IMPLEMENTING
NETWORK SECURITY

with MikroTik RouterOS

IP FIREWALL

ADVANCED and EXTRA CONDITIONS

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MTCNA | MTCRE | MTCUME | MTCTCE | MTCWE

CCSI | CCNP | CCNA | MCT | MCSA | FCT | NSE4
UBWS | HCDA | CSSA | PCE | VMTSP

INQUIRINITY CORPORATION

Davao City, Philippines

ICT certification-based training center

MikroTik Academy – Inquirinity Computer Academy

Reseller of ICT products – MikroTik & others

Partnered for a start-up WISP

System and Network consultation

OBJECTIVES

- To list built-in MikroTik IP Firewall capabilities in implementing network security
- A primer on MTCTCE certification
- To look beyond network connectivity - build and maintain secure networks

NEED FOR GRANULAR POLICIES

IP FIREWALL

General conditions form the basic firewall rules and are certainly significant however will be inefficient or at worst inapplicable on scenarios that would need to consider non-contiguous networks, unknown ports, content, time, connection rate - just to name a few

ADVANCED CONDITIONS

IP FIREWALL

- Src. Address List
- Dst. Address List
- Layer 7 protocol
- Content
- Connection Bytes
- Connection Rate
- Packet size
- TCP Flags
- ICMP Options

SRC/DST ADDRESS LIST
ADVANCED CONDITIONS

Allow or block multiple non-contiguous IP address or networks without using multiple firewall rules

Addresses could be entered statically or acquired dynamically and either remain in disk permanently or removed after a specific timeout

SRC/DST ADDRESS LIST
ADVANCED CONDITIONS

Network Security Use Cases:

- BOGON filtering
- Port Knocking
- Whitelisting
- Blacklisting

LAYER 7 PROTOCOL

ADVANCED CONDITIONS

L7 matcher collects the first 10 packets of a connection or the first 2KB of a connection and searches for the pattern in the collected data.

L7 matcher is very resource intensive and can’t identify protocols in SSL tunnels

LAYER 7 PROTOCOL

ADVANCED CONDITIONS

Network Security Use Cases:

- File type filtering
- Malware patterns

Check for some Made for MikroTik solutions/plugins

TLS-HOST

ADVANCED CONDITIONS

"Allows to match HTTPS traffic based on TLS SNI hostname. Accepts GLOB syntax for wildcard matching.

Matcher will not be able to match hostname if TLS handshake frame is fragmented into multiple TCP segments (packets)"

TLS-HOST

ADVANCED CONDITIONS

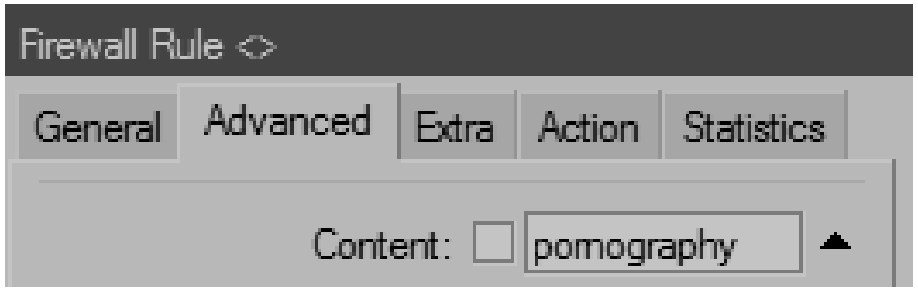
Network Security Use Cases:

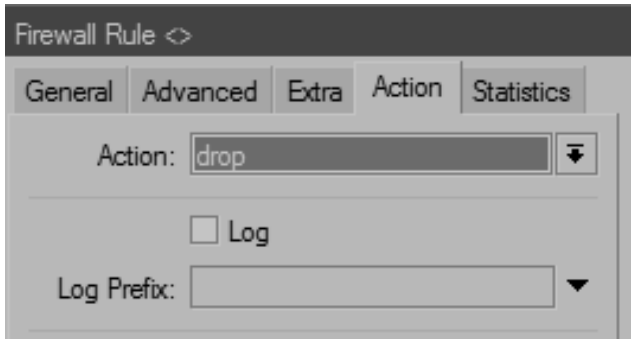
- Block HTTPS (malicious) websites

CONTENT

ADVANCED CONDITIONS

Match packets that contain specified text





Will not work on encrypted or fragmented packet

CONTENT

ADVANCED CONDITIONS

Network Security Use Cases:

- Will form part as a solution in dealing with Brute Force attacks

CONNECTION BYTES

ADVANCED CONDITIONS

Matches packets if only a given amount of bytes has been transferred through the particular connection – upload and download

CONNECTION RATE

ADVANCED CONDITIONS

"A firewall matcher that allows to capture traffic based on present speed of the connection.

