/0]
root         3  0.0  0.0      0     0 ?        SN   Mar22   0:04 [ksoftirqd/0]
root         4  0.0  0.0      0     0 ?        S    Mar22   1:27 [migration/1]
root         5  0.0  0.0      0     0 ?        SN   Mar22   0:03 [ksoftirqd/1]
root         6  0.0  0.0      0     0 ?        S    Mar22   1:02 [migration/2]
root         7  0.0  0.0      0     0 ?        SN   Mar22   0:03 [ksoftirqd/2]
root         8  0.0  0.0      0     0 ?        S    Mar22   1:25 [migration/3]
root         9  0.0  0.0      0     0 ?        SN   Mar22   0:03 [ksoftirqd/3]
root        10  0.0  0.0      0     0 ?        S<   Mar22   0:02 [events/0]
root        11  0.0  0.0      0     0 ?        S<   Mar22   0:00 [events/1]
root        12  0.0  0.0      0     0 ?        S<   Mar22   0:00 [events/2]
root        13  0.0  0.0      0     0 ?        S<   Mar22   0:00 [events/3]
root        14  0.0  0.0      0     0 ?        S<   Mar22   0:00 [khelper]
root        15  0.0  0.0      0     0 ?        S<   Mar22   0:00 [kacpid]
root        45  0.0  0.0      0     0 ?        S<   Mar22   0:00 [kblockd/0]
root        46  0.0  0.0      0     0 ?        S<   Mar22   0:00 [kblockd/1]
```

Test 3 *(Control 3)* **Result: pass**

