

Monitoring RouterOS

Simple Network Management Protocol

ElasticSearch, LogStash & Kibana

MUM Cambodia 2019

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ALAGAS NETWORK

www.mikrotik.sg



AlagasNetwork



ABOUT ME

.....

My name is Soragan
Ong

I am MikroTik
Certified Trainer

Also IPv6 Forum
certified engineer

ខ្ញុំធ្វើការឱ្យ Alagas
Network

WHO IS ALAGAS NETWORK?

- MikroTik VAD based in Singapore
- Distributing MikroTik since 2010
- 2Gbps in Singapore in 2014, second in the world after Japan
- MikroTik Training Centre Since 2016

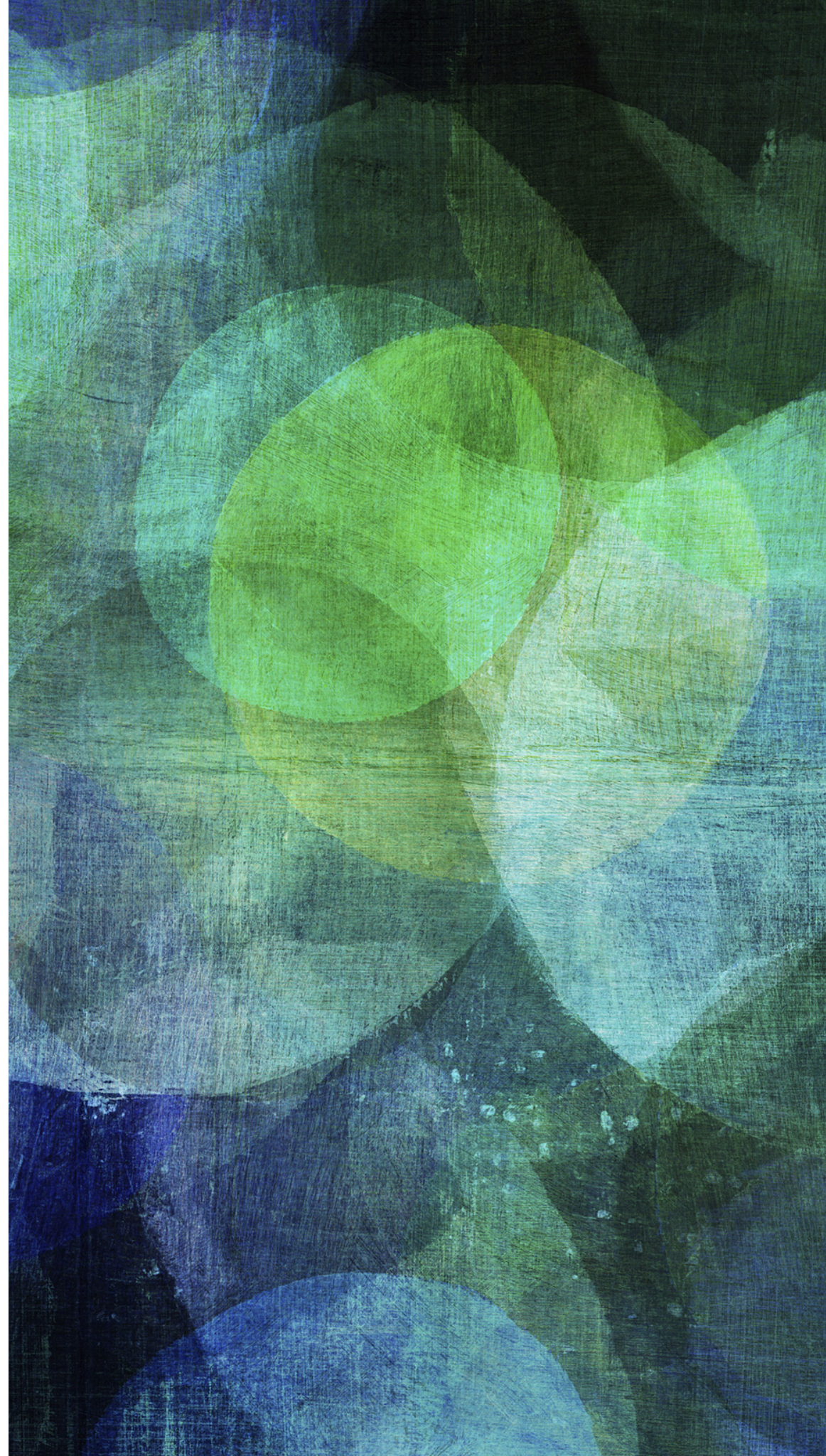


HOW CAN WE MONITOR?

.....

- Does NOT require extra software:
 - Built-in Tools
- Require external software
 - Simple Network Management Protocol
 - Flows / ELK Stack
- The Dude

ROUTEROS BUILT-IN TOOLS



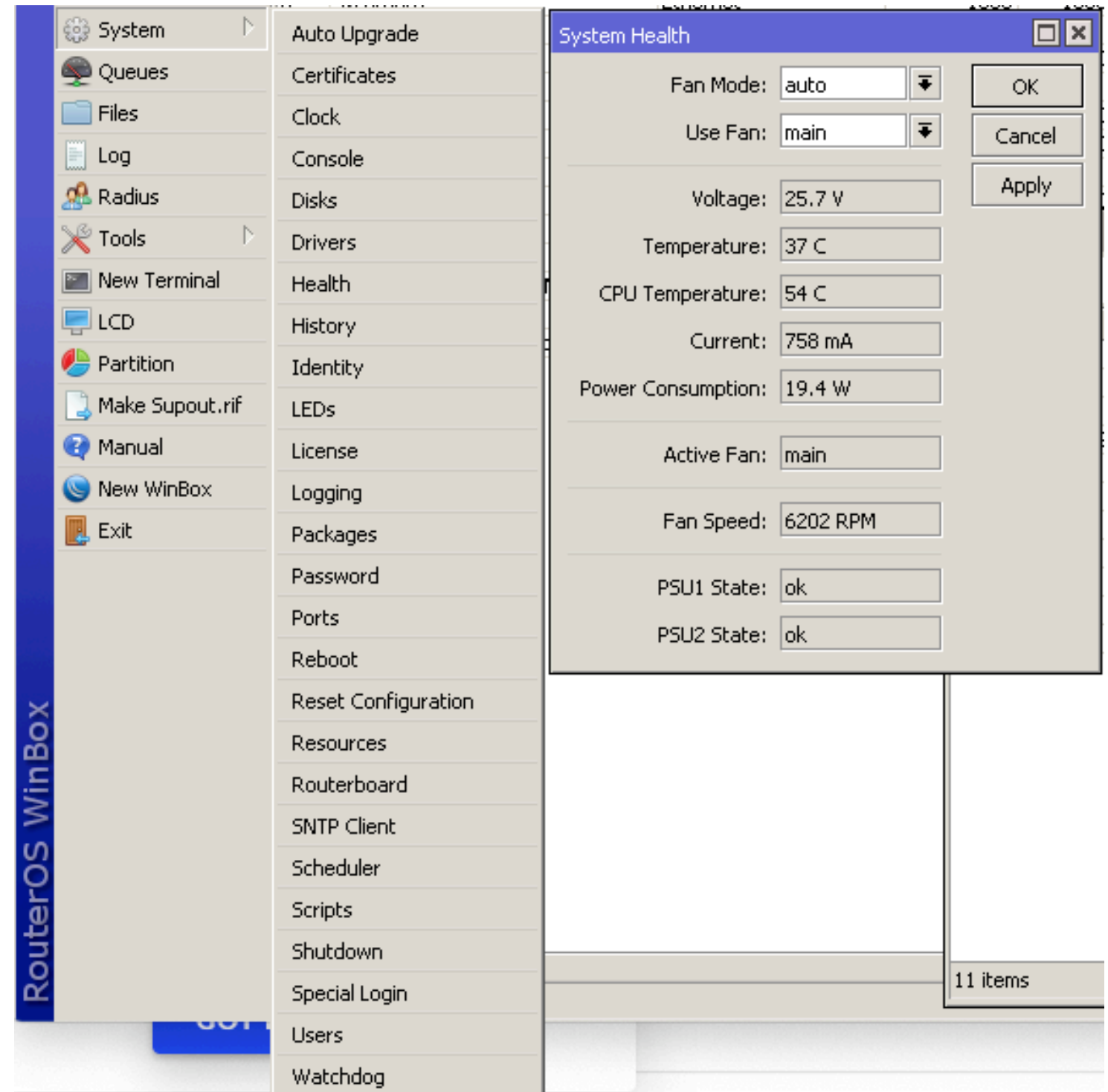
ROUTEROS BUILT-IN TOOLS

➤ Hardware Health

- Fan status
- Electricity Supply
- Temperature

➤ Hardware Failure: Fan, PSU

➤ Power Outage



ROUTEROS BUILT-IN TOOLS

➤ Resource Usage

- CPU
- Memory / RAM
- Storage

➤ Hardware Upgrade

The screenshot displays the RouterOS WinBox interface. On the left is a vertical sidebar with a blue header labeled 'RouterOS WinBox'. The sidebar contains a list of menu items: System, Queues, Files, Log, Radius, Tools, New Terminal, LCD, Partition, Make Supout.rif, Manual, New WinBox, and Exit. The 'Tools' menu is currently expanded, showing a list of sub-items: Auto Upgrade, Certificates, Clock, Console, Disks, Drivers, Health, History, Identity, LEDs, License, Logging, Packages, Password, Ports, Reboot, Reset Configuration, Resources, Routerboard, SNMP Client, Scheduler, Scripts, Shutdown, and Special Login. The 'Resources' window is open, showing various system metrics. The window has a blue title bar and a close button. The metrics are as follows:

Metric	Value
Uptime	45d 17:34:29
Free Memory	645.7 MiB
Total Memory	933.3 MiB
CPU	tilegx
CPU Count	9
CPU Frequency	1200 MHz
CPU Load	0 %
Free HDD Space	82.0 MiB
Total HDD Size	128.0 MiB
Architecture Name	tile
Board Name	CCR1009-8G-15
Version	6.42.10 (long-term)
Build Time	Nov/14/2018 15:04:25
Factory Software	