Works only with TCP and UDP traffic. You need to specify protocol to activate these options"

CONNECTION BYTES/RATE

ADVANCED CONDITIONS

Network Security Use Cases:

- Although implementation is more towards traffic prioritization, it could be a significant part of establishing baselines, it turn forms basis for any network monitoring activities

PACKET SIZE

ADVANCED CONDITIONS

Matches packets of specified size or size range in bytes

Integer value from 0 to 65535

PACKET SIZE
ADVANCED CONDITIONS

Network Security Use Cases:

- Prevent ICMP Attacks – ICMP tunnelling (injecting arbitrary data into an echo packet)

TCP FLAGS

ADVANCED CONDITIONS

Matches specified TCP flags

- ack - acknowledging data
- cwr - congestion window reduced
- ece - ECN-echo flag
- fin - close conneciton
- psh - push function

TCP FLAGS

ADVANCED CONDITIONS

Matches specified TCP flags

- rst - drop connection
- syn - new connection
- urg - urgent data

TCP FLAGS

ADVANCED CONDITIONS

Network Security Use Cases:

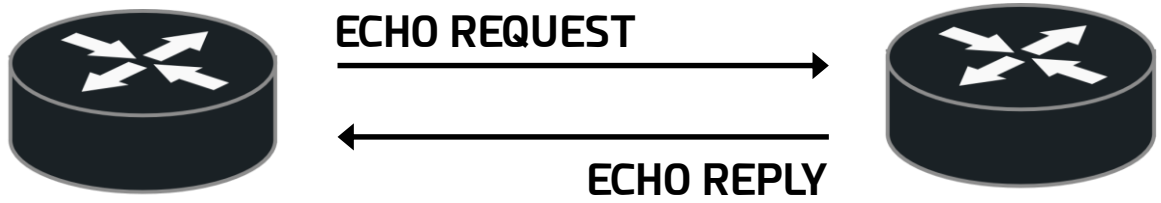
- Various combinations of TCP flags can indicated port scanner activity

ICMP OPTIONS

ADVANCED CONDITIONS

Matches ICMP **type:code** fields

- Type 0 - Echo reply
- Type 3 - Destination Unreachable
- Type 8 - Echo
- Type 11 - Time Exceeded



ICMP OPTIONS

ADVANCED CONDITIONS

Matches ICMP **type:code** fields

- Code 0 - Echo reply
- Code 3 - Destination Unreachable
- Code 4 - Source Quench

ICMP OPTIONS
ADVANCED CONDITIONS

Network Security Use Cases:

- Allow typical ICMP messages

  For PING – messages **0:0** and **8:0**

  For TRACEROUTE – messages **11:0** and **3:3**

  For Path MTU discovery – message **3:4**

  Other types of ICMP messages should be blocked

EXTRA CONDITIONS

IP FIREWALL

Connection Limit

Limit

Dst. Limit

Time

Src/Dst address type

PSD

CONNECTION LIMIT

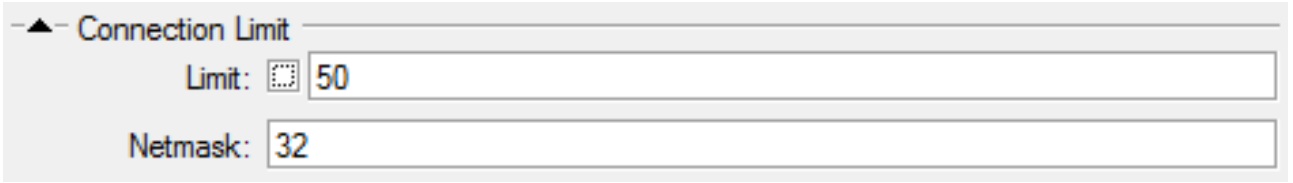
EXTRA CONDITIONS

"Matches connections per address or address block up to and including the given value

Should be used together with connection-state=new and/or with tcp-flags=syn because this matcher is very resource intensive"

CONNECTION LIMIT

EXTRA CONDITIONS



Match until the connection limit of 50 is reached per /32 IP address of network in the src-address

LIMIT

EXTRA CONDITIONS

Matches packets up to a limited rate

Rule using this matcher will match until this limit is reached.

Parameters are the following:

Rate	Burst
Time	Mode

LIMIT

EXTRA CONDITIONS

Match until an average rate of 100 packets per minute is reached, not counting the 5 burst packets

DST-LIMIT

EXTRA CONDITIONS

Matches packets until a given rate is exceeded. Rate is defined as packets per time interval.

As opposed to the limit matcher, every flow has it's own limit.