```
root         47  0.0  0.0     0     0 ?        S<   Mar22   0:00 [kblockd/2]
root         48  0.0  0.0     0     0 ?        S<   Mar22   0:00 [kblockd/3]
root         61  0.0  0.0     0     0 ?        S<   Mar22   0:00 [aio/0]
root         62  0.0  0.0     0     0 ?        S<   Mar22   0:00 [aio/1]
root         63  0.0  0.0     0     0 ?        S<   Mar22   0:00 [aio/2]
root         64  0.0  0.0     0     0 ?        S<   Mar22   0:00 [aio/3]
root         49  0.0  0.0     0     0 ?        S    Mar22   0:00 [khubd]
root         60  0.0  0.0     0     0 ?        S    Mar22  11:59 [kswapd0]
root        137  0.0  0.0     0     0 ?        S    Mar22   0:00 [kseriod]
root        215  0.0  0.0     0     0 ?        S<   Mar22   0:00 [kmirrord]
root        216  0.0  0.0     0     0 ?        S<   Mar22   0:00 [kmir_mon]
root        224  0.0  0.0     0     0 ?        S    Mar22  23:59 [kjournald]
root       1469  0.0  0.0     0     0 ?        S<   Mar22   0:00 [kauditd]
root       1515  0.0  0.0     0     0 ?        S    Mar22   0:00 [kjournald]
root       2192  0.0  0.0  3048   728 ?        Ss   Mar22   1:45 syslogd -m 0 -r
root       2196  0.0  0.0  2840   468 ?        Ss   Mar22   0:00 klogd -x
root       2206  0.0  0.0  1712   476 ?        Ss   Mar22   0:00 irqbalance
root       2297  0.0  0.0  2528   548 ?        Ss   Mar22   0:00 /usr/sbin/acpid
root       2348  0.0  0.0  2772   872 ?        Ss   Mar22   0:00 xinetd -stayalive
-pidfile /var/run/xinetd.pid
root       2506  0.0  0.7 27316 16556 ?        Ss   Mar22   0:04 /usr/sbin/httpd
root       2515  0.0  0.0  6612 1120 ?        Ss   Mar22   0:01 crond
root       2831  0.1  0.0 114684 1048 ?        Ssl  Mar22 114:38 hpasmd
dbus       3045  0.0  0.0  3620 1068 ?        Ss   Mar22   0:00 dbus-daemon-1 --system
root       3056  0.0  0.0  1512  416 tty1     Ss+  Mar22   0:00 /sbin/mingetty tty1
root       3058  0.0  0.0  2160  416 tty2     Ss+  Mar22   0:00 /sbin/mingetty tty2
root       3059  0.0  0.0  1632  416 tty3     Ss+  Mar22   0:00 /sbin/mingetty tty3
root       3061  0.0  0.0  3488  416 tty4     Ss+  Mar22   0:00 /sbin/mingetty tty4
root       3062  0.0  0.0  2032  416 tty5     Ss+  Mar22   0:00 /sbin/mingetty tty5
root       3064  0.0  0.0  2760  416 tty6     Ss+  Mar22   0:00 /sbin/mingetty tty6
root      17894  0.0  0.0  7192 1404 ?        S    Mar22   0:00 crond
root        556  0.0  0.0  5164  564 ?        Ss   Apr18   0:00 rhnsd --interval 240
root      16038  0.0  0.0  2612  468 ?        S<s  Apr18   0:00 udevd
root      17703  0.0  0.0  5144 1692 ?        Ss   Apr18   0:00 /usr/sbin/sshd
ntp       22869  0.0  0.2  5148 5148 ?        SLs  Apr18   0:00 ntpd -u ntp:ntp -p
/var/run/ntpd.pid -g
apache    19651  0.0  1.2 35292 25424 ?        S    Jun04   0:06 /usr/sbin/httpd
apache    19652  0.0  1.2 35508 25564 ?        S    Jun04   0:07 /usr/sbin/httpd
apache    19653  0.0  1.2 35504 25632 ?        S    Jun04   0:07 /usr/sbin/httpd
apache    19654  0.0  1.2 35372 25480 ?        S    Jun04   0:08 /usr/sbin/httpd
apache    19655  0.0  1.2 35320 25416 ?        S    Jun04   0:03 /usr/sbin/httpd
apache    19656  0.0  1.2 35676 25692 ?        S    Jun04   0:04 /usr/sbin/httpd
apache    19657  0.0  1.2 35568 25636 ?        S    Jun04   0:10 /usr/sbin/httpd
apache    19658  0.0  1.2 35164 25272 ?        S    Jun04   0:03 /usr/sbin/httpd
apache     9241  0.0  1.2 35088 25204 ?        S    Jun06   0:08 /usr/sbin/httpd
root       5773  0.0  0.1  7492 2236 ?        Ss   11:20   0:00 sshd: user01 [priv]
user01     5775  0.0  0.1  7492 2292 ?        S    11:20   0:00 sshd: user01@pts/0
user01     5776  0.0  0.0  5700 1392 pts/0    Ss   11:20   0:00 -bash
root       6967  0.0  0.0  4572 1184 pts/0    S    11:25   0:00 su - root
root       6972  0.0  0.0  5940 1476 pts/0    S    11:25   0:00 -bash
root       2541  0.0  0.0  2724  748 pts/0    R+   12:56   0:00 ps aux

# netstat -lnp --tcp -udp
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address          Foreign Address     State       PID/Program name
tcp        0      0 0.0.0.0:13782          0.0.0.0:*           LISTEN      2348/xinetd
tcp        0      0 0.0.0.0:13783          0.0.0.0:*           LISTEN      2348/xinetd
tcp        0      0 0.0.0.0:13722          0.0.0.0:*           LISTEN      2348/xinetd
tcp        0      0 0.0.0.0:13724          0.0.0.0:*           LISTEN      2348/xinetd
tcp        0      0 :::22                  :::*                LISTEN      17703/sshd
tcp        0      0 :::443                 :::*                LISTEN      2506/httpd
udp        0      0 0.0.0.0:514            0.0.0.0:*                       2192/syslogd
udp        0      0 192.169.2.49:123       0.0.0.0:*                       22869/ntpd
udp        0      0 127.0.0.1:123          0.0.0.0:*                       22869/ntpd
udp        0      0 0.0.0.0:123            0.0.0.0:*                       22869/ntpd
udp        0      0 :::123                 :::*                            22869/ntpd
```

Test 3** (Control 3)* ***Result: pass

Findings
Both commands show only approved processes and open ports, i.e. xinetd, ssh, httpd, syslog and ntpd.

Recommendation
None

Test 4** (Control 3)* ***Result: pass

Testing procedure
We're going to verify the open ports from yet another perspective, from the remote side.

