Cyber Attack Evaluation Dataset for Deep Packet Inspection and Analysis

Authors

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Keywords

Cyber Attacks, Evaluation Dataset, Attack Techniques, Defense Mechanisms

Abstract

To determine the effectiveness of any defense mechanism, there is a need for comprehensive real-time network data that solely references various attack scenarios based on older software versions or unprotected ports, and so on. This presented dataset has entire network data at the time of several cyber attacks to enable experimentation on challenges based on implementing defense mechanisms on a larger scale. For collecting the data, we captured the network traffic of configured virtual machines using Wireshark and tcpdump. To analyze the impact of several cyber attack scenarios, this dataset presents a set of ten computers connected to Router1 on VLAN1 in a Docker Bridge network, that try and exploit each other. It includes browsing the web and downloading foreign packages including malicious ones. Also, services like File Transfer Protocol (FTP) and Secure Shell (SSH) were exploited using several attack mechanisms. The presented dataset shows the importance of updating and patching systems to protect themselves to a greater extent, by following attack tactics on older versions of packages as compared to the newer and updated ones. This dataset also includes an Apache Server hosted on the different subset on VLAN2 which is connected to the VLAN1 to demonstrate isolation and cross- VLAN communication. The services on this web server were also exploited by the previously stated ten computers. The attack types include: Distributed Denial of Service, SQL Injection, Account Takeover, Service Exploitation (SSH, FTP), DNS and ARP Spoofing, Scanning and Firewall Searching and Indexing (using Nmap), Hammering the services to brute-force passwords and usernames, Malware attacks, Spoofing, and Man-in-the-Middle Attack. The attack scenarios also show various scanning mechanisms and the impact of Insider Threats on the entire network.

Specifications table

Subject	*Computer Networks and Communication*
Specific subject area	*Simulation Dataset for analysis of various Attack and Defense scenarios*
Type of data	Image Chart Graph Figure

How the data were acquired	*All the data were generated in real time using virtual machines running in a sandboxed (containerized) environment. Two VLANs namely VLAN1 and VLAN2 were created as part of the network level organization. Thereafter, 10 virtual machines were attached to the VLAN1 network and an Apache server was attached to the VLAN2 network to separate it such that it is not available locally to the attached machines. The attack and defense scenarios were developed taken into consideration the machines attached to the VLAN1 where they perform absolute permutations in attacking each other in their local subnet based on their vulnerabilities, and also the web server on VLAN2 to exploit its capacity and gain Remote Code Execution to the server.*
Data format	Raw CSV Analyzed CSV Filtered XLSX Real-timee Capture pcap SQL format for dataset regeneration
Description of Data Collection	*For the purpose of collecting the raw packet data, 11 virtual machines were created in a containerized environment where they were attached to a completely different network bridged to the host machine. Two separate bridge networks were created, one for connecting the 10 attack/victim machines and the other for maintaining the web server such that they are kept different from each other and cannot ping each other locally. Several attack scripts were executed simultaneously on the attack/victim machines to have different combinations of attack and defense scenarios for a period of 23 hours, 31 minutes and 54 seconds. The collected data were then converted from Raw pcaps to a Database format using SQL such that they can be easily analyzed and altered. Also the IP addresses of the known machines were flagged and annotated in the database to have a brief understanding of the already-known and foreign IPs. The machines were left connected to the Internet where they acted like normal day-to-day computers downloading online data and performing daily operations which were then exploited using specially-crafted payloads. This provided a real-life operation scenario of attack and defense in regular machines that are connected to the Internet.*
Data Source Location	• *Institution: VIT Bhopal University* • *City/Town/Region: Bhopal, Madhya Pradesh* • *Country: India* • *Latitude and Longitude: 23.0774° N, 76.8513° E*
Data accessibility	The dataset can be downloaded from https://data.mendeley.com/datasets/3szjvt3w78/1 The full version of the dataset is freely available at https://data.mendeley.com/datasets/3szjvt3w78

Table 1: Specifications Table

Table 1 provides a brief overview of the specifications of the dataset presented in this paper which includes the Subject area of the dataset, the type of the data, how the data was acquired, format of the data, description of the data collection, source location and accessibility of the presented dataset.

1. Value of Data

Communication systems form an important factor in the daily life of the users. Computer Networks are used for various data processing, learning processes, widespread collaboration and data review [1]. The Internet in today's world is full of attacks and account takeovers where unauthorized adversaries try to gain access to user data and exploit their access.

- To analyze the impact of several attack scenarios, this dataset presents a set of 10 computers connected to Router1 on VLAN1 in a Docker Bridge network, that try and exploit each other. It includes browsing the web and downloading foreign packages including malicious ones. Also, services like FTP (File Transfer Protocol) and SSH (Secure Shell) were exploited using several attack mechanisms.
- The presented dataset shows the importance of updating and patching systems to protect themselves to a greater extent, by following attack tactics on older versions of packages as compared to the newer and updated ones.
- This data can further elaborate on how regular users connected to the Internet can get exploited for using several unsigned packages from the Internet and outdated services and protocols.

In order to comprehend and analyze the effect of any possible cyber attack on a critical asset of an organization, real-time network activity data is needed by the researchers. The presented dataset contains the recorded network data of sandboxed machines which demonstrates several attack vectors in a controlled network environment. To isolate an actual attack on a large network, it is important to inspect and analyze the effect of the attack on a smaller scale and determine the risk mitigation steps. The presented dataset is intended to provide standard network data to the community to facilitate comparative research in this domain.

In table 2, existing datasets containing network captures and network enumeration live sets were studied to follow the types of network topologies and patterns of the system used, including the type of traffic transfer and the significance of different types of attack mechanisms when or if imposed on such networks.

The presented dataset provides an overall distribution of a separate network divided into 2 different subnets and is specifically used to determine the attack and defense effects of several network and host-based attacks in an isolated versus open environment.

PAPER	DOMAIN	CONTRIBUTIONS
Uses and Challenges for Network Datasets [2]	General Network	Analysis of research based concerns on several datasets including current and suggested practices
Anomaly, event, and fraud detection in large network datasets [3]	Large Networks	Comprehensive overview of several anomalies, events and fraud detection. Analysis of data mining and machine algorithm algorithms
Local Learning for Mining Outlier Subgraphs from Network Datasets [4]	Mining Networks	Graphical representation of determining outliers on several synthetic and real datasets
UNSW-NB15: a comprehensive data set for network intrusion detection systems (UNSW-NB15 network data set) [5]	Network Intrusion Detection	Hybrid dataset containing modern normal and synthesized attacks on a network traffic
Computer network database of attack and defense [6]	Network Databases	Computer network Databases attacks and mitigation steps analysis and experimentation
APT datasets and attack modeling for automated detection methods: A review [7]	Automated Detection Review	Description of different stages of attacks on cyber physical systems and large networks based on an attack model
A Survey of Intrusion Detection Systems Leveraging Host Data [8]	Host based Intrusion	Access to different types of host based data including intrusions, and research activities
A detailed analysis of the KDD CUP 99 data set [9]	Network Intrusion Detection	Statistical analysis of KDDCUP'99 Dataset. Proposed NSL-KDD dataset that avoids performance and poor evaluation concerns using KDDCUP'99 dataset

Table 2: Summary of Related Work in Datasets

2. Data Description

The dataset presented in this article includes raw data which was prepared using live machines built into a virtual sandboxed environment, which consists of 10 machines which are connected to a Router on VLAN1 and an Apache Server hosted on a different subset on VLAN2 which is connected to the VLAN1 to demonstrate isolation and cross VLAN communication. The services on this web server were also exploited by the previously stated 10 computers.

