

# MIKROTIK ADVANCE TRAFFIC CONTROL

HTB (Hierarchical Token Bucket)

Queue Tree-System

Mikrotik user Meeting

Jakarta, Indonesia(2016)

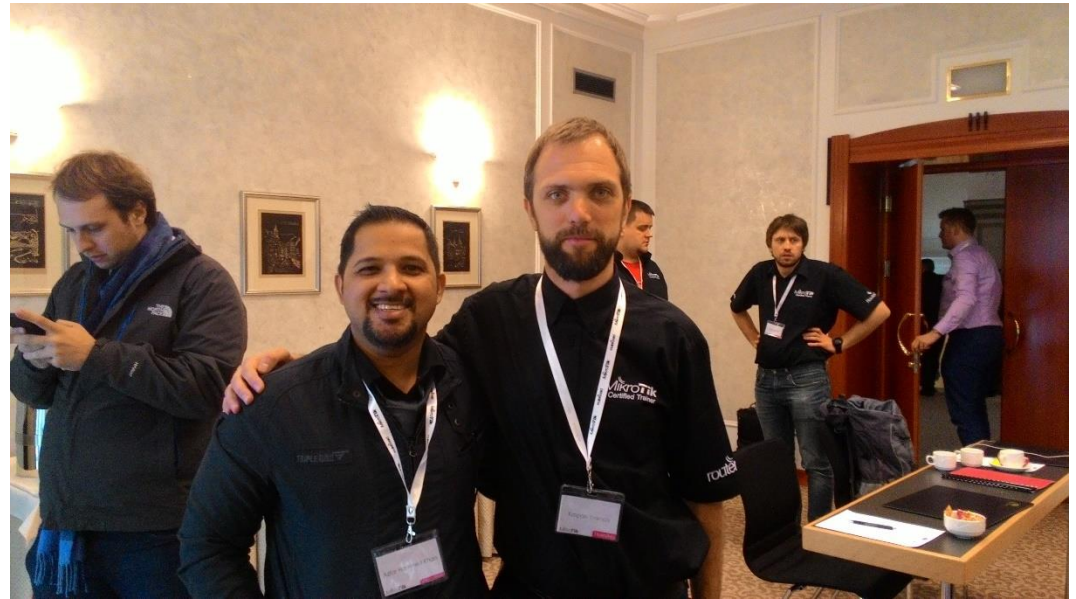


**AZFAR HAMEED KHAN**  
 Mikrotik Certified Networking Engineer  
 Simpati : 0813-1749-3615  
 XL : 0878-0818-1016

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**Prepared by,  
 Azfar Hameed Khan**







# **MOTIF & TUJUAN:**

- **Seperti kita tau bandwidth itu mahal, khususnya di daerah daerah Terpencil dan di Negara Negara yang sedang berkembang.**
- **Kebanyakan pelanggan memulai nonton youtube di format High definition (HD). Era 4K telah mulai.**
- **Cara cerdas di butuhkan untuk alokasi bandwidth.**

# SMART TV'S & SMART HOMES



**WARNING!**  
**TRAFFIC CONTROLERS.**  
**SMART TV AHEAD**



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# APA YANG TERJADI PADA SAAT KITA NONTON YOUTUBE?

Ayu Ting Ting - Sambalado [Official Music Video]

HITS Records

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HITS Records

20,292,931 views

Mix - Ayu Ting Ting - Sambalado [Official Music Video]

YouTube

Ayu Ting Ting - Sik Asik [Official Music Video Clip]

# APA YANG TERJADI PADA SAAT ANDA NONTON YOUTUBE?

DENGAN RESOLUSI.....240 P

The screenshot displays the Mikrotik WinBox interface. The top status bar shows 'Session Settings Dashboard', 'Safe Mode', 'Session: 10.10.11.2:8292', 'Uptime: 4d 04:35:08', 'Memory: 1471.1 MiB', 'CPU: 2%', 'Date: Sep/17/2016', and 'Time: 02:07:13'. The left sidebar contains a navigation menu with categories like Quick Set, CAPsMAN, Interfaces, Wireless, Bridge, PPP, Switch, Mesh, IP, IPv6, MPLS, Routing, System, and Queues. The main window is divided into two panes. The top pane, titled 'Interface List', shows a table of network interfaces:

Name	Type	Actual MTU	L2 MTU	Tx	Rx	Tx Packet (p/s)	Rx
ether1_ihome_official	Ethernet	1500	1598	1850.5 kbps	2.3 Mbps	296	
ether2_Latihan_anak_PKL	Ethernet	1500	1598	0 bps	0 bps	0	

The bottom pane, titled 'Queue List', shows a table of queue configurations:

#	Name	Target	Upload Max Limit	Download Max Limit	Packet Marks	Upload	Download	Total Max Limit (bi...
0	MY_PC	192.168.101.248	10M	100M		5.6 kbps	143.9 kbps	

A red circle highlights the 'Upload' and 'Download' columns in the Queue List table, with a red arrow pointing upwards from below the circle.



# APA YANG TERJADI PADA SAAT ANDA NONTON YOUTUBE?

DENGAN RESOLUSI.....240 P

Session Settings Dashboard

Safe Mode Session: 10.10.11.2:8292 Uptime: 4d 04:39:21 Memory: 1471.1 MiB CPU: 1% Date: Sep/17/2016 Time: 02:11:27

Interface List

Interface	Type	Actual MTU	L2 MTU	Tx	Rx	Tx Packet (p/s)	Rx
ether1_home_official	Ethernet	1500	1598	1267.9 kbps	4.3 Mbps	344	
ether2_Latihan_anak_PKL	Ethernet	1500	1598	0 bps	0 bps	0	

Queue List

#	Name	Target	Upload Max Limit	Download Max Limit	Packet Marks	Upload	Download	Total Max Limit (bi...
0	MY_PC	192.168.101.248	10M	100M		128.3 kbps	3.8 Mbps	

# APA YANG TERJADI PADA SAAT ANDA NONTON YOUTUBE?

DENGAN RESOLUSI.....240 P

The screenshot shows the Mikrotik WinBox interface with the Queue List window open. The Queue List table displays the following data:

#	Name	Target	Upload Max Limit	Download Max Limit	Packet Marks	Upload	Download	Total Max Limit (pi...
0	MY_PC	192.168.101.248	10M	100M		585.7 kbps	18.2 Mbps	

A red circle highlights the 'Upload' and 'Download' columns, and a red arrow points upwards from below the circle.

# APA YANG TERJADI PADA SAAT ANDA NONTON YOUTUBE?

DENGAN RESOLUSI.....1080 P

The screenshot shows the Mikrotik WinBox interface. The 'Queue List' tab is active, displaying a table of network queues. The table has columns for '#', 'Name', 'Target', 'Upload Max Limit', 'Download Max Limit', 'Packet Marks', 'Upload', 'Download', and 'Total Max Limit (bi...'. The row for 'MY\_PC' shows an 'Upload' of 2.2 Mbps and a 'Download' of 80.2 Mbps. These two values are circled in red, and red arrows point upwards from below the table towards them.

