MikroTik RouterOS Workshop

QoS Best Practice

Chicago,IL

MUM USA 2008

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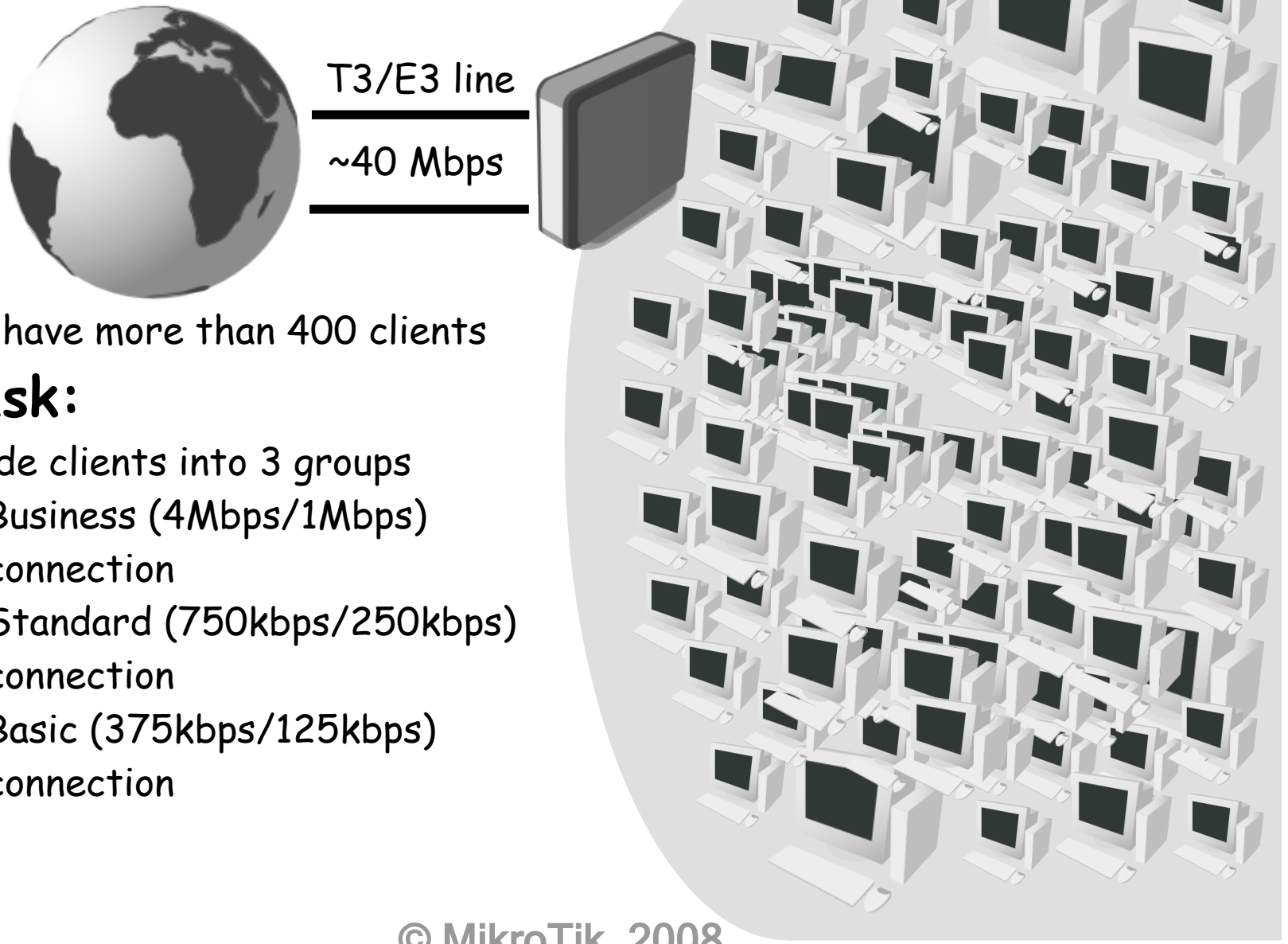
Plan

- Discuss best QoS practice for
  - Large scale user speed limitations
  - Prioritization of traffic based on traffic type
- Implement best practice

You will be able to follow the progress – just connect to SSID “QoS” and open up the Winbox to address 10.1.1.254 (default user name and password)

User Limitation



- You have more than 400 clients
- **Task:**
- Divide clients into 3 groups
  - Business (4Mbps/1Mbps) connection
  - Standard (750kbps/250kbps) connection
  - Basic (375kbps/125kbps) connection

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Simple Queue For Each Client

- Each simple queue creates 3 separate queues:
  - One in global-in (“direct” part)
  - One in Global-out (“reverse” part)
  - One in Global-total (“total” part)
- Simple queues are ordered - similar to firewall rules
  - further down = longer packet processing
  - further down = smaller chance to get traffic

(necessary to reduce number of queues)

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Possible Solutions

- RouterOS have 4 queue types:
  - FIFO – First In First Out (for Bytes or for Packets)
  - RED – Random Early Detect (or Drop)
  - SFQ – Stochastic Fairness Queuing
  - PCQ – Per Connection Queuing (MikroTik Proprietary)
- Firewall Mangle and Address-lists
- Queue Tree