```
# nmap -sS -P0 -sV -p1-65535 log_server

Starting Nmap 4.03 ( http://www.insecure.org/nmap/ ) at 2006-06-09 13:08 CEST
Interesting ports on log_server.corp.com (192.168.2.49):
(The 65526 ports scanned but not shown below are in state: closed)
PORT      STATE SERVICE     VERSION
22/tcp    open  ssh         OpenSSH 3.9p1 (protocol 2.0)
443/tcp   open  ssl/http    Apache httpd 2.0.52 ((Red Hat))
13722/tcp open  netbackup   Veritas Netbackup java listener
13724/tcp open  vnetd       Veritas Netbackup Network Utility
13782/tcp open  bpcd        Veritas Netbackup (refused)
13783/tcp open  arcserve    ARCserve Discovery
Service Info: OS: Unix

Nmap finished: 1 IP address (1 host up) scanned in 31.028 seconds
```

After scanning the TCP ports, we're scanning all UDP ports:

```
# nmap -sU -P0 -p1-65535 log_server

Starting Nmap 4.03 ( http://www.insecure.org/nmap/ ) at 2006-06-12 14:44 CEST
Interesting ports on log_server.corp.com (192.168.2.49):
(The 65526 ports scanned but not shown below are in state: closed)
PORT    STATE         SERVICE
123/udp open|filtered ntp
514/udp open|filtered syslog