#	Name	Target	Upload Max Limit	Download Max Limit	Packet Marks	Upload	Download	Total Max Limit (bi...
0	MY_PC	192.168.101.248	10M	100M		2.2 Mbps	80.2 Mbps	

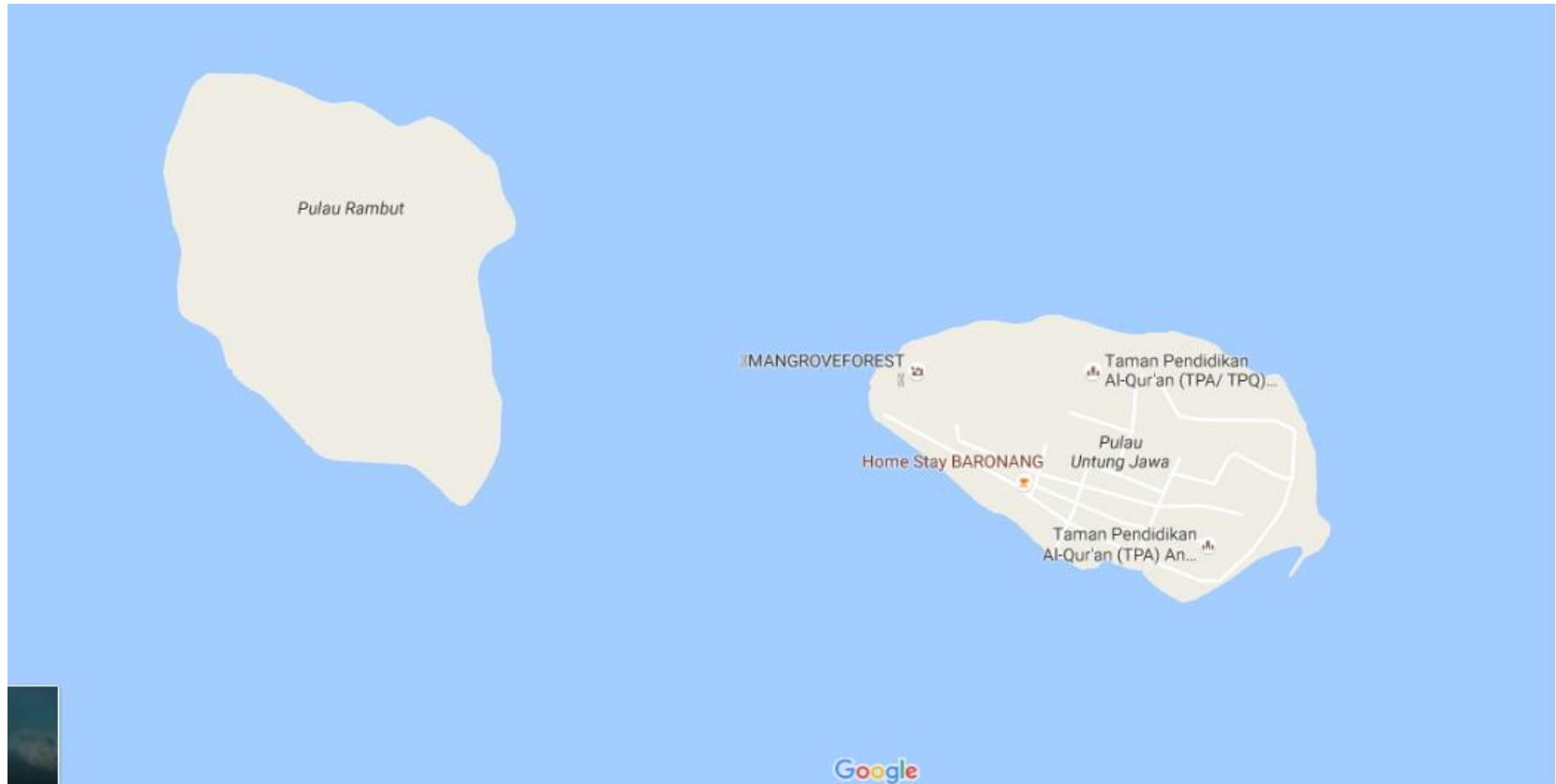
KITA BISA BAYANGKAN APA YANG AKAN TERJADI KALAU SAYA PILIH ..... 4K?

# SKENARIO





# SKENARIO



# SKENARIO



# **PILIHAN UNTUK MENGATUR BANDWIDTH**

- **SIMPLE QUEUES**
  - **SEDERHANA UNTUK DI IMPLEMENTASIKAN**
  - **BAGUS UNTUK PEMULA**
  - **DENGAN PERKEMBANGAN DI DUNIA JARINGAN, SIMPLE QUEUE IKUT BERKEMBANG DAN MEMEMILIKI BANYAK FITUR FITUR BARU**
  - **DI VERSI 6 SIMPLE QUEUE MEMILIKI HASHING SYSTEM YANG LEBIH EFFISIEN**
- **HTB – QUEUE TREE**
  - **ADVANCE BANDWIDTH MANAGEMENT (LEBIH ADVANCE)**
  - **MEMPUNYAI PILIHAN LEBIH BANYAK UNTUK PENGATURAN BANDWIDTH**

# HTB-Queue Tree EXAMPLE

Queue List

Simple Queues | Interface Queues | Queue Tree | Queue Types

+ - ✓ ✗ 📁 🗑️ 00 Reset Counters 00 Reset All Counters Find

Name	Parent	Packet Marks	Priority	Limit At...	Max Limit...	Avg. Rate
TOTAL DOWNLOAD	wlan1		8		5M	5.0 Mbps
THE BOSS DOWNLOADING	TOTAL DOWNLOAD	THE BOSS's packet	7	1M	2M	1010.2 kbps
THE OFFICE STAFF DOWNLOADING	TOTAL DOWNLOAD		8		4M	4.0 Mbps
THE MANAGER DOWNLOADING	THE OFFICE STAFF DOWNL...	THE MANAGER's packet	3	1M	2M	2.0 Mbps
THE OFFICE BOY DOWNLOADING	THE OFFICE STAFF DOWNL...	THE OFFICE BOY's packet	5	1M	2M	1018.5 kbps
THE SECRETARY DOWNLOADING	THE OFFICE STAFF DOWNL...	THE SECRETARY's packet	8	1M	2M	1005.9 kbps
TOTAL UPLOAD	ether2_ISP		8		5M	285.1 kbps
THE BOSS UPLOADING	TOTAL UPLOAD	THE BOSS's packet	8	1M	2M	61.3 kbps
THE OFFICE STAFF UPLOADING	TOTAL UPLOAD		8		4M	223.7 kbps
THE MANAGER UPLOADING	THE OFFICE STAFF UPLOA...	THE MANAGER's packet	3	1M	2M	102.3 kbps
THE OFFICE BOY UPLOADING	THE OFFICE STAFF UPLOA...	THE OFFICE BOY's packet	5	1M	2M	61.9 kbps
THE SECRETARY UPLOADING	THE OFFICE STAFF UPLOA...	THE SECRETARY's packet	8	1M	2M	59.4 kbps

12 items (1 selected)      278.3 KB queued      193 packets queued



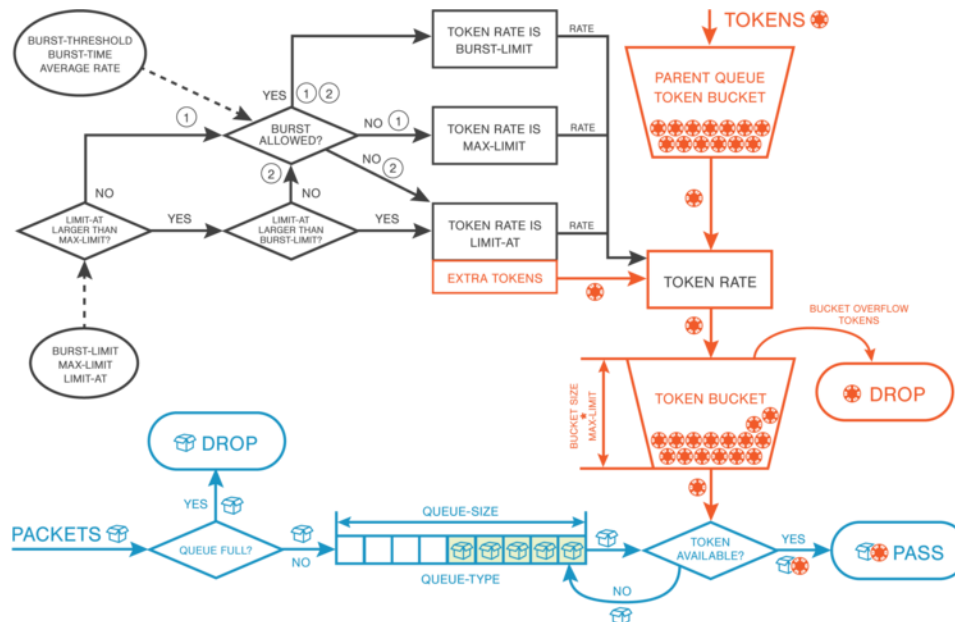
# UTAMAKAN TRAFFIC

- Queue Tree

Name	Parent	Packet Marks	Priority	Limit At (bps)	Max Limit	Avg. R...	Queued Bytes	Bytes	Pack
main	global		8	10M	10M	0 bps	0 B	0 B	
background	main	background	8	2M	10M	0 bps	0 B	0 B	
e-mail	main	e-mail	3	4M	10M	0 bps	0 B	0 B	
tcp_sql	main	tcp_sql	2	3M	6M	0 bps	0 B	0 B	
voice	main	voice	1	1M	3M	0 bps	0 B	0 B	