The Exiting Files in this dataset include:

- L1_Cap_10PC_1S.pcapng : This is the Raw pcap file captured using Wireshark for a specific time-period on 11 machines (10 Machines & 1 Apache Server). Total Packets: 3,962,784
- L1_Cap_10PC_1S_dissec.xlsx : This file is the segregated first 1,048,576 rows of the Raw pcap file for small compute analysis. Note: 1,048,576 rows is the maximum row limit for Microsoft Excel (Version Home and Business 2021) as of 5th September 2022

- L1_Cap_10PC_1S_dissec.csv: This file is the segregated first 1,048,576 rows of the Raw pcap file for small compute analysis.
- L1_Cap_10PC_1S_dissec_complete.csv : This the complete Raw exported pcap file in .csv format. Total Packets: 3,962,784
- L1_Cap_202209051617.csv : This is the labeled dataset which 2 columns added to the Raw Dataset – Source_Known and Destination_Known which flags known IP addresses in the Source and Destination fields to belong to the 10+1 machine range. Here, '1' represents True and '0' represents False
- L1_Cap_202209051620.sql : This is the labelled dataset compiled in .sql format so that this can be easily imported into an SQL Database and analyzed based on the user requirement. This makes the analysis of large datasets easier and more convenient.

3. Experimental design, materials and methods

Figure 1 provides a network architecture diagram of the implemented dataset along with the IP addresses of the nodes included in the Virtual LANs and the Host Network. This diagram also provides the Host Server on IP address '172.16.49.135', on which the Wireshark tool was executed to capture the traffic flowing through the VLANs 1 and 2. The packets are directed to flow from each VLAN through the mentioned server to reach the Host Network router located on IP address '172.16.49.1'.

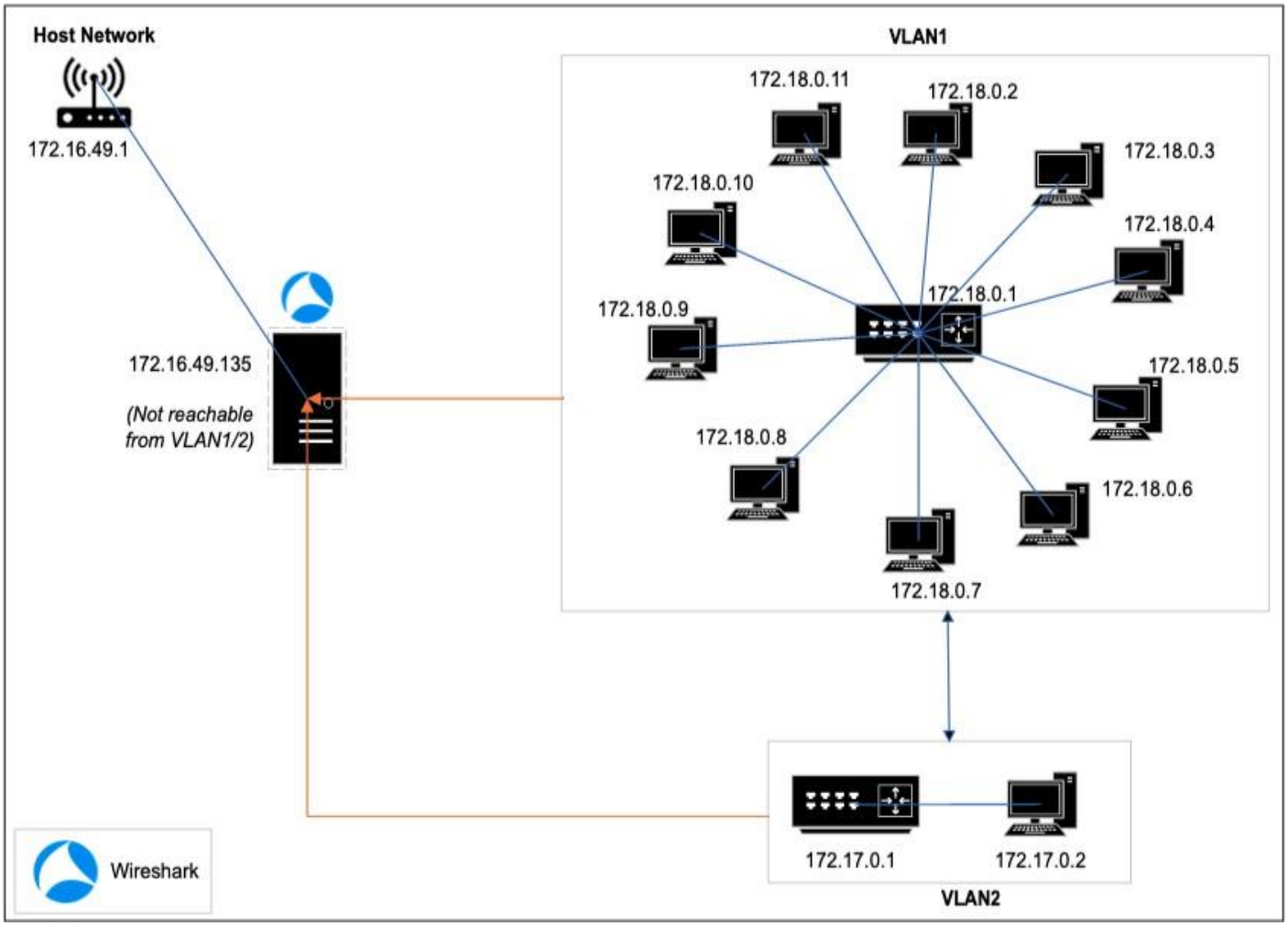
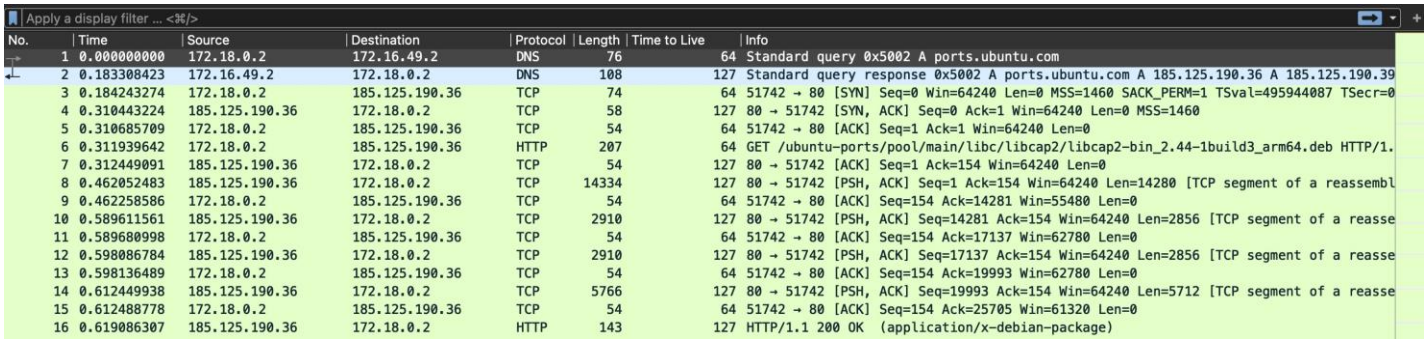


Figure 1: Position of Wireshark in the network

The files mentioned in the above points can be used for analysis either in the form of segregated data or in the form of a complete set of real-world traffic defining different attack and defense scenarios. The presented subfolder of files can be opened by the following means:

- File 1 (L1_Cap_10PC_1S.pcapng):
  - Install Wireshark from https://www.wireshark.org/#download
  - Double Click on the file to open it using Wireshark for packet level deep inspection and analysis



