Instituto Superior Técnico

SNORT

Master's in computer science and Engineering

Network Advanced Security and Architecture

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Introduction

This report will study an important concept regarding network security. This concept is a NIDS, called Snort. (Note: Snort is an IPS but can be configured as a IDS which is the case for this study).

An Intrusion Detection System (IDS) analyse network traffic for signatures matching known attacks. On the other hand, an Intrusion Prevention System (IPS) also analyse the network traffic, but it can stop the packets from being delivered (“prevents”). Why is it important? It is important because it does monitoring of the network traffic, alerting such attacks as Denial of Service and imposing a small impact on performance.

There are two types of IDS, a NIDS and a HIDS. A HIDS is a Host-based intrusion detection system and as the name says, it is used to analyse events on a computing device rather than the traffic that goes through the network. On the other hand, NIDS is a network-based intrusion detection system and is used to analyse the network traffic.

In this study we will configure a NIDS, called Snort, to alert several types of Denial-of-Service attacks. For each attack, will be briefly explained what it is and will be demonstrated the attack running and the alert given by Snort. It is also given a simple Scapy script to replicate the attack as also as the Snort rule to alert the attack.

All attacks were targeted at the specific snort machine, but all the rules implemented were made general enough for snort to behave like a real NIDS. A network topology where snort would be an NIDS of an organization was not used for reasons of time and because the objective of this work was to understand how to make rules, and how to protect from some general attacks.

Snort

So, to understand a little more let's analyse some basic files about Snort. Firstly, there is a configuration file called *snort.conf* which states the main steps to make our own custom configuration:

```
##################################################
# This file contains a sample snort configuration.
# You should take the following steps to create your own custom configuration:
#
#  1) Set the network variables.
#  2) Configure the decoder
#  3) Configure the base detection engine
#  4) Configure dynamic loaded libraries
#  5) Configure preprocessors
#  6) Configure output plugins
#  7) Customize your rule set
#  8) Customize preprocessor and decoder rule set
#  9) Customize shared object rule set
##################################################
```

Figure 1 Snort configuration file overview

By the Figure 1 is possible to see the structure of this configuration file. In the first step, which is "set the network variables", we setup the HOME_NET variable to the subnet of our organization, in this case is 192.168.1.0/24. Then, in the second step there is also an important configuration if we need to configure snort as inline mode that can be used to run snort as an IPS.

```
# Configure ports to ignore
# config ignore_ports: tcp 21 6667:6671 1356
# config ignore_ports: udp 1:17 53

# Configure active response for non inline operation. For more information, see REAMDE.active
# config response: eth0 attempts 2

# Configure DAQ related options for inline operation. For more information, see README.daq
#
# config daq: <type>
# config daq_dir: <dir>
# config daq_mode: <mode>
# config daq_var: <var>
```

Figure 2 Snort configuration file DAQ configuration

In the Figure 2, we see what would be needed to configure the inline mode. For example:

```
config daq: afpacket
config daq_mode: inline
```

where *afpacket* tell us it is in inline on Linux using two bridged interfaces. To check the available *daq* types just type "*snort --daq-list*". Let's see some *daq* types very generally:

- Pcap: is the default mode, used for sniffer and IDS modes
- Afpacket: inline on Linux using two bridged interfaces
- Ipq: old way to process iptables packets
- Nfq: new improved way to process iptables packet
- Ipfw: inline mode in BSD systems
- Dump: allows you to test the various inline mode features

After this, another important step is related with the rules of snort. In this configuration file we can include or exclude (comment out) which rules we want to and do not want to use, as we can see in Figure 3.

```
##################################################
# Step #7: Customize your rule set
# For more information, see Snort Manual, Writing Snort Rules
#
# NOTE: All categories are enabled in this conf file
##################################################

# site specific rules
include $RULE_PATH/local.rules

include $RULE_PATH/app-detect.rules
include $RULE_PATH/attack-responses.rules
include $RULE_PATH/backdoor.rules
```

Figure 3 Snort configuration file import rules

But what is this Snort rule? Is a methodology for performing detection and has the following structure:

- Rule Header
  <action> <protocol> <IP_source> <source_port> <action> <IP_destination> <destination_port>
- Rule Options
  <Option_keyword> <arguements>

For example, let's see this structure in the following rule:

```
alert tcp any !21 -> 10.10.10.10 400: (msg: "TCP connection";)
```

The action is an **alert** so it will generate an alert (it can also be **log** which after generating the alert, it then logs the packet, or **pass** which ignores the packet and drops it). Related to the protocol it can be **TCP**, **UDP** or **ICMP** and in this case is TCP. The source IP address is any (it can also be a subnet like 10.10.10.0/24) and source port is any except 21. After this we have "**->**" which indicates the direction of the connection (it can also be "**<>**" which indicates it is in both directions). The destination IP address is 10.10.10.10 with any port greater than or equal to 400. So, in translating it into English it means that will alert all TCP traffic that comes from any IP address with any source port except 21 to the destination 10.10.10.10 to any port greater than or equal to 400. Then, if this happens it will print the message specified in the Rule Options which is "TCP connection". There are several rule options available that will be used and discussed further in this report.

Network topology

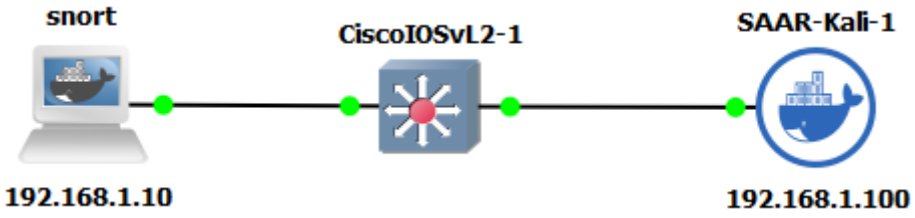


Figure 4 Network topology used for testing

The Figure 4 represents the topology used for testing the snort rules and see the attack taking into play. The topology used was simple because the purpose of this report is to understand the attacks and which rules can be implemented for detecting them.

- Command to test if the snort configurations (rules inclusive) are OK:
  `snort -T -i eth0 -c /etc/snort/snort.conf`
- Command to run snort (in alert mode, in quit mode and with the specified snort file configuration):
  `snort -A console -q -c /etc/snort/snort.conf -i eht0`

DoS based attacks

ICMP flood

ICMP flood or Ping flood is a Denial of Service (DoS) attack where the attacker overwhelms the victim with ICMP echo requests.

Snort Rule

Adding the following rule in local.rules will alert if an ICMP flood is happening:

```
alert icmp any any -> $HOME_NET any (msg:"ICMP flood"; sid:1000001; rev:1; classtype:icmp-event; detection_filter:track by_dst,count 100, seconds 3;)
```

So, analysing the rule, it will keep a track by destination of icmp packets with any source IP and any source port to $HOME_NET to any destination port and if it reaches 100 in 3 seconds will raise an alert with the message ICMP flood and type ICMP Event.