# Perkenalan HTB

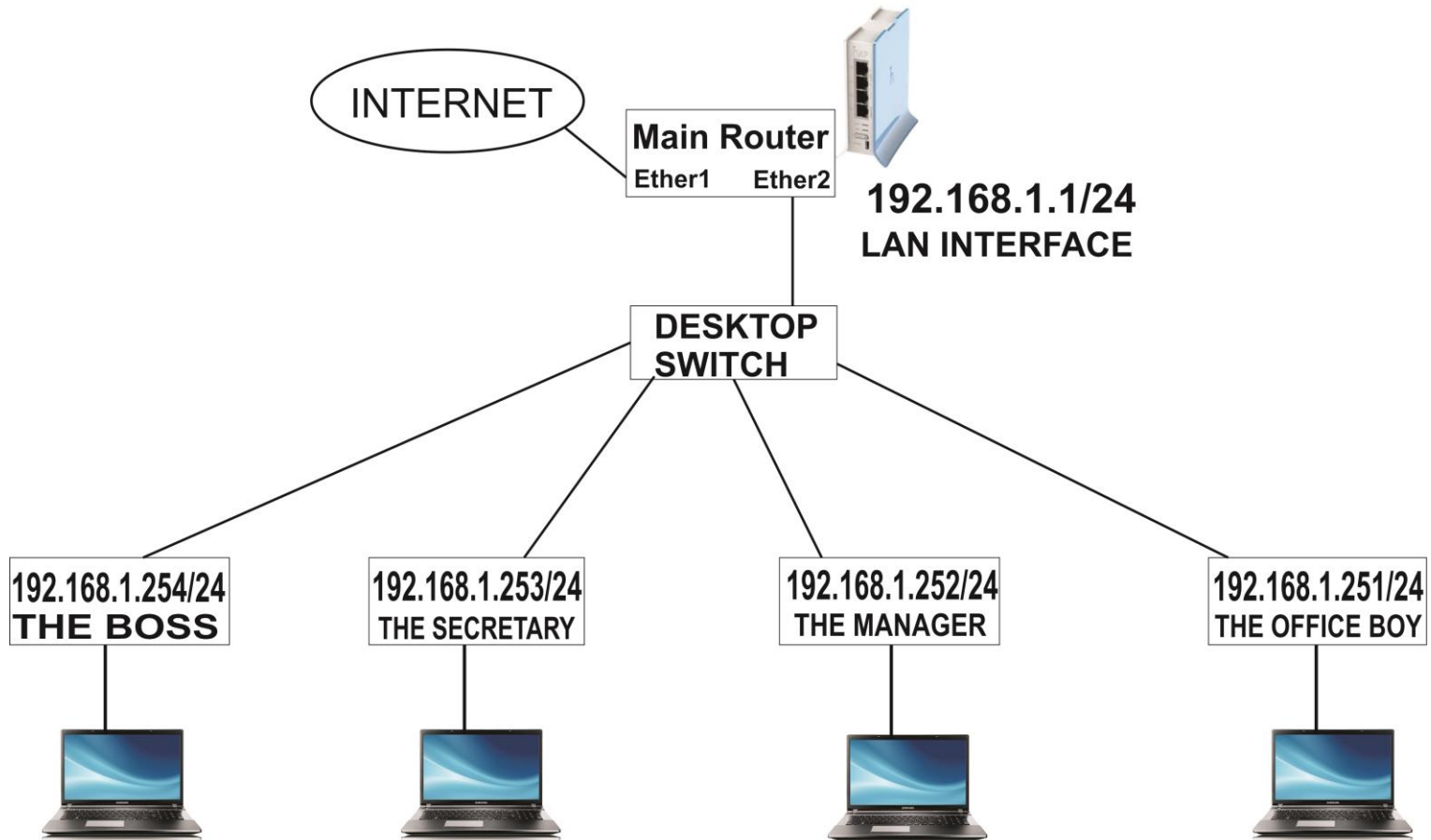
- Apa itu HTB?
- HTB (Hierarchical Token Bucket) adalah metode antrian classful network yang berguna untuk menangani berbagai jenis traffic.



# BUCKET SIZE



# COMMON OFFICE TOPOLOGIES

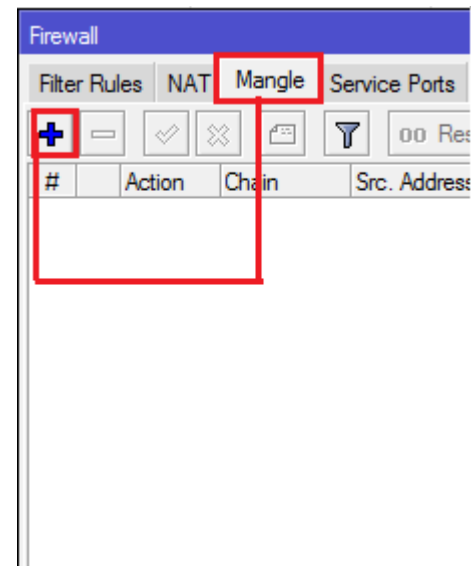
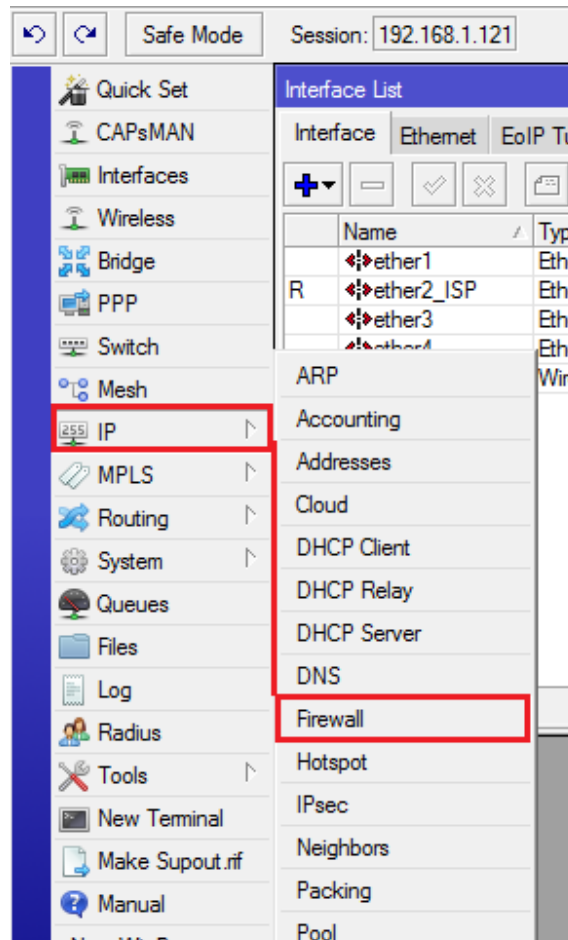




# STEPS TO BE REMEMBERED :

- **Before we start make sure that you know your upload and download interfaces.**
- **1. Mark Connections**
- **2. Mark Packets**
- **3. Create an HTB total upload parent queue**
- **4. Create an HTB total download parent queue**
- **5. Create total Download's child queue**
- **6. Create total Upload's child queue**

# Step 1. Mark Connection Pictorial Explanation.



# Step 1-A. Mark Connection Pictorial Explanation.

New Mangle Rule

General | Advanced | Extra | Action | Statistics

Chain:

Src. Address:

Dst. Address:

Protocol:

Src. Port:

Dst. Port:

Any. Port:

P2P:

In. Interface:

OK

Cancel

Apply

Disable

Comment

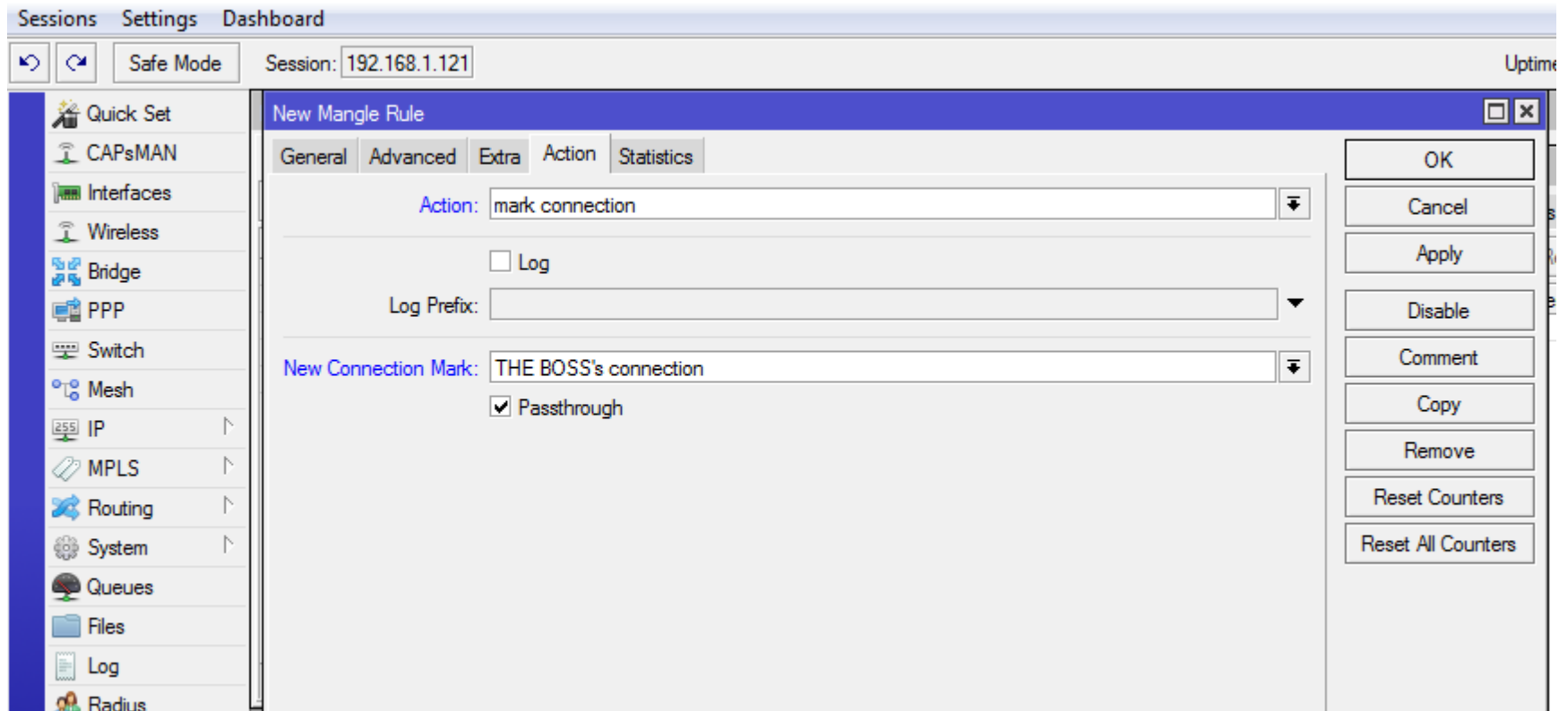
Copy

Remove

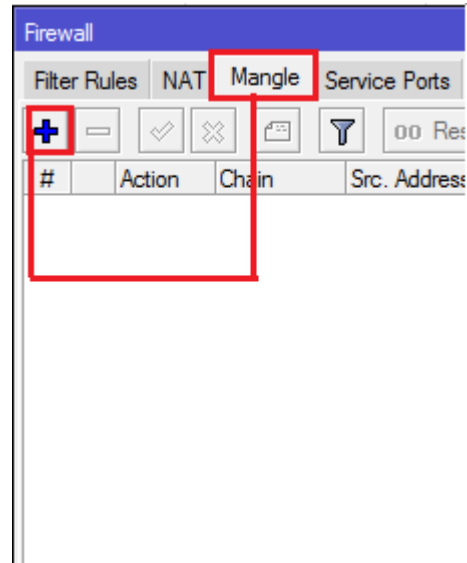
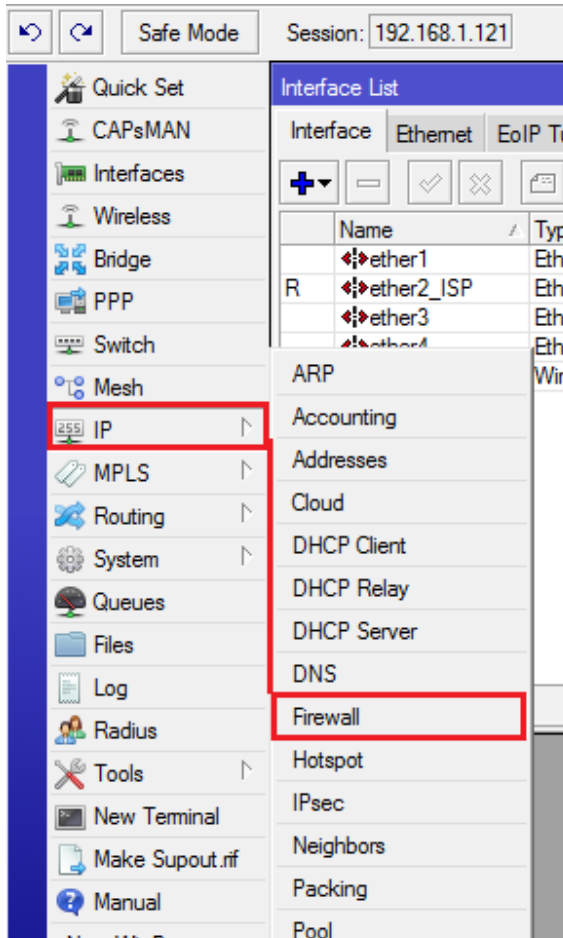
Reset Counters

Reset All Counters

# Step 1-B. Mark Connection Pictorial Explanation.



# Step 2. Mark Packet Pictorial Explanation.



# Step 2-A. Mark Packet Pictorial Explanation.

Mangle Rule <>

General | Advanced | Extra | Action | Statistics

Chain: forward

Src. Address:

Dst. Address:

Protocol:

Src. Port:

Dst. Port:

Any. Port:

P2P:

In. Interface:

Out. Interface:

Packet Mark:

Connection Mark:  THE BOSS's connection **Don't forget this while marking packets**

Routing Mark:

Routing Table:

OK

Cancel

Apply

Disable

Comment

Copy

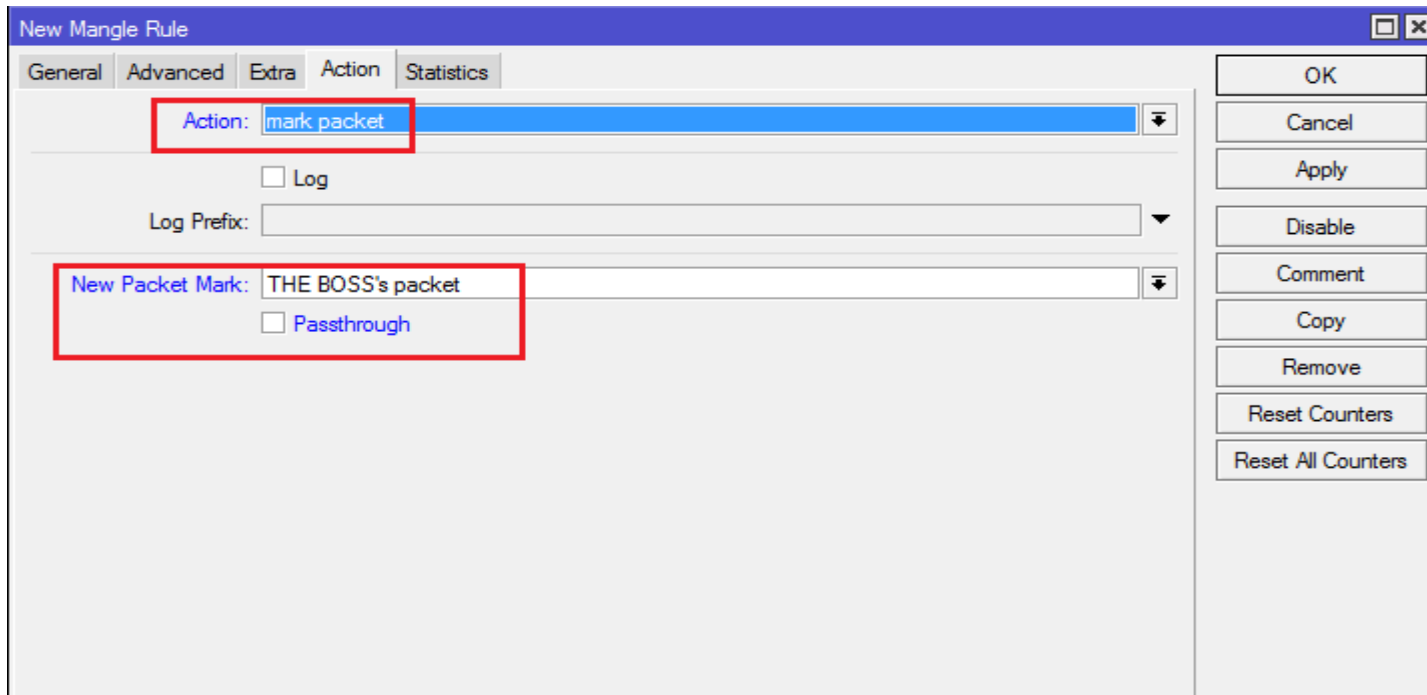
Remove

Reset Counters

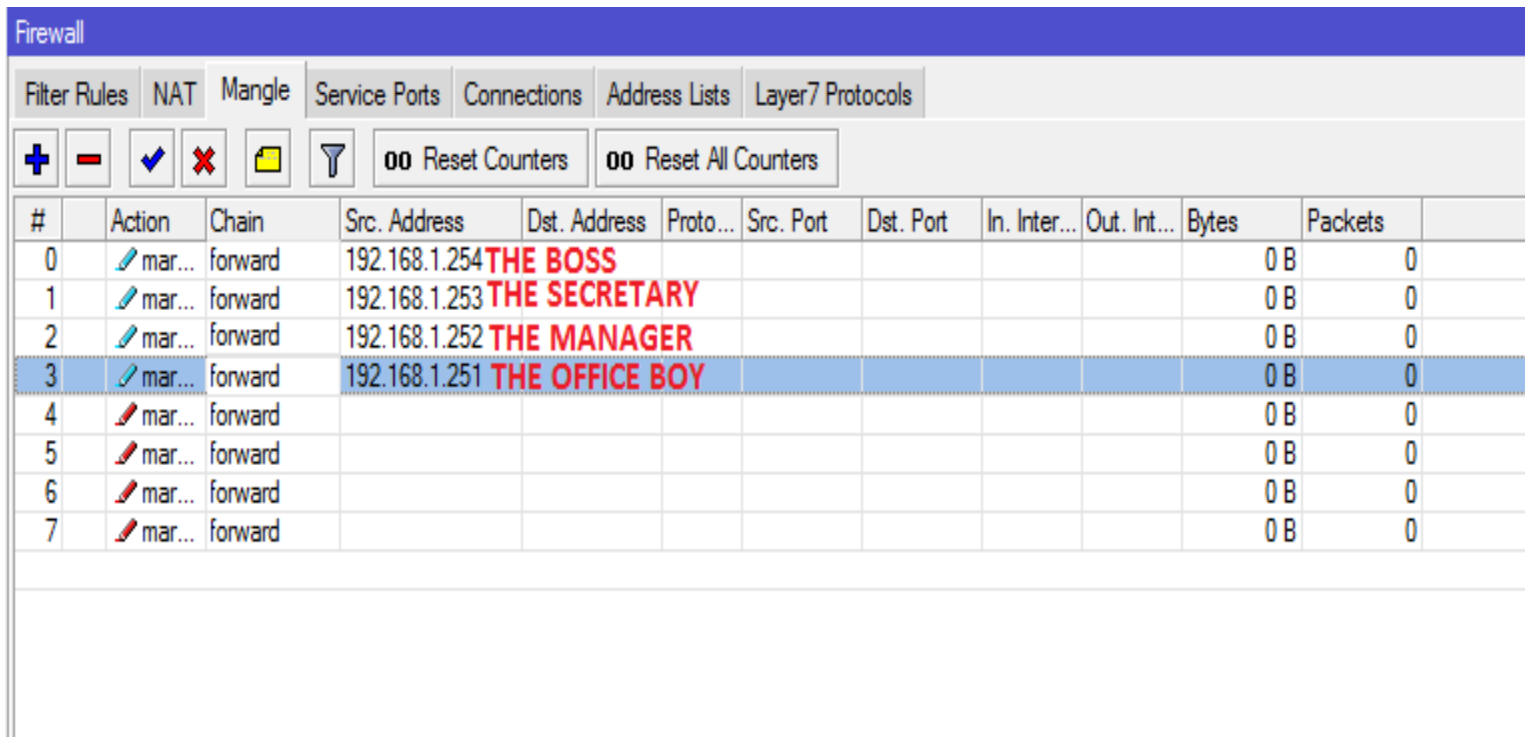
Reset All Counters



# Step 2-B. Mark Packet Pictorial Explanation.



# Working mangle winbox view, this is how it should look like.

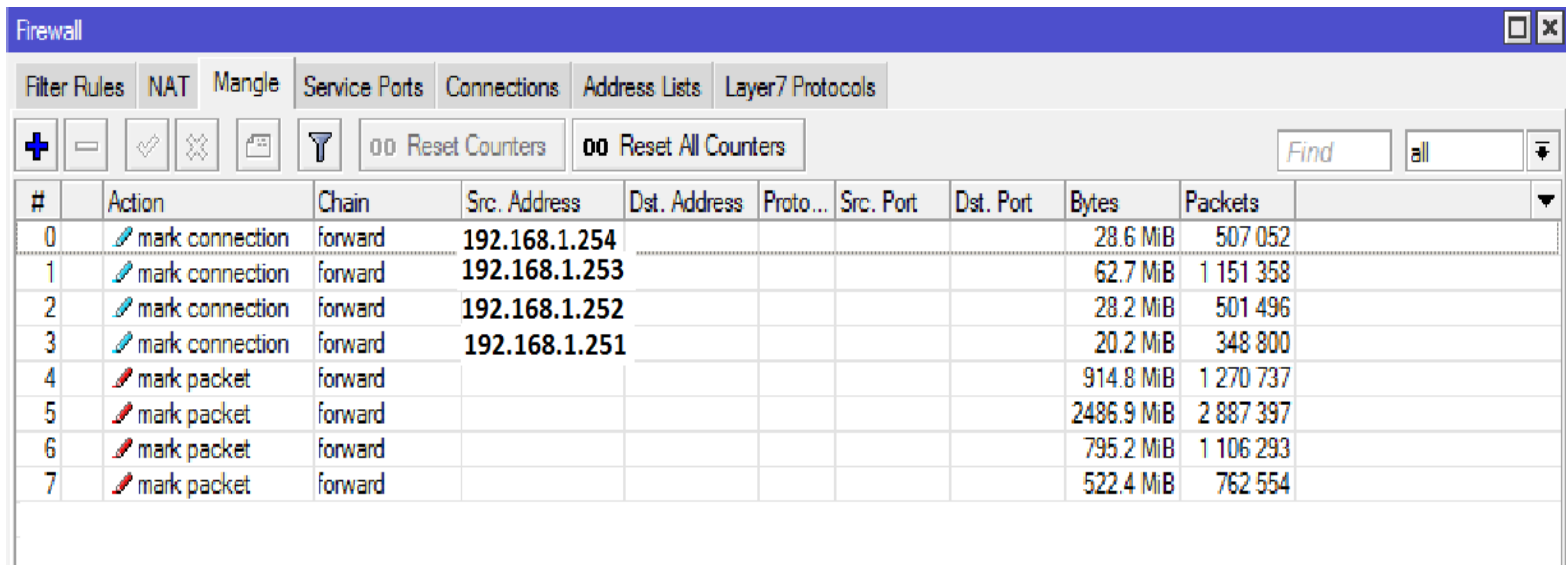


The screenshot shows the Mikrotik WinBox Firewall configuration window, specifically the Mangle tab. The interface includes a toolbar with icons for adding, deleting, enabling, and disabling rules, as well as buttons for 'Reset Counters' and 'Reset All Counters'. Below the toolbar is a table listing mangle rules. The table has columns for rule number, action, chain, source address, destination address, protocol, source port, destination port, input interface, output interface, bytes, and packets. The third rule (index 3) is highlighted in blue and has the destination address '192.168.1.251' with the comment 'THE OFFICE BOY' in red text. Other rules have similar comments like 'THE BOSS', 'THE SECRETARY', and 'THE MANAGER'.