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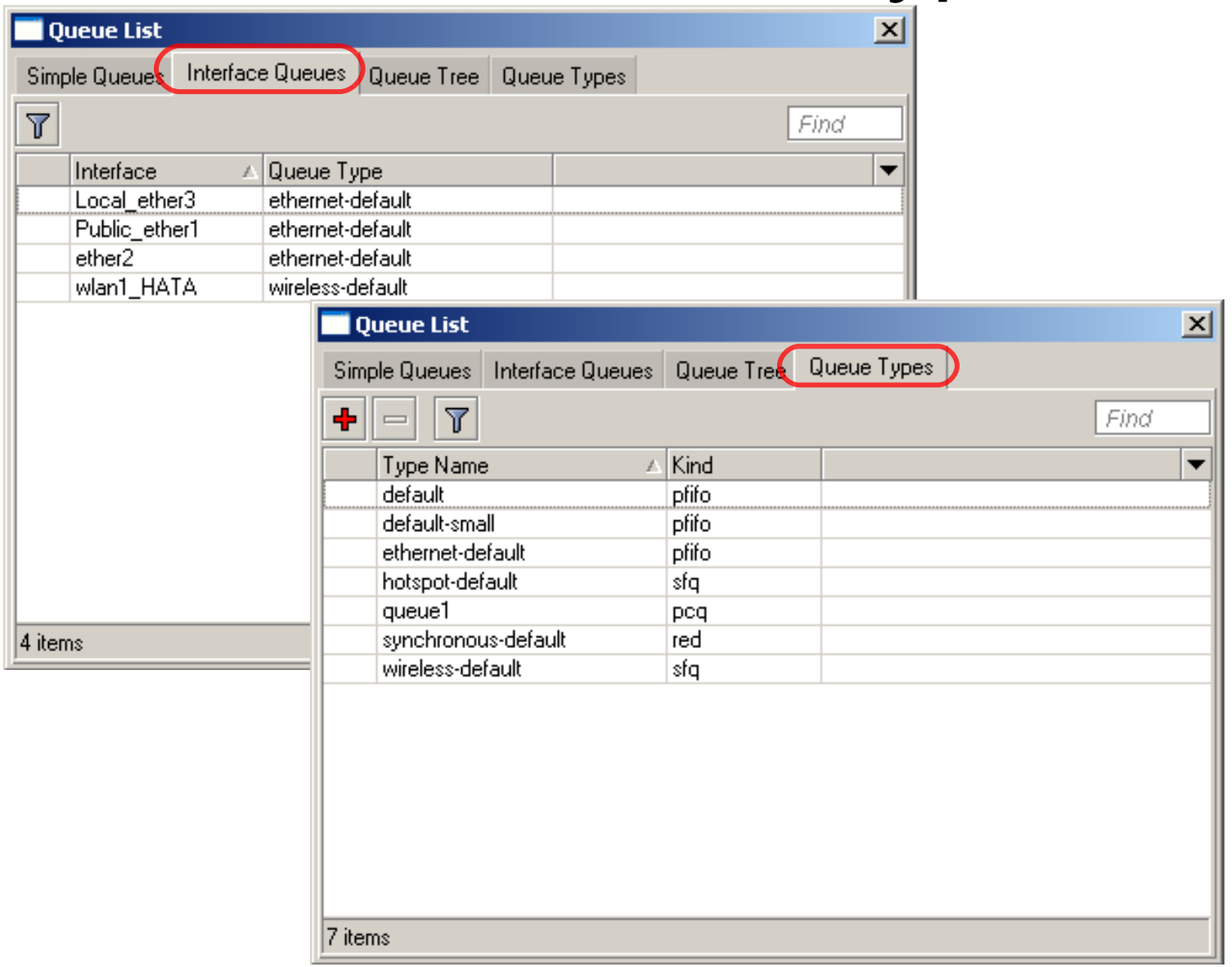
Default Queue Types



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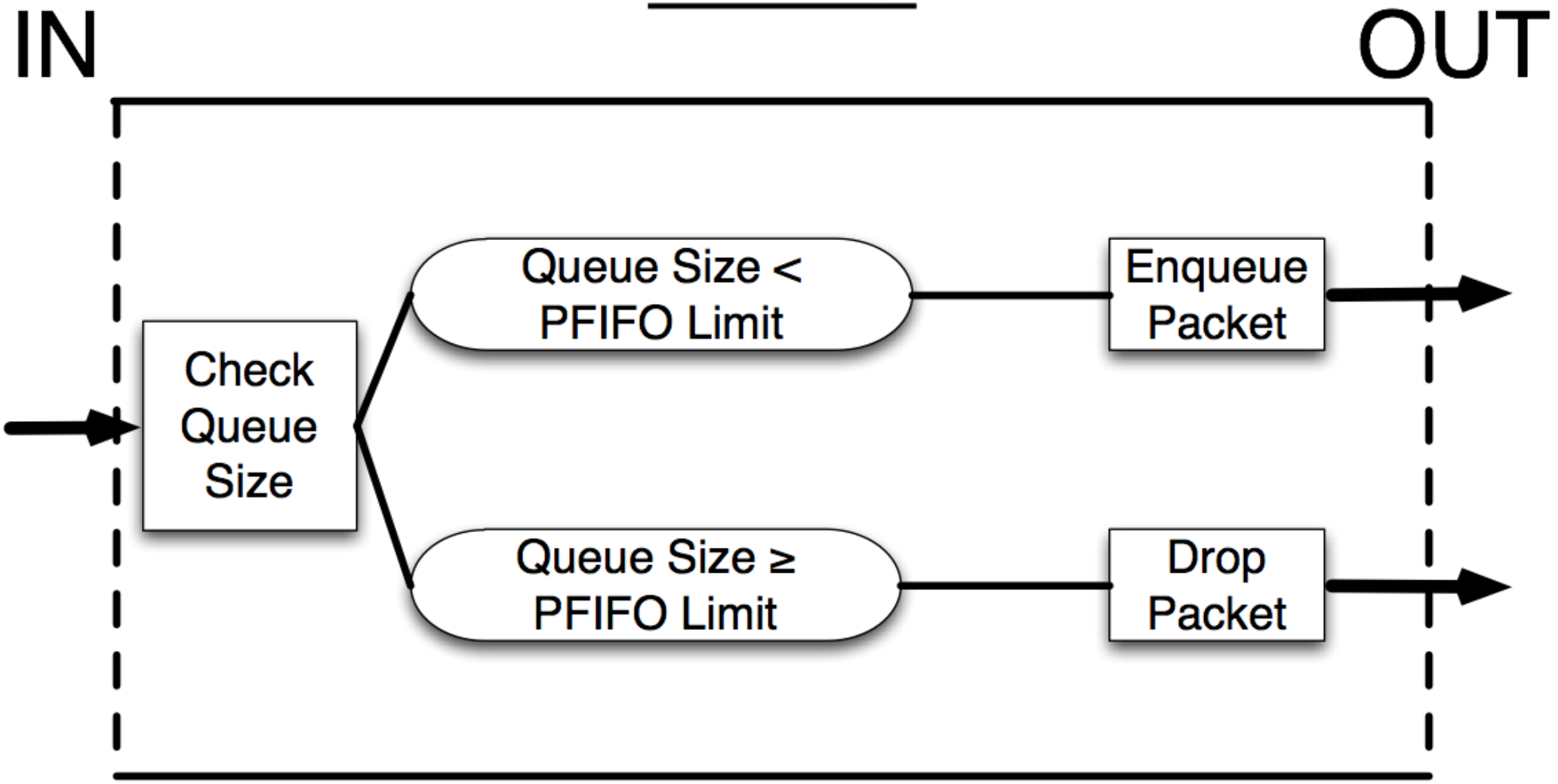
PFIFO