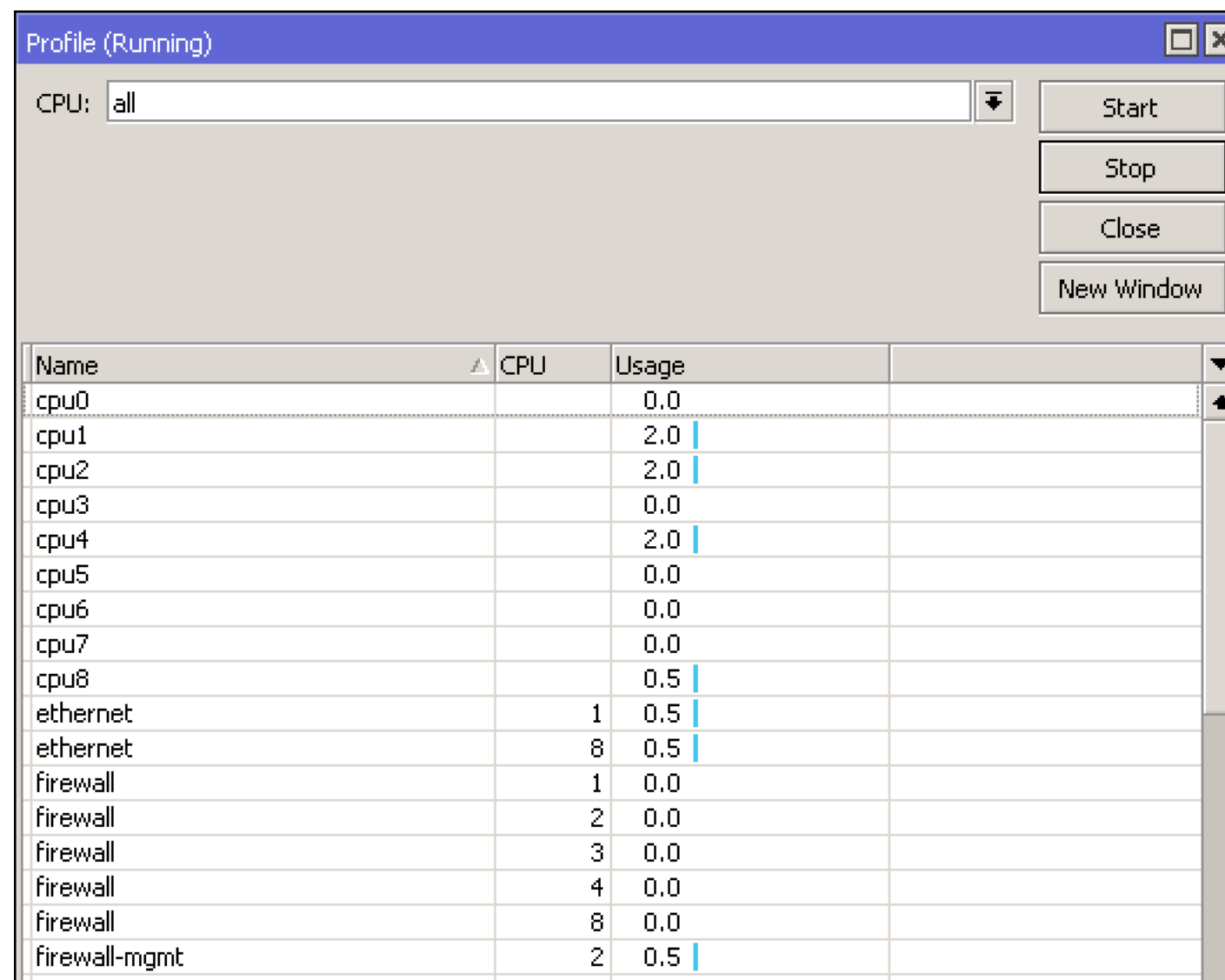
On the right side of the Resources window, there are buttons for 'OK', 'PCI', 'USB', 'CPU', and 'IRQ'. At the bottom of the window, there is a status bar showing '1 item' and '0 B queued'.

ROUTEROS BUILT-IN TOOLS

► Tool > Profile

- Your best friend when you experiencing high CPU usage

<https://wiki.mikrotik.com/wiki/Manual:Tools/Profiler>



Profile (Running)

CPU: [v]

Start

Stop

Close

New Window

Name	CPU	Usage
cpu0		0.0
cpu1		2.0
cpu2		2.0
cpu3		0.0
cpu4		2.0
cpu5		0.0
cpu6		0.0
cpu7		0.0
cpu8		0.5
ethernet	1	0.5
ethernet	8	0.5
firewall	1	0.0
firewall	2	0.0
firewall	3	0.0
firewall	4	0.0
firewall	8	0.0
firewall-mgmt	2	0.5

ROUTEROS BUILT-IN TOOLS

Torch (Running)

Interface: ether2

Entry Timeout: 00:00:03 s

Collect:

- ☒ Src. Address
- ☒ Dst. Address
- ☒ MAC Protocol
- ☒ Protocol
- ☒ DSCP
- ☒ Src. Address6
- ☒ Dst. Address6
- ☒ Port
- ☒ VLAN Id

Filters:

Src. Address: 0.0.0.0/0

Dst. Address: 0.0.0.0/0

Src. Address6: ::/0

Dst. Address6: ::/0

MAC Protocol: all

Protocol: any

Port: any

VLAN Id: any

DSCP: any

Start

Stop

Close

New Window

Eth. Protocol	Protocol	Src.	Dst.	VLAN Id	DSCP	Tx Rate	Rx Rate	Tx Pack...	Rx Pack...
4 (802.2)			0.0.0.0			0 bps	480 bps	0	1
800 (ip)	6 (tcp)	172.3:49316	172.291 (winbox)			46.9 kbps	10.2 kbps	9	13
800 (ip)	1 (icmp)	103.194	103.:71		48	0 bps	0 bps	0	0
800 (ip)	6 (tcp)	118.:76:33409	103.:71:443 (https)			0 bps	0 bps	0	0
800 (ip)	6 (tcp)	223.3:42347	103.:71:443 (https)			2.6 kbps	5.7 kbps	5	5
800 (ip)	1 (icmp)	103.194	172.:96			0 bps	0 bps	0	0
800 (ip)	1 (icmp)	172.196	103.:94			0 bps	0 bps	0	0
800 (ip)	17 (udp)	103.194:44553	172.:161 (snmp)			0 bps	0 bps	0	0
800 (ip)	6 (tcp)	117.:35839	103.:71:443 (https)			0 bps	0 bps	0	0
800 (ip)	17 (udp)	103.194:34643	172.:161 (snmp)			0 bps	0 bps	0	0
800 (ip)	6 (tcp)	216.:66:43645	103.:71:443 (https)			0 bps	0 bps	0	0
800 (ip)	6 (tcp)	116.70:57469	103.:71:443 (https)			3.5 kbps	3.4 kbps	4	4