Attack demonstration

To test this, an attacker will do an ICMP flood with the command "hping3 -C --faster --flood -V -p 80 192.168.1.10" as can be seen in the Figure 5.

```
root@SAAR-Kali-1:/usr/attacks# hping3 -C --faster --flood -V -p 80 192.168.1.10
using eth0, addr: 192.168.1.100, MTU: 1500
HPING 192.168.1.10 (eth0 192.168.1.10): icmp mode set, 28 headers + 0 data bytes
hping in flood mode, no replies will be shown
^C
--- 192.168.1.10 hping statistic ---
903231 packets transmitted, 0 packets received, 100% packet loss
round-trip min/avg/max = 0.0/0.0/0.0 ms
root@SAAR-Kali-1:/usr/attacks#
```

Figure 5 ICMP flood attack command execution

By the Figure 6 is possible to see what packets were sent, ICMP packets:

No.	Time	Source	Destination	Protocol	Length	Info
2749	25.785717	192.168.1.100	192.168.1.10	ICMP	60	Echo (ping) reply id=0x4d00, seq=8633/47393, ttl=64
2750	25.806660	192.168.1.100	192.168.1.10	ICMP	60	Echo (ping) reply id=0x4d00, seq=8889/47394, ttl=64
2751	25.806967	192.168.1.100	192.168.1.10	ICMP	60	Echo (ping) reply id=0x4d00, seq=9145/47395, ttl=64
2752	25.808980	192.168.1.100	192.168.1.10	ICMP	60	Echo (ping) reply id=0x4d00, seq=9401/47396, ttl=64

```
> Frame 2750: 60 bytes on wire (480 bits), 60 bytes captured (480 bits) on interface -, id 0
> Ethernet II, Src: 82:3d:de:74:71:7f (82:3d:de:74:71:7f), Dst: 02:68:7d:4b:94:ec (02:68:7d:4b:94:ec)
> Internet Protocol Version 4, Src: 192.168.1.100, Dst: 192.168.1.10
> Internet Control Message Protocol
```

Figure 6 ICMP flood Wireshark capture

Snort with the rule specified above will raise an enormous number of alerts in the console as can be seen in the Figure 7.

```
5/31-19:26:42.320348  [**] [1:1000001:1] ICMP flood [**] [Classification: Generic ICMP event] [Priority: 3] {ICMP} 192.168.
.100 -> 192.168.1.10
5/31-19:26:42.320631  [**] [1:1000001:1] ICMP flood [**] [Classification: Generic ICMP event] [Priority: 3] {ICMP} 192.168.
.100 -> 192.168.1.10
5/31-19:26:42.322646  [**] [1:1000001:1] ICMP flood [**] [Classification: Generic ICMP event] [Priority: 3] {ICMP} 192.168.
.100 -> 192.168.1.10
5/31-19:26:42.322947  [**] [1:1000001:1] ICMP flood [**] [Classification: Generic ICMP event] [Priority: 3] {ICMP} 192.168.
.100 -> 192.168.1.10
5/31-19:26:42.324470  [**] [1:1000001:1] ICMP flood [**] [Classification: Generic ICMP event] [Priority: 3] {ICMP} 192.168.
.100 -> 192.168.1.10
5/31-19:26:42.324764  [**] [1:1000001:1] ICMP flood [**] [Classification: Generic ICMP event] [Priority: 3] {ICMP} 192.168.
.100 -> 192.168.1.10
```

Figure 7 ICMP flood snort alert

- Possible Scapy Script:

```
from scapy.all import *

packet=IP(src=RandIP(), dst="192.168.1.10")/ICMP()
send(packet, loop=1)
```

SYN flood

SYN flood is a Denial of Service (DoS) attack where the attacker overwhelms the victim by making him consume resources by exploiting part of the normal TCP three-way handshake. This handshake consists in

1. Client requests the connection by sending a TCP packet with the SYN flag on
2. Server responds with a TCP packet with SYN and ACK flags on
3. Client responds with a TCP packet with ACK flag on

After these 3 steps the connections is stablished and the client-server can communicate. Now, an attacker exploits this by executing the step 1, the victim does the second step, but the third step is not done by the attacker which leads to the victim waiting for the ACK packet wasting resources.

Snort Rule

Adding the following rule in local.rules will alert if an SYN flood is happening:

```
alert tcp any any -> $HOME_NET 80 (flags: S; msg:"Possible SYNflood"; flow:stateless;
sid: 1000002; rev:1; detection_filter:track by_dst, count 20, seconds 10;)
```

So, analysing the rule, it will keep a track by destination of tcp packets with any source IP and any source port to $HOME_NET to port 80 and if it reaches 20 in 10 seconds will raise an alert with the message Possible SYNflood. Note that the flow is stateless which means that the alert will be triggered regardless of the state of the stream processor.

Attack demonstration

To test this, an attacker will do an SYN flood with the command " hping3 -S --faster --flood -V -p 80 192.168.1.10" as can be seen in the Figure 8.

```
root@SAAR-Kali-1:/usr/attacks/dos_attacks# hping3 -S --faster --flood -V -p 80 192.168.1.10
using eth0, addr: 192.168.1.100, MTU: 1500
HPING 192.168.1.10 (eth0 192.168.1.10): S set, 40 headers + 0 data bytes
hping in flood mode, no replies will be shown
^C
--- 192.168.1.10 hping statistic ---
62107 packets transmitted, 0 packets received, 100% packet loss
round-trip min/avg/max = 0.0/0.0/0.0 ms
root@SAAR-Kali-1:/usr/attacks/dos_attacks#
```

Figure 8 SYN flood attack command execution

By the Figure 9 is possible to see what packets were sent which are the SYN packets and their response SYN-ACK but the connection is not stablished:

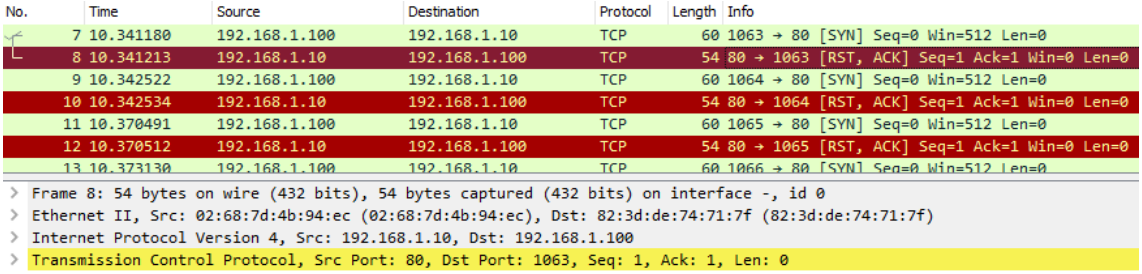


Figure 9 SYN flood Wireshark capture

Snort with the rule specified above will raise an enormous number of alerts in the console as can be seen in the Figure 10.