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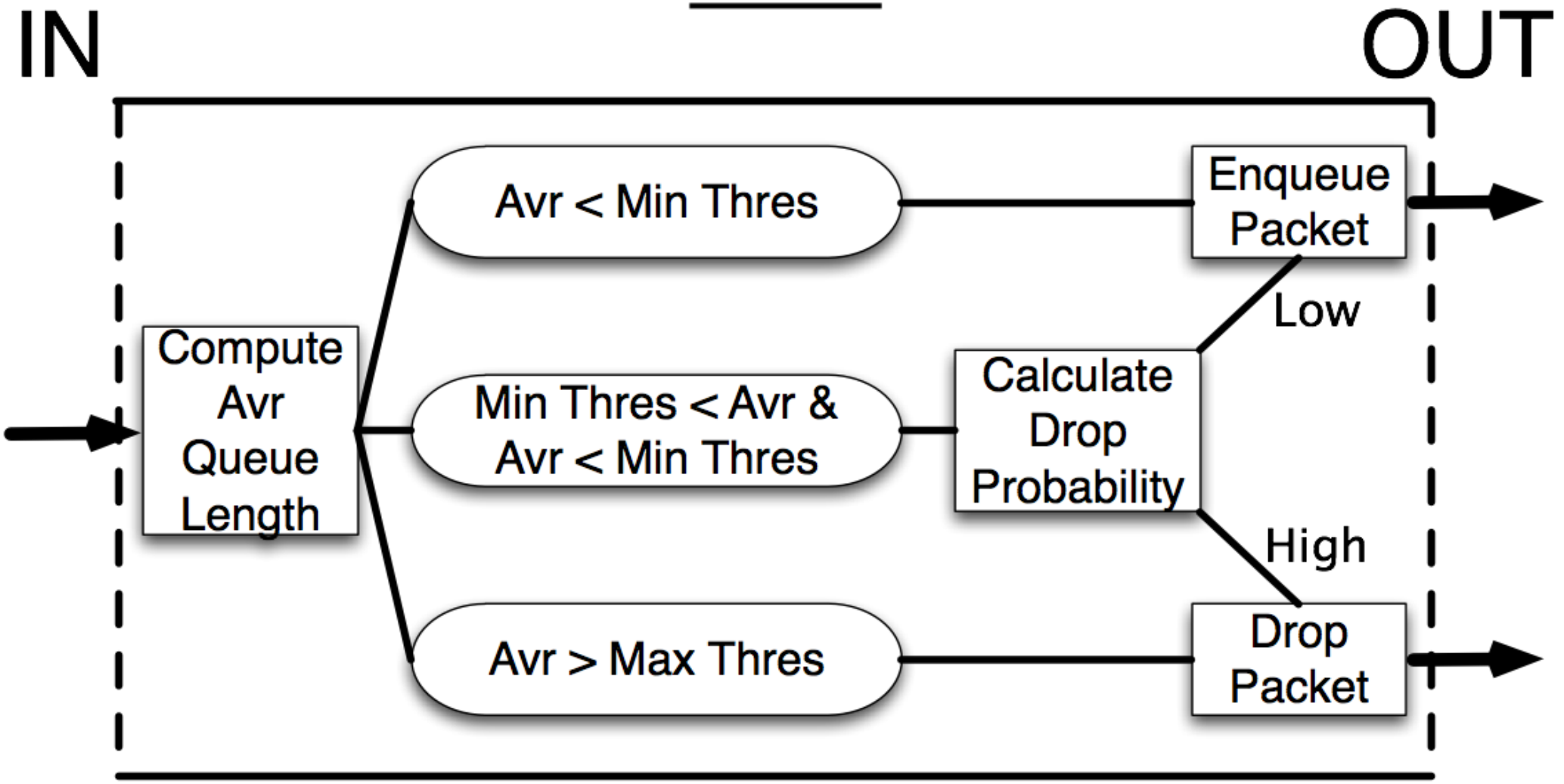
RED