12 items

Total Tx: 53.1 kbps

Total Rx: 19.9 kbps

Total Tx Packet: 18

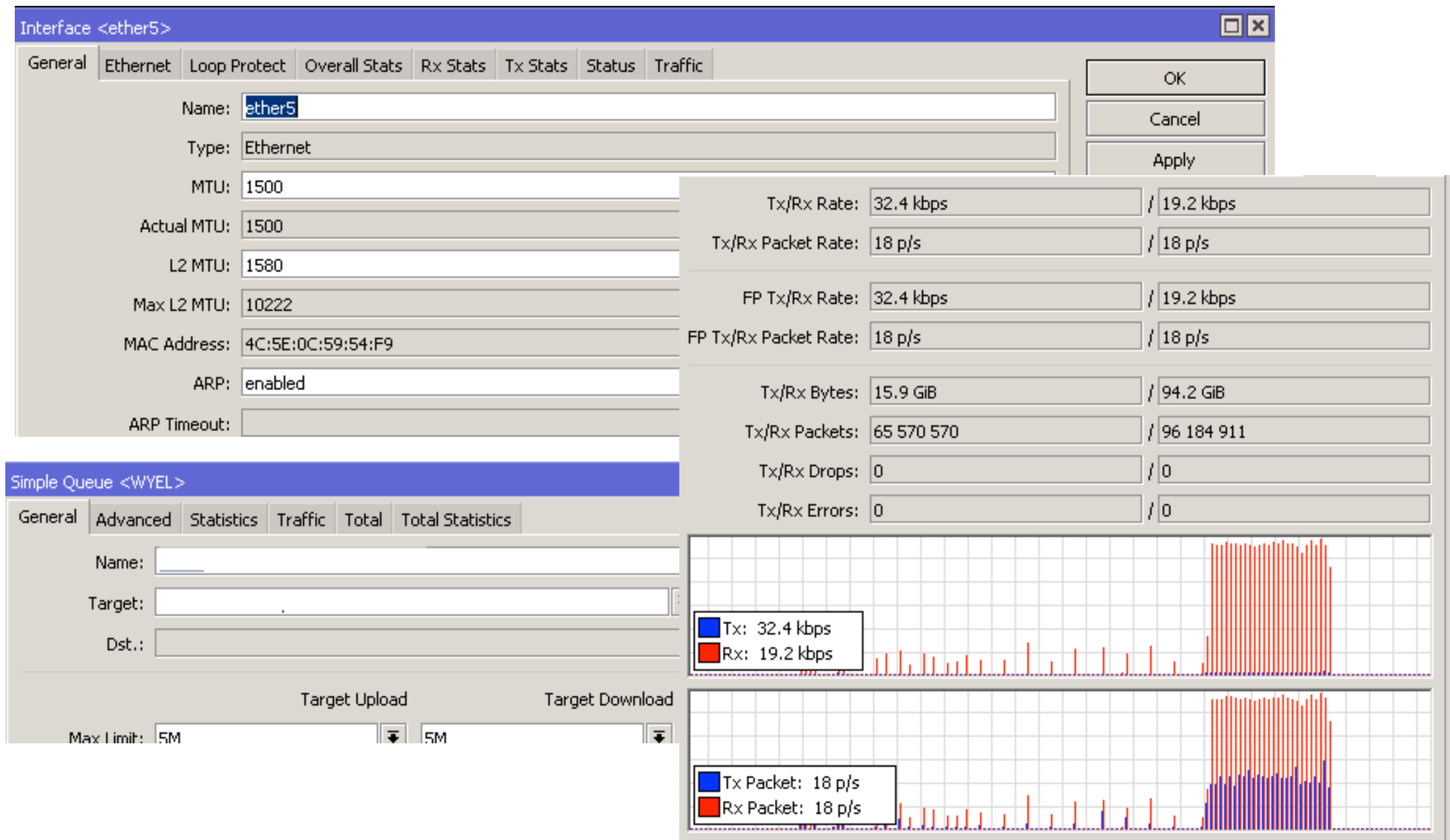
Total Rx Packet: 23

► Torch

- Live data on network traffic

ROUTEROS BUILT-IN TOOLS

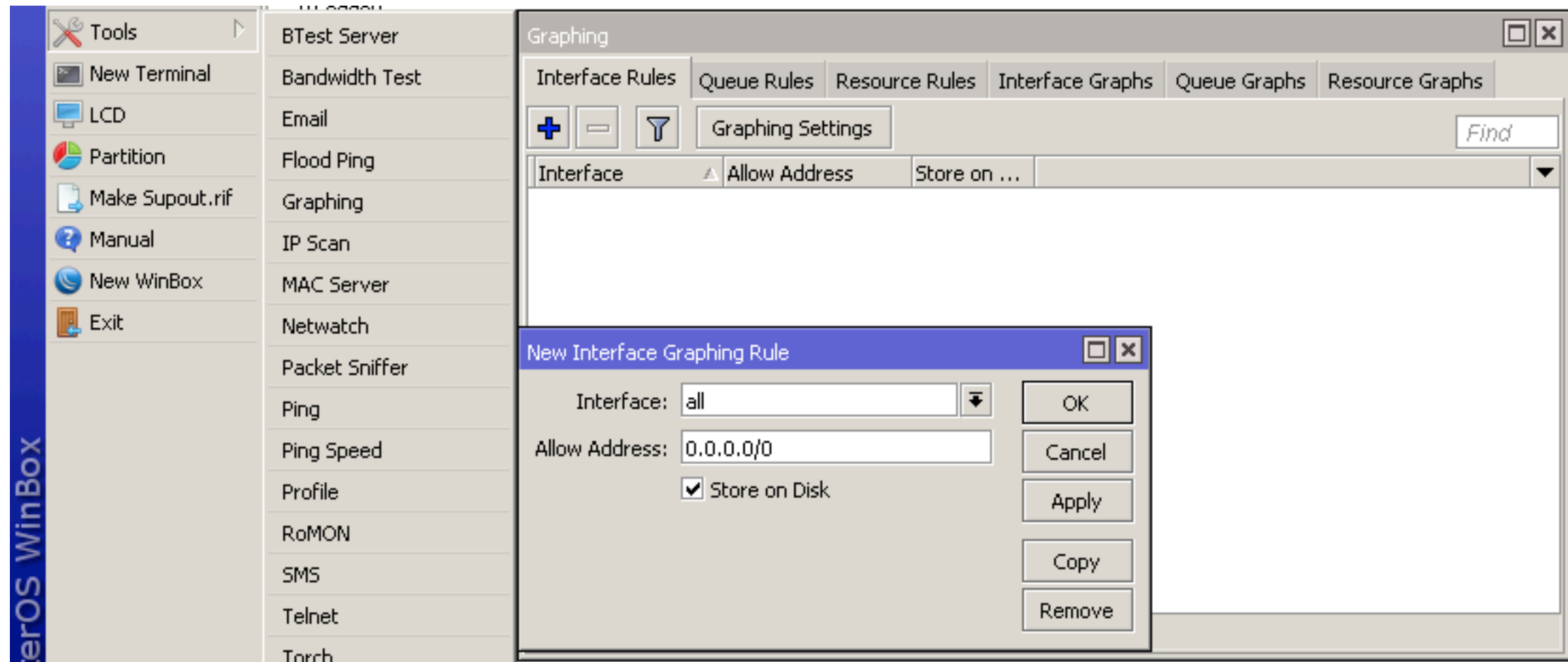
► Interface / Queue live network utilisation



ROUTEROS BUILT-IN TOOLS

► Graphing

Store information, continuous recording

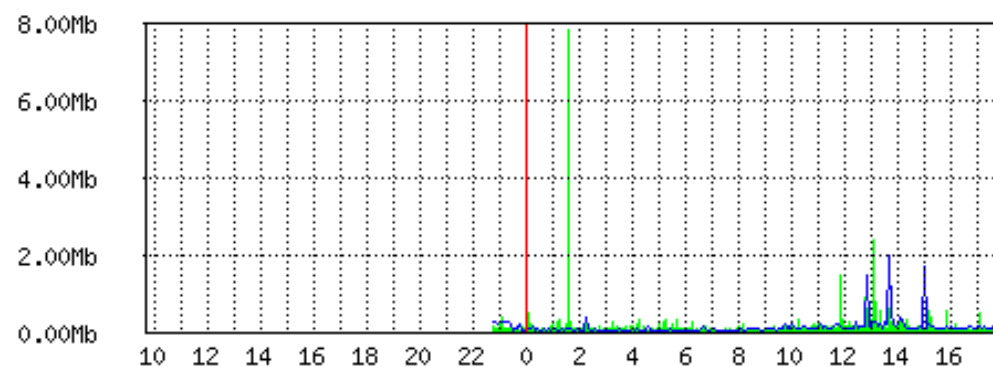


ROUTEROS BUILT-IN TOOLS

Interface <ether5> Statistics

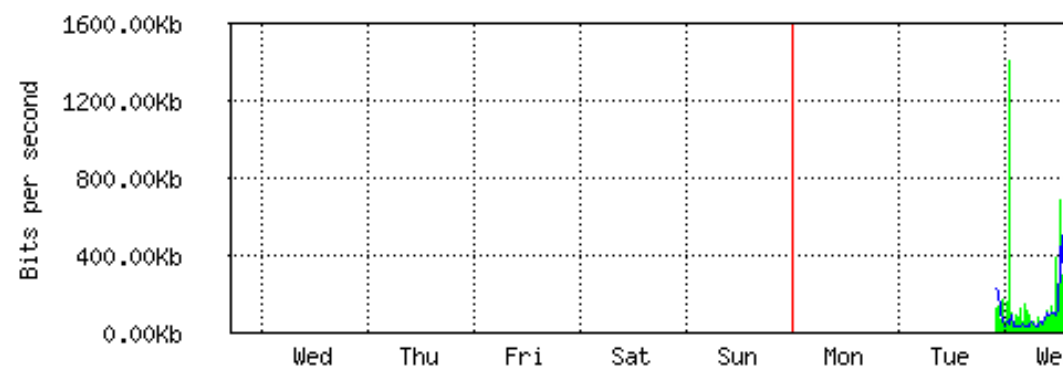
• Last update: Wed Jan 16 17:40:04 2019

"Daily" Graph (5 Minute Average)



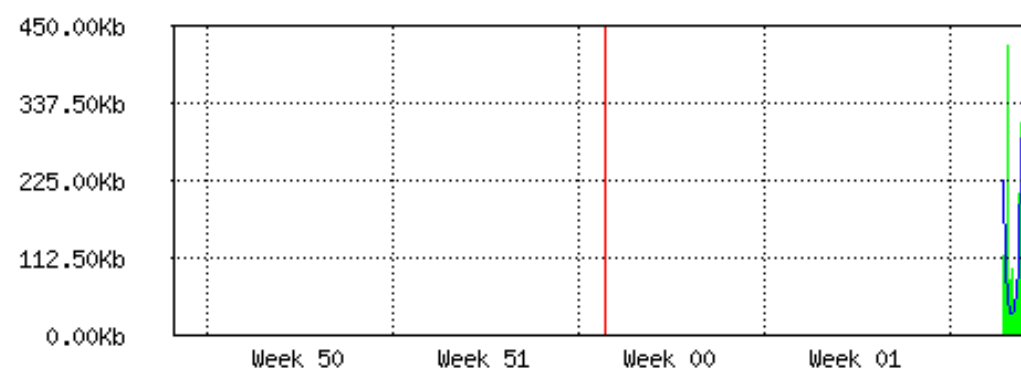
Max **In**: 7.91Mb; Average **In**: 154.42Kb; Current **In**: 41.78Kb;
Max **Out**: 1.94Mb; Average **Out**: 92.63Kb; Current **Out**: 220.52Kb;

"Weekly" Graph (30 Minute Average)



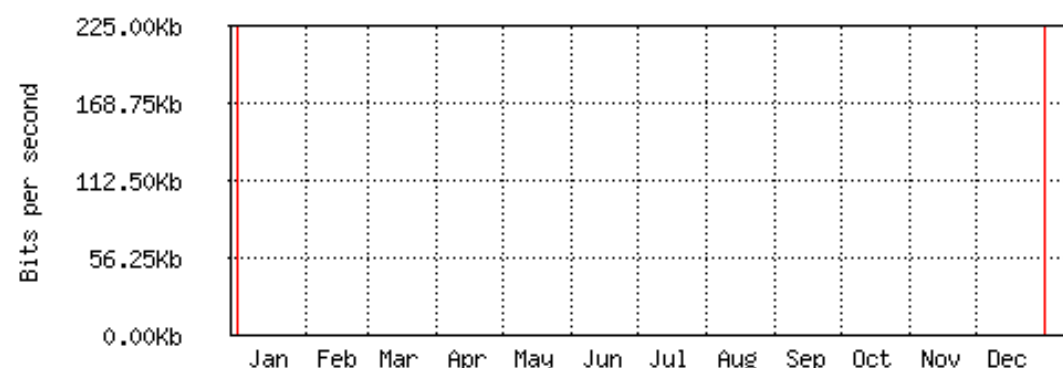
Max **In**: 1.41Mb; Average **In**: 156.14Kb; Current **In**: 128.72Kb;
Max **Out**: 495.08Kb; Average **Out**: 95.49Kb; Current **Out**: 81.58Kb;

"Monthly" Graph (2 Hour Average)