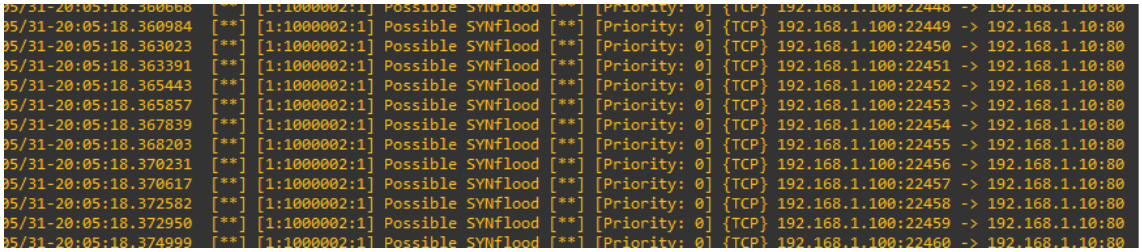


Figure 10 SYN flood Snort alert

- Possible Scapy Script:

```
from scapy.all import *

packet=IP(src=RandIP(), dst="192.168.1.10")/TCP(dport=80, flags="S")
send(packet, loop=1)
```

Ping of Death

Ping of death is a Denial of Service (DoS) attack where the attacker overwhelms the victim by sending an IPv4 packet larger than 65,535 bytes in fragments because the maximum accepted size for an IP packet is 65,535 bytes. Old devices attempting to reassemble the fragments could end up with an oversized packet and crashes could occur (because a memory overflow could occur, for example).

Snort Rule

Adding the following rule in local.rules will alert if a Ping of Death is happening:

```
alert icmp any any -> $HOME_NET any (msg: "Ping of Death"; sid:1000003; rev:1; dsize:
>60000;)
```

So, analysing the rule, it will see the icmp packets with any source IP and any source port to $HOME_NET to any destination port and if the packet size is greater than 65535 will raise an alert with the message Ping of Death.

Attack demonstration

To test this, an attacker will do a Ping of Death with the Scapy script:

```
from scapy.all import *
```

```
packet=IP(src=RandIP(), dst="192.168.1.10")/ICMP()/("X"*60000)
send(fragment(packet), loop=1)
```

No demonstrations are given because the student could not put the attack to work (maybe because it is a simulated environment, but further investigation would be needed?!)

Land Attack

Land attack is a Denial of Service (DoS) attack where the attacker sets the source and destination of a TCP packet to be the same and possibly crashing the victim due to the packet being repeatedly processed by the TCP stack.

Snort Rule

Adding the following rule in local.rules will alert if a Land Attack is happening:

```
alert tcp any any -> $HOME_NET any (sameip; msg:"LAND attack"; sid:10000004; rev:1;)
```

So, analysing the rule, it will see the tcp packets with any source IP and any source port to $HOME_NET to any destination port and if the source and destination IP are the same will raise an alert with the message LAND attack.

Attack demonstration

To test this, an attacker will do a Land attack with the Scapy script:

```
from scapy.all import *

packet=IP(src="192.168.1.10", dst="192.168.1.10")/TCP(dport=RandShort())
send(packet, loop=1)
```

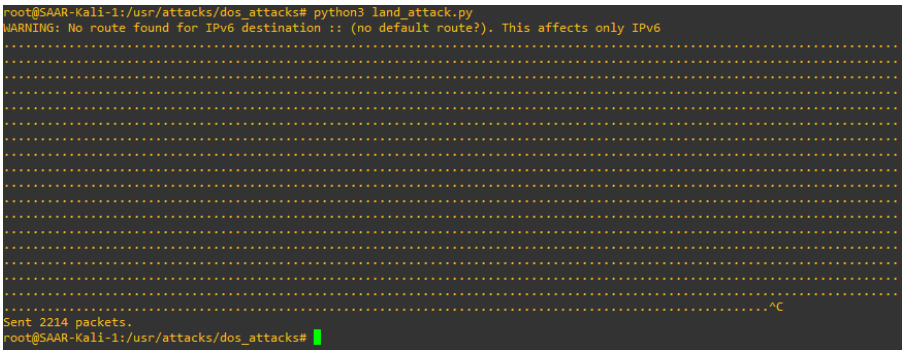


Figure 11 Land attack command execution

By the Figure 12 is possible to see what packets were sent, with the same source and destination addresses:

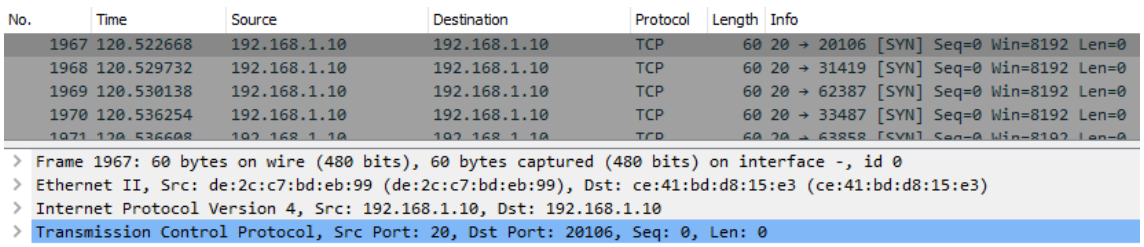


Figure 12 Land attack Wireshark capture

Snort with the rule specified above will raise an enormous number of alerts in the console as can be seen in the Figure 13.

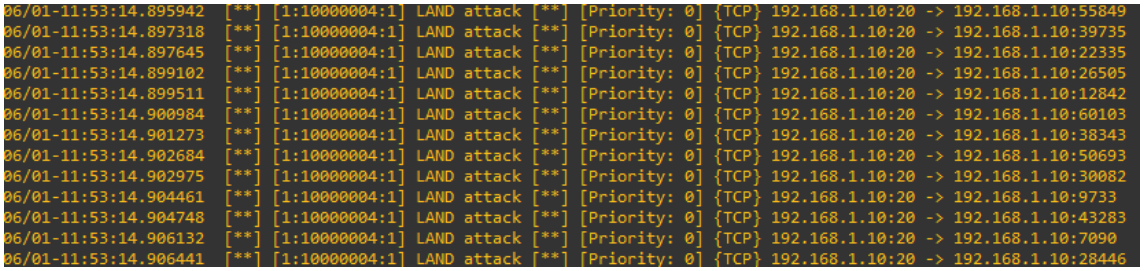


Figure 13 Land attack Snort alert

HTTP flooding

HTTP flooding is a Denial of Service (DoS) attack where the attacker overwhelms the victim with HTTP requests. To understand the potential of this attack let's assume we have a HTTP server. The attacker will send a numerous GET requests trying to obtain an object (for example a big image) wasting server resources.