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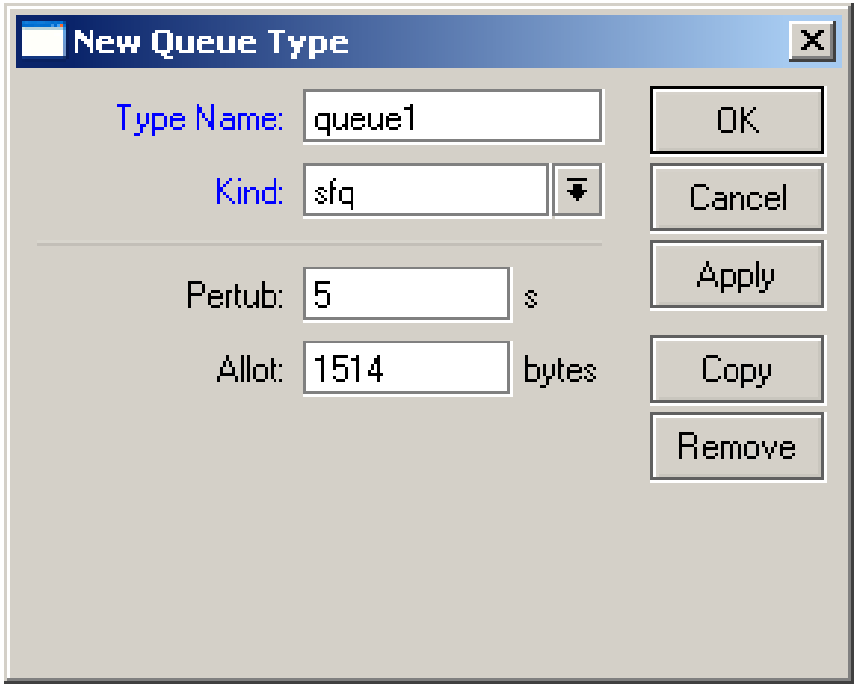
SFQ

Behaviour:

Based on hash value from source and destination address SFQ divides traffic into 1024 sub-streams

Then Round Robin algorithm will distribute equal amount of traffic to each sub-stream



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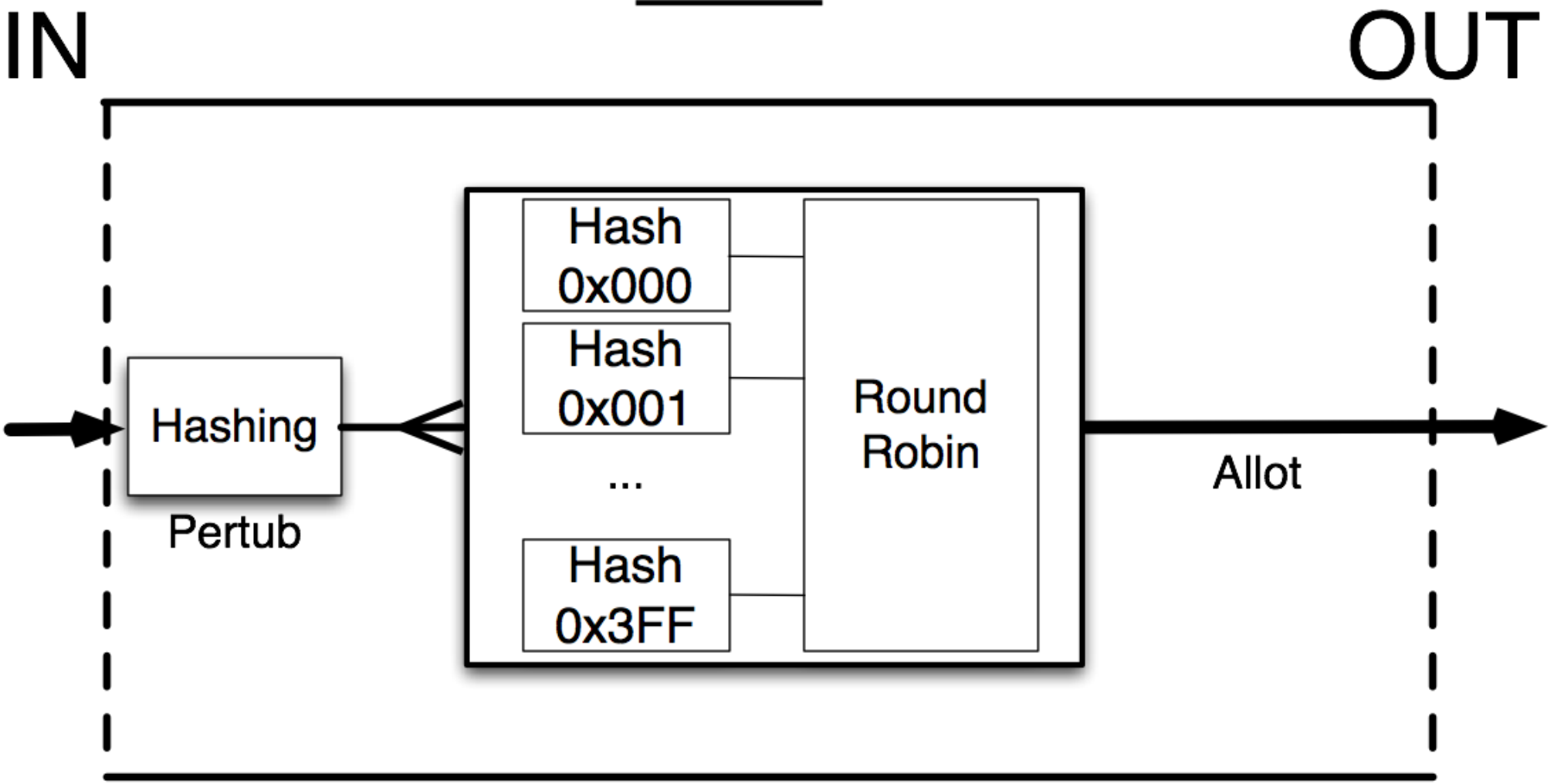
SFQ