Nmap finished: 1 IP address (1 host up) scanned in 1476.177 seconds
```

Findings
The portscan confirms the test done on the system, there are only approved ports open.

Recommendation
None

Control 4 - Identify common vulnerabilities in the OS

Test 1** (Control 4)* ***Result: pass

Testing procedure
This test involves the Nessus vulnerability scanner. Here are two screen shots of the Nessus setup and it's report :

Test 1** (Control 4)* ***Result: pass

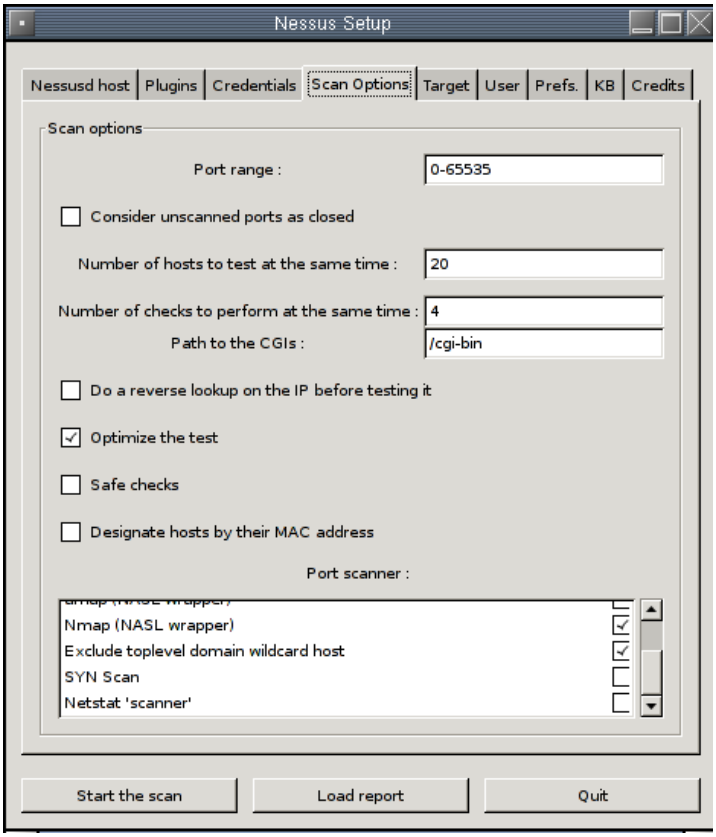


Illustration 8: Nessus Scan Options

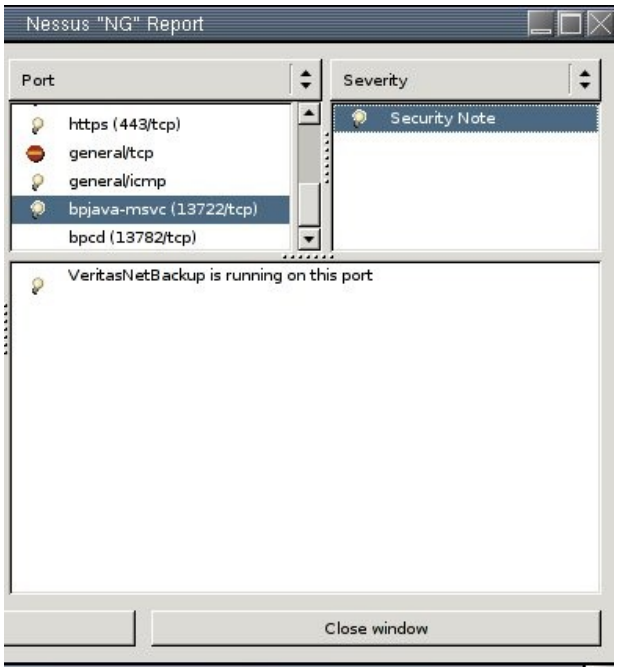


Illustration 9: Nessus Report

***Test 1** (Control 4)*	***Result: pass***

The following was found by Nessus (list of open ports):

- ssh (22/tcp) (Security notes found)
- https (443/tcp) (Security notes found)
- bpjava-msvc (13722/tcp) (Security notes found)
- vnetd (13724/tcp)
- bpcd (13782/tcp)
- vopied (13783/tcp)
- general/icmp (Security notes found)

Findings
Nessus listed some security notes, however no security holes were found.

Recommendation
None

Control 5 - Verify that the OS is up to date with security patches

***Test 1** (Control 5)*	***Result: fail***

Testing procedure
This test verifies if all patches have been installed. The following command lists all available packages:

```
# up2date --dry-run

Fetching Obsoletes list for channel: rhel-i386-ws-4...

Fetching rpm headers...
########################################

Name                                    Version        Rel
----------------------------------------------------------
ethereal                                0.99.0         EL4.2          i386
ipsec-tools                             0.3.3          6.rhel4.1      i386
kernel                                  2.6.9          34.0.1.EL      i686
kernel-devel                            2.6.9          34.0.1.EL      i686
kernel-hugemem-devel                    2.6.9          34.0.1.EL      i686
kernel-smp                              2.6.9          34.0.1.EL      i686
kernel-smp-devel                        2.6.9          34.0.1.EL      i686
libtiff                                 3.6.1          10             i386
php                                     4.3.9          3.12           i386
php-ldap                                4.3.9          3.12           i386
php-mysql                               4.3.9          3.12           i386
php-pear                                4.3.9          3.12           i386
ruby-libs                               1.8.1          7.EL4.3        i386


Testing package set / solving RPM inter-dependencies...
########################################