Apply a display filter ... <⌘/>

No.	Time	Source	Destination	Protocol	Length	Time to Live	Info
1	0.000000000	172.18.0.2	172.16.49.2	DNS	76	64	Standard query 0x5002 A ports.ubuntu.com
2	0.183308423	172.16.49.2	172.18.0.2	DNS	108	127	Standard query response 0x5002 A ports.ubuntu.com A 185.125.190.36 A 185.125.190.39
3	0.184243274	172.18.0.2	185.125.190.36	TCP	74	64	51742 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=495944087 TSecr=0
4	0.310443224	185.125.190.36	172.18.0.2	TCP	58	127	80 → 51742 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460
5	0.310685709	172.18.0.2	185.125.190.36	TCP	54	64	51742 → 80 [ACK] Seq=1 Ack=1 Win=64240 Len=0
6	0.311939642	172.18.0.2	185.125.190.36	HTTP	207	64	GET /ubuntu-ports/pool/main/libc/libcap2/libcap2-bin_2.44-1build3_arm64.deb HTTP/1.
7	0.312449091	185.125.190.36	172.18.0.2	TCP	54	127	80 → 51742 [ACK] Seq=1 Ack=154 Win=64240 Len=0
8	0.462052483	185.125.190.36	172.18.0.2	TCP	14334	127	80 → 51742 [PSH, ACK] Seq=1 Ack=154 Win=64240 Len=14280 [TCP segment of a reassembl
9	0.462258586	172.18.0.2	185.125.190.36	TCP	54	64	51742 → 80 [ACK] Seq=154 Ack=14281 Win=55480 Len=0
10	0.589611561	185.125.190.36	172.18.0.2	TCP	2910	127	80 → 51742 [PSH, ACK] Seq=14281 Ack=154 Win=64240 Len=2856 [TCP segment of a reasse
11	0.589680998	172.18.0.2	185.125.190.36	TCP	54	64	51742 → 80 [ACK] Seq=154 Ack=17137 Win=62780 Len=0
12	0.598086784	185.125.190.36	172.18.0.2	TCP	2910	127	80 → 51742 [PSH, ACK] Seq=17137 Ack=154 Win=64240 Len=2856 [TCP segment of a reasse
13	0.598136489	172.18.0.2	185.125.190.36	TCP	54	64	51742 → 80 [ACK] Seq=154 Ack=19993 Win=62780 Len=0
14	0.612449938	185.125.190.36	172.18.0.2	TCP	5766	127	80 → 51742 [PSH, ACK] Seq=19993 Ack=154 Win=64240 Len=5712 [TCP segment of a reasse
15	0.612488778	172.18.0.2	185.125.190.36	TCP	54	64	51742 → 80 [ACK] Seq=154 Ack=25705 Win=61320 Len=0
16	0.619086307	185.125.190.36	172.18.0.2	HTTP	143	127	HTTP/1.1 200 OK (application/x-debian-package)

- File 2 and 3 (L1_Cap_10PC_1S_dissec.xlsx, L1_Cap_10PC_1S_dissec.csv)
  - Open any Text Editor to view these files – Notepad (Windows), TextEdit (Linux), TextMate (Mac)

```
No.,dff,Source,Destination,Protocol,Length,Time to Live,Info,Source Known,Destination Known,Source Flag,Dst Flag
1,0,172.18.0.2,172.16.49.2,DNS,76,64,Standard query 0x5002 A ports.ubuntu.com,172.18.0.2,#N/A,Y,N
2,0,0.183308423,172.16.49.2,172.18.0.2,DNS,108,127,Standard query response 0x5002 A ports.ubuntu.com A 185.125.190.36 A
185.125.190.39,#N/A,172.18.0.2,N,Y
3,0,0.184243274,172.18.0.2,185.125.190.36,TCP,74,64,51742  >  80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=495944087 TSecr=0
WS=128,172.18.0.2,#N/A,Y,N
4,0,0.310443224,185.125.190.36,172.18.0.2,TCP,58,127,"80  >  51742 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460",#N/A,172.18.0.2,N,Y
5,0,0.310685709,172.18.0.2,185.125.190.36,TCP,54,64,51742  >  80 [ACK] Seq=1 Ack=1 Win=64240 Len=0,172.18.0.2,#N/A,Y,N
6,0,0.311939642,172.18.0.2,185.125.190.36,HTTP,207,64,GET /ubuntu-ports/pool/main/libc/libcap2/libcap2-bin_2.44-1build3_arm64.deb HTTP/1.1
,172.18.0.2,#N/A,Y,N
7,0,0.312449091,185.125.190.36,172.18.0.2,TCP,54,127,80  >  51742 [ACK] Seq=1 Ack=154 Win=64240 Len=0,#N/A,172.18.0.2,N,Y
8,0,0.462052483,185.125.190.36,172.18.0.2,TCP,14334,127,"80  >  51742 [PSH, ACK] Seq=1 Ack=154 Win=64240 Len=14280 [TCP segment of a
reassembled PDU]",#N/A,172.18.0.2,N,Y
9,0.462258586,172.18.0.2,185.125.190.36,TCP,54,64,51742  >  80 [ACK] Seq=154 Ack=14281 Win=55480 Len=0,172.18.0.2,#N/A,Y,N
10,0.589611561,185.125.190.36,172.18.0.2,TCP,2910,127,"80  >  51742 [PSH, ACK] Seq=14281 Ack=154 Win=64240 Len=2856 [TCP segment of a
reassembled PDU]",#N/A,172.18.0.2,N,Y
11,0.589680998,172.18.0.2,185.125.190.36,TCP,54,64,51742  >  80 [ACK] Seq=154 Ack=17137 Win=62780 Len=0,172.18.0.2,#N/A,Y,N
12,0.598086784,185.125.190.36,172.18.0.2,TCP,2910,127,"80  >  51742 [PSH, ACK] Seq=17137 Ack=154 Win=64240 Len=2856 [TCP segment of a
reassembled PDU]",#N/A,172.18.0.2,N,Y
13,0.598136489,172.18.0.2,185.125.190.36,TCP,54,64,51742  >  80 [ACK] Seq=154 Ack=19993 Win=62780 Len=0,172.18.0.2,#N/A,Y,N
14,0.612449938,185.125.190.36,172.18.0.2,TCP,5766,127,"80  >  51742 [PSH, ACK] Seq=19993 Ack=154 Win=64240 Len=5712 [TCP segment of a
reassembled PDU]",#N/A,172.18.0.2,N,Y
15,0.612488778,172.18.0.2,185.125.190.36,TCP,54,64,51742  >  80 [ACK] Seq=154 Ack=25705 Win=61320 Len=0,172.18.0.2,#N/A,Y,N
16,0.619086307,185.125.190.36,172.18.0.2,HTTP,143,127,HTTP/1.1 200 OK  (application/x-debian-package),#N/A,172.18.0.2,N,Y
17,0.61913418,172.18.0.2,185.125.190.36,TCP,54,64,51742  >  80 [ACK] Seq=154 Ack=25794 Win=62780 Len=0,172.18.0.2,#N/A,Y,N
```

  - These files are limited to 1,048,576 rows which is the standard Excel row limit so these can also be opened and viewed using Excel.
    - Right Click on the File and Open With : Microsoft Excel

	A	B	C	D	E	F	G	H
1	No.	dff	Source	Destination	Protocol	Length	Time to Live	Info
2	1	0	172.18.0.2	172.16.49.2	DNS	76	64	Standard query 0x5002 A ports.ubuntu.com
3	2	0.183308423	172.16.49.2	172.18.0.2	DNS	108	127	Standard query response 0x5002 A ports.ubuntu.com A 185.125.190.36 A 185.1
4	3	0.184243274	172.18.0.2	185.125.190.36	TCP	74	64	51742 > 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=49
5	4	0.310443224	185.125.190.36	172.18.0.2	TCP	58	127	80 > 51742 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460
6	5	0.310685709	172.18.0.2	185.125.190.36	TCP	54	64	51742 > 80 [ACK] Seq=1 Ack=1 Win=64240 Len=0
7	6	0.311939642	172.18.0.2	185.125.190.36	HTTP	207	64	GET /ubuntu-ports/pool/main/libc/libcap2/libcap2-bin_2.44-1build3_arm64.de
8	7	0.312449091	185.125.190.36	172.18.0.2	TCP	54	127	80 > 51742 [ACK] Seq=1 Ack=154 Win=64240 Len=0
9	8	0.462052483	185.125.190.36	172.18.0.2	TCP	14334	127	80 > 51742 [PSH, ACK] Seq=1 Ack=154 Win=64240 Len=14280 [TCP segment of
10	9	0.462258586	172.18.0.2	185.125.190.36	TCP	54	64	51742 > 80 [ACK] Seq=154 Ack=14281 Win=55480 Len=0
11	10	0.589611561	185.125.190.36	172.18.0.2	TCP	2910	127	80 > 51742 [PSH, ACK] Seq=14281 Ack=154 Win=64240 Len=2856 [TCP segmer
12	11	0.589680998	172.18.0.2	185.125.190.36	TCP	54	64	51742 > 80 [ACK] Seq=154 Ack=17137 Win=62780 Len=0
13	12	0.598086784	185.125.190.36	172.18.0.2	TCP	2910	127	80 > 51742 [PSH, ACK] Seq=17137 Ack=154 Win=64240 Len=2856 [TCP segmer
14	13	0.598136489	172.18.0.2	185.125.190.36	TCP	54	64	51742 > 80 [ACK] Seq=154 Ack=19993 Win=62780 Len=0
15	14	0.612449938	185.125.190.36	172.18.0.2	TCP	5766	127	80 > 51742 [PSH, ACK] Seq=19993 Ack=154 Win=64240 Len=5712 [TCP segmer