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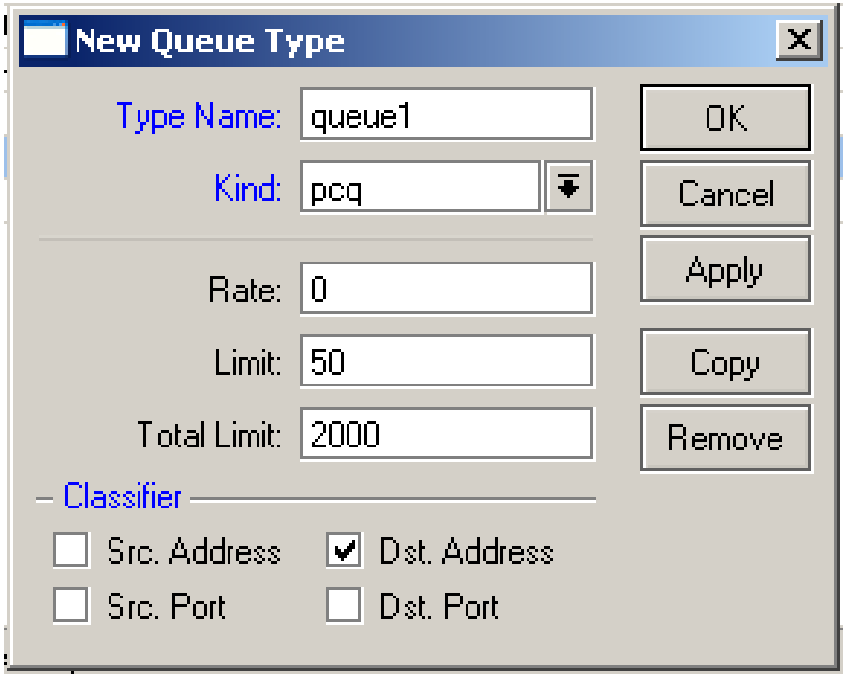
PCQ

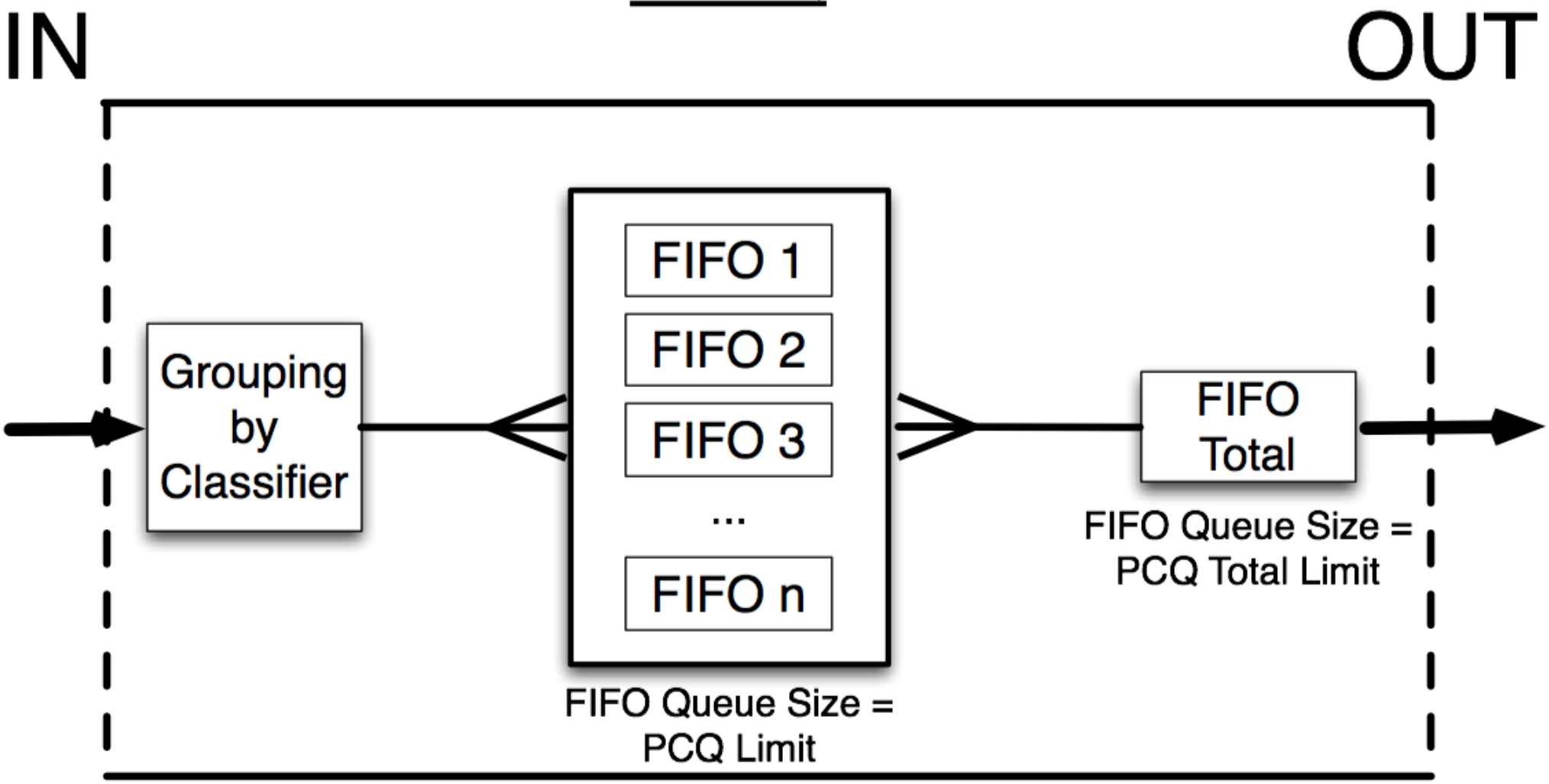
Behaviour:

Based on classifier PCQ divides traffic into sub-streams. Each sub-stream can be considered as FIFO queue with queue size specified by “limit” option

After this PCQ can be considered as FIFO queue where queue size is specified by “total-limit” option.



PCQ



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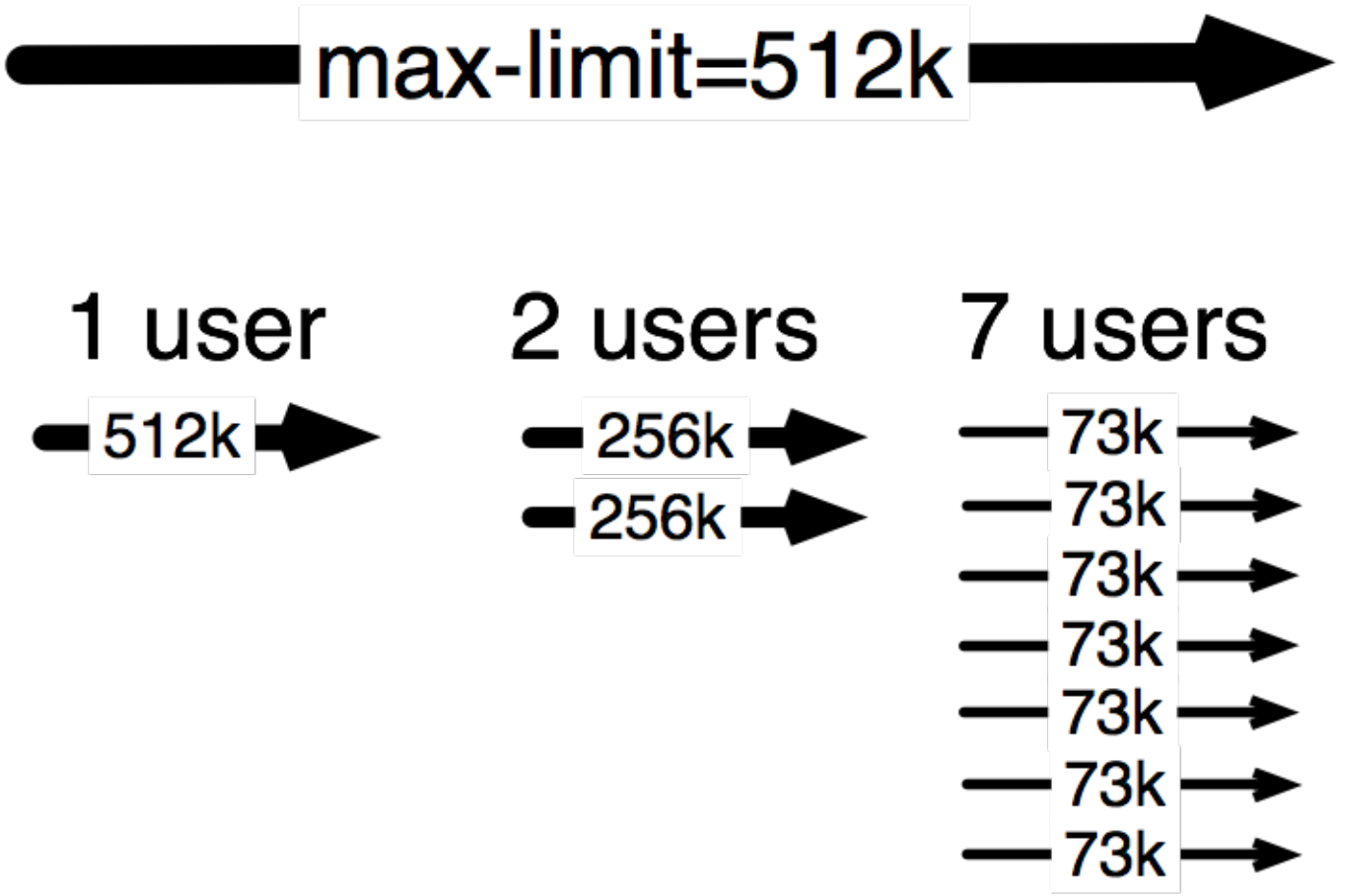
pcq-rate=0