#	Action	Chain	Src. Address	Dst. Address	Proto...	Src. Port	Dst. Port	In. Inter...	Out. Int...	Bytes	Packets
0	mar...	forward	192.168.1.254	THE BOSS						0 B	0
1	mar...	forward	192.168.1.253	THE SECRETARY						0 B	0
2	mar...	forward	192.168.1.252	THE MANAGER						0 B	0
3	mar...	forward	192.168.1.251	THE OFFICE BOY						0 B	0
4	mar...	forward								0 B	0
5	mar...	forward								0 B	0
6	mar...	forward								0 B	0
7	mar...	forward								0 B	0

# PLEASE CHECK

**1. Check if the bytes and the packets have started running in their respective columns. (mangle facility)**



The screenshot shows the Mikrotik WinBox Firewall configuration window, specifically the Mangle tab. The table displays the following data:

#	Action	Chain	Src. Address	Dst. Address	Proto...	Src. Port	Dst. Port	Bytes	Packets
0	mark connection	forward	192.168.1.254					28.6 MiB	507 052
1	mark connection	forward	192.168.1.253					62.7 MiB	1 151 358
2	mark connection	forward	192.168.1.252					28.2 MiB	501 496
3	mark connection	forward	192.168.1.251					20.2 MiB	348 800
4	mark packet	forward						914.8 MiB	1 270 737
5	mark packet	forward						2486.9 MiB	2 887 397
6	mark packet	forward						795.2 MiB	1 106 293
7	mark packet	forward						522.4 MiB	762 554

# Step 3. Create A Total Upload Queue

The screenshot displays the Mikrotik WinBox interface. On the left, the 'Queues' menu is highlighted. The 'Queue List' window shows a table with one entry: 'Total Download'. The 'New Queue' dialog is open, showing the following configuration:

- Name: TOTAL UPLOAD
- Parent: ether1\_ISP
- Packet Marks: (empty)
- Queue Type: default-small
- Priority: 8
- Bucket Size: 0.100 (highlighted with a red box and a red arrow pointing to it with the text 'NEW FEATURE')
- Limit At: (empty) bits/s
- Max Limit: 5M bits/s
- Burst Limit: (empty) bits/s
- Burst Threshold: (empty) bits/s
- Burst Time: (empty) s

Buttons on the right side of the dialog include: OK, Cancel, Apply, Disable, Comment, Copy, Remove, Reset Counters, and Reset All Counters.

# Step 4. Create A Total Download Queue

The screenshot displays the Mikrotik WinBox interface. On the left, the 'Queues' menu item is highlighted with a red box. In the main window, the 'Queue List' tab is active, and the 'Queue Tree' sub-tab is selected, also highlighted with a red box. A red box highlights the '+' icon in the Queue List toolbar. The 'New Queue' dialog box is open, showing the following configuration:

- Name:** Total Download
- Parent:** ether2\_LAN
- Queue Type:** default
- Priority:** 8
- Bucket Size:** 0.100
- Limit At:** No limit At's are required in parent Queues
- Max Limit:** 5M
- Burst Limit:** (empty)
- Burst Threshold:** (empty)
- Burst Time:** (empty)

The dialog box also includes buttons for OK, Cancel, Apply, Disable, Comment, Copy, Remove, Reset Counters, and Reset All Counters. The 'enabled' checkbox at the bottom is checked.

# Step 5. CREATE Total Download's child queue

The screenshot shows the Mikrotik WinBox interface. On the left, the 'Queues' menu is highlighted. The main window displays the 'Queue List' for the 'wlan1' interface, showing 'Total Download' and 'Total Upload' queues. A 'New Queue' dialog box is open, showing the configuration for a new queue named 'THE BOSS DOWNLOADING'. The configuration includes:

- Name: THE BOSS DOWNLOADING
- Parent: TOTAL DOWNLOAD
- Packet Marks: THE BOSS's packet
- Queue Type: default
- Priority: 7
- Bucket Size: 0.100
- Limit At: 1M
- Max Limit: 2M
- Burst Limit: (empty)
- Burst Threshold: (empty)
- Burst Time: (empty)

The 'New Queue' dialog box also includes buttons for OK, Cancel, Apply, Disable, Comment, Copy, Remove, Reset Counters, and Reset All Counters. The 'enabled' checkbox is checked.



# Step 6. CREATE Total Upload's child queue

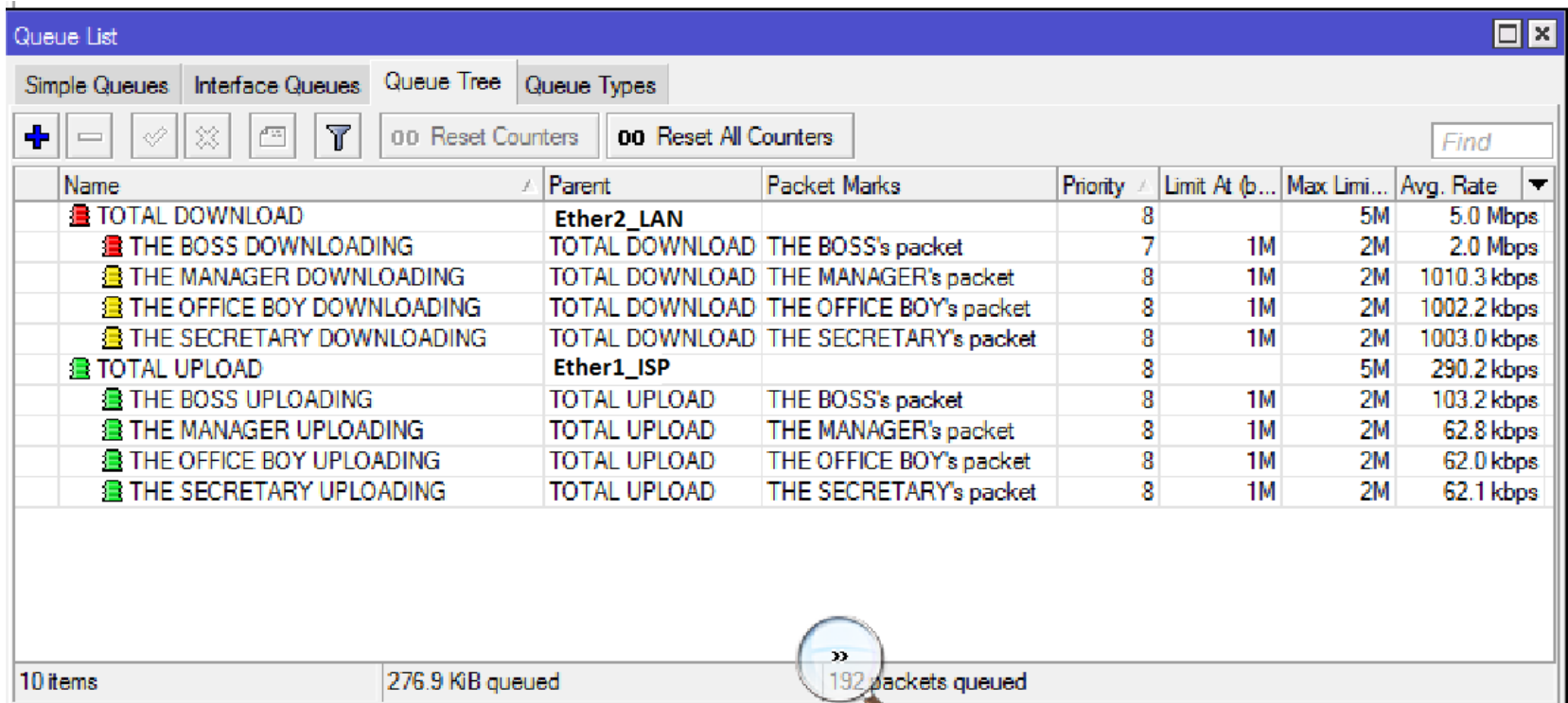
The screenshot shows the Mikrotik WinBox interface. On the left, the 'Queues' menu item is highlighted. The main window displays the 'Queue List' with three entries: 'Total Download', 'The Boss Downloading', and 'Total Upload'. The 'Queue Tree' tab is selected, and the 'New Queue' dialog is open.

