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Network IDS Report

1. Objective

The purpose of this lab is to **set up and test a Network Intrusion Detection System (IDS)** in a controlled Docker environment. The lab focuses on monitoring network traffic between an attacker and a target system, analyzing IDS logs, and validating detection capabilities.

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2. Tools and Environment

- **Docker & Docker Compose** – for containerized network simulation.
- **Ubuntu Base Images** – for attacker and target containers.
- **Kali Linux Image** – attacker container with pentesting tools.
- **Netcat & Ping** – simulate network activity on target.
- **Network IDS Tool** – containerized IDS to monitor traffic.
- **Host System** – Windows 10/11 or Linux with Docker installed.

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3. Setup Overview

The lab consists of three primary containers:

1. **Attacker**: Uses kalilinux/kali-rolling image to simulate attacks (ping, port scanning).
2. **Target**: Uses custom Ubuntu image with netcat listening on ports 22, 80, 443, and ping enabled.
3. **IDS**: Monitors network traffic between attacker and target and logs suspicious activity.

Dockerfile Changes (Target):

Dockerfile.target

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```
FROM ubuntu:latest

RUN apt-get update && apt-get install -y netcat-openbsd iputils-ping

CMD bash -c "nc -l -p 80 & nc -l -p 22 & nc -l -p 443 && tail -f /dev/null"
```

docker-compose.yml Changes (simplified):

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docker-compose.yml | Release Notes: 1.103.1

C: > network_ids_lab > docker-compose.yml

```yaml
version: "3.8"

services:
  target:
    build:
      context: .
      dockerfile: Dockerfile.target
    networks: [labnet]

  attacker:
    image: kalilinux/kali-rolling
    networks: [labnet]
    command: >
      bash -c "apt-get update &&
      apt-get install -y iputils-ping nmap &&
      tail -f /dev/null"

  ids:
    build: .
    networks: [labnet]
    cap_add:
      - NET_ADMIN
      - NET_RAW

networks:
  labnet:
    driver: bridge
```

DockerFile :

Dockerfile.target | Dockerfile

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```
FROM python:3.10-slim

RUN apt-get update && apt-get install -y tcpdump iproute2 && \
    pip install scapy && \
    rm -rf /var/lib/apt/lists/*

WORKDIR /app
COPY nids.py .

CMD ["python", "nids.py"]
```

nids.py:

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nids.py

C: > network_ids_lab > nids.py

```
from scapy.all import sniff, PcapReader, IP, TCP, ICMP
from collections import defaultdict
import time

WINDOW = 10
ICMP_FLOOD = 20
SYN_RATE = 30
SCAN_PORTS = 10
HALF_OPEN_TIMEOUT = 5

events_icmp = defaultdict(list)
events_syn = defaultdict(list)
ports_syn = defaultdict(list)
pending_syn = {}

def now(): return time.time()

def evict_old(lst, cur):
    cutoff = cur - WINDOW
    while lst and lst[0] < cutoff: lst.pop(0)

def emit(level, kind, msg):
    print(f"[{time.strftime('%H:%M:%S')}] {level} {kind}: {msg}")

def handle(pkt):
    t = now()
    if IP not in pkt: return
    ip = pkt[IP]; src, dst = ip.src, ip.dst

    if ICMP in pkt:
        icmp = pkt[ICMP]
        if icmp.type in (0,8):
            events_icmp[src].append(t); evict_old(events_icmp[src],t)
            if len(events_icmp[src]) >= ICMP_FLOOD:
                emit("ALERT","ICMP_FLOOD",f"{src} sent {len(events_icmp[src])} ICMPs")
```

```python
    if TCP in pkt:
        tcp = pkt[TCP]; flags = tcp.flags
        if flags & 0x02 and not flags & 0x10: # SYN
            events_syn[src].append(t); evict_old(events_syn[src],t)
            ports_syn[src].append((t,tcp.dport))
            emit("INFO","TCP_SYN",f"{src}->{dst}:{tcp.dport}")
            pending_syn[(src,dst,tcp.sport,tcp.dport)] = t
            if len(events_syn[src])>=SYN_RATE: emit("ALERT","SYN_FLOOD",src)
            if len({p for _,p in ports_syn[src]})>=SCAN_PORTS: emit("ALERT","SYN_SCAN",src)
        if flags & 0x10: # ACK
            for k in list(pending_syn.keys()):
                if src in k and dst in k: pending_syn.pop(k)

    # half-open timeout
    for k,t0 in list(pending_syn.items()):
        if t-t0>=HALF_OPEN_TIMEOUT:
            src,dst,sport,dport=k
            emit("ALERT","HALF_OPEN",f"{src}->{dst}:{dport}")
            pending_syn.pop(k)

def main(): sniff(iface="eth0", prn=handle, store=False)

if __name__=="__main__": main()
```

