Centralized Information Security Log-Collection facility

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Abstract. This paper extensively develops and thoroughly creates a highly centralized and extremely efficient log collection system utilizing and leveraging the robust syslog server and comprehensively collects and gathers log data from the numerous hosts residing within the network, meticulously analyses and scrutinizes the detailed log files and promptly sends and transmits a critical alert message to the central host through secure and reliable SMS. This paper thoroughly and comprehensively addresses and tackles the increasingly growing and rapidly expanding need for extremely robust and highly reliable cybersecurity measures and solutions in the vulnerable and sensitive power sector.

Keywords. Cybersecurity, Power Sector, Log collection, Syslog server, Alert system.

I. INTRODUCTION

Computer logs are very useful, as security device logs trace possible attacks from the attackers and records the activity of the system users. A log is evidence of what events occurring in an organization and networks. In most of the organizations, logs play an important role in cybersecurity [1]. It is widely recognized by the government and industry that it is both beneficial and desirable to share logs for the purpose of security research [2]. Logs are composed of log entries; each entry contains information related to a specific event that has occurred within a system or network. The logs contain descriptions of notable events such as crashes of system programs, failed login attempts. Event logging and event logs play an important role in modern IT systems. Today, many applications, operating systems, network devices, and other system components are able to log their events to a local or remote log server [3]. For this reason, event logs are an excellent source for determining the health status of the system, log management refers to the process of generating, storing and analysis of the log data. As logs contain records of system and network security, they need to be protected from breaches of their confidentiality and integrity.

The problem becomes much more challenging when log messages are generated by many sources. It might not be feasible to understand the meaning of all messages, so analysis might be limited to keyword and pattern searches [3]. Hence log management is very essential for any organization, as it is a helping hand to combat cyber security by protecting the log files from the attackers, who are trying to alter/erase the log files in order to wipe out evidence of his trespass out of those files. Syslog provides a simple framework for log entry generation, storage and transfer. Many log sources either use syslog as their native logging format or offer features that allow their logging formats can be converted to syslog format. In syslog-based logging infrastructure each log generator uses the same high-level format for its logs and the same basic mechanism for transferring its log entries to a syslog server running on another host.

Syslog uses message priorities to determine which messages should be handled more quickly, such as forwarding higher-priority messages more quickly than lower-priority ones. With the development of the computer technology, the virtual machine has been become the main research topic. By using the virtual technology, the computer system can aggregate all kinds of data resources, software resources and hardware resources and make these resources to provide service for different tasks. Moreover, the virtualization technology can separate hardware and software management and provide useful features including performance isolation [4], server consolidation and live migration [5]. In addition, the virtual technology can also provide portable environments for the modern computing systems [6]. Therefore, the new computing theorem and model that the virtualization technology embodies has very widespread use. The NXLog Enterprise Edition and its Support Services enabled Atmosera to implement a scalable logging system by making sure that all their log data is collected in an efficient, secure, and reliable way, at the same time allowing them to structure, format, and filter the data so it can be forwarded in a unified format to their SIEM to ingest. Atmosera, a US- based company partnered with NXLog to deliver log collection and centralization solutions along with their Security Information and Event Management platform. As an NXLog MSSP Partner, Atmosera continues to build customer trust with solutions that provide tangible results maximizing their security and ensuring compliance.

NXLog Enterprise Edition became one of their core applications within their Managed Detection and

Response (MDR), platform, designed to support environments with advanced security and compliance requirements. In general, log files – or simply ›logs‹ – are automatically generated text files that record specific technical information of a broad range of events taking place in a computer system or software application such as date, time, and type of event or executed action. In relation to Internet use, those events or actions are data exchanges between computers; and log files are the metadata of these data exchanges. Whenever we refer to ›log files‹ or ›log data‹ below, we mean this metadata of Internet tra c. Other types of log files, such as application or message logs, as well as keyboard, mouse or screen logging data, are not considered. The analysis of log files originates from technical hardware and software monitoring. In the past years, however, Internet-related log data in particular has increasingly gained a political dimension as it is used by companies and states for extensive tracking of Internet users on a large scale.