- File 4 and 5 (L1_Cap 10PC 1S dissec complete.csv, L1 Cap 202209051617.csv):
  - Open any Text Editor to view these file – Notepad (Windows), TextEdit (Linux), TextMate (Mac)

```
"No.","Time","Source","Destination","Protocol","Length","Time to Live","Info"
"1","0.000000000","172.18.0.2","172.16.49.2","DNS","76","64","Standard query 0x5002 A ports.ubuntu.com"
"2","0.183308423","172.16.49.2","172.18.0.2","DNS","108","127","Standard query response 0x5002 A ports.ubuntu.com A 185.125.190.36 A 185.125.190.39"
"3","0.184243274","172.18.0.2","185.125.190.36","TCP","74","64","51742  >  80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=495944087 TSecr=0
WS=128"
"4","0.310443224","185.125.190.36","172.18.0.2","TCP","58","127","80  >  51742 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460"
"5","0.310685709","172.18.0.2","185.125.190.36","TCP","54","64","51742  >  80 [ACK] Seq=1 Ack=1 Win=64240 Len=0"
"6","0.311939642","172.18.0.2","185.125.190.36","HTTP","207","64","GET /ubuntu-ports/pool/main/libc/libcap2/libcap2-bin_2.44-1build3_arm64.deb HTTP/1.1 "
"7","0.312449091","185.125.190.36","172.18.0.2","TCP","54","127","80  >  51742 [ACK] Seq=1 Ack=154 Win=64240 Len=0"
"8","0.462052483","185.125.190.36","172.18.0.2","TCP","14334","127","80  >  51742 [PSH, ACK] Seq=1 Ack=154 Win=64240 Len=14280 [TCP segment of a
reassembled PDU]"
"9","0.462258586","172.18.0.2","185.125.190.36","TCP","54","64","51742  >  80 [ACK] Seq=154 Ack=14281 Win=55480 Len=0"
"10","0.589611561","185.125.190.36","172.18.0.2","TCP","2910","127","80  >  51742 [PSH, ACK] Seq=14281 Ack=154 Win=64240 Len=2856 [TCP segment of a
reassembled PDU]"
"11","0.589680998","172.18.0.2","185.125.190.36","TCP","54","64","51742  >  80 [ACK] Seq=154 Ack=17137 Win=62780 Len=0"
"12","0.598086784","185.125.190.36","172.18.0.2","TCP","2910","127","80  >  51742 [PSH, ACK] Seq=17137 Ack=154 Win=64240 Len=2856 [TCP segment of a
reassembled PDU]"
"13","0.598136489","172.18.0.2","185.125.190.36","TCP","54","64","51742  >  80 [ACK] Seq=154 Ack=19993 Win=62780 Len=0"
"14","0.612449938","185.125.190.36","172.18.0.2","TCP","5766","127","80  >  51742 [PSH, ACK] Seq=19993 Ack=154 Win=64240 Len=5712 [TCP segment of a
reassembled PDU]"
"15","0.612488778","172.18.0.2","185.125.190.36","TCP","54","64","51742  >  80 [ACK] Seq=154 Ack=25705 Win=61320 Len=0"
"16","0.619086307","185.125.190.36","172.18.0.2","HTTP","143","127","HTTP/1.1 200 OK  (application/x-debian-package)"
"17","0.619134180","172.18.0.2","185.125.190.36","TCP","54","64","51742  >  80 [ACK] Seq=154 Ack=25794 Win=62780 Len=0"
"18","0.619721308","172.18.0.2","185.125.190.36","HTTP","355","64","GET /ubuntu-ports/pool/main/i/iputils/iputils-ping_20211215-1_arm64.deb HTTP/1.1 GET
/ubuntu-ports/pool/main/libc/libcap2/libpam-cap_2.44-1build3_arm64.deb HTTP/1.1 "
```

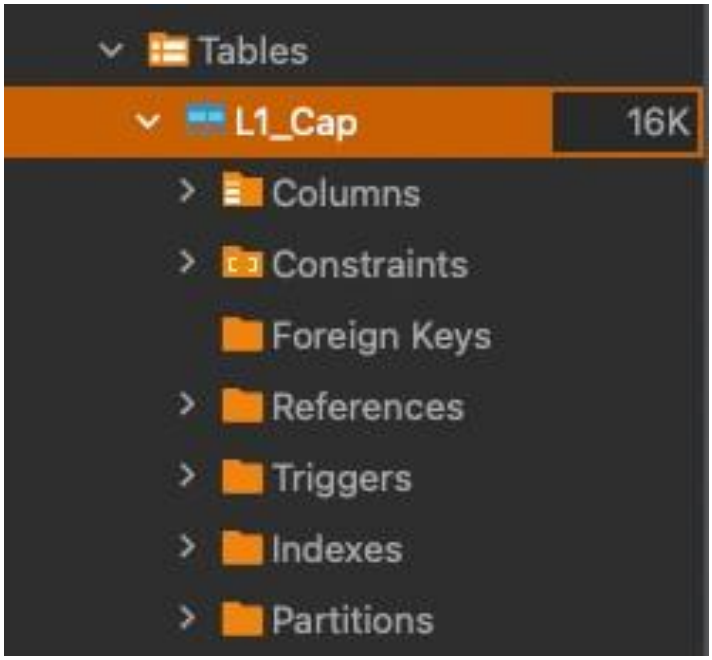
- File 6 (L1 Cap 202209051620.sql):
  - To import the MySQL file install MySQL from https://www.mysql.com/downloads/
  - Open a terminal prompt and type ‘ mysql -u root -p ‘. If prompted for a password, enter the password used during the installation of MySQL or keep blank if None was set. Then execute the below commands in MySQL prompt
    - mysql> create database pcdataset;

```
mysql> create database pcdataset;
Query OK, 1 row affected (0.00 sec)
```

    - mysql> use pcdataset;
    - mysql> CREATE TABLE L1 Cap(‘No.‘ int, ‘Time‘ int, Source varchar(50), Destination varchar(50), Protocol varchar(50), ‘Length‘ int, ‘Time to Live‘ int, Info varchar(1024), Source_Known int, Destination_Known int);
    - mysql> exit
  - Now, Open a terminal prompt and type ‘ mysql -u root -p pcdataset < file-path/ L1_Cap_202209051620.sql ’. The dataset will be imported in the SQL Database “pcdataset”.
  - To view the dataset, use:
    - prompt> mysql -u root -p

* mysql> use pcdataset;
* mysql> show tables;
* mysql> select * from L1_Cap;