Name                                    Version        Rel
----------------------------------------------------------
ethereal                                0.99.0         EL4.2          i386
ipsec-tools                             0.3.3          6.rhel4.1      i386
kernel                                  2.6.9          34.0.1.EL      i686
```

***Test 1** (Control 5)*			***Result: fail***
kernel-devel	2.6.9	34.0.1.EL	i686
kernel-hugemem-devel	2.6.9	34.0.1.EL	i686
kernel-smp	2.6.9	34.0.1.EL	i686
kernel-smp-devel	2.6.9	34.0.1.EL	i686
libtiff	3.6.1	10	i386
php	4.3.9	3.12	i386
php-ldap	4.3.9	3.12	i386
php-mysql	4.3.9	3.12	i386
php-pear	4.3.9	3.12	i386
ruby-libs	1.8.1	7.EL4.3	i386

The output lists the packages which are ready to install. Those packages have not yet been installed.

Findings
There are some packages which haven't been updated.

Recommendation
It is recommended that the system is updated in a regular interval.

Control 6 - Verify user accounts and their privileges

Test 1** (Control 6)* ***Result: pass

Testing procedure
We are now verifying that the only account with UID 0 is root:

```
# awk -F: '($3==0){print $1}' /etc/passwd
root
```

Findings
There is only one root account with UID 0.

Recommendation
None

Test 2** (Control 6)* ***Result: pass

Testing procedure
This test verifies that no enabled user account is having a null password:

```
# awk -F: '($2==“”){print $1}' /etc/shadow
```

There is no output, which means there is no account with an empty password field.

Findings
All account have a password set.

Recommendation
None

Test 3** (Control 6)* ***Result: pass

Testing procedure

By inspecting the file `/etc/passwd` we are verifying that no unnecessary user accounts are set up on the system:

```
# cat /etc/passwd
root:x:0:0:root:/root:/bin/bash
bin:x:1:1:bin:/bin:/sbin/nologin
daemon:x:2:2:daemon:/sbin:/sbin/nologin
adm:x:3:4:adm:/var/adm:/sbin/nologin
lp:x:4:7:lp:/var/spool/lpd:/sbin/nologin
sync:x:5:0:sync:/sbin:/bin/sync
shutdown:x:6:0:shutdown:/sbin:/sbin/shutdown
halt:x:7:0:halt:/sbin:/sbin/halt
nobody:x:99:99:Nobody:/:/sbin/nologin
rpm:x:37:37::/var/lib/rpm:/sbin/nologin
haldaemon:x:68:68:HAL daemon:/:/sbin/nologin
sshd:x:74:74:Privilege-separated SSH:/var/empty/sshd:/sbin/nologin
mailnull:x:47:47::/var/spool/mqueue:/sbin/nologin
smmsp:x:51:51::/var/spool/mqueue:/sbin/nologin
pcap:x:77:77::/var/arpwatch:/sbin/nologin
apache:x:48:48:Apache:/var/www:/sbin/nologin
ntp:x:38:38::/etc/ntp:/sbin/nologin
hpsmh:x:79:79::/opt/hp/hpsmh:/sbin/nologin
user01:x:500:500:User 01:/home/user01:/bin/bash
user02:x:501:501:User 02:/home/user02:/bin/bash
```

Most users are created by the system and are disabled. Only two users (user01 and user02) are “normal” user accounts.

Findings

There are no unused user accounts set up.

Recommendation

None

Test 4** (Control 6)* ***Result: pass

Testing procedure

This test is using John for a password strength verification. First, we have to get a copy of the password file.

```
# unshadow /etc/passwd /etc/shadow > mypasswd
```

This created a file `mypasswd` with the password hashes. Now let's run John:

```
$ john mypasswd
Loaded 4 passwords with 4 different salts (FreeBSD MD5 [32/32])
guesses: 0  time: 0:00:02:03 (3)  c/s: 4148  trying: mullan1
guesses: 0  time: 0:00:14:52 (3)  c/s: 4188  trying: scHOMe
guesses: 0  time: 0:00:33:29 (3)  c/s: 4162  trying: amot29
guesses: 0  time: 0:01:16:15 (3)  c/s: 4143  trying: Bageg5
guesses: 0  time: 0:01:26:23 (3)  c/s: 4136  trying: smOUAQ