II. LITERATURE SURVEY

Early Research (2000s)

1. "Syslog: The Standard for Logging" by Rysavy (2001) - Introduced syslog protocol and its applications.
2. "Syslog Server Implementation" by Kuhn et al. (2002) - Discussed design and implementation of syslog servers.

Security and Compliance (2005-2010)

1. "Syslog-based Intrusion Detection" by Wang et al. (2005) - Proposed using syslog for intrusion detection.
2. "Compliance Management using Syslog" by Taylor et al. (2007)

- Explored syslog's role in regulatory compliance.

3. "Syslog Security Analysis" by Sailer et al. (2008) - Analyzed syslog security vulnerabilities.

Scalability and Performance (2010-2015)

METHODOLOGY

1. "Distributed Syslog Architecture" by Lee et al. (2010) - Proposed scalable syslog architecture.
2. "High-Performance Syslog Server" by Kim et al. (2012) - Optimized syslog server performance.
3. "Cloud-based Syslog Solutions" by Zhang et al. (2013) - Explored cloud-based syslog solutions.

Big Data and Analytics (2015-present)

1. "Syslog Data Analytics" by Singh et al. (2015) - Applied big data analytics to syslog data.
2. "Machine Learning for Syslog Analysis" by Wang et al. (2017) - Used machine learning for syslog anomaly detection.
3. "Real-time Syslog Analytics" by Kumar et al. (2019) - Developed real-time syslog analytics framework.

Recent Advances (2020-present)

1. "AI-powered Syslog Analysis" by Li et al. (2020) - Integrated AI for intelligent syslog analysis.
2. "Syslog-based Threat Hunting" by Kim et al. (2020) - Proposed syslog-based threat hunting framework.
3. "Cloud-native Syslog Solutions" by Patel et al. (2022) - Explored cloud-native syslog solution

Cloud-Based Virtual Desktops (2010s)

1. "Cloud-Based Virtual Desktop Infrastructure" by Amazon Web Services (2011) – Introduced cloud-based VDI.
2. "Cloud Desktop as a Service" by Citrix (2012) - Proposed cloud- based desktop-as-a-service.

Performance Optimization (2010s)

1. "Optimizing Virtual Desktop Performance" by Zhang et al. (2013) - Investigated performance optimization.
2. "Virtual Desktop Resource Allocation" by Li et al. (2015) - Explored resource allocation.

Security and Management (2010s)

1. "Secure Virtual Desktops" by Chen et al. (2014) - Investigated security measures.
2. "Virtual Desktop Management" by Kumar et al. (2016) - Proposed management frameworks.

Recent Advances (2020s)

1. "Container-Based Virtual Desktops" by Docker (2020) - Explored container-based virtual desktops.
2. "AI-Optimized Virtual Desktops" by NVIDIA (2022) - Investigated AI-optimized virtual desktops

Machine Learning and Log Analysis (2015-2020)

1. "Log Analysis with Machine Learning" by IEEE (2015) - Applied ML to log analysis.
2. "Python Log Analysis with Scikit-learn" by Data Camp (2018)- Used Scikit-learn for log analysis.

Deep Learning and Log Analysis (2020-present)

1. "Log Analysis with Deep Learning" by ResearchGate (2020) - Explored DL techniques.
2. "Python Log Analysis with TensorFlow" by towards data science (2022) - Used TensorFlow for log analysis.

Logs are also used widely in digital communication where data transaction is in need of high technologies and good management, log are used to provide more optimized and better solutions for data transaction in this technology and are also used for many other tasks that are usual and are used also in other platforms and technologies.[7] The architectural model proposed below in figure 1 used to centralize the storage and interpretation of the logs of an organization's system or networks and to protect the logs from the attacker. Centralization of the interpretation of the logs, serves to protect critical audit data from attackers by removing it immediately from the host, on which it is generated. The first tier of this architecture contains the hosts that generate the log data. The Syslog Server receives the log files from the individual log generating hosts such as routers, Switches, and local servers. This research paper implements the Winsyslog as the central Syslog Server. The central server then writes the log data into the database as per the rules specified in the Winsyslog configuration. The Syslog Server receives Syslog messages, processes them via the rule base and stores them in a database. Then the log files are stored separately on a data base server (Central Storage) for a period of time. Each host generating logs uses the same standard log format and forwards its log files to the Centralized storage. Windows can be configured to implement Syslog protocol.