The 'New Queue' dialog has the following configuration:

- Name: The Boss Uploading
- Parent: Total Upload
- Packet Marks: THE BOSS's packet
- Queue Type: default
- Priority: 8
- Bucket Size: 0.100
- Limit At: 1M
- Max Limit: 2M
- Burst Limit: (empty)
- Burst Threshold: (empty)
- Burst Time: (empty)

The dialog also includes buttons for OK, Cancel, Apply, Disable, Comment, Copy, Remove, Reset Counters, and Reset All Counters. The 'enabled' checkbox is checked.

# QUEUE TREE WINBOX VIEW



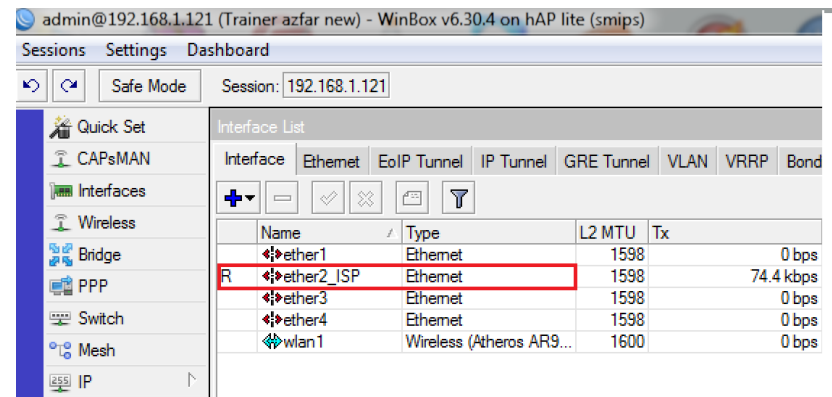
The screenshot shows the WinBox Queue List window. The window title is "Queue List". It has tabs for "Simple Queues", "Interface Queues", "Queue Tree", and "Queue Types". Below the tabs are several icons and buttons: a plus sign, a minus sign, a checkmark, a cross, a folder, a funnel, "00 Reset Counters", "00 Reset All Counters", and a "Find" search box. The main area contains a table with columns: Name, Parent, Packet Marks, Priority, Limit At (b..., Max Limi..., and Avg. Rate. The table lists 10 items, including "TOTAL DOWNLOAD" and "TOTAL UPLOAD" for both interfaces, and their respective sub-queues for "THE BOSS", "THE MANAGER", "THE OFFICE BOY", and "THE SECRETARY".

Name	Parent	Packet Marks	Priority	Limit At (b...	Max Limi...	Avg. Rate
TOTAL DOWNLOAD	Ether2_LAN		8		5M	5.0 Mbps
THE BOSS DOWNLOADING	TOTAL DOWNLOAD	THE BOSS's packet	7	1M	2M	2.0 Mbps
THE MANAGER DOWNLOADING	TOTAL DOWNLOAD	THE MANAGER's packet	8	1M	2M	1010.3 kbps
THE OFFICE BOY DOWNLOADING	TOTAL DOWNLOAD	THE OFFICE BOY's packet	8	1M	2M	1002.2 kbps
THE SECRETARY DOWNLOADING	TOTAL DOWNLOAD	THE SECRETARY's packet	8	1M	2M	1003.0 kbps
TOTAL UPLOAD	Ether1_ISP		8		5M	290.2 kbps
THE BOSS UPLOADING	TOTAL UPLOAD	THE BOSS's packet	8	1M	2M	103.2 kbps
THE MANAGER UPLOADING	TOTAL UPLOAD	THE MANAGER's packet	8	1M	2M	62.8 kbps
THE OFFICE BOY UPLOADING	TOTAL UPLOAD	THE OFFICE BOY's packet	8	1M	2M	62.0 kbps
THE SECRETARY UPLOADING	TOTAL UPLOAD	THE SECRETARY's packet	8	1M	2M	62.1 kbps

10 items      276.9 KB queued      192 packets queued

# ADVANTAGES OF HTB QUEUE-TREE SYSTEM

- Queue Tree is one directional only and can be placed in any of the available Interface. Upload interface or download interface.



The screenshot shows the Mikrotik WinBox interface. The 'Interface List' table is visible, showing the following data:

Name	Type	L2 MTU	Tx
ether1	Ethernet	1598	0 bps
R ether2_JSP	Ethernet	1598	74.4 kbps
ether3	Ethernet	1598	0 bps
ether4	Ethernet	1598	0 bps
wlan1	Wireless (Atheros AR9...	1600	0 bps

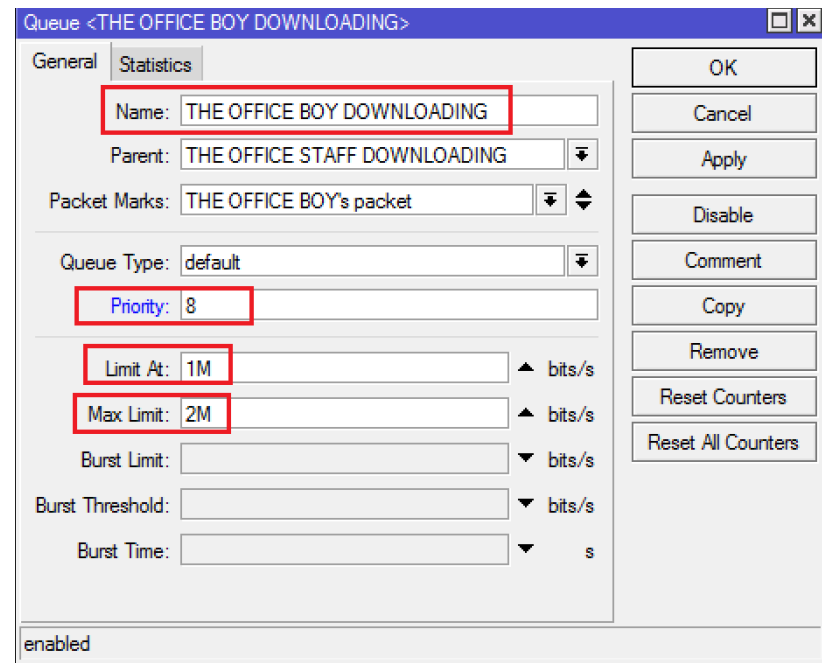
# ADVANTAGES OF HTB QUEUE-TREE SYSTEM

- We can prioritize our Bosses, directors and managers over the poor office boy but still giving him maximum available bandwidth whenever its available.

The screenshot shows the 'Queue <THE BOSS DOWNLOADING>' configuration window. The 'General' tab is active. The 'Name' field is 'THE BOSS DOWNLOADING', 'Parent' is 'TOTAL DOWNLOAD', and 'Packet Marks' is 'THE BOSS's packet'. The 'Queue Type' is 'default' and the 'Priority' is '1'. The 'Limit At' is '1M', 'Max Limit' is '2M', and 'Burst Limit' is empty. The 'Burst Threshold' and 'Burst Time' are also empty. The 'enabled' checkbox is checked. On the right side, there are buttons for 'OK', 'Cancel', 'Apply', 'Disable', 'Comment', 'Copy', 'Remove', 'Reset Counters', and 'Reset All Counters'.

# ADVANTAGES OF HTB QUEUE-TREE SYSTEM

- we can have dual limitations on a single user, allowing that user to use maximum available bandwidth in **non-rush hours**? (CIR/Limit At & MIR/Maximum Limit).