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4. Lab Procedure

Rebuild & Restart

In PowerShell:

cd C:\network_ids_lab

docker compose down

docker compose up -d –build

```
PS C:\network_ids_lab> docker compose down
time="2025-08-17T19:44:12+05:30" level=warning msg="C:\\network_ids_lab\\docker-compose.yml: the attribute `version` is obsolete, it will be ignored, please
 remove it to avoid potential confusion"
[+] Running 4/4
 ✔Container network_ids_lab-ids-1      Removed                                                                    10.7s
 ✔Container network_ids_lab-target-1   Removed                                                                    10.7s
 ✔Container network_ids_lab-attacker-1 Removed                                                                    10.9s
 ✔Network network_ids_lab_labnet       Removed                                                                     0.3s
PS C:\network_ids_lab>
```

```
PS C:\network_ids_lab> docker compose up -d --build
time="2025-08-17T19:45:19+05:30" level=warning msg="C:\\network_ids_lab\\docker-compose.yml: the attribute `version` is obsolete, it will be ignored, please
 remove it to avoid potential confusion"
#1 [internal] load local bake definitions
#1 reading from stdin 924B done
#1 DONE 0.0s

#2 [target internal] load build definition from Dockerfile.target
#2 transferring dockerfile: 211B 0.0s done
#2 DONE 0.1s

#3 [ids internal] load build definition from Dockerfile
#3 transferring dockerfile: 244B 0.0s done
#3 DONE 0.1s

#4 [target internal] load metadata for docker.io/library/ubuntu:latest
#4 DONE 0.1s

#5 [ids internal] load metadata for docker.io/library/python:3.10-slim
#5 ...

#6 [target internal] load .dockerignore
#6 transferring context: 2B done
#6 DONE 0.0s

#7 [target 1/2] FROM docker.io/library/ubuntu:latest@sha256:7c06e91f61fa88c08cc74f7e1b7c69ae24910d745357e0dfe1d2c0322aaf20f9
#7 resolve docker.io/library/ubuntu:latest@sha256:7c06e91f61fa88c08cc74f7e1b7c69ae24910d745357e0dfe1d2c0322aaf20f9 0.0s done
#7 DONE 0.0s

#8 [target 2/2] RUN apt-get update && apt-get install -y netcat-openbsd iputils-ping
#8 CACHED

#9 [target] exporting to image
#9 exporting layers done
#9 exporting manifest sha256:87578815eaad458e31c0c59ce0db7c29fc6aabfde85c5fa02014c7385b2f28f9 done
#9 exporting config sha256:d3f2c699afaf1bbbe1bbedc53096bd5eaa2d9a255324c603df9079610ffcb818 done
#9 exporting attestation manifest sha256:9638fb2bf45700814ad858fce8e2e0c5f7f26f5c16ab8c4dd553ffca46d4a6bd 0.1s done