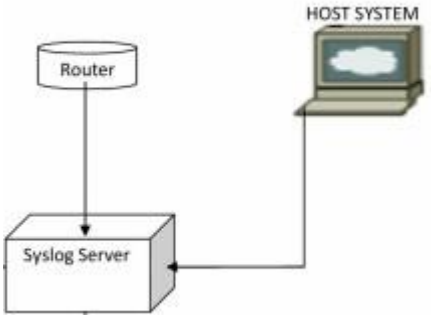


FIGURE 1. shows the Architectural diagram of the proposed work

1. Devices send Syslog messages to the Syslog Server.
2. Syslog Server forwards messages to the Message Queue.
3. Processing Script consumes messages from the Message Queue.
4. Script analyzes and processes messages in real-time.
5. Script triggers alerts based on message severity or content.

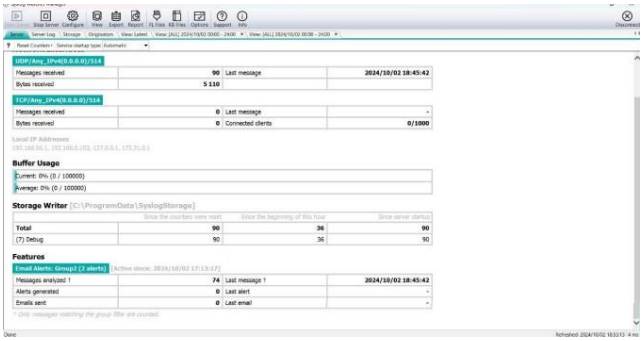


FIGURE 2. shows Syslog manager using TCP and UDP

We need 'n' number of guest systems in the network so that their logs are monitored by our system which is acting as host. Instead of installing many desktops in the network we tend to use the virtual desktop which solves our hardware constraints. Our model gets simplified and compacted to project. We use Oracle VM VirtualBox for installing virtual machine on the host which is shown in the Fig. 3.

Download and Install VirtualBox

1. Download VirtualBox from the official website.
2. Run the installer and follow the prompts.
3. Choose the installation location and components.
4. Install the VirtualBox Extension Pack (optional).

Create a New Virtual Machine

1. Launch VirtualBox.
2. Click "New" to create a new VM.
3. Enter VM name, type, and version.
4. Allocate memory (RAM) and CPU resources.
5. Create a virtual hard disk (VDI, VMDK, or VHD).

Configure VM Settings

1. Network: Select NAT, Bridged, or Host-only.
2. Storage: Add ISO file or installation media.
3. Audio: Select audio controller.
4. Display: Select graphics controller.

Install Guest Operating System

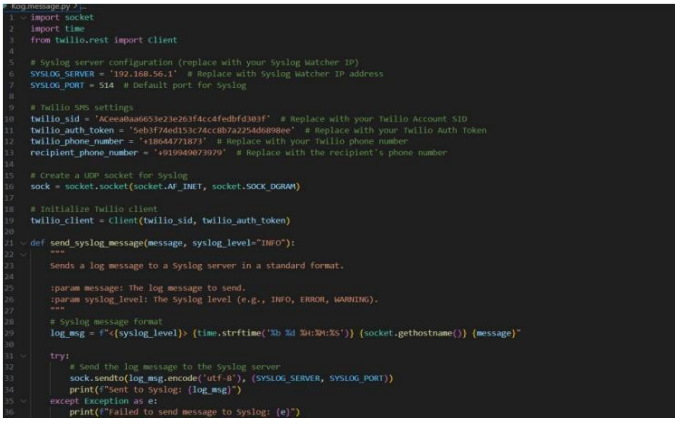
1. Start the VM.
2. Follow the installation prompts for the guest OS.
3. Install necessary drivers and software.