$ john -show mypasswd
0 passwords cracked, 4 left
```

***Test 4** (Control 6)*	***Result: pass***
John displays a status information when you hit any key. You see the first status message after 2 minutes and 3 seconds, and the last one after 1 hour, 26 minutes and 23 seconds, and John still hasn't been able to crack the passwords. The last column is showing the actual password which is being tried at that time.	
Findings No passwords have been found in one hour.	
Recommendation None	

Control 7 - Verify that the backup procedure is in place and is working correctly

Test 1** (Control 7)* ***Result: pass

Testing procedure

This test performs a restore of several test files to ensure that backup can be restored. All tested files must be able to restore completely.

First, we delete some arbitrary files, let's delete a whole directory:

```
$ ls
ja  ja_JP.eucJP man1
$ rm -r man1/
$ ls
ja  ja_JP.eucJP
```

The directory `man1` has just been deleted. Now we're going to use the NetBackup graphical user interface (the NetBackup Administration Console), a Java-based, graphical-user interface to restore the directory. There is also a character-based, menu interface that is started by running the `bpadm` command.

Start the NetBackup Administration Console:

```
/usr/openv/netbackup/bin/jnbSA
```

Log in with your user name and password. In the 'Restore files' tab, select the directory we've just deleted in the file tree. Now click on the “Restore...” button. In the “Restore Files” dialog, verify that “Restore everything to its original location” is checked, then click “Start Restore”. When the restore is finished, the status will go to “Successful”. Now we are verifying that the restore completed successfully.