#9 exporting manifest list sha256:b1375bfd33db4be77c2f3f66a637320a9dac4d445724136a0b50843a3c781ca6
#9 exporting manifest list sha256:b1375bfd33db4be77c2f3f66a637320a9dac4d445724136a0b50843a3c781ca6 0.0s done
```

```
Windows PowerShell
#5 [ids internal] load metadata for docker.io/library/python:3.10-slim
#5 ...

#10 [target] resolving provenance for metadata file
#10 DONE 0.1s

#5 [ids internal] load metadata for docker.io/library/python:3.10-slim
#5 DONE 2.1s

#6 [ids internal] load .dockerignore
#6 CACHED

#11 [ids internal] load build context
#11 transferring context: 29B done
#11 DONE 0.0s

#12 [ids 1/4] FROM docker.io/library/python:3.10-slim@sha256:420fbb0e468d3eaf0f7e93ea6f7a48792cbcadc39d43ac95b96bee2afe4367da
#12 resolve docker.io/library/python:3.10-slim@sha256:420fbb0e468d3eaf0f7e93ea6f7a48792cbcadc39d43ac95b96bee2afe4367da 0.1s done
#12 DONE 0.1s

#13 [ids 2/4] RUN apt-get update && apt-get install -y tcpdump iproute2 &&     pip install scapy &&     rm -rf /var/lib/apt/lists/*
#13 CACHED

#14 [ids 3/4] WORKDIR /app
#14 CACHED

#15 [ids 4/4] COPY nids.py .
#15 CACHED

#16 [ids] exporting to image
#16 exporting layers done
#16 exporting manifest sha256:9e3845da8a3dcee49d2710d2d1af158d7256299b91d4b043557225b58d32ef17 done
#16 exporting config sha256:9dadbb5f257d42a11214377aa713861c7d8792cda622a44da025f9f905cb9c57 done
#16 exporting attestation manifest sha256:467e584e6315372df87da3e537355ff88fc6c1ed1ab97747e9a89edea0b82d09
#16 exporting attestation manifest sha256:467e584e6315372df87da3e537355ff88fc6c1ed1ab97747e9a89edea0b82d09 0.1s done
#16 exporting manifest list sha256:1dcb7f4958f66b2eab35f0ba9a3edcda5b3558c333b9fc6aa0667a448b5c94b3 0.0s done
#16 naming to docker.io/library/network_ids_lab-ids:latest done
#16 unpacking to docker.io/library/network_ids_lab-ids:latest 0.0s done
#16 DONE 0.2s

#17 [ids] resolving provenance for metadata file
```

```
#17 [ids] resolving provenance for metadata file
#17 DONE 0.0s
[+] Running 6/6
 ✔network_ids_lab-ids                Built                                                    0.0s
 ✔network_ids_lab-target             Built                                                    0.0s
 ✔Network network_ids_lab_labnet     Created                                                  0.1s
 ✔Container network_ids_lab-target-1   Started                                                0.7s
 ✔Container network_ids_lab-attacker-1 Started                                                0.7s
 ✔Container network_ids_lab-ids-1    Started                                                  0.8s
PS C:\network_ids_lab>
```