Max **In**: 423.61Kb; Average **In**: 153.58Kb; Current **In**: 107.85Kb;
Max **Out**: 286.76Kb; Average **Out**: 105.46Kb; Current **Out**: 148.65Kb;

"Yearly" Graph (1 Day Average)



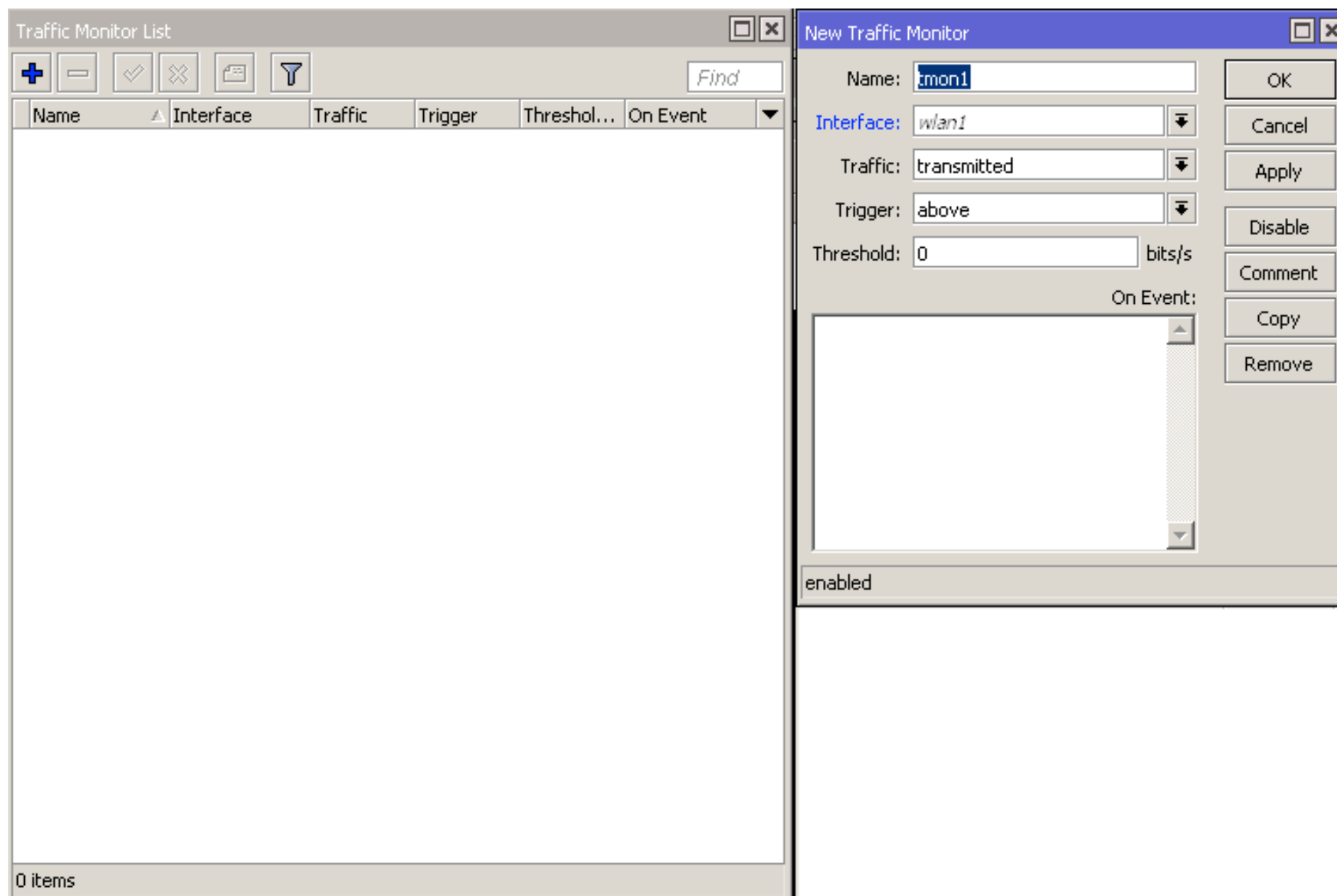
Max **In**: 112.84Kb; Average **In**: 112.84Kb; Current **In**: 112.84Kb;
Max **Out**: 223.74Kb; Average **Out**: 223.74Kb; Current **Out**: 223.74Kb;

[Main page](#)

ROUTEROS BUILT-IN TOOLS

➤ Traffic Monitor

- Proactive monitoring with action script

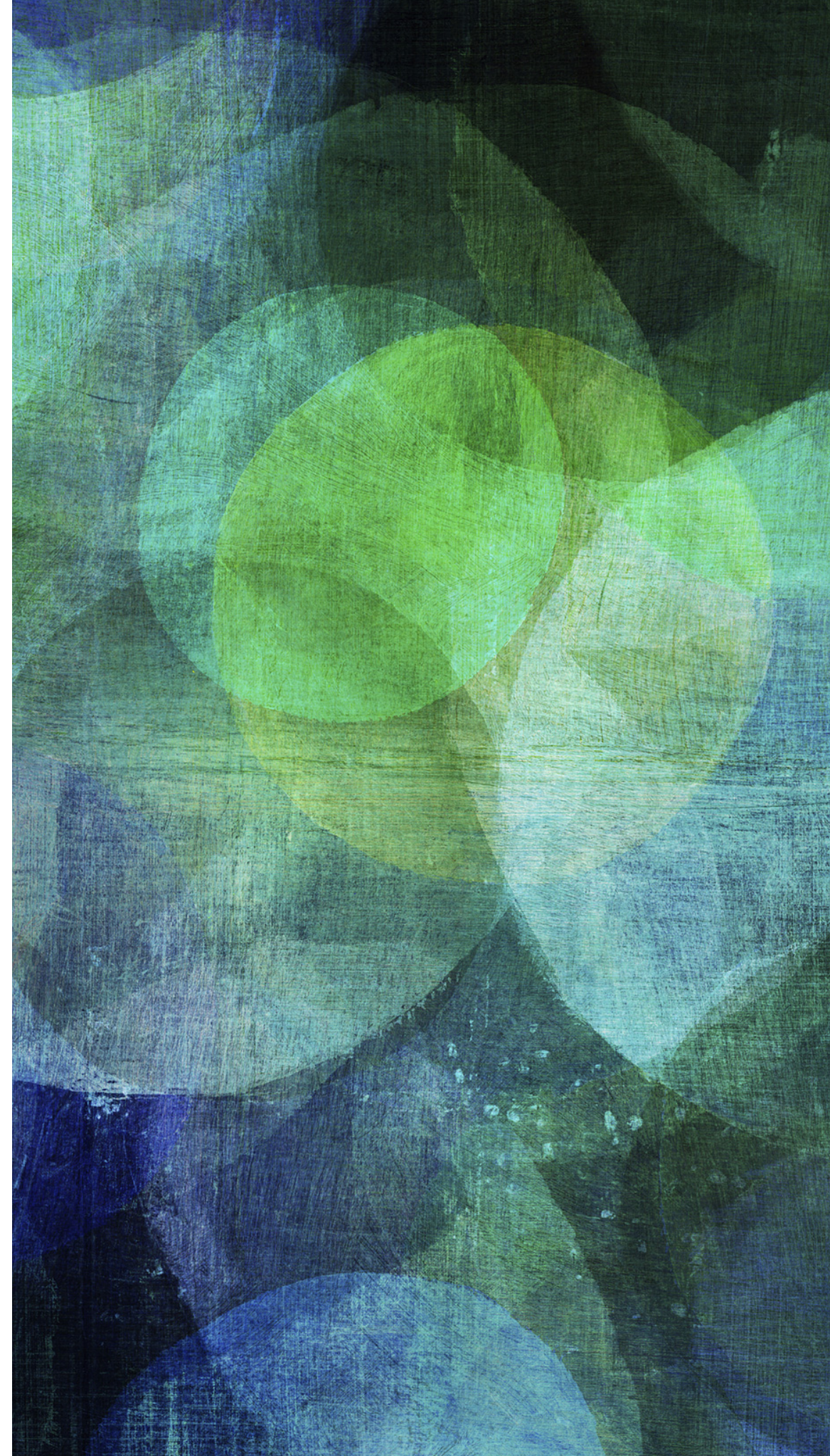


“

Demo

Basic Monitoring with internal tools

SIMPLE NETWORK MANAGEMENT PROTOCOL



WHAT IS SNMP?

- Simple Network Management Protocol
- Define by Internet Engineering Task Force (IETF)
- Started in 1989, finalised in 1991
- Application Layer protocol
- MikroTik support SNMP version: 1, 2c, 3

WHY SNMP?

- Open Standard hence widely used
- It is Simple
- Remote monitoring
- Requires minimal bandwidth and CPU
- Ability to monitor many data

SNMP ARCHITECTURE

➤ Agent

- Process running in nodes that collect information
- Listening on UDP 161

➤ Manager

- Process running in a host that request information from Agent
- Send request to UDP 161

➤ Trap

- Process running in a host that receive event from nodes

SNMP ARCHITECTURE

- Trap

- Process running in a host that receive trap event from agent in nodes
- Listening on UDP 162