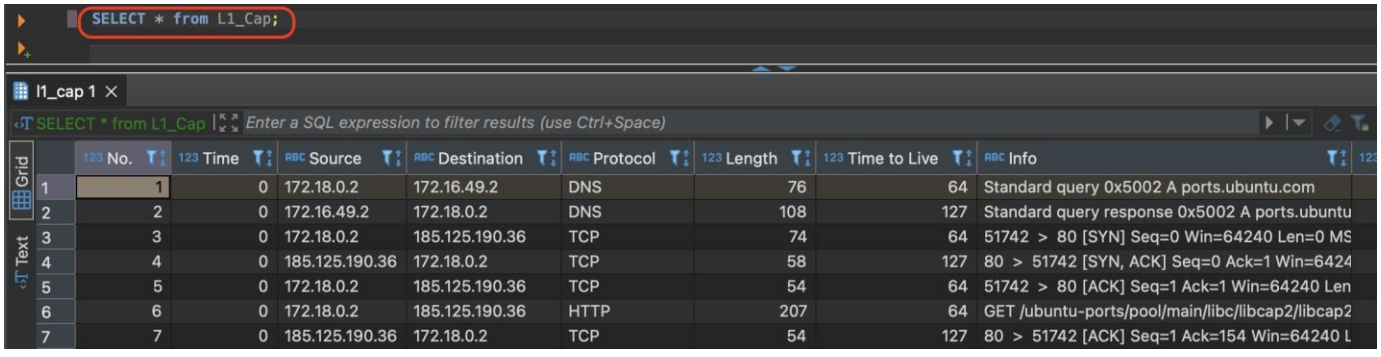
- Several other queries can now to executed to perform analysis on the data
- Alternatively, this data can be viewed using GUI Database Managers like DBeaver (https://dbeaver.io/downlo
  * Open the DBeaver app and connect to local host to view the tables and databases



  * Click on Tables and Double on the Table Name to view the table

	stination	Protocol	Length	Time to Live	Info	Source_Known	Destination_Known
1	.49.2	DNS	76	64	Standard query 0x5002 A ports.ubuntu.com	1	0
2	.0.2	DNS	108	127	Standard query response 0x5002 A ports.ubuntu	0	1
3	5.190.36	TCP	74	64	51742 > 80 [SYN] Seq=0 Win=64240 Len=0 MS	1	0
4	.0.2	TCP	58	127	80 > 51742 [SYN, ACK] Seq=0 Ack=1 Win=6424	0	1
5	5.190.36	TCP	54	64	51742 > 80 [ACK] Seq=1 Ack=1 Win=64240 Len	1	0
6	5.190.36	HTTP	207	64	GET /ubuntu-ports/pool/main/libc/libcap2/libcap2	1	0
7	.0.2	TCP	54	127	80 > 51742 [ACK] Seq=1 Ack=154 Win=64240 L	0	1
8	.0.2	TCP	14,334	127	80 > 51742 [PSH, ACK] Seq=1 Ack=154 Win=64	0	1
9	5.190.36	TCP	54	64	51742 > 80 [ACK] Seq=154 Ack=14281 Win=55	1	0
10	.0.2	TCP	2,910	127	80 > 51742 [PSH, ACK] Seq=14281 Ack=154 Wi	0	1
11	5.190.36	TCP	54	64	51742 > 80 [ACK] Seq=154 Ack=17137 Win=627	1	0

  * Also, SQL queries can be executed using the build-in SQL Query Editor



	No.	Time	Source	Destination	Protocol	Length	Time to Live	Info
1	1	0	172.18.0.2	172.16.49.2	DNS	76	64	Standard query 0x5002 A ports.ubuntu.com
2	2	0	172.16.49.2	172.18.0.2	DNS	108	127	Standard query response 0x5002 A ports.ubuntu
3	3	0	172.18.0.2	185.125.190.36	TCP	74	64	51742 > 80 [SYN] Seq=0 Win=64240 Len=0 MS
4	4	0	185.125.190.36	172.18.0.2	TCP	58	127	80 > 51742 [SYN, ACK] Seq=0 Ack=1 Win=6424
5	5	0	172.18.0.2	185.125.190.36	TCP	54	64	51742 > 80 [ACK] Seq=1 Ack=1 Win=64240 Len
6	6	0	172.18.0.2	185.125.190.36	HTTP	207	64	GET /ubuntu-ports/pool/main/libc/libcap2/libcap2
7	7	0	185.125.190.36	172.18.0.2	TCP	54	127	80 > 51742 [ACK] Seq=1 Ack=154 Win=64240 L

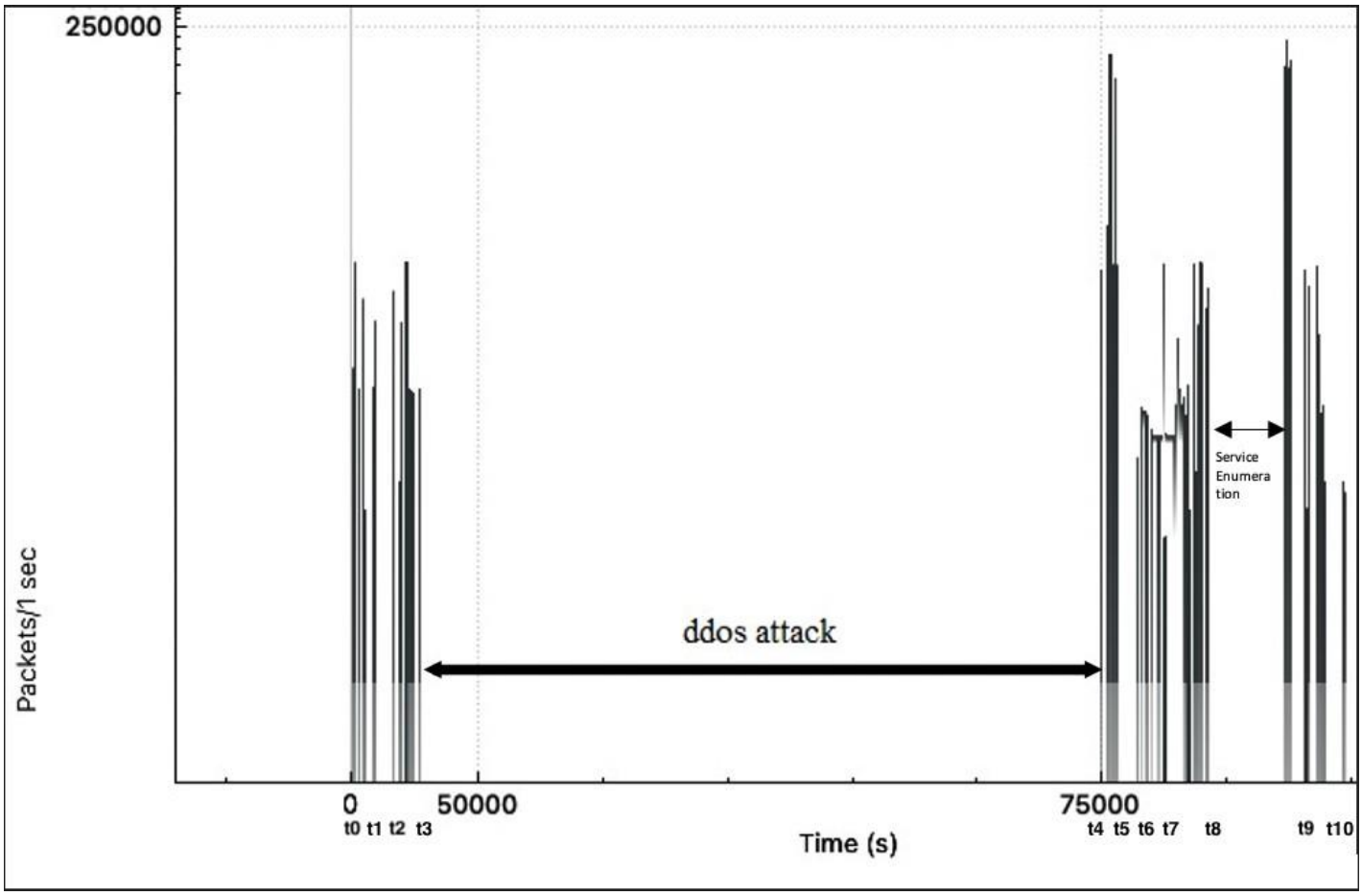


Figure 2: DDoS Attack and Service Enumeration Chart

The Data Input Output per second was measured and plotted to result into a potential view of traffic capture statistics for a stipulated time of 23 hours, 31 minutes, and 54 seconds.

Figure 2 represents the Packet to Time ratio of the packets that are presented in the dataset which also provides a clear representation of the Distributed Denial of Service Attacks (DDoS) and Service Enumeration path that were performed on a local packet capturing tool in order to prevent the virtual environment from crashing due to heavy packet flow.