Configure Guest OS

1. Set up network connections.
2. Install VirtualBox Guest Additions.
3. Configure display and audio settings.

FIGURE 3. shows virtual machine on the host system

Log analysis script should run on all the guest os/virtual machines that automates the process of examining and interpreting log data from various sources to the host. Fig. 4 shows the log analysis script.



```
log_message.py
import socket
import time
from twilio.rest import Client

# Syslog server configuration (replace with your Syslog Watcher IP)
SYSLOG_SERVER = '192.168.56.1'  # Replace with Syslog Watcher IP address
SYSLOG_PORT = 514  # Default port for Syslog

# Twilio SMS settings
twilio_sid = 'ACeea0aa6653e23e263f4cc4fedbfd303f'  # Replace with your Twilio Account SID
twilio_auth_token = 'eb3f74ed153c74cc8b7a2254d6898ee'  # Replace with your Twilio Auth Token
twilio_phone_number = '+18644771873'  # Replace with your Twilio phone number
recipient_phone_number = '+919949073979'  # Replace with the recipient's phone number

# Create a UDP socket for Syslog
sock = socket.socket(socket.AF_INET, socket.SOCK_DGRAM)

# Initialize Twilio client
twilio_client = Client(twilio_sid, twilio_auth_token)

def send_syslog_message(message, syslog_level="INFO"):
    """
    Sends a log message to a Syslog server in a standard format.

    :param message: The log message to send.
    :param syslog_level: The Syslog level (e.g., INFO, ERROR, WARNING).
    """
    # Syslog message format
    log_msg = f"<{syslog_level}> {time.strftime('%b %d %H:%M:%S')} {socket.gethostname()} {message}"

    try:
        # Send the log message to the Syslog server
        sock.sendto(log_msg.encode('utf-8'), (SYSLOG_SERVER, SYSLOG_PORT))
        print(f"Sent to Syslog: {log_msg}")
    except Exception as e:
        print(f"Failed to send message to Syslog: {e}")
```

FIGURE 4. shows Log analysis python script

Step 1: Importing Libraries

import socket import datetime import logging import re

- socket: for creating a network socket to connect to the Syslog server.
- datetime: for handling dates and times.
- logging: for logging purposes (not used extensively in this script).
- re: for regular expression pattern matching.

Step 2: Defining Syslog Server Settings

# Define Syslog server settings SYSLOG_SERVER = '192.168.1.100'
SYSLOG_PORT = 514

- Replace '192.168.1.100' with your Syslog server's IP address.
- 514 is the default Syslog port.

Step 3: Defining Log File Path and Name

# Define log file path and name LOG_FILE_PATH = 'C:\\SyslogLogs\\'
LOG_FILE_NAME = 'syslog_log_{}.log'.format(datetime.date.today())

- Define the directory path where logs will be saved.
- The log file name includes the current date.

Step 4: Creating Log File Directory (if needed)

Create log file directory if it doesn't exist import os
if not os.path.exists(LOG_FILE_PATH): os.makedirs(LOG_FILE_PATH)

- Check if the log file directory exists.
- If not, create the directory using os.makedirs().

Step 5: Defining Log Analysis Parameters # Define log analysis parameters
START_TIME = datetime.datetime.now() - datetime.timedelta(hours=1)
END_TIME = datetime.datetime.now()

- Define the time range for log analysis (last hour).

Step 6: Creating a Syslog Socket # Create a Syslog socket
sock = socket.socket(socket.AF_INET, socket.SOCK_DGRAM)

- Create a UDP socket for Syslog communication.

Step 7: Binding the Socket to the Syslog Server # Bind the socket to the Syslog server
sock.bind((SYSLOG_SERVER, SYSLOG_PORT))

- Bind the socket to the Syslog server's IP address and port.