Flow is defined by mode parameter

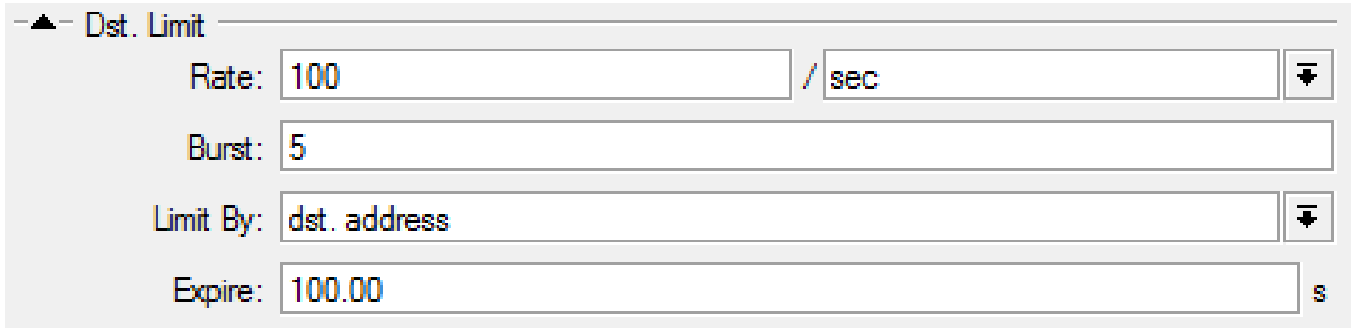
DST-LIMIT
EXTRA CONDITIONS

Parameters are the following:

- Rate
- Time
- Burst
- Limit By
- Expire

DST-LIMIT

EXTRA CONDITIONS



For every flow by dst. address, match until an average rate of 100 packets per second is reached, not counting the 5 burst packets.

For every 100 seconds, flow with no packets will be allowed to be deleted

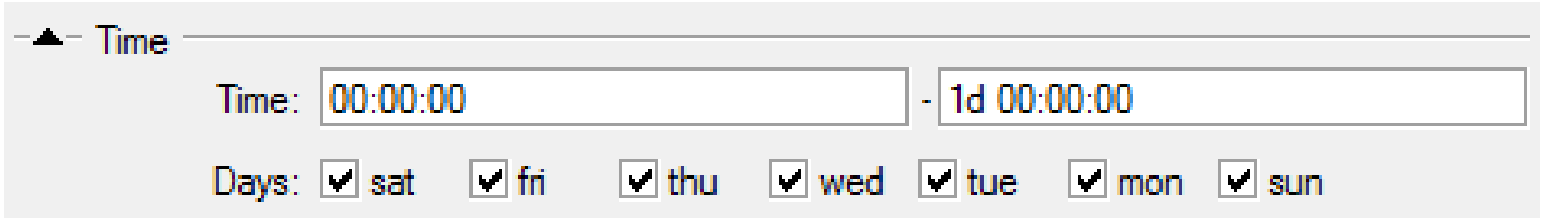
CONNECTION LIMIT / LIMIT / DST-LIMIT

EXTRA CONDITIONS

Network Security Use Cases:

- DDoS Detection and Blocking
- Dealing with Brute Force attacks

TIME
EXTRA CONDITIONS



Allows to create a filter based on the packets arrival time and date or for locally generated packets, departure time and date

TIME
EXTRA CONDITIONS

Network Security Use Cases:

- Time-based access rules

SRC/DST ADDRESS TYPE
EXTRA CONDITIONS

Matches the source/destination address type

unicast	IP address used for point to point transmission
local	IP address assigned to one of router's interfaces
broadcast	Packet is sent to all devices in subnet
multicast	Packet is forward to defined group of devices

SRC/DST ADDRESS TYPE
EXTRA CONDITIONS

Network Security Use Cases:

- DDoS attacks use the special broadcast address – Block any packets (outside your network) directed to the broadcast address and Block outgoing packets (from your network) destined for the broadcast address

PSD
EXTRA CONDITIONS

WeightThreshold Total weight of the latest TCP/UDP scans

DelayThreshold Delay for the packets with different destination ports coming from the same host to be treated as possible port scan sequence

LowPortWeight Weight of the packets with privileged (<=1024) destination port

HighPortWeight Weight of the packet with non-privileged destination port

PSD

EXTRA CONDITIONS

Network Security Use Cases:

- Drop Port Scanners

Implement PSD in the input chain (to protect from) and forward chain (local port scanners)

NOTABLE MUM PRESENTATIONS

Layer 7 Protocol

https://mum.mikrotik.com//presentations/US18/presentation_5365_1524221989.pdf

TLS-HOST

https://mum.mikrotik.com/presentations/CR18/presentation_5701_1532535774.pdf

NOTABLE MUM PRESENTATIONS

Brute Force – Content, Address List

https://mum.mikrotik.com//presentations/ID16/presentation_3549_1476685233.pdf

IDS – Limit, Port Knocking, PSD

https://mum.mikrotik.com/presentations/ID18/presentation_5640_1540365379.pdf

NOTABLE MUM PRESENTATIONS

DoS – TCP Flags, Connection-Limit

https://mum.mikrotik.com//presentations/CY15/Denial_of_Service_Attack.pdf

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Resources:

https://wiki.mikrotik.com

https://mum.mikrotik.com

https://forum.mikrotik.com

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THANK **YOU**