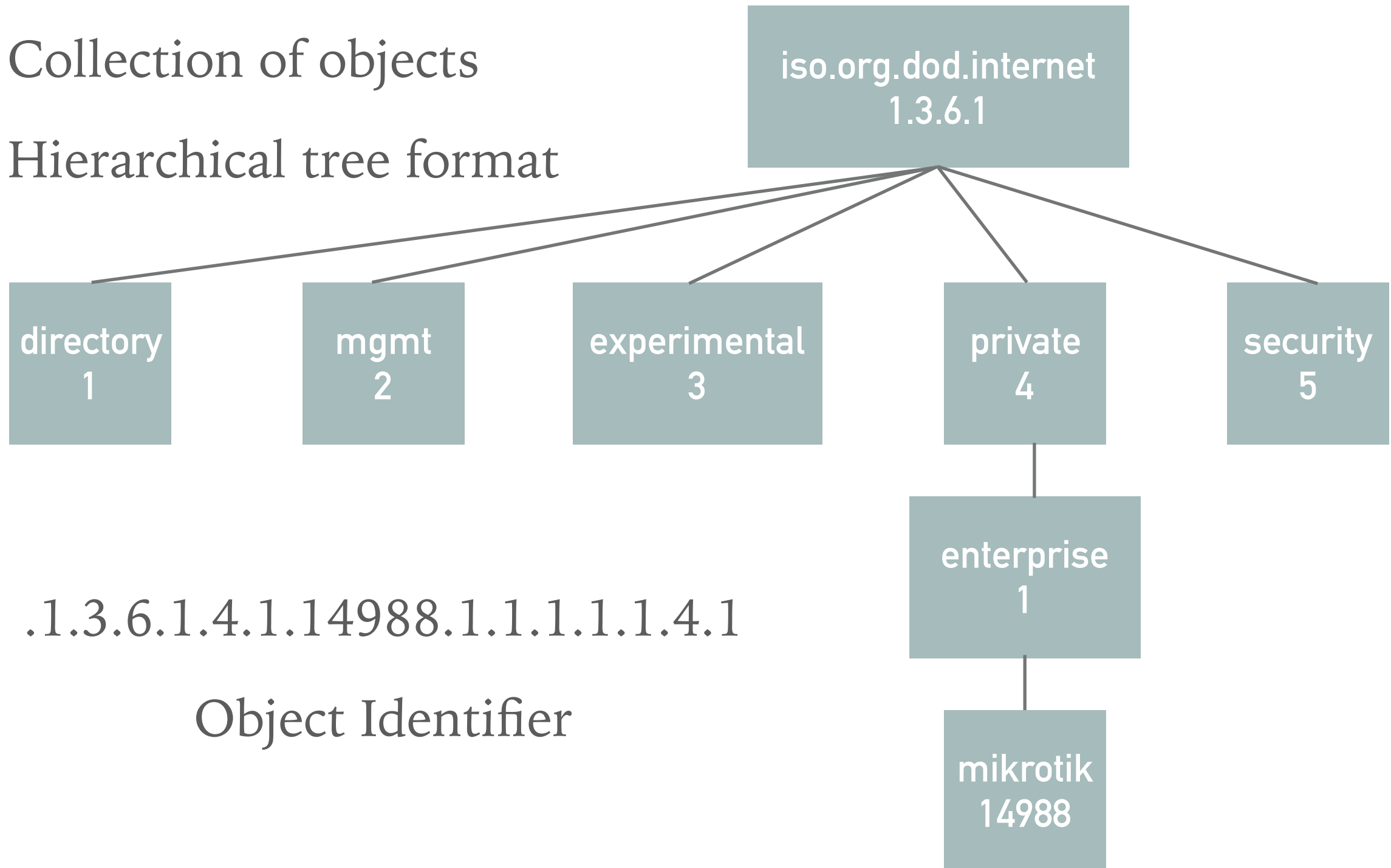
SNMP COMPONENTS

.....

- Management Information Base (MIB)
- Object Identifier (OID)
- Structure of Management Information (SMI)

MANAGEMENT INFORMATION BASE

- Database
- Collection of objects
- Hierarchical tree format



MIKROTIK MIB

- <https://wiki.mikrotik.com/wiki/Manual:SNMP>
- Last updated 5 December 2018

```
MIKROTIK-MIB DEFINITIONS ::= BEGIN

IMPORTS
MODULE-IDENTITY, OBJECT-TYPE, Integer32, Counter32, Gauge32, IpAddress,
Counter64, enterprises, NOTIFICATION-TYPE, TimeTicks FROM SNMPv2-SMI
TEXTUAL-CONVENTION, DisplayString, MacAddress, DateAndTime FROM SNMPv2-TC
OBJECT-GROUP, NOTIFICATION-GROUP FROM SNMPv2-CONF;

mikrotikExperimentalModule MODULE-IDENTITY
    LAST-UPDATED "201812050000Z"
    ORGANIZATION "MikroTik"
    CONTACT-INFO "support@mikrotik.com"
    DESCRIPTION ""
    REVISION "201812050000Z"
    DESCRIPTION ""
    ::= { mikrotik 1 }

mikrotik OBJECT IDENTIFIER ::= { enterprises 14988 }
mtXMetaInfo OBJECT IDENTIFIER ::= { mikrotikExperimentalModule 2 }
mtXRouterOsGroups OBJECT IDENTIFIER ::= { mtXMetaInfo 1 }
```

```
HexInt ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "x"
    STATUS current
    DESCRIPTION "Hex"
    SYNTAX Integer32 (-2147483648..2147483647)

Voltage ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "d-1"
    STATUS current
    DESCRIPTION ""
    SYNTAX Integer32 (-2147483648..2147483647)
```

```
mtxrWlStatIndex OBJECT-TYPE
    SYNTAX ObjectIndex
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION ""
    ::= { mtxrWlStatEntry 1 }

mtxrWlStatTxRate OBJECT-TYPE
    SYNTAX Gauge32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION "bits per second"
    ::= { mtxrWlStatEntry 2 }

mtxrWlStatRxRate OBJECT-TYPE
    SYNTAX Gauge32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION "bits per second"
    ::= { mtxrWlStatEntry 3 }

mtxrWlStatStrength OBJECT-TYPE
    SYNTAX Integer32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION "dBm"
    ::= { mtxrWlStatEntry 4 }
```


STRUCTURE OF MANAGEMENT INFORMATION (SMI)

➤ Define rules for object:

- Name
- Type
- Encoding
- Etc

```

MIKROTIK-MIB DEFINITIONS ::= BEGIN

IMPORTS
MODULE-IDENTITY, OBJECT-TYPE, Integer32, Counter32, Gauge32, IpAddress,
Counter64, enterprises, NOTIFICATION-TYPE, TimeTicks FROM SNMPv2-SMI
TEXTUAL-CONVENTION, DisplayString, MacAddress, DateAndTime FROM SNMPv2-TC
OBJECT-GROUP, NOTIFICATION-GROUP FROM SNMPv2-CONF;

mikrotikExperimentalModule MODULE-IDENTITY
    LAST-UPDATED "201812050000Z"
    ORGANIZATION "MikroTik"
    CONTACT-INFO "support@mikrotik.com"
    DESCRIPTION ""
    REVISION "201812050000Z"
    DESCRIPTION ""
    ::= { mikrotik 1 }

mikrotik OBJECT IDENTIFIER ::= { enterprises 14988 }

mtXRouterOs OBJECT IDENTIFIER ::= { mikrotikExperimentalModule 1 }
mtxrWireless OBJECT IDENTIFIER ::= { mtXRouterOs 1 }

-- WIRELESS *****

mtxrWlStatTable OBJECT-TYPE
    SYNTAX SEQUENCE OF MtxrWlStatEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION ""
    ::= { mtxrWireless 1 }

mtxrWlStatEntry OBJECT-TYPE
    SYNTAX MtxrWlStatEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION "Wireless station mode interface"

```

```

MIKROTIK-MIB DEFINITIONS ::= BEGIN

IMPORTS
MODULE-IDENTITY, OBJECT-TYPE, Integer32, Counter32, Gauge32,
Counter64, enterprises, NOTIFICATION-TYPE, TimeTicks FROM SN
TEXTUAL-CONVENTION, DisplayString, MacAddress, DateAndTime F
OBJECT-GROUP, NOTIFICATION-GROUP FROM SNMPv2-CONF;

mikrotikExperimentalModule MODULE-IDENTITY
    LAST-UPDATED "201812050000Z"
    ORGANIZATION "MikroTik"
    CONTACT-INFO "support@mikrotik.com"
    DESCRIPTION ""
    REVISION "201812050000Z"
    DESCRIPTION ""
    ::= { mikrotik 1 }

mikrotik OBJECT IDENTIFIER ::= { enterprises 14988 }

mtXRouterOs OBJECT IDENTIFIER ::= { mikrotikExperimentalModu
mtxrWireless OBJECT IDENTIFIER ::= { mtXRouterOs 1 }

-- WIRELESS *****

mtxrWlStatTable OBJECT-TYPE
    SYNTAX SEQUENCE OF MtxrWlStatEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION ""
    ::= { mtxrWireless 1 }

mtxrWlStatEntry OBJECT-TYPE
    SYNTAX MtxrWlStatEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION "Wireless station mode interface"
    INDEX { mtxrWlStatIndex }
    ::= { mtxrWlStatTable 1 }

MtxrWlStatEntry ::= SEQUENCE {
    mtxrWlStatIndex ObjectIndex,
    mtxrWlStatTxRate Gauge32,
    mtxrWlStatRxRate Gauge32,
    mtxrWlStatStrength Integer32,
}

mtxrWlStatStrength OBJECT-TYPE
    SYNTAX Integer32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION "dBm"
    ::= { mtxrWlStatEntry 4 }

```

How to read MIB file??