Figure 3 provides a baseline timeline of the various attack and activities performed to generate the data presented in the proposed dataset. Timeline start from $t0$ and ends at $t10$, which is labelled in figure 2 to indicate the referred time stamp of script execution. This figure represents the data collected through Wireshark for the activities or attacks performed in correlation with time. The detailed summary of the activities or attack performed along with their outcomes and the tools used to perform them with correlation with time is attached in table 3

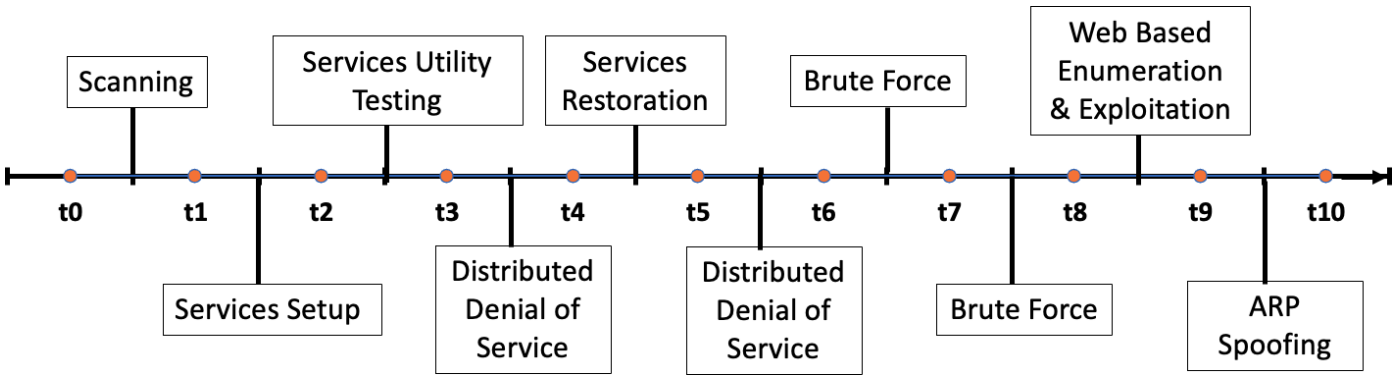


Figure 3: Timeline of attack / activities

TIME	ACTIVITY	OUTCOME	TOOLS
t0 - t1	Scanning	Network Scanning within VLAN1	nmap, custom ping utility script
t1 - t2	Services Setup	Setup of ftp, ssh, apache	vsftpd, openssh, apache
t2 - t3	Services Utility Testing	Internal file sharing and communication on VLAN1 and VLAN2	ftp, ssh, apache
t3 - t4	Distributed Denial of Service Attack	Includes system unavailability - On VLAN2 web server from VLAN1	hping3 flooding with random source
t4 - t5	Service Restoration	Restored after DDoS and Services Utility Testing Includes higher wait times and response from VLAN2 web server	-
t5 - t6	Distributed Denial of Service Attack	Testing within VLAN2 on Services ssh and ftp communication - Includes services unavailability	hping3 flooding with random source
t6 - t7	Brute Force	On ftp and ssh services to login to gain access within VLAN2	hydra using pre-determined wordlists of usernames and passwords
t7 - t8	Service Enumeration and Exploitation (Brute Force)	Includes running scripts for Privilege Escalation	Hydra using customized wordlists of usernames and passwords created using cewl, Customized privilege escalation scripts
t8 - t9	Web Based Enumeration and Exploitation	On test website hosted on VLAN1 web server from VLAN2	nikto, sqlmap (SQL Injection), XSS (Manual Testing), Command Injection and Directory Traversal (through URL manual testing)
t9 - t10	ARP Spoofing	Between VLAN1 and VLAN2	dsniff tools to listen to network traffic (arpspoof)

Table 3: Summary of Activities / Attacks performed

The Domain Name System is a naming convention to identify machines that are reachable through the Internet or over a network. The records link IP to Domain names and resolve requests for names to IP Addresses of the reachable machines and vice versa. The Domain Name System Resolution graph for the proposed dataset

describes the packet count for each resolution factor along with their burst rate.

Topic / Item	Count	Average	Min Val	Max Val	Rate (ms)	Percent	Burst Rate	Burst Start
Total Packets	149				0.0000	100%	0.0700	76426.403
rcode	149				0.0000	100.00%	0.0700	76426.403
No such name	10				0.0000	6.71%	0.0300	76426.417
No error	139				0.0000	93.29%	0.0600	2177.567
opcodes	149				0.0000	100.00%	0.0700	76426.403
Standard query	149				0.0000	100.00%	0.0700	76426.403
Query/Response	149				0.0000	100.00%	0.0700	76426.403
Response	73				0.0000	48.99%	0.0300	2177.575
Query	76				0.0000	51.01%	0.0400	76426.403
Query Type	149				0.0000	100.00%	0.0700	76426.403
SRV (Server Selection)	12				0.0000	8.05%	0.0200	817.241
PTR (domain name PoinTeR)	14				0.0000	9.40%	0.0200	76582.821
AAAA (IPv6 Address)	4				0.0000	2.68%	0.0400	76426.403
A (Host Address)	119				0.0000	79.87%	0.0600	2177.567
Class	149				0.0000	100.00%	0.0700	76426.403
IN	149				0.0000	100.00%	0.0700	76426.403
Service Stats	0				0.0000	100%	-	-
request-response time (msec)	73	427.70	0.701064	15018.991211	0.0000		0.0300	2177.575
no. of unsolicited responses	0				0.0000		-	-
no. of retransmissions	0				0.0000		-	-
Response Stats	0				0.0000	100%	-	-
no. of questions	146	1.00	1	1	0.0000		0.0600	2177.575
no. of authorities	146	0.11	0	1	0.0000		0.0600	2177.575
no. of answers	146	1.56	0	2	0.0000		0.0600	2177.575
no. of additionals	146	0.00	0	0	0.0000		0.0600	2177.575
Query Stats	0				0.0000	100%	-	-
Qname Len	76	17.51	8	27	0.0000		0.0400	76426.403
Label Stats	0				0.0000		-	-
4th Level or more	13				0.0000		0.0100	817.241
3rd Level	57				0.0000		0.0300	2177.567
2nd Level	4				0.0000		0.0200	76426.426
1st Level	2				0.0000		0.0200	76426.403
Payload size	149	51.17	26	106	0.0000	100%	0.0700	76426.403

The attack types include: Distributed Denial of Service, SQL Injection, Account Takeover, Service Exploitation (SSH, FTP), DNS and ARP Spoofing, Scanning and Firewall Searching and Indexing (using Nmap), Hammering the services to brute-force passwords and usernames, Malware attack, Spoofing and Man-in-the-Middle Attack. The attack scenarios also show various scanning mechanisms and the impact of Insider Threats on the entire network.

The dataset presented was for the following time span:

Time	
First packet:	2022-08-30 13:54:31
Last packet:	2022-08-31 13:26:26
Elapsed:	23:31:54

And the packet capture statistics can be viewed as:

172.18.0.1	Router1
172.18.0.2	dev
172.18.0.3	devone
172.18.0.4	devtwo
172.18.0.5	devthree
172.18.0.6	devfour
172.18.0.7	devfive
172.18.0.8	devsix
172.18.0.9	devseven
172.18.0.10	deveight
172.18.0.11	devnine
172.17.0.1	Router2
172.17.0.2	server

Table 4: Machine Information

Measurement	Captured
Packets	3962784
Time span, s	84714.903
Average pps	46.8
Average packet size, B	217
Bytes	858082296
Average bytes/s	10 k
Average bits/s	81 k

The proposed dataset provides a set of attack and defense approaches to a network topology consisting of two VLANs connected to each other. The VLANs are:

- 172.17.0.1 /16
- 172.18.0.1 /16

172.17.0.1 /16 consists of an Apache Server and is connected to a Router. 172.18.0.1/16 consists of 10 machines interconnected to each other and are connected to a different Router. The assigned machines' IPs and names are as follows:

Table 3 displays the specified machines that were categorized into both Attack and Victim machines having all probabilities of attack scenarios along with defense mechanisms implemented onto each of them. The environment used for maintaining these machines were isolated into 2 different bridged networks which were managed by a traffic capture device and were connected independently to 2 different Routers to route traffic specifically to those subnets. The subnet routers are further interconnected to form a larger set of machines that are talking to each other and sharing resources and hosting web applications.