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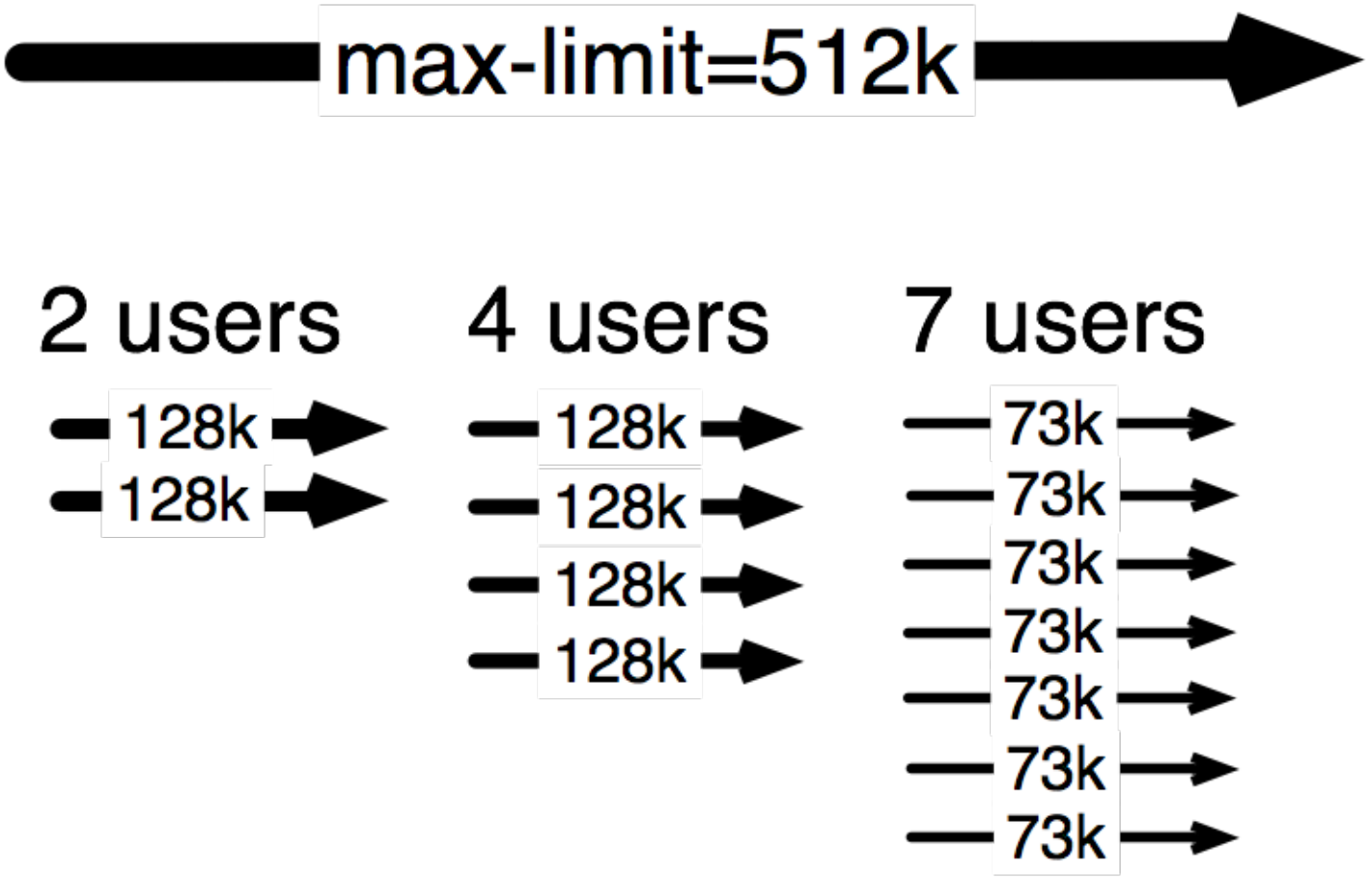
pcq-rate=128000



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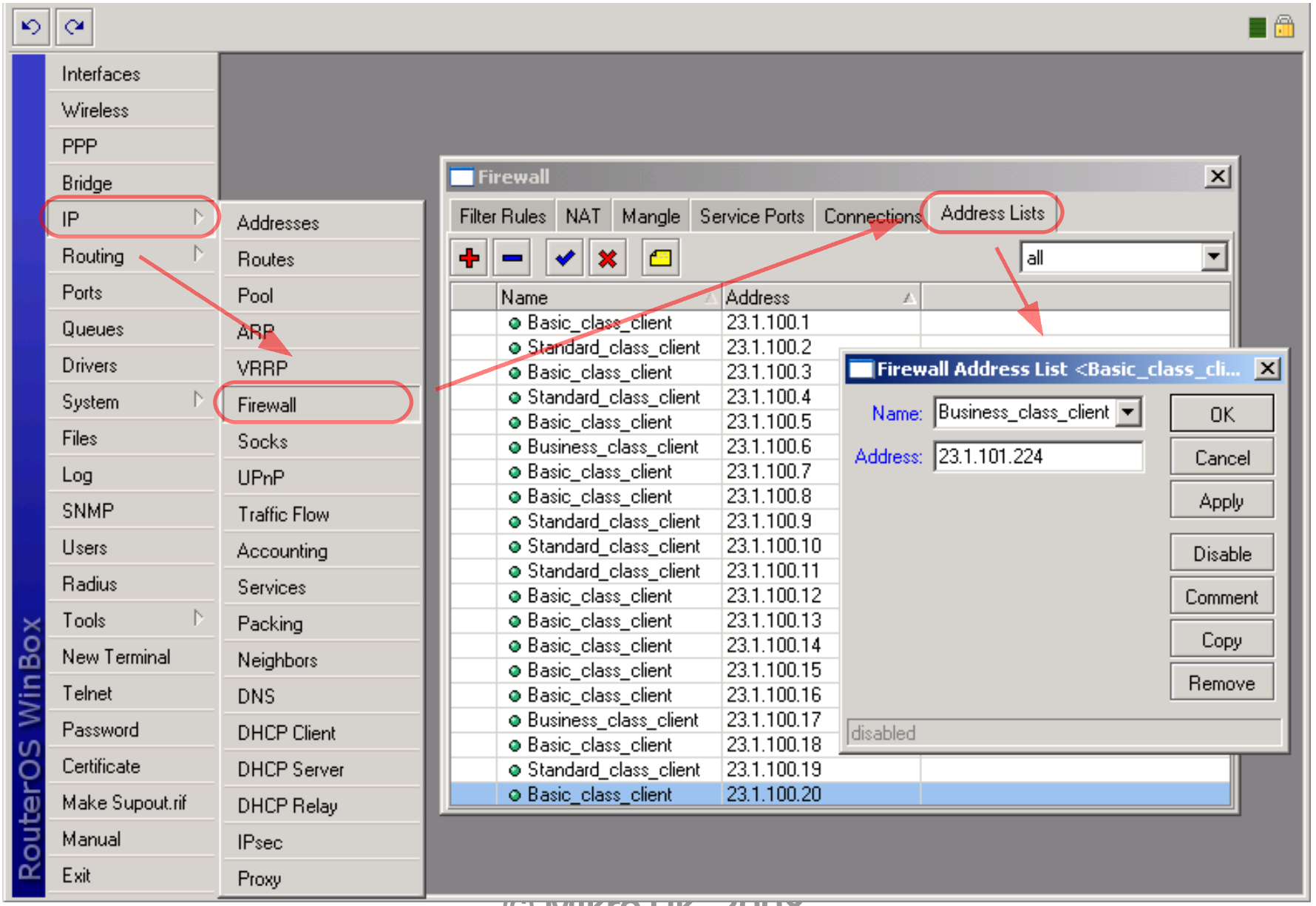
Plan