EXTERNAL SOFTWARE

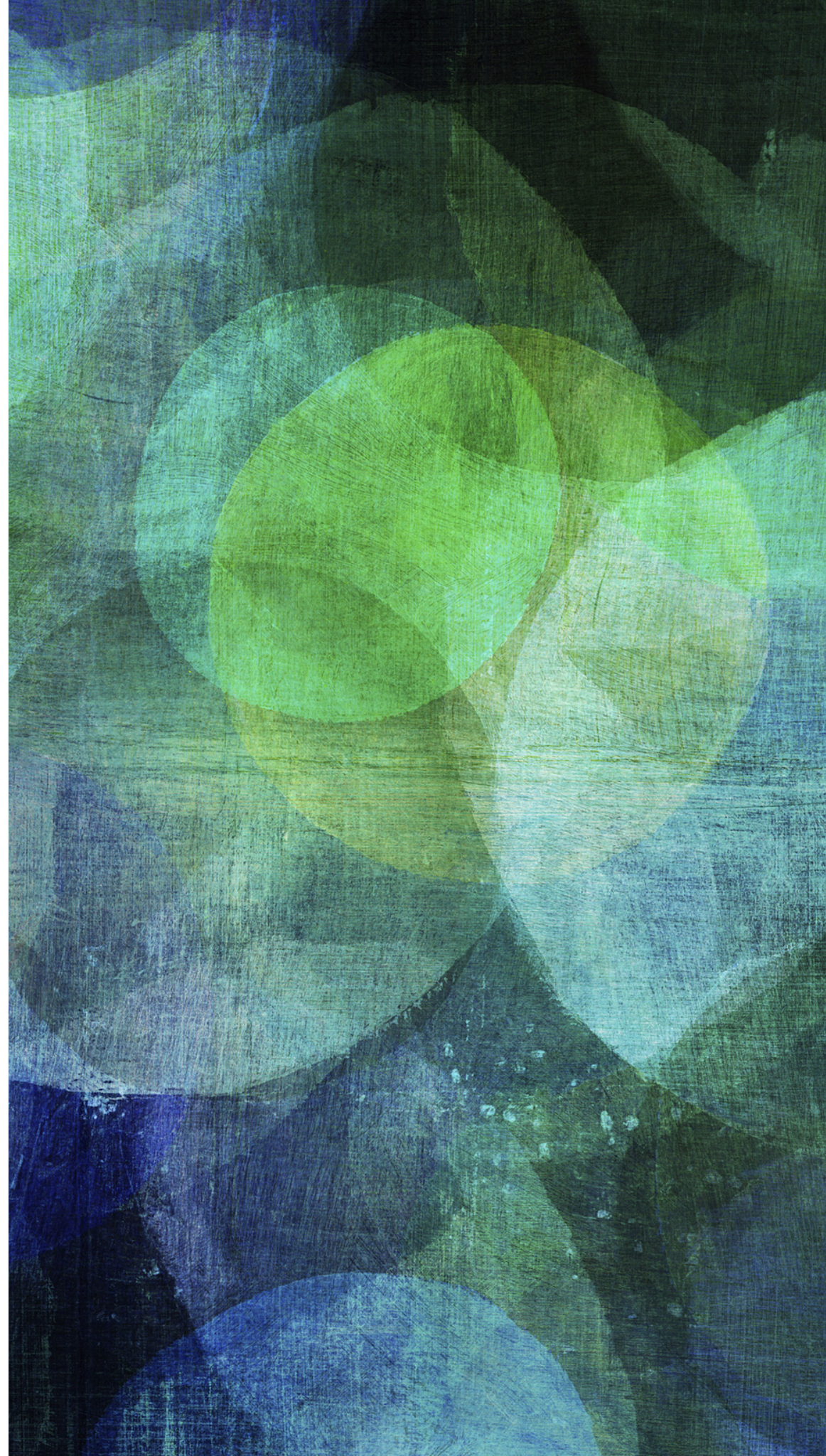
- Command Line: Net-SNMP
- Visual: MRTG, Zabbix, Nagios, PRTG, etc

“

Demo

Getting RouterOS version via SNMP

ROUTEROS TRAFFIC FLOW

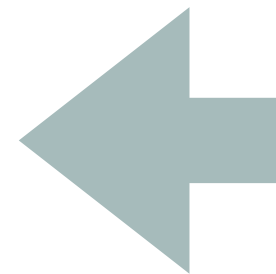
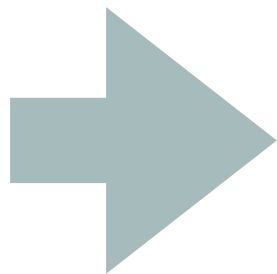


ROUTEROS TRAFFIC FLOW

- Provide statistics of network traffic
- Compatible with Cisco Netflow
- Version 1, 5 & 9

WHAT IS ELK

- ElasticSearch (Database)
- Logstash (Input)
- Kibana (Visual)



WHY ELK?

- Open Source
- SNMP information is not detailed enough
- It support more than just Flow
- Support Clustering
- Direct query into the data is possible
- High performance: 5Gbps, more than 100.000 flows

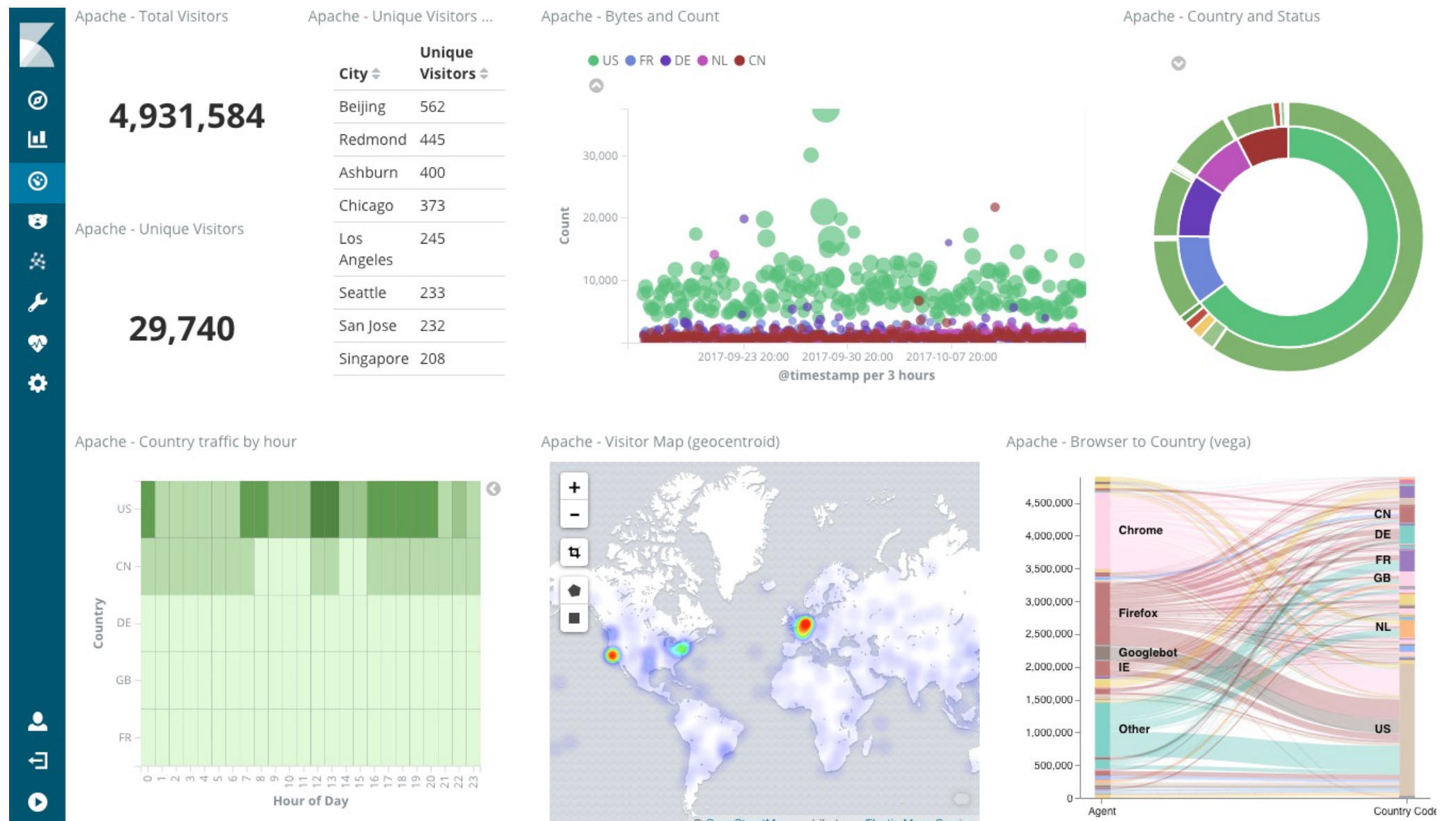


-
- Open Source
 - Server Side data processing
 - Ingest Data from multitude of sources simultaneously
 - Input Plugins: <https://www.elastic.co/guide/en/logstash/current/input-plugins.html>
 - Amazon CloudWatch & S3, File, Github Webhook, HTTP/HTTPS, SNMP & Trap, Syslog, TCP, UDP, etc
 - Filters: Parse & Transform
 - Output



-
- Open Source
 - Distributed, RESTful search
 - Centrally store data in the ELK stack
 - Really really really FAST
 - Numbers, text, geo, structured, unstructured. All data types are welcome

- Open Source
- Graphical User Interface
- Created to visualise your Elasticsearch data



INSTALLATION

- Download source package, compile, install, edit config
- Binary Installation: YUM, APT, MSI, PKG
- Docker

BINARY INSTALLATION

- CentOS 7 / YUM / RPM
- Yum Repository: easy, fast, manageable

```
[elasticsearch-6.x]  
name=Elasticsearch repository for 6.x packages  
baseurl=https://artifacts.elastic.co/packages/6.x/yum  
gpgcheck=1  
gpgkey=https://artifacts.elastic.co/GPG-KEY-elasticsearch  
enabled=1  
autorefresh=1  
type=rpm-md
```

```
$ sudo yum install elasticsearch
```



```
/etc/elasticsearch/elasticsearch.yml
```

```
network.host: localhost
```

You can test whether your Elasticsearch service is running by sending an HTTP request:

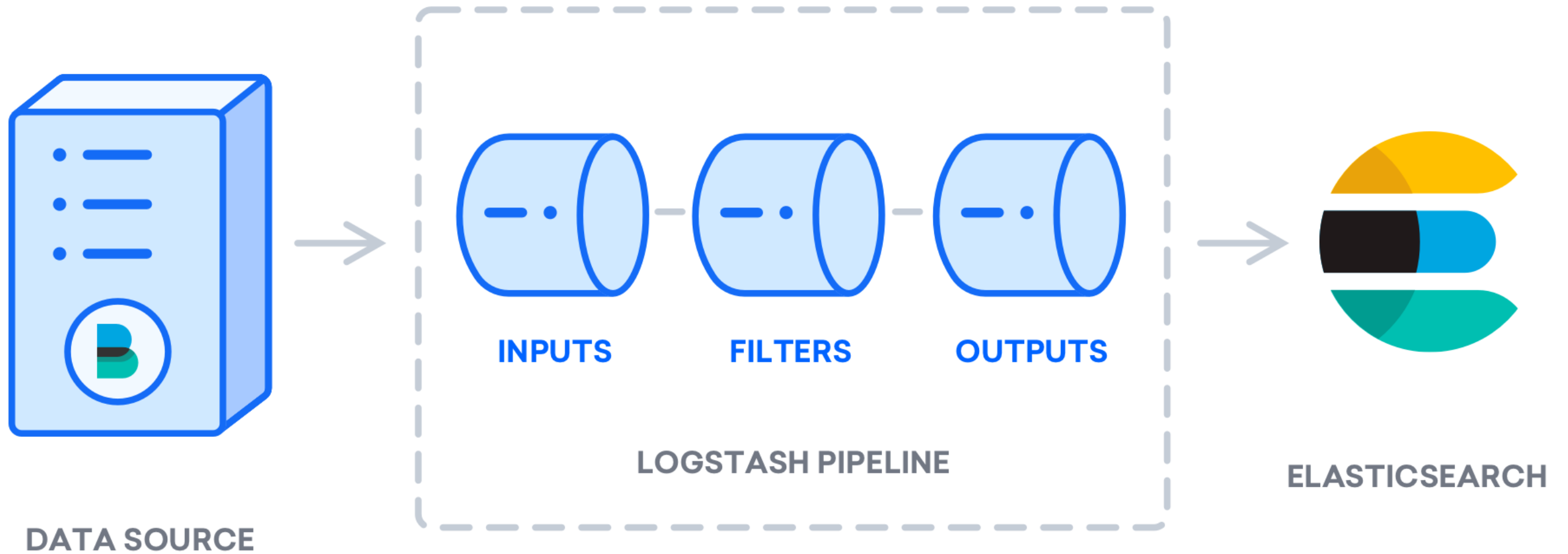
```
$ curl -X GET "localhost:9200"
```

You will see a response showing some basic information about your local node, similar to this:

Output

```
{
  "name" : "8oSCBFJ",
  "cluster_name" : "elasticsearch",
  "cluster_uuid" : "1Nf9ZymBQaOWKpMRBfisog",
  "version" : {
    "number" : "6.5.2",
    "build_flavor" : "default",
    "build_type" : "rpm",
    "build_hash" : "9434bed",
    "build_date" : "2018-11-29T23:58:20.891072Z",
    "build_snapshot" : false,
    "lucene_version" : "7.5.0",
    "minimum_wire_compatibility_version" : "5.6.0",
    "minimum_index_compatibility_version" : "5.0.0"
  },
  "tagline" : "You Know, for Search"
}
```

```
$ sudo yum install Logstash
```



```
input {  
  udp {  
    port => 2055  
    codec => netflow  
  }  
}
```

```
output {  
  if "port_9996" in [tags] {  
    elasticsearch {  
      hosts => "127.0.0.1"  
      index => "logstash-netflow-9996-%{+YYYY.MM.dd}"  
    }  
  } else if "port_9995" in [tags] {  
    elasticsearch {  
      hosts => "127.0.0.1"  
      index => "logstash-netflow-9995-%{+YYYY.MM.dd}"  
    }  
  }  
}
```



```
$ sudo yum install Kibana
```

- Run on its own port, def 561
- Use Nginx as reverse proxy

```
server {  
    listen 80;  
  
    server_name example.com www.example.com;  
  
    auth_basic "Restricted Access";  
    auth_basic_user_file /etc/nginx/htpasswd.users;  
  
    location / {  
        proxy_pass http://localhost:5601;  
        proxy_http_version 1.1;  
        proxy_set_header Upgrade $http_upgrade;  
        proxy_set_header Connection 'upgrade';  
        proxy_set_header Host $host;  
        proxy_cache_bypass $http_upgrade;  
    }  
}
```

Kibana status is Green

elastic

1.40 GB

Heap total

161.32 MB

Heap used

0.00, 0.01, 0.05

Load

95.09 ms

Response time avg

1132.00 ms

Response time max

6.80

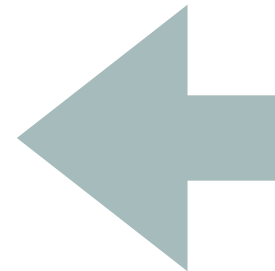
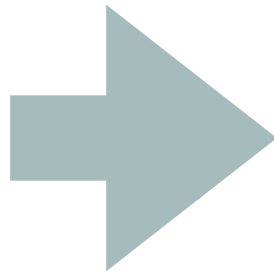
Requests per second

Plugin status

BUILD 18730 COMMIT 467f35fb

ID	Status
 plugin:kibana@6.5.0	Ready
 plugin:elasticsearch@6.5.0	Ready
 plugin:xpack_main@6.5.0	Ready
 plugin:searchprofiler@6.5.0	Ready
 plugin:ml@6.5.0	Ready
 plugin:tilemap@6.5.0	Ready
 plugin:watcher@6.5.0	Ready
 plugin:license_management@6.5.0	Ready
 plugin:index_management@6.5.0	Ready

LOGSTASH + ELASTICSEARCH + KIBANA



*

Uses lucene query syntax

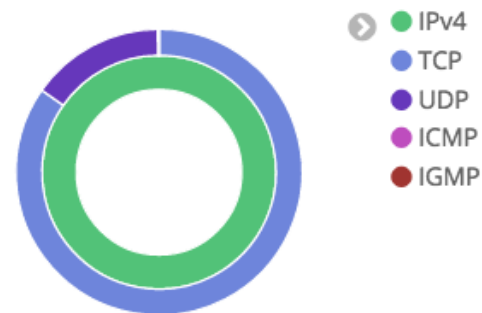


Add a filter +

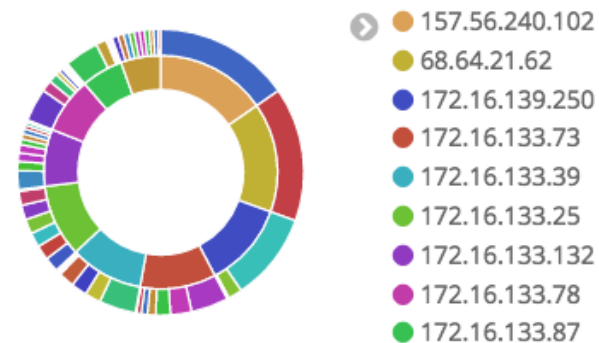
Netflow: Dashboard Navigation

[Overview](#) | [Conversation Partners](#) | [Traffic Analysis](#) | [Top-N](#) | [Geo Location](#) | [Autonomous Systems](#) | [Flow Exporters](#) | [Raw Flow Records](#)

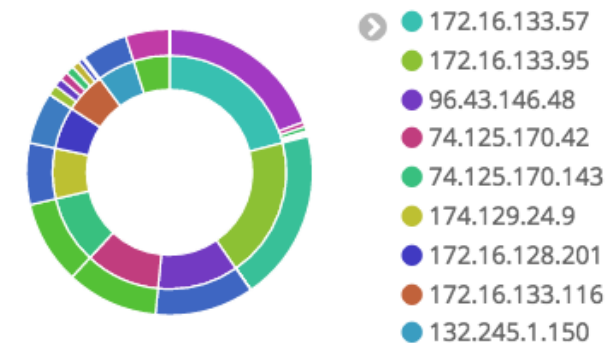
Netflow: IP Version and Protocols (bytes)



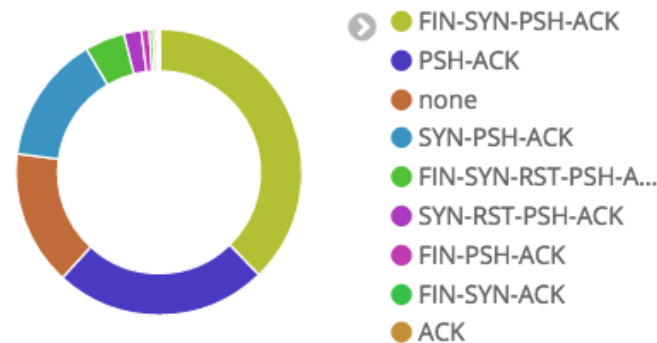
Netflow: Destinations and Ports (bytes)



Netflow: Sources and Ports (bytes)



Netflow: TCP Flags (bytes)



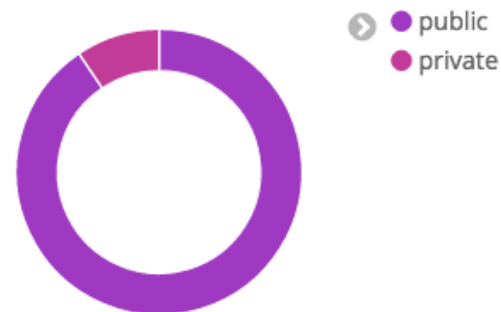
Netflow: Types of Service (bytes)



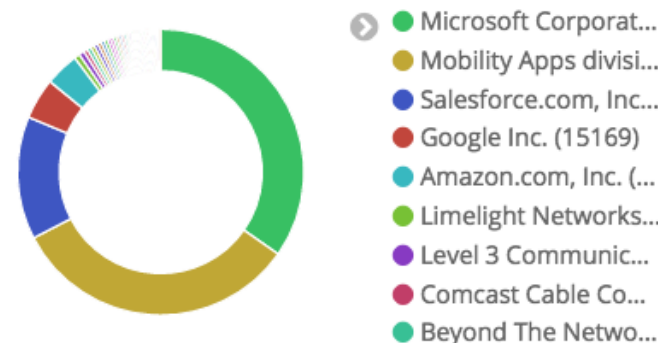
Netflow: VLANs (bytes)

No results displayed because all values equal 0.