The packet captured by the capturing device was used not only to capture the traffic between the machines connected but also the traffic from the external Internet which includes downloading repositories, updating the machines, pulling old version of softwares and various external exploitations caused due to connecting from unknown sources.

No.	Time	Source	Destination	Protocol	Length	Time to Live	Info	Source_Knowr	Destination_Known
1	0	172.18.0.2	172.16.49.2	DNS	76	64	Standard query 0x5(	1	0
2	0	172.16.49.2	172.18.0.2	DNS	108	127	Standard query resp	0	1
3	0	172.18.0.2	185.125.190.36	TCP	74	64	51742 > 80 [SYN] S	1	0
4	0	185.125.190.36	172.18.0.2	TCP	58	127	80 > 51742 [SYN, A	0	1
5	0	172.18.0.2	185.125.190.36	TCP	54	64	51742 > 80 [ACK] S	1	0
6	0	172.18.0.2	185.125.190.36	HTTP	207	64	GET /ubuntu-ports/p	1	0
7	0	185.125.190.36	172.18.0.2	TCP	54	127	80 > 51742 [ACK] S	0	1
8	0	185.125.190.36	172.18.0.2	TCP	14,334	127	80 > 51742 [PSH, A	0	1
9	0	172.18.0.2	185.125.190.36	TCP	54	64	51742 > 80 [ACK] S	1	0
10	1	185.125.190.36	172.18.0.2	TCP	2,910	127	80 > 51742 [PSH, A	0	1
11	1	172.18.0.2	185.125.190.36	TCP	54	64	51742 > 80 [ACK] S	1	0
12	1	185.125.190.36	172.18.0.2	TCP	2,910	127	80 > 51742 [PSH, A	0	1
13	1	172.18.0.2	185.125.190.36	TCP	54	64	51742 > 80 [ACK] S	1	0
14	1	185.125.190.36	172.18.0.2	TCP	5,766	127	80 > 51742 [PSH, A	0	1
15	1	172.18.0.2	185.125.190.36	TCP	54	64	51742 > 80 [ACK] S	1	0
16	1	185.125.190.36	172.18.0.2	HTTP	143	127	HTTP/1.1 200 OK (a	0	1
17	1	172.18.0.2	185.125.190.36	TCP	54	64	51742 > 80 [ACK] S	1	0
18	1	172.18.0.2	185.125.190.36	HTTP	355	64	GET /ubuntu-ports/p	1	0

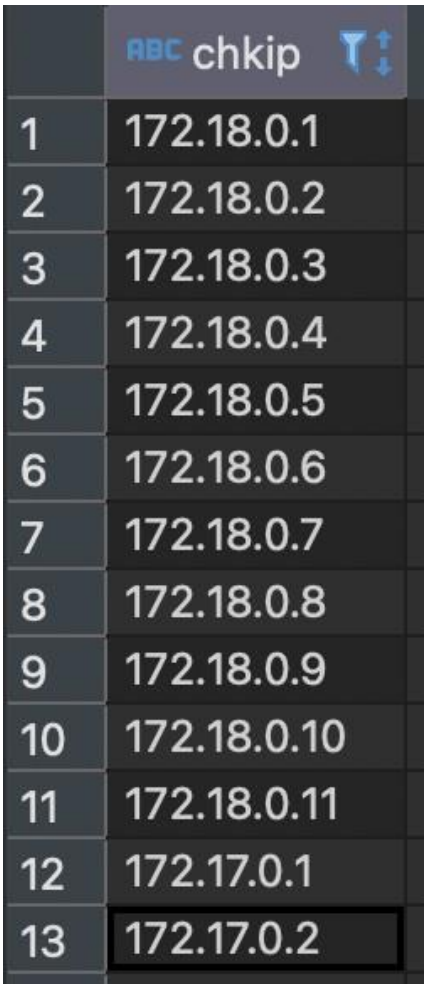
The graphical representation of the Database provides a brief overview of the dataset with the following properties of the captured network data:

- No. : Packet Serial Number
- Time : Time for packet capture starting from 0
- Source : Source IP Address for Packet Transfer
- Destination : Destination IP Address for Packet Transfer
- Protocol : Rules for transmission of information across a communication channel

Topic / Item	Count	Average	Min Val	Max Val	Rate (ms)	Percent	Burst Rate	Burst Start
IP Protocol Types	3961995				0.0468	100%	299.1600	75518.850
UDP	159				0.0000	0.00%	0.0700	76426.403
TCP	3961640				0.0468	99.99%	299.1600	75518.850
NONE	196				0.0000	0.00%	0.2000	228.555

- Length : Length of each packet
- Time of Time : Count of hops for a packer to exist in a network before it is removed from the routing device
- Info : Packet Information
- Source_Known : Flag to check if the Source IP Address falls under the category of known machine IPs
- Destination_Known : Flag to check if the Destination IP Address falls under the category of known machine IPs

To determine the Source_Known and Destination_Known flag, the set of Known IPs are provided in a separate table to form a link between the existing dataset and the IP sets based on joining.



	chkip
1	172.18.0.1
2	172.18.0.2
3	172.18.0.3
4	172.18.0.4
5	172.18.0.5
6	172.18.0.6
7	172.18.0.7
8	172.18.0.8
9	172.18.0.9
10	172.18.0.10
11	172.18.0.11
12	172.17.0.1
13	172.17.0.2

3.1 Monitored Potential outcome of several activities on a Host or Network

3.1.1 Unpatched hosts

Ten machines were set up to use an old version of their Operating System with old repositories which made them potentially more vulnerable. The older version were not having certain firewall mechanisms and system hardening techniques that made an attacker machine discover potentially vulnerable services on the machine and also opened a way of pivoting to the other machines present in the same subnet network. This clearly indicated that an unpatched machine not only opens a gate to it, being breached by an attacker machine but also becomes a reason behind large-scale attack scenarios where multiple hosts connected to the same affected network reach a state of getting exploited.

The systems were then updated to experiment if the latest patch causes any effect on the hosts under the same attack conditions. The said machines were brought back to a stable safe snapshot and rebuilt to the latest build version available. On execution of the same attack scanning and pivoting script, the targeted victim machine detected the traffic flow and blocked the ping probes, which when bypassed by modifying the scripts, prevented it from execution by allowing only certain traffic to enter the network while blocking repeated packet hits thus blocking brute force approaches to a host getting exploited. The host was then made vulnerable manually in order to get access to the host in an exceptional case to test out the pivoting mechanism. Unlike the expected network getting exploited, the pivoting was immediately blocked by the firewalls that hardened the systems by determining the type of packets hammered towards them.

This also provided a mechanism to determine and infer that whether 1 particular machine is vulnerable to certain service and gets exploited, the other machines if patched, can prevent themselves from getting attacked.

3.1.2 Network Scanning

In order to record the impact of several network mapping tools on the network, the proposed dataset contains a set of machines performing scanning of ports, services, and versions of the services using Network Mappers and their impact or network logs were recorded and managed by an external Network Capture Device. The machines were configured to run different services and tools and were maintained on different bridged connections which were NATed to the host network for connecting to the External Internet. The Network Mapper tools were executed on all machines to scan each other and the traffic to monitor a united probability of the ports and services running on each machine.
The Mapper was configured under the following set of configurations:

- Execute Default Network Scanning Scripts
- Determine the Services running on the hosts
- Determine the Version of the services scanned
- Identify all ports
- Enumerate port 80 for the Apache web server hosted on different subversions

All 10 host systems were then hardened to manage the scanning mechanism which added a secured mechanism to prevent pinging of the machines which might cause blocking of ping probes and show that the host is down for an attacker scanning the ports and services on the host. But this can be easily bypassed using scripts on the Network Mapper that considers each host to be up and starts scanning them. However, when the firewall was activated on the machines a Filtered flag was added to the services and the version enumeration failed.

3.1.3 Service Exploitation

Various host-based services were exploited, for example, FTP (File Transfer Protocol) and SSH (Secure Shell).