Snort Rule

Adding the following rule in local.rules will alert if a HTTP flood is happening:

```
alert tcp any any -> $HOME_NET 80 (msg: "Possible http flood attack"; flow:established;
content:"GET"; nocase; http_method; detection_filter:track by_dst, count 1000, seconds
10; sid: 10000005; rev:1;)
```

So, analysing the rule, it will keep a track by destination of tcp packets with any source IP and any source port to $HOME_NET port 80 and that are with an established connection. If the HTTP method is GET (no case which is not case sensitive) and if it reaches 1000 in 10 seconds will raise an alert with the message Possible http flood attack. //FALAR do estabablished no mundo real e na simulação!!!

NOTE: in this report only a simulation has been done so the attacker will not open a TCP connection to send the HTTP requests and that's why the above rule does not work. To see the alert running with the script given in this report the following rule must be used:

```
alert tcp any any -> $HOME_NET 80 (msg: "Possible http flood attack"; content:"GET";
nocase; http_method; detection_filter:track by_dst, count 1000, seconds 10; sid:
10000005; rev:1;)
```

The only difference is that the parameter "flow:established" is not used because the script will send only the HTTP packets and will not open a TCP connection.

Attack demonstration

To test this, an attacker will do a HTTP flooding with the Scapy script:

```
from scapy.all import *

packet=IP(src=RandIP(), dst="192.168.1.10")/TCP(dport=80)/ "GET /HTTP/1.0\r\n\r\n"
send(packet, loop=1)
```

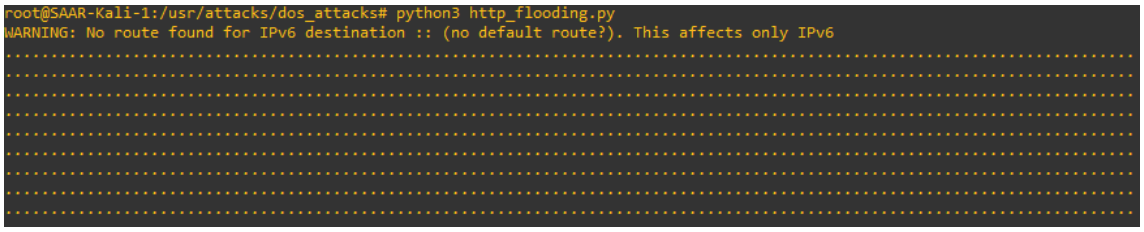


Figure 14 HTTP flooding attack command execution

By the Figure 15 is possible to see what packets were sent, simple HTTP packets:

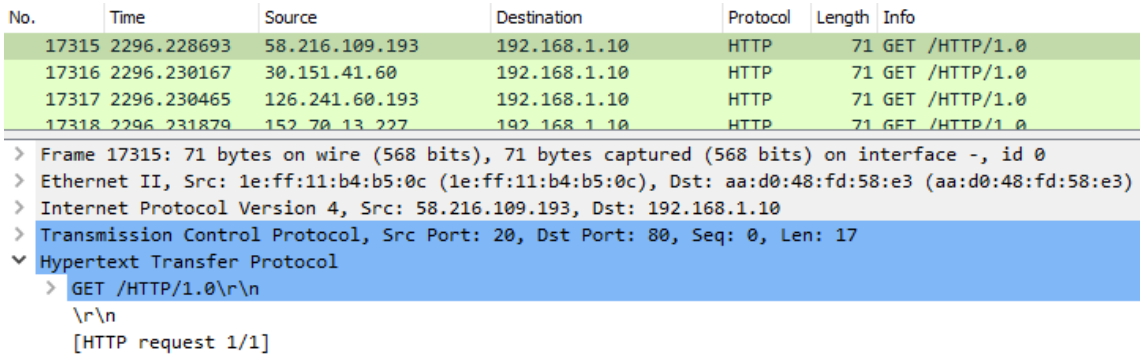


Figure 15 HTTP flood Wireshark capture

Snort with the rule specified above will raise an enormous number of alerts in the console as can be seen in the Figure 16.

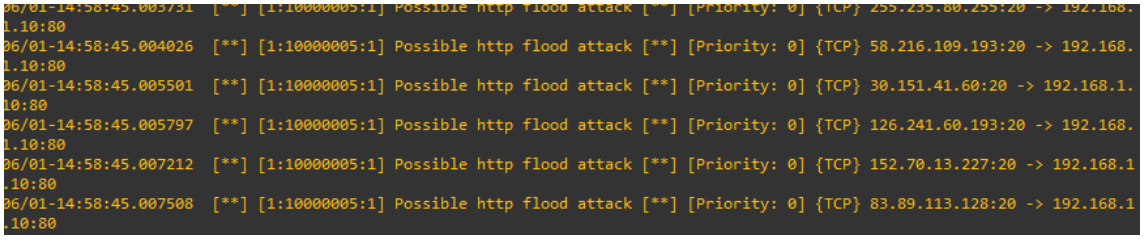


Figure 16 HTTP flood Snort alert

TCP reset attack

TCP reset attack is a Denial of Service (DoS) attack where the attacker overwhelms the victim by sending a TCP packet with RST flag on. To understand it better let's see assume a simple scenario where the victim has a TCP connection to an organization's private server. So, an attacker starts sending RST packets to the victim to close the connections it has (if a connection exists closes it and a RST packet is sent when it is received a packet in a closed port)

Snort Rule

Adding the following rule in local.rules will alert if a TCP reset attack is happening:

```
alert tcp any any -> $HOME_NET any (flags:R; msg: "Possible TCP reset attack"; flow:stateless; sid: 10000006; rev:1;)
```

So, analysing the rule, it will see tcp packets with any source IP and any source port to $HOME_NET to any destination port and if the flags is R (RST) will raise an alert with the message Possible TCP reset attack.

Attack demonstration

To test this, an attacker will do a TCP reset attack with the Scapy script (to simplify only the port 80 was used but we could send to all ports to close all connections):

```
from scapy.all import *

packet=IP(src=RandIP(), dst="192.168.1.10")/TCP(dport=80, flags="R")
send(packet, loop=1)
```

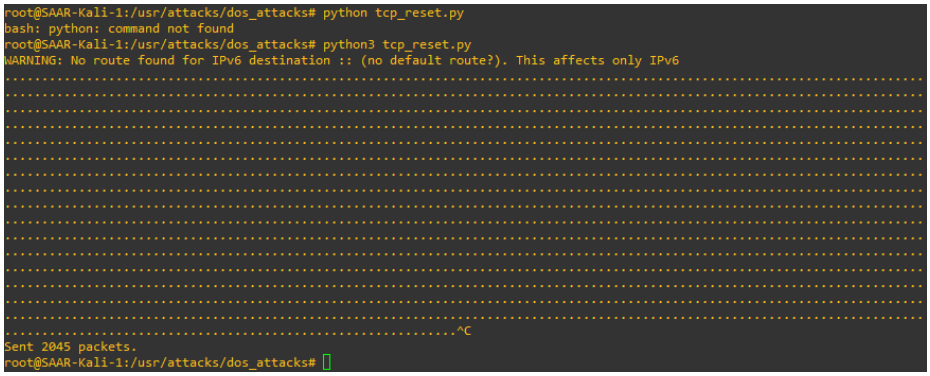


Figure 17 TCP reset attack command execution

By the Figure 18 is possible to see what packets were sent, a TCP packet with the flag RST on, from random sources:

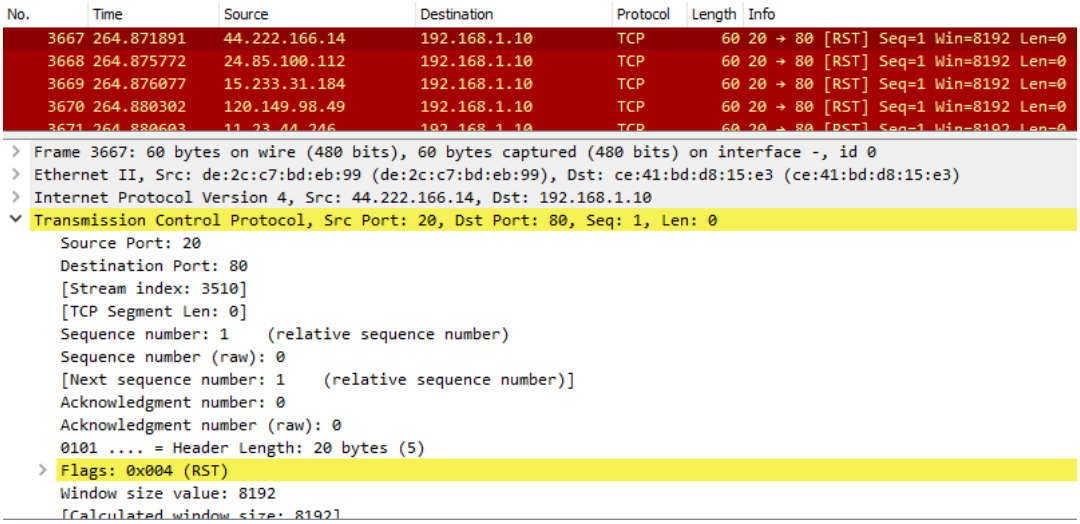


Figure 18 TCP reset attack Wireshark capture

Snort with the rule specified above will raise an enormous number of alerts in the console as can be seen in the Figure 19.

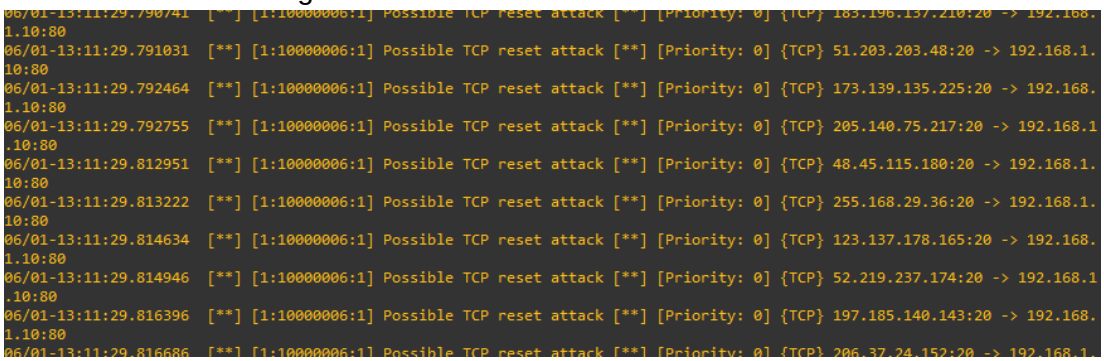


Figure 19 TCP reset attack Snort rule

Christmas tree attack

Christmas tree attack is a Denial of Service (DoS) attack where the attacker overwhelms the victim with special crafted TCP packets, where the URG, PSH and FIN flags are on. The problem is that some devices do not know what to do with such packets, for example, some devices may reboot, others respond and allow recognition (for example, to see which operation a host is running). The DoS comes when an attacker overwhelms the victim with these packets because they require much more processing than a “normal” one.

Snort Rule

Adding the following rule in local.rules will alert if a Christmas tree attack is happening:

```
alert tcp any any -> $HOME_NET any (flags:FPU; msg: "Possible X-MAS tree attack";
flow:stateless; sid: 10000007; rev:1;)
```

So, analysing the rule, it will see tcp packets with any source IP and any source port to $HOME_NET to any destination port and if the flags F, P and U (FIN, PSH and URG respectively) will raise an alert with the message Possible X-MAS tree attack.

Attack demonstration

To test this, an attacker will do a Christmas tree attack with the Scapy script:

```
from scapy.all import *

packet=IP(src=RandIP(), dst="192.168.1.10")/TCP(dport=80, flags="FPU")
send(packet, loop=1)
```

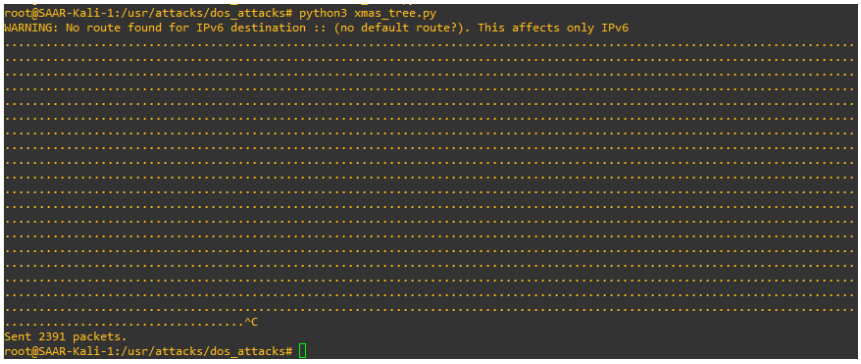


Figure 20 XMAS tree attack command execution

By the Figure 21 is possible to see the packets sent, with FIN, PSH and URG flags on:

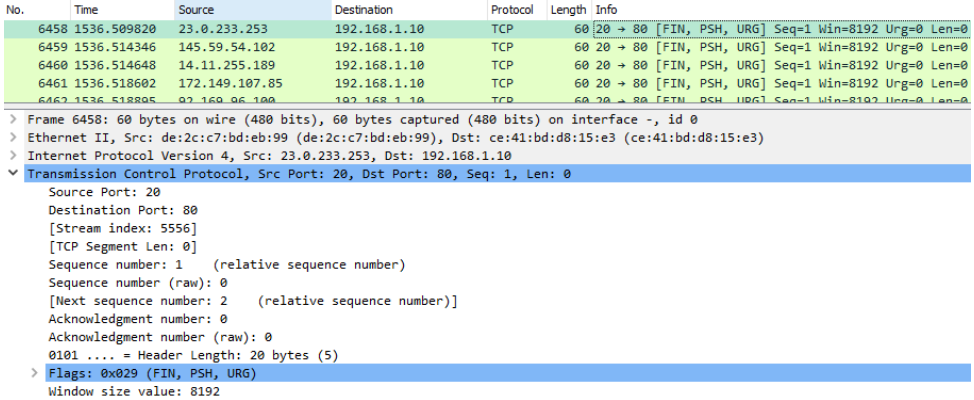


Figure 21 XMAS tree attack Wireshark capture

Snort with the rule specified above will raise an enormous number of alerts in the console as can be seen in the Figure 22.