Step 8: Collecting Syslog Logs # Collect Syslog logs
logs = [] while True:
data, addr = sock.recvfrom(1024)

log_message = data.decode('utf-8') logs.append(log_message)

Break the loop if 1000 logs are collected if len(logs) >= 1000:
break

- Receive Syslog logs from the server.
- Decode the logs from bytes to UTF-8 string.
- Append each log to the logs list.
- Break the loop after collecting 1000 logs.

Step 9: Saving Logs to File # Save logs to file
with open(LOG_FILE_PATH + LOG_FILE_NAME, 'w') as f: for log in logs:
f.write(log + '\n')

- Open the log file in write mode.
- Write each log message to the file followed by a newline.

Step 10: Analyzing Logs # Analyze logs
error_logs = [log for log in logs if re.search(r'ERROR', log)]
warning_logs = [log for log in logs if re.search(r'WARNING', log)]

NXlogger

We use nxlogger as a comprehensive logging solution to collect and store log data from the network devices. We integrate nxlogger with syslog server where we get in detail information of the syslogs.

Installation:

1. Download the NXLogger installer from the official website.
2. Run the installer and follow the prompts.
3. Choose the installation location and components.

Configuration:

1. Launch NXLogger.
2. Configure the logging settings:

- Log sources (e.g., Windows Event Logs, Syslog).
- Log formats (e.g., CSV, JSON).
- Log filters (e.g., event ID, severity).

3. Set up log storage:

- Local file storage.
- Remote storage (e.g., Syslog server, database).

4. Configure alerting and notification options.

Setting up local file enables to store the log in .txt files.

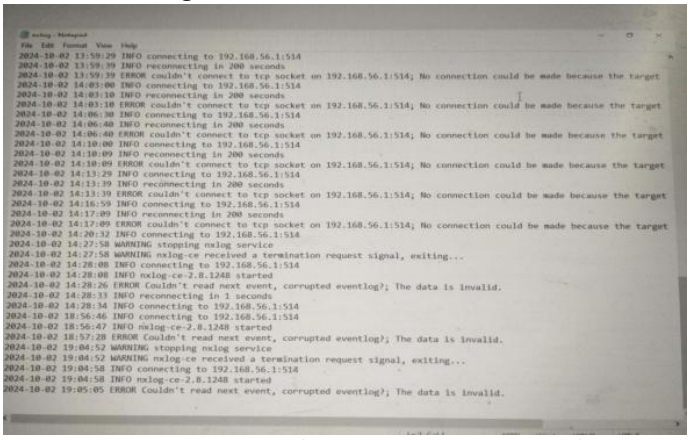


FIGURE 5. shows local file collecting syslogs in .txt format

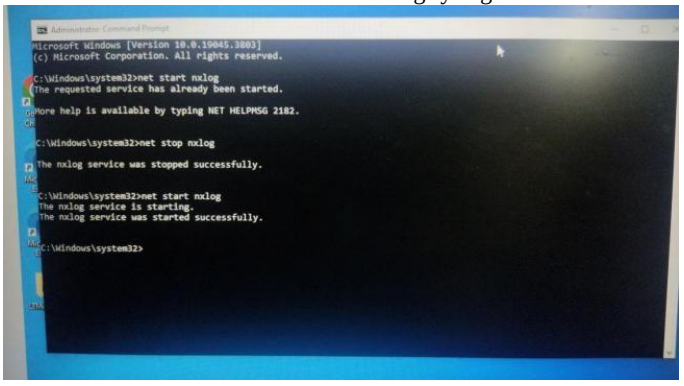


FIGURE 6. shows running nxlog in command prompt of the guest system

After running the nxlog we can see that our syslog server analysis our collected and stored logs and visualizes the information in the form of table with clear arguments mentioned in it.