# ADVANTAGES OF HTB QUEUE-TREE SYSTEM

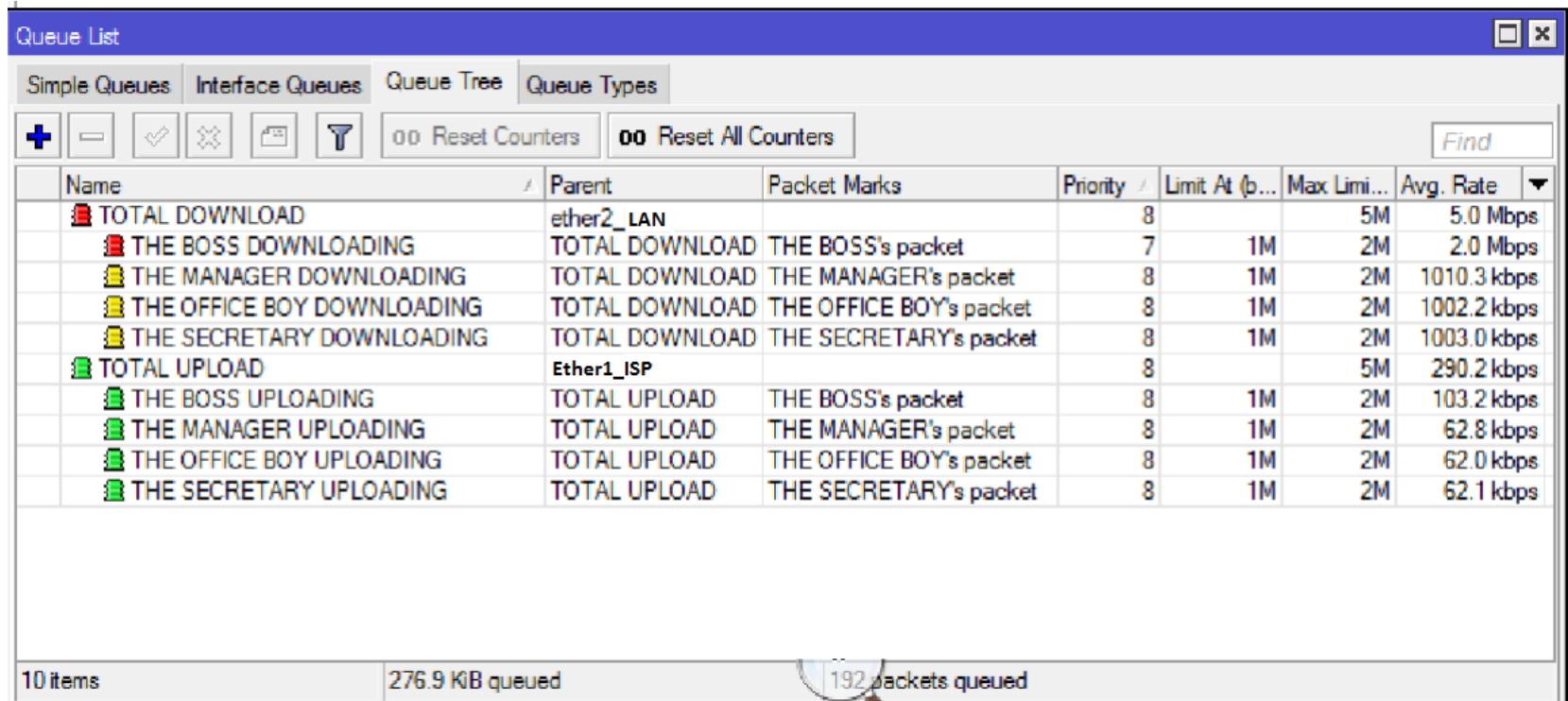
- Queue-Tree queues don't have any order – all traffic is processed simultaneously.
- Every single user can use maximum bandwidth available .



# IMPORTANT POINTS

- Parent queues don't need limit At's.
- Priority only works at the lowest child queue. (so put the boss at the bottom of the queue tree)
- Priority starts working when all the limit At's have already been full filled.
- All child queues must have packet marks from “/IP firewall mangle” facility assigned to them. (PARENT QUEUES DON'T NEED PACKET MARKS)

# Working queue Tree winbox view



The screenshot shows the Mikrotik WinBox 'Queue List' window. The 'Queue Tree' tab is selected. The window displays a hierarchical list of queues. The root nodes are 'TOTAL DOWNLOAD' (parent: ether2\_LAN) and 'TOTAL UPLOAD' (parent: Ether1\_ISP). Each root node has four sub-queues: 'THE BOSS', 'THE MANAGER', 'THE OFFICE BOY', and 'THE SECRETARY'. The status bar at the bottom indicates 10 items, 276.9 KiB queued, and 192 packets queued.

Name	Parent	Packet Marks	Priority	Limit At (b...	Max Limi...	Avg. Rate
TOTAL DOWNLOAD	ether2_LAN		8		5M	5.0 Mbps
THE BOSS DOWNLOADING	TOTAL DOWNLOAD	THE BOSS's packet	7	1M	2M	2.0 Mbps
THE MANAGER DOWNLOADING	TOTAL DOWNLOAD	THE MANAGER's packet	8	1M	2M	1010.3 kbps
THE OFFICE BOY DOWNLOADING	TOTAL DOWNLOAD	THE OFFICE BOY's packet	8	1M	2M	1002.2 kbps
THE SECRETARY DOWNLOADING	TOTAL DOWNLOAD	THE SECRETARY's packet	8	1M	2M	1003.0 kbps
TOTAL UPLOAD	Ether1_ISP		8		5M	290.2 kbps
THE BOSS UPLOADING	TOTAL UPLOAD	THE BOSS's packet	8	1M	2M	103.2 kbps
THE MANAGER UPLOADING	TOTAL UPLOAD	THE MANAGER's packet	8	1M	2M	62.8 kbps
THE OFFICE BOY UPLOADING	TOTAL UPLOAD	THE OFFICE BOY's packet	8	1M	2M	62.0 kbps
THE SECRETARY UPLOADING	TOTAL UPLOAD	THE SECRETARY's packet	8	1M	2M	62.1 kbps

10 items      276.9 KiB queued      192 packets queued

# INNER QUEUE TREE WINBOX VIEW

Queue List

Simple Queues | Interface Queues | Queue Tree | Queue Types

+ - ✓ ✗ 📁 🗑️ 00 Reset Counters 00 Reset All Counters Find

Name	Parent	Packet Marks	Priority	Limit At...	Max Limit...	Avg. Rate
TOTAL DOWNLOAD	wlan1		8		5M	5.0 Mbps
THE BOSS DOWNLOADING	TOTAL DOWNLOAD	THE BOSS's packet	7	1M	2M	1010.2 kbps
THE OFFICE STAFF DOWNLOADING	TOTAL DOWNLOAD		8		4M	4.0 Mbps
<b>THE MANAGER DOWNLOADING</b>	THE OFFICE STAFF DOWNL...	THE MANAGER's packet	<b>3</b>	<b>1M</b>	<b>2M</b>	<b>2.0 Mbps</b>
THE OFFICE BOY DOWNLOADING	THE OFFICE STAFF DOWNL...	THE OFFICE BOY's packet	5	1M	2M	1018.5 kbps
THE SECRETARY DOWNLOADING	THE OFFICE STAFF DOWNL...	THE SECRETARY's packet	8	1M	2M	1005.9 kbps
TOTAL UPLOAD	ether2_ISP		8		5M	285.1 kbps
THE BOSS UPLOADING	TOTAL UPLOAD	THE BOSS's packet	8	1M	2M	61.3 kbps
THE OFFICE STAFF UPLOADING	TOTAL UPLOAD		8		4M	223.7 kbps
THE MANAGER UPLOADING	THE OFFICE STAFF UPLOAD...	THE MANAGER's packet	3	1M	2M	102.3 kbps
THE OFFICE BOY UPLOADING	THE OFFICE STAFF UPLOAD...	THE OFFICE BOY's packet	5	1M	2M	61.9 kbps
THE SECRETARY UPLOADING	THE OFFICE STAFF UPLOAD...	THE SECRETARY's packet	8	1M	2M	59.4 kbps

12 items (1 selected)      278.3 KB queued      193 packets queued

## CONCLUSION

- **For low bandwidth network, Use:**
  - Queue Tree, HTB, Burst
- **Your network has been maximized to use every single bit of your available bandwidth without wasting “even” a single bit.**



**THANK YOU!**  
**Questions Please?**