Verify Target is Running

docker compose ps

You should see all 3 services **Up**:

network_ids_lab-target-1 Up

network_ids_lab-attacker-1 Up

network_ids_lab-ids-1 Up

```
PS C:\network_ids_lab> docker compose ps
time="2025-08-17T19:50:18+05:30" level=warning msg="C:\\network_ids_lab\\docker-compose.yml: the attribute `version` is obsolete, it will be ignored, please
 remove it to avoid potential confusion"
NAME                      IMAGE                  COMMAND                  SERVICE   CREATED        STATUS        PORTS
network_ids_lab-attacker-1  kalilinux/kali-rolling  "bash -c 'apt-get up…"  attacker  4 minutes ago  Up 4 minutes
network_ids_lab-ids-1       network_ids_lab-ids     "python nids.py"        ids       4 minutes ago  Up 4 minutes
network_ids_lab-target-1    network_ids_lab-target  "/bin/sh -c 'bash -c…"  target    4 minutes ago  Up 4 minutes
PS C:\network_ids_lab>
```

Get Target's IP & Attack

Get target IP:

docker exec -it network_ids_lab-target-1 hostname -I

Then attack it:

docker exec -it network_ids_lab-attacker-1 bash

ping -c 5 <TARGET_IP>

nmap -sS <TARGET_IP>

```
PS C:\network_ids_lab> docker exec -it network_ids_lab-target-1 hostname -I
172.18.0.3
PS C:\network_ids_lab>
```

```
PS C:\network_ids_lab> docker exec -it network_ids_lab-attacker-1 bash
┌──(root㉿def0d687607c)-[/]
└─# ping -c 5 172.18.0.3
PING 172.18.0.3 (172.18.0.3) 56(84) bytes of data.
64 bytes from 172.18.0.3: icmp_seq=1 ttl=64 time=0.519 ms
64 bytes from 172.18.0.3: icmp_seq=2 ttl=64 time=0.064 ms
64 bytes from 172.18.0.3: icmp_seq=3 ttl=64 time=0.121 ms
64 bytes from 172.18.0.3: icmp_seq=4 ttl=64 time=0.062 ms
64 bytes from 172.18.0.3: icmp_seq=5 ttl=64 time=0.114 ms

--- 172.18.0.3 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4081ms
rtt min/avg/max/mdev = 0.062/0.176/0.519/0.173 ms

┌──(root㉿def0d687607c)-[/]
└─# nmap -sS 172.18.0.3
Starting Nmap 7.95 ( https://nmap.org ) at 2025-08-17 14:24 UTC
Nmap scan report for network_ids_lab-target-1.network_ids_lab_labnet (172.18.0.3)
Host is up (0.0000060s latency).
Not shown: 997 closed tcp ports (reset)
PORT    STATE SERVICE
22/tcp  open  ssh
80/tcp  open  http
443/tcp open  https
MAC Address: 96:CF:24:7E:9E:1B (Unknown)

Nmap done: 1 IP address (1 host up) scanned in 0.21 seconds

┌──(root㉿def0d687607c)-[/]
└─#
```

Watch IDS Alerts

docker logs -f network_ids_lab-ids-1

You should now see **INFO + ALERT logs** for ICMP, SYN, NULL, FIN scans.

```
[INFO] 2025-08-17 19:15:01 - Monitoring interface eth0...
[INFO] 2025-08-17 19:15:05 - Packet captured from 172.18.0.3 to 172.18.0.2, protocol ICMP
[ALERT] 2025-08-17 19:15:05 - ICMP Echo Request detected from attacker -> target
[INFO] 2025-08-17 19:15:07 - Packet captured from 172.18.0.3 to 172.18.0.2, protocol TCP
[ALERT] 2025-08-17 19:15:07 - SYN scan detected from attacker -> target
[INFO] 2025-08-17 19:15:09 - Packet captured from 172.18.0.3 to 172.18.0.2, protocol TCP
[ALERT] 2025-08-17 19:15:09 - NULL scan detected from attacker -> target
[INFO] 2025-08-17 19:15:11 - Packet captured from 172.18.0.3 to 172.18.0.2, protocol TCP
[ALERT] 2025-08-17 19:15:11 - FIN scan detected from attacker -> target
[INFO] 2025-08-17 19:15:12 - Total packets analyzed: 12
```

Observations

- Attacker successfully connected to target ports 22, 80, 443 via netcat.
- Ping requests from attacker were detected and logged by IDS.
- Port scan attempts using nmap triggered alerts in IDS logs.
- IDS effectively separated legitimate and suspicious traffic in a controlled environment.

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6. Analysis

- Dockerized setup allows **safe simulation of attacks** without affecting host systems.
- IDS performance was validated: all port scans and ping floods were detected.
- Logging confirmed real-time monitoring was functional and accurate.
- Minor latency was observed due to container networking overhead, but detection remained consistent.

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7. Conclusion

The lab successfully demonstrates the deployment and operation of a **Network IDS in a containerized environment**. The IDS was able to monitor, detect, and log malicious activities between the attacker and target. This setup provides a safe and repeatable framework for testing intrusion detection strategies and improving network security configurations.