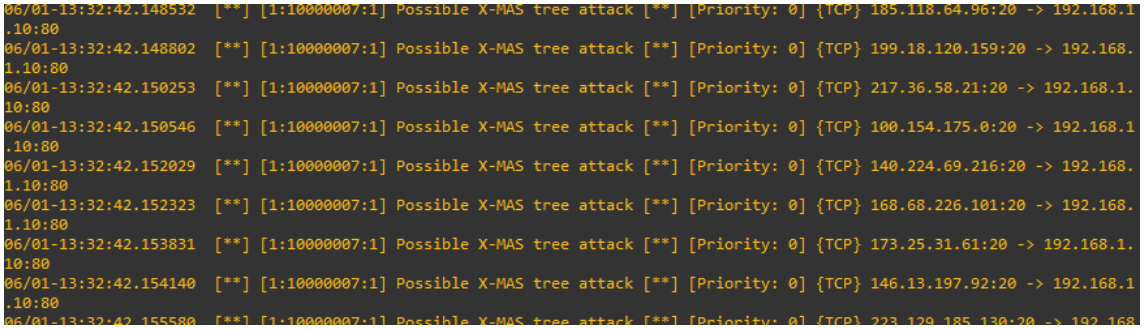


Figure 22 XMAS tree attack Snort alert

UDP flood

UDP flood is a Denial of Service (DoS) attack where the attacker overwhelms the victim with UDP datagrams.

Snort Rule

Adding the following rule in local.rules will alert if a UDP flood is happening:

```
alert udp any any -> $HOME_NET !53 (msg: "UDP flood detected"; flow:stateless;
detection_filter:track by_dst, count 1000, seconds 10; sid:10000008; rev:1;)
```

So, analysing the rule, it will keep track by destination of udp packets with any source IP and any source port to $HOME_NET to any destination port different than 53 and if it reaches 1000 in 10 seconds will raise an alert with the message UDP flood detected.

Attack demonstration

To test this, an attacker will do a UDP flood attack to random ports with the Scapy script:

```
from scapy.all import *

packet=IP(src=RandIP(), dst="192.168.1.10")/UDP(dport=RandShort())
send(packet, loop=1)
```

Figure 23 UDP flood attack command execution

By the Figure 24 is possible to see what packets were sent, UDP datagrams:

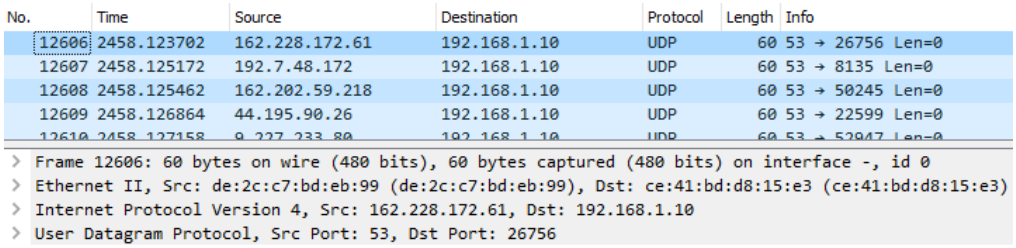


Figure 24 UDP flood Wireshark capture

Snort with the rule specified above will raise an enormous number of alerts in the console as can be seen in the Figure 25.

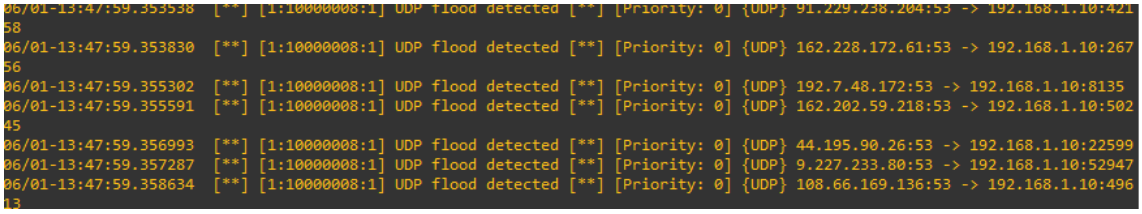


Figure 25 UDP flood Snort alert

DNS flood

DNS flood is a Denial of Service (DoS) attack where the attacker overwhelms the victim, DNS server, to resolve some resource records wasting their resources to emulated requests (and because it is hard to differentiate the real requests from these ones, this attack is hard to prevent).

Snort Rule

Adding the following rule in local.rules will alert if a DNS flood is happening:

```
alert udp any any -> $HOME_NET 53 (msg: "DNS flood detected"; detection_filter:track
by_dst, count 1000, seconds 10; sid:10000009; rev:1;)
```

So, analysing the rule, it will keep track by destination of udp packets with any source IP and any source port to $HOME_NET to port 53 which is DNS, and if it reaches 1000 in 10 seconds will raise an alert with the message DNS flood detected.

Attack demonstration

To test this, an attacker will do a DNS flood attack with the Scapy script:

```
from scapy.all import *

packet=IP(src=RandIP(),                                dst="192.168.1.10")/UDP()/DNS(rd=1,
qd=DNSQR(qname="www.attack.com"))
send(packet, loop=1)
```

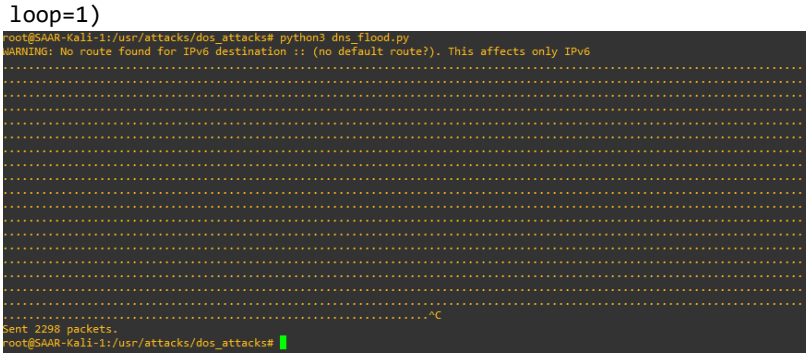


Figure 26 DNS flood attack command execution

By the Figure 27 is possible to see what packets were sent:

No.	Time	Source	Destination	Protocol	Length	Info
16987	2936.068277	182.108.83.7	192.168.1.10	DNS	74	Standard query 0x0000 A www.attack.com
16988	2936.068549	130.58.9.34	192.168.1.10	DNS	74	Standard query 0x0000 A www.attack.com
16989	2936.069960	245.86.234.247	192.168.1.10	DNS	74	Standard query 0x0000 A www.attack.com
16990	2936.070251	192.243.125.190	192.168.1.10	DNS	74	Standard query 0x0000 A www.attack.com

```
> Frame 13094: 74 bytes on wire (592 bits), 74 bytes captured (592 bits) on interface -, id 0
> Ethernet II, Src: de:2c:c7:bd:eb:99 (de:2c:c7:bd:eb:99), Dst: ce:41:bd:d8:15:e3 (ce:41:bd:d8:15:e3)
> Internet Protocol Version 4, Src: 61.17.195.146, Dst: 192.168.1.10
> User Datagram Protocol, Src Port: 53, Dst Port: 53
> Domain Name System (query)
```

Figure 27 DNS flood Wireshark capture

Snort with the rule specified above will raise an enormous number of alerts in the console as can be seen in the Figure 28.

```
06/01-13:55:57.298411  [**] [1:10000009:1] DNS flood detected [**] [Priority: 0] {UDP} 182.108.83.7:53 -> 192.168.1.10:53
06/01-13:55:57.298678  [**] [1:10000009:1] DNS flood detected [**] [Priority: 0] {UDP} 130.58.9.34:53 -> 192.168.1.10:53
06/01-13:55:57.300090  [**] [1:10000009:1] DNS flood detected [**] [Priority: 0] {UDP} 245.86.234.247:53 -> 192.168.1.10:53
06/01-13:55:57.300380  [**] [1:10000009:1] DNS flood detected [**] [Priority: 0] {UDP} 192.243.125.190:53 -> 192.168.1.10:53
06/01-13:55:57.301849  [**] [1:10000009:1] DNS flood detected [**] [Priority: 0] {UDP} 183.117.229.248:53 -> 192.168.1.10:53
06/01-13:55:57.302151  [**] [1:10000009:1] DNS flood detected [**] [Priority: 0] {UDP} 228.143.174.193:53 -> 192.168.1.10:53
06/01-13:55:57.303640  [**] [1:10000009:1] DNS flood detected [**] [Priority: 0] {UDP} 42.62.190.166:53 -> 192.168.1.10:53
06/01-13:55:57.303936  [**] [1:10000009:1] DNS flood detected [**] [Priority: 0] {UDP} 234.218.201.200:53 -> 192.168.1.10:53
06/01-13:55:57.305348  [**] [1:10000009:1] DNS flood detected [**] [Priority: 0] {UDP} 25.5.55.22:53 -> 192.168.1.10:53
06/01-13:55:57.305643  [**] [1:10000009:1] DNS flood detected [**] [Priority: 0] {UDP} 199.12.67.35:53 -> 192.168.1.10:53
```

Figure 28 DNS flood Snort alert

Smurf attack

Smurf attack is a Denial of Service (DoS) attack where the attacker overwhelms the victim by sending ICMP packets to the broadcast IP address with the source as the victim IP address. So, with this, all hosts in the network will reply to that request answering back to the victim (because it was his spoofed IP address).

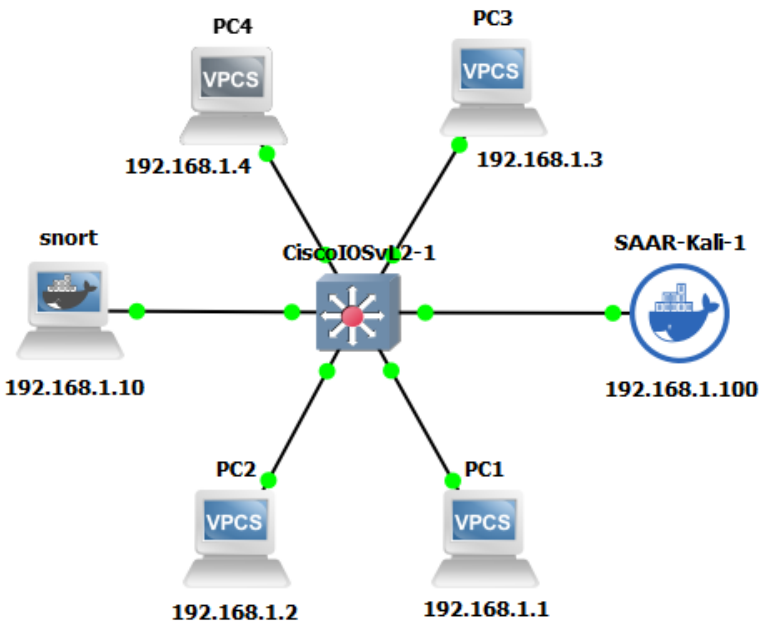


Figure 29 Smurf attack network topology

For this demonstration, a new network topology was made to easily see the attack, Figure 29. This topology is the one in the Figure 29. For the new VPCs the command `ip 192.168.1.X 255.255.255.0` where “X” was the VPC number, was used to give an IP address to each VPC. For “snort” and “SAAR-kali-1” machines configuration, see the annex chapter.

Snort Rule

Adding the following rule in local.rules will alert if a smurf attack is happening:

```
alert icmp any any -> $HOME_NET any (msg: "SMURF attack detected"; itype:0;
detection_filter:track by_dst, count 1000, seconds 10; sid:10000010; rev:1;)
```

So, analysing the rule, it will keep track by destination of icmp packets type 0 which represent echo replies with any source IP and any source port to $HOME_NET to any destination port and if it reaches 1000 in 10 seconds will raise an alert with the message SMURF attack detected.

Attack demonstration

To test this, an attacker will do a smurf attack with the Scapy script:

```
from scapy.all import *

packet1=IP(src="192.168.1.10", dst="192.168.1.1")/ICMP()
packet2=IP(src="192.168.1.10", dst="192.168.1.2")/ICMP()
packet3=IP(src="192.168.1.10", dst="192.168.1.3")/ICMP()
packet4=IP(src="192.168.1.10", dst="192.168.1.4")/ICMP()
packets = [packet1, packet2, packet3, packet4]

while True:
        for packet in packets:
                send(packet)
```

Note: the script is done to send to each VPC because when used the broadcast address which in this case is 192.168.1.255 the VPCs were receiving but not responding, maybe it is a limitation of the GNS3 (but this requires more investigating to say it). The script to execute a smurf attack would be:

```
from scapy.all import *

packet=IP(src="192.168.1.10", dst="192.168.1.255")/ICMP()
send(packet, loop=1)
```

By the Figure 30 which is a Wireshark capture, is possible to see that was sent ICMP packets from 192.168.1.10 (which is the victim) for the VPCs, in this case for the VPC1 who will reply to that ICMP packet:

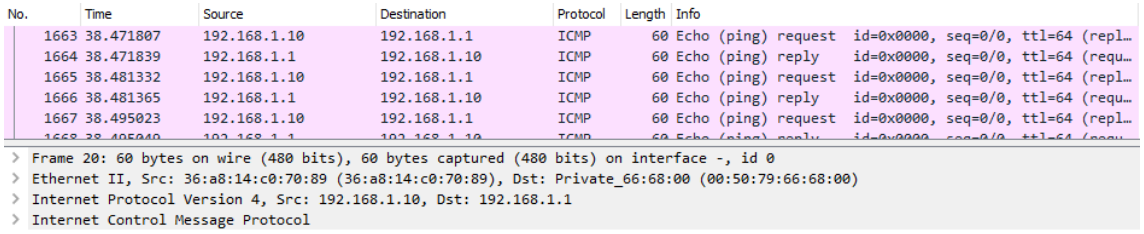
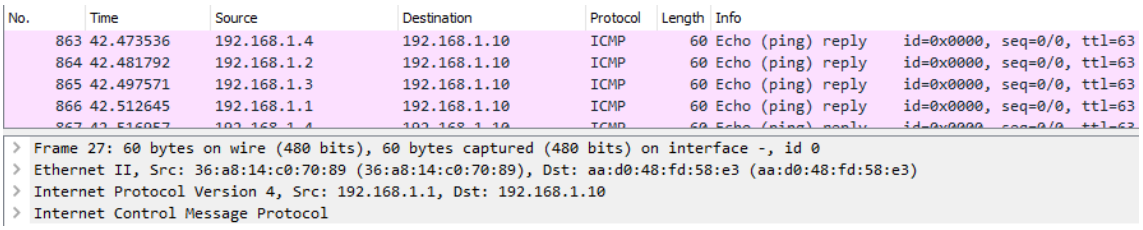


Figure 30 Smurf attack VPC1 Wireshark capture

The Wireshark capture in Figure 31, shows the reply packets arrived at the victim PC:



No.	Time	Source	Destination	Protocol	Length	Info
863	42.473536	192.168.1.4	192.168.1.10	ICMP	60	Echo (ping) reply id=0x0000, seq=0/0, ttl=63
864	42.481792	192.168.1.2	192.168.1.10	ICMP	60	Echo (ping) reply id=0x0000, seq=0/0, ttl=63
865	42.497571	192.168.1.3	192.168.1.10	ICMP	60	Echo (ping) reply id=0x0000, seq=0/0, ttl=63
866	42.512645	192.168.1.1	192.168.1.10	ICMP	60	Echo (ping) reply id=0x0000, seq=0/0, ttl=63

```
> Frame 27: 60 bytes on wire (480 bits), 60 bytes captured (480 bits) on interface -, id 0
> Ethernet II, Src: 36:a8:14:c0:70:89 (36:a8:14:c0:70:89), Dst: aa:d0:48:fd:58:e3 (aa:d0:48:fd:58:e3)
> Internet Protocol Version 4, Src: 192.168.1.1, Dst: 192.168.1.10
> Internet Control Message Protocol
```

Figure 31 Smurf attack Snort machine Wireshark capture

Snort with the rule specified above will raise an enormous number of alerts in the console as can be seen in the Figure 32.

```
06/01-16:24:20.506354  [**] [1:10000010:1] SMURF attack detected [**] [Priority: 0] {ICMP} 192.168.1.1 -> 192.168.1.10
06/01-16:24:20.534892  [**] [1:10000010:1] SMURF attack detected [**] [Priority: 0] {ICMP} 192.168.1.2 -> 192.168.1.10
06/01-16:24:20.539388  [**] [1:10000010:1] SMURF attack detected [**] [Priority: 0] {ICMP} 192.168.1.3 -> 192.168.1.10
06/01-16:24:20.548932  [**] [1:10000010:1] SMURF attack detected [**] [Priority: 0] {ICMP} 192.168.1.1 -> 192.168.1.10
06/01-16:24:20.560531  [**] [1:10000010:1] SMURF attack detected [**] [Priority: 0] {ICMP} 192.168.1.4 -> 192.168.1.10
06/01-16:24:20.568783  [**] [1:10000010:1] SMURF attack detected [**] [Priority: 0] {ICMP} 192.168.1.2 -> 192.168.1.10
06/01-16:24:20.584565  [**] [1:10000010:1] SMURF attack detected [**] [Priority: 0] {ICMP} 192.168.1.3 -> 192.168.1.10
06/01-16:24:20.599638  [**] [1:10000010:1] SMURF attack detected [**] [Priority: 0] {ICMP} 192.168.1.1 -> 192.168.1.10
06/01-16:24:20.603948  [**] [1:10000010:1] SMURF attack detected [**] [Priority: 0] {ICMP} 192.168.1.4 -> 192.168.1.10
```

Figure 32 Smurf attack Snort alert

References

Network Intrusion Detection Systems (SNORT)
Network Intrusion Detection Systems (SNORT) - YouTube
Snort
https://pt.wikipedia.org/wiki/Snort
hping3 flood ddos
https://linuxhint.com/hping3/
Writing Effective Snort Rules with Examples [Best Practices]
https://coralogix.com/blog/writing-effective-snort-rules-for-the-sta/
Basic snort rules syntax and usage [updated 2021]
https://resources.infosecinstitute.com/topic/snort-rules-workshop-part-one/
Snort Intrusion Prevention System (IPS) Configuration and Rule Creation
https://www.youtube.com/watch?v=enSll_9Bjaq
Detecting DDos attack using Snort
https://www.researchgate.net/publication/338660054_DETECTING_DDoS_ATTACK_USING_Snort
Ping of Death
https://www.cloudflare.com/learning/ddos/ping-of-death-ddos-attack/
Mitigation of DoS and Port Scan Attacks Using Snort
https://www.researchgate.net/publication/335803817_Mitigation_of_DoS_and_Port_Scan_Attacks_Using_Snort

Annex

Snort

- PC1:

```
ip 192.168.1.1 255.255.255.0 192.168.1.254
```

- PC2:

```
ip 192.168.1.2 255.255.255.0 192.168.1.254
```

- SAAR-Kali-1:

```
Edit config:
auto eth0
iface eth0 inet static
       address 192.168.1.100
       netmask 255.255.255.0
```

- Snort:

```
Edit config:
auto eth0
iface eth0 inet static
       address 192.168.1.10
       netmask 255.255.255.0

Edit file /etc/snort/snort.conf and change the line:
# Setup the network addresses you are protecting
ipvar HOME_NET 192.168.1.0/24

==== EXTRA (not used) ====
```

- Setup a port mirroring in CiscoIOSvL2-1

```
en
conf t
monitor session 1 source interface g0/1
monitor session 1 destination interface g0/0
end
```