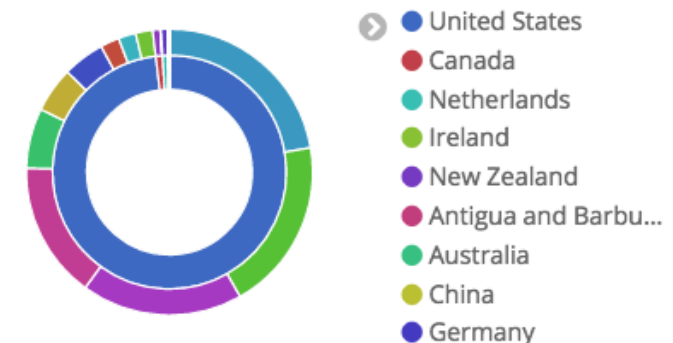
Netflow: Locality (bytes)



Netflow: Autonomous Systems (bytes)



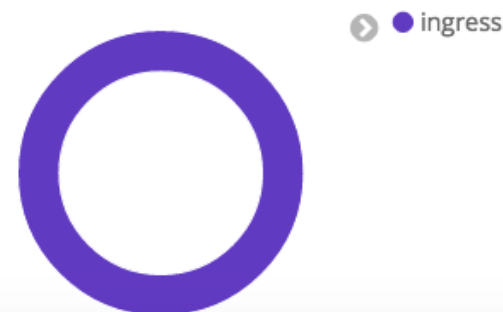
Netflow: Countries and Cities (bytes)



Netflow: Flow Exporters (bytes)



Netflow: Direction (bytes)



Netflow: Version (bytes)



Uses lucene query syntax

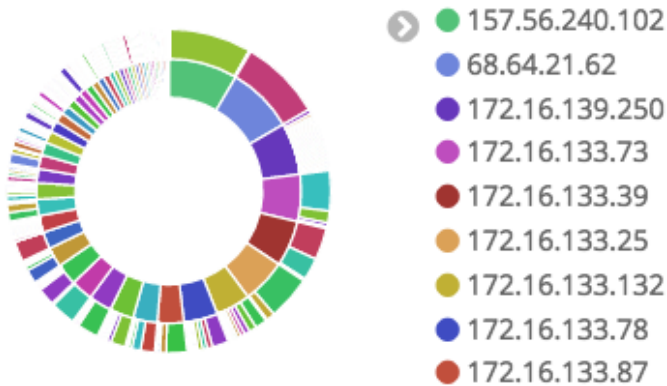
🔍

Add a filter +

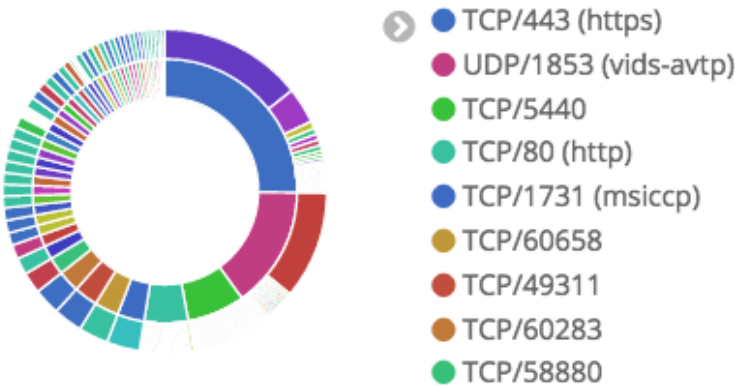
Netflow: Dashboard Navigation

[Overview](#) | [Conversation Partners](#) | [Traffic Analysis](#) | [Top-N](#) | [Geo Location](#) | [Autonomous Systems](#) | [Flow Exporters](#) | [Raw Flow Records](#)

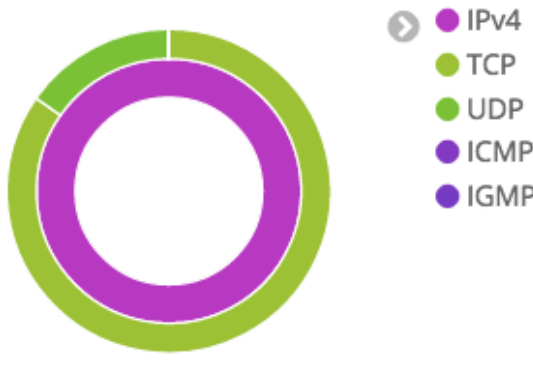
Netflow: Destinations and Sources (bytes)



Netflow: Destination and Source Ports (bytes)



Netflow: IP Version and Protocols (bytes)



Netflow: Conversation Partners

Source	Destination	Bytes	Packets	Flow Records
172.16.133.95	157.56.240.102	17,166,977	12,518	1
172.16.133.57	68.64.21.62	16,958,158	25,733	54
74.125.170.42	172.16.133.25	9,177,921	6,171	6
74.125.170.143	172.16.133.73	8,345,434	5,601	3
174.129.24.9	172.16.133.39	6,618,028	4,502	7
172.16.128.201	172.16.133.6	5,206,722	4,475	4
132.245.1.150	172.16.133.39	4,598,676	3,471	2
96.43.146.48	172.16.133.116	4,407,160	5,458	10
172.16.133.55	157.56.232.214	4,310,098	3,163	2
74.125.226.70	172.16.133.87	4,205,634	3,642	1

Export: [Raw](#) [Formatted](#)

*

Uses lucene query syntax

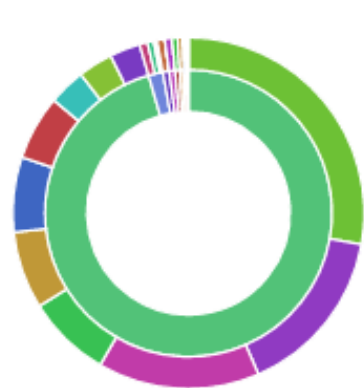


Add a filter +

Netflow: Dashboard Navigation

[Overview](#) | [Conversation Partners](#) | [Traffic Analysis](#) | [Top-N](#) | [Geo Location](#) | [Autonomous Systems](#) | [Flow Exporters](#) | [Raw Flow Records](#)

Netflow: Countries and Cities (flow records)



- United States
- Canada
- Australia
- Netherlands
- China
- Ireland
- Antigua and Barbu...
- New Zealand
- Singapore

Netflow: Destinations and Sources (flow records)



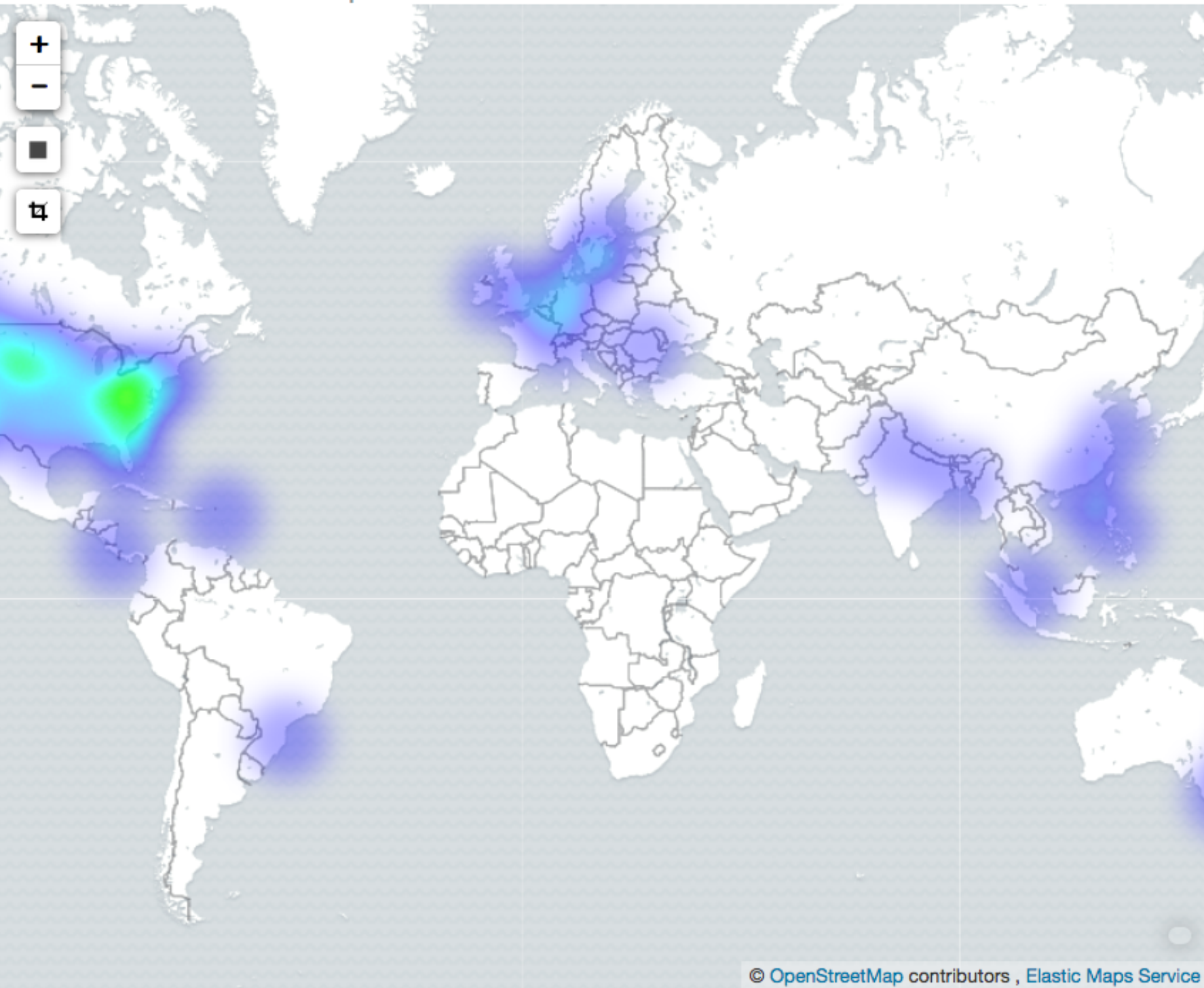
- 172.16.139.250
- 172.16.133.6
- 8.8.8.8
- 172.16.128.169
- 172.16.133.54
- 172.16.128.202
- 172.16.133.132
- 172.16.133.41
- 172.16.133.254

Netflow: Destination and Source Ports (flow records)



- TCP/5440
- TCP/80 (http)
- TCP/443 (https)
- UDP/53 (dns)
- UDP/161 (snmp)
- UDP/1853 (vids-avtp)
- UDP/1900 (ssdp)
- UDP/8200 (trivnet1)
- UDP/137 (netbios-...)

Netflow: Geo Location Heatmap



SINGAPORE MIKROTIK USER GROUP

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- March 8th 2019
- ELK Stack + MikroTik Router
- <https://www.meetup.com/MikroTik-User-Group-Singapore-MUG-SG/events/257894335/>

The Meetup logo, featuring the word "meetup" in a red, lowercase, cursive script font.



Question?



Approach me :)



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