```
$ ls
ja  ja_JP.eucJP  man1
$ ls man1/
java.1     kinit.1  orbd.1        rmid.1         tnameserv.1
javaws.1   klist.1  pack200.1     rmiregistry.1  unpack200.1
keytool.1  ktab.1   policytool.1  servertool.1
```

The man1 directory including all files have appeared again.

***Test 1** (Control 7)*	***Result: pass***

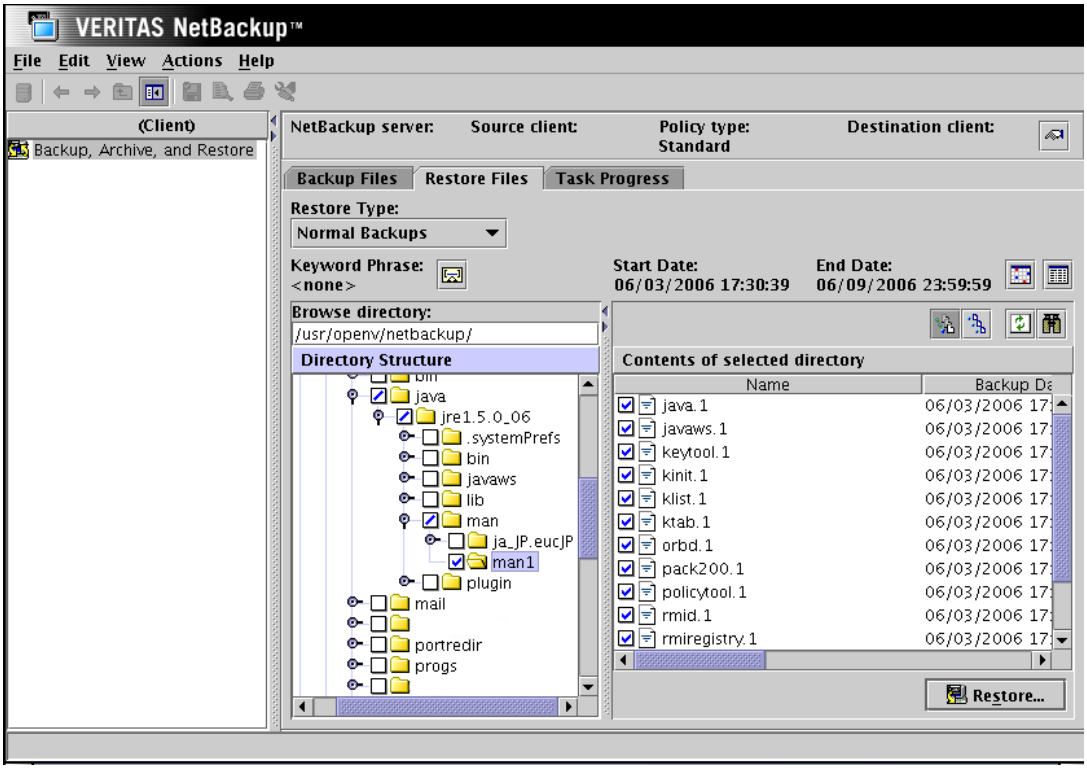


Illustration 10: NetBackup: Restore Files

Findings
The restore of the files was successful.
Recommendation
None

Control 8 - Prevent hardware outages

***Test 1** (Control 8)*	***Result: pass***
Testing procedure	
Each power plug has been plugged out and the server continued running as intended.	
Findings	
Both power supplies are working correctly.	
Recommendation	
None	

***Test 2** (Control 8)*	***Result: pass***
Testing procedure	
The UPS system documentation has been checked and the system is operated as it is supposed to be. The system, including the emergency generators, is tested once a year.	
Findings	
The UPS is operated and working correctly.	
Recommendation	
None	

Control 9 - Prevent physical access for unauthorized people

***Test 1** (Control 9)*	***Result: pass***
Control objective Prevent physical access for unauthorized people	
Testing procedure The entrance doors to the computer room have been inspected. There is a biometric access control in place. Only employees with a formal request are set up on the biometric system. The entrance system creates a log file with the date, time, access door and employee name.	
Findings Physical access is protected adequately.	
Recommendation None	

6.2 Summary of findings and recommendations

The audit found three issues which can be improved.

Bogus syslog entries can fill logs

The syslog daemon uses UDP to transfer log entries, which is unreliable and does not provide confidentiality and integrity. It is recommended use a reliable syslog server like syslog-ng and additionally stunnel to encrypt the logs in transfer.

Weak apache SSL configuration

Apache supports weak cipher suites, including LOW (<56 bits) and the protocol SSLv2. It is recommended to switch to strong ciphers and only allow SSLv3 and TLSv1 protocols.

Missing system patches on the OS level

There are multiple packages which haven't been updated to the most recent version. It is recommended that the system is updated in a regular interval. Additionally, unused services should be uninstalled and not only disabled, this prevents local exploits and accidentally enabled services.

7 Conclusion

Log management is an important and essential part of every corporation. There are many benefits of log data like identifying security events / fraudulent activity and forensic analysis. Several federal legislations and regulations require corporations to analyze and retain certain logs. A big challenge in the log management is the vast amount of ever increasing log data. It's a balance of keeping the right amount of data and still being able to analyze them.

The audited log server is a RHEL (Red Hat Enterprise Linux) machine. It's collecting and archiving the log files of multiple devices like firewalls and routers.

The objective of risk management is to spend the right amount of protective measures to protect the IT systems and data. Risk is a function of the likelihood of a given threat exercising a particular potential vulnerability, and the resulting impact of that adverse event on the organization. The definition of risk, threat, vulnerability and impact were described together with examples.

The following three risks have been analyzed:

- Unauthorized access of logs (loss of confidentiality)
- Unauthorized modification of logs
- Loss of logs

Multiple vulnerabilities have been listed for each risk and 9 different control mechanisms have been defined with each having multiple tests. Those tests were explained in detail and then executed. The audit found the following weaknesses:

- bogus syslog entries can fill logs
- missing system patches on the OS level
- weak apache SSL configuration

Each audit finding comes with a recommendation to mitigate the threat or to close the security hole. There were no high risk findings and in general the log server is configured and operated in a secure way.

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