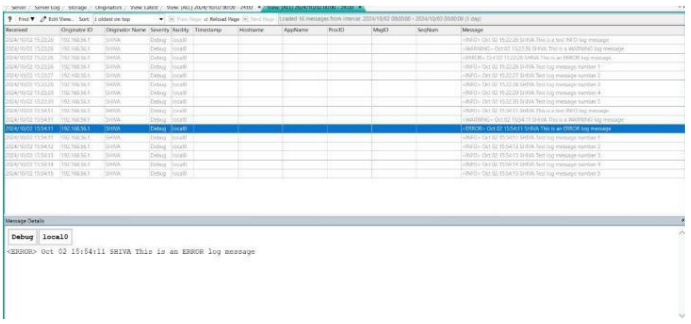


FIGURE 7. shows syslog server analyzed and visualized the syslogs

III. RESULT

We write a python script to integrate with syslog server to send alerts to the host through SMS

Create a Python script that:

1. Connects to your Syslog server.
2. Parses logs for specific events.
3. Sends SMS alerts using Twilio.

Example script:

```
import sys import logging
from twilio.rest import Client

# Twilio account settings account_sid = 'your_account_sid' auth_token = 'your_auth_token'
client = Client(account_sid, auth_token)

# Syslog server settings syslog_server = 'your_syslog_server' syslog_port = 514

# Define SMS settings
sms_from = 'your_twilio_phone_number' sms_to = 'recipient_phone_number'

# Define log filtering rules log_filter = 'your_log_filter'

# Connect to Syslog server import pySyslog
syslog = pySyslog.Client(syslog_server, syslog_port)
# Parse logs and send SMS alerts for log in syslog:
if log_filter in log:
message = client.messages.create( body=log,
from_=sms_from, to=sms_to
)
print(f'SMS sent: {message.sid}')
```

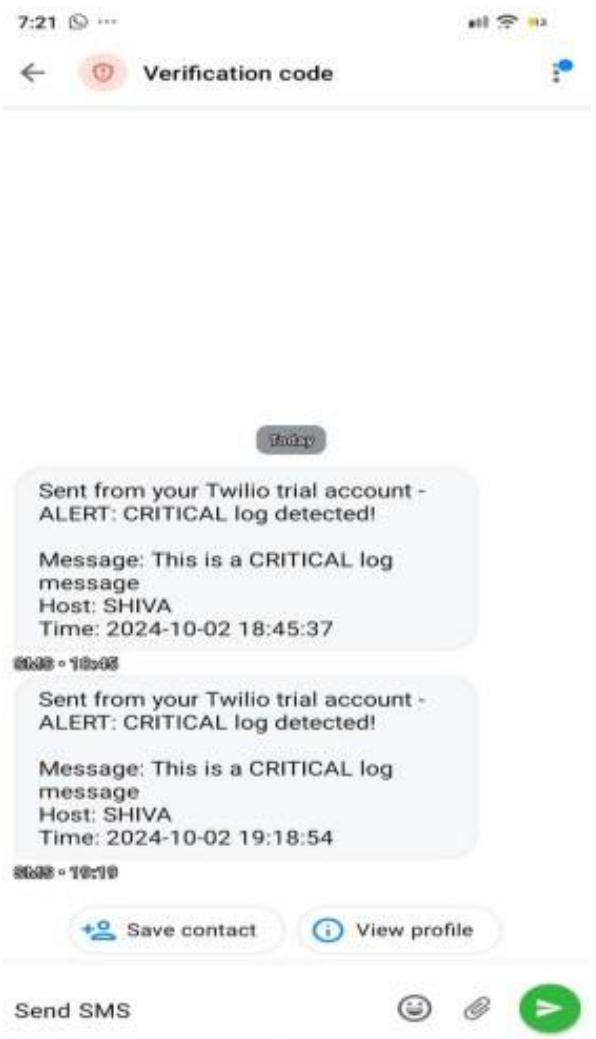


FIGURE 8. shows the SMS alert is sent to the host

IV. CONCLUSION

This paper develops a centralized log collection system using the syslog server and collects log from the hosts in the network, analyses the log files and sends an alert message to the central host through SMS. This paper addresses the growing need for robust cybersecurity in the power sector.

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