File Transfer Protocol

A specific service called ”vsftpd” was installed and configured on the systems. The service was then initialized on 5 host machines and the other 4 were used as an authenticated client on a simultaneous connection based on a different subnet and 1 attacker machine to brute force login credentials, to the following defaults:

- Default home folder
- Allow Anonymous login
- Default owner permissions - Read, Write, Execute

The system was further scanned using Network Mapper and also tried to be connected to using an FTP Client. Since Anonymous Login was allowed, the login attempt brute force passed on the first attempt and the root folder was accessible to the outside world as the owner of the home folder was the root or a super administrator of the system. Most users use their system as super administrators to avoid permission concerns that were inferred to be a potential breach by an adversary.

The FTP Configuration file was then reverted to the previous snapshot and was re-initialized updating the following setting:

- Default folder: Different User specific to FTP file sharing
- Anonymous Login: Disabled
- Default owner permissions: Read Only

This updated configuration prevented access to the root folder using anonymous login. The presented dataset shows a way to hammer the network and get access to weak FTP credentials. This leads to file system access to a machine, however allows an adversary to have only read permissions and prevents script execution or data manipulation.

Secure Shell

As for the case with FTP, SSH is widely used for easy remote access to a host machine. In this experiment, two ways of login were analyzed on each of the 9 host machines excluding the dev machine that was used as the client machine:

- Password-based Login
- Key & Passphrase based login

For Case 1: The password was hammered using password guessing tools that were used to brute force commonly used passwords and a weak password was easily cracked and SSH access was granted to the machine.

For Case 2: Public-private key pairs were generated using ssh-keygen for safe password-free login. Whosoever holds the valid key can get access to the system. A passphrase refers to a secret text that can be used to safeguard the encryption key. This passphrase is initialized during the key generation phase and prevents access by brute force. This when enabled, presents no way to login through a password-based mechanism. However, protecting the keys form a major step in this case, as unauthorized access to the key can allow access to the system by an adversary.

3.1.4 Web Based Exploitation

An Apache server was initialized on a different server-end subnet mask however connected to allow external traffic. The machine was successfully scanned to have Port 80 and 443 open Password-based service. The traffic on the web page was captured using the Packet Capture and Management Devwere. Web-based attacks like Standard Query Language Injection and Cross Site Scripting attacks were implemented however since the website logs generate and manage user input, the packet flow shows no specific analysis based on user input. Even so when the website was hosted on a vulnerable host, the Directory Traversal Attack passed and the /var/www folder was accessible over the web which opened a way of easy access to system directory access and command injection through User Input on the hosted website.
The directory traversal was performed from a host browser using port forwarding mechanism to transfer the Internal IP through thto e router so that it is accessible to the host machine under a controlled environment.
Note:

- SQL Injection refers to a code injection mechanism that can be used to get access to the underlying Database used to store user data posted using the POST method from the website. The exploitation of a database can cause sensitive user data leakage and outcomes to a major breach.
- Cross Site Scripting refers to a mechanism of injecting malicious scripts into a website allowing user access and therefore crashing the website functionalities and providing access to the machine hosting the website, which could further provide unauthorized access to website data and sensitive user information.
- Command Injection refers to a process for executing malicious host-based commands to grant access to the website hosting machine.
- Directory Traversal refers to the file data reading based on the path of the file on the server. This can be achieved by manipulating the website URL to something similar to ”http://172.17.0.2/..commands/www/../” where ”../” refers to moving to the higher directory.

The web-based packet capture statistics as presented in the proposed dataset can be displayed as:

Topic / Item	Count	Average	Min Val	Max Val	Rate (ms)	Percent	Burst Rate	Burst Start
Total HTTP Packets	1151				0.0000	100%	0.1500	83628.672
Other HTTP Packets	77				0.0000	6.69%	0.1200	2180.960
HTTP Response Packets	526				0.0000	45.70%	0.1000	83628.672
???: broken	0				0.0000	0.00%	-	-
5xx: Server Error	0				0.0000	0.00%	-	-
4xx: Client Error	0				0.0000	0.00%	-	-
3xx: Redirection	0				0.0000	0.00%	-	-
2xx: Success	526				0.0000	100.00%	0.1000	83628.672
200 OK	526				0.0000	100.00%	0.1000	83628.672
1xx: Informational	0				0.0000	0.00%	-	-
HTTP Request Packets	548				0.0000	47.61%	0.1100	2148.238
GET	548				0.0000	100.00%	0.1100	2148.238

3.1.5 Distributed Denial of Service

The most important factor in a service hosting platform is to maintain the Availability of its resource such that the authorized personnel always have access to the requested data without any interruption. A Denial of Service attack requires an attacker to flood the web service with arbitrary traffic such that the server gets too busy to reply to actual requests. The said attack when performed by several machines at the same time can cause a Distributed Denial of Service or disruption to the Availability constraint to the website data.
A Distributed Denial of Service attack was performed on the hosted web server by all the 10 host machines under a different subnet which was disconnected from the server subnet to prevent concerns based on the same subnet flooding, using the attack machines under the following parameter until the web server crashed and was no longer accessible unless the service was restarted:

- Flood the server with arbitrary data requests
- Send continuous SYN traffic
- Make the flooding quit or reduce logging on the web server end
- Set data size to 120
- Request numeric output
- Target web server port

The attack scenario when launched caused all the 10 attacker machines (dev, devone, devtwo, devthree, devfour, devfive, devsix, devseven, deveight, and devnine) transfer data each of size 120 simultaneously for the server, to halt after some time as the firewall blocked the traffic from the suspected machines and the flooding stopped. This was bypassed when a random source flag was specified on the attacker machines (also known as botnets) and the web server could no longer determine the attacker machines, and the flooding continued after which the server stopped responding and the services were denied access by legitimate users.

3.1.6 ARP Spoofing

ARP Spoofing attack refers to the Man in the Middle attack which allows an adversary to sit in between a communication channel between two machines and listen to the communication.
The ARP Spoofing attack was initialized on the standard Ethernet protocol of the dev and devone, dev and devtwo, dev and devthree, dev and devfour, dev and devfive, dev and devsix, dev and devseven, dev and deveight & dev and devnine machines and the target IP was set to the victim machine and access point, the machine is connected to which informs the target access point that the attacker is the targeted client. Next,

the targeted user is informed that the target access point is the attacker machine, such that the machines keep exchanging data without suspecting the attacker is listening to the communication between them. This was then prevented by using encryption and decryption algorithms on the sender and receiver side which allowed the attacker to intercept data but the data was not decrypted and therefore the communication channel remained secure. All 10 machines on the same subnet were set to arpspoof on the dev routing protocol on Router 1 such that all machine traffic goes through dev and the dev machine can act as the Man in the Middle and perform packet and data sniffing.

3.2 Deployment

To generate the dataset in its complete form in the local system, navigate to the 'L1 Cap 202209051620.sql' and import it into MySQL on the local system. Please note that the table with the defined properties needs to be created before the import process. Inside the database, L1 Cap file can be found which consists of the PCAP file database for the analysis of the packets that were captured to display both attack and defense mechanisms. The Info tab includes the Information about each packet which can be filtered from the generated database in MySQL and analyzed. For the packets to be analyzed graphically, the 'L1 Cap 10PC 1S.pcapng' can be directly imported into Wireshark. This can properly segregate the packets and can provide a graphical representation for analysis.

4. Ethics Statements

The authors confirm that the provided data-set and presented work strictly meet the ethics requirements for publication in Data in Brief as mentioned in https://www.elsevier.com/authors/journal-authors/policies-and-ethics

5. CRediT Author Statement

Shishir Kumar Shandilya: Conceptualization, Methodology; Chirag Ganguli: Data Curation, Writing –original draft, Visualization, Investigation; Ivan Izonin: Methodology, Formal Analysis; Prof. Atulya Kumar Nagar: Conceptualization, Coordination.

6. Acknowledgements

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7. Declaration of Competing Interest

*Please **tick** the appropriate statement below and declare any financial interests/personal relationships which may affect your work in the box below.*

✓ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

× The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

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