- Create an address list for client classes
- Use “connection-mark” (mangle) feature to classify all connections based on client class
- Use “packet-mark” (mangle) feature to classify all traffic based on client class
- Create a PCQ queue for each client class with rate option specified
  - ...what about user-user communications???
  - ...what about unmarked traffic ?

Address Lists



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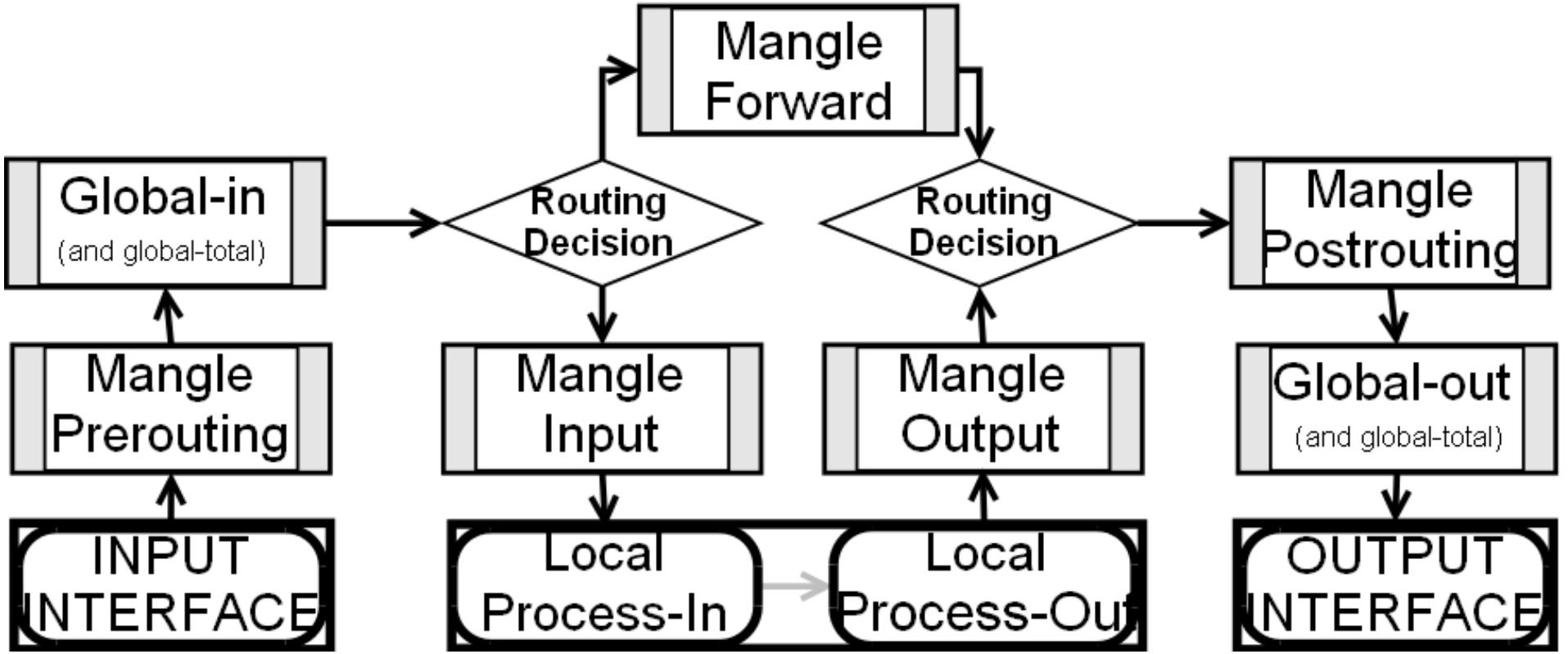
Where?

- There are 5 places to mangle
- There are 4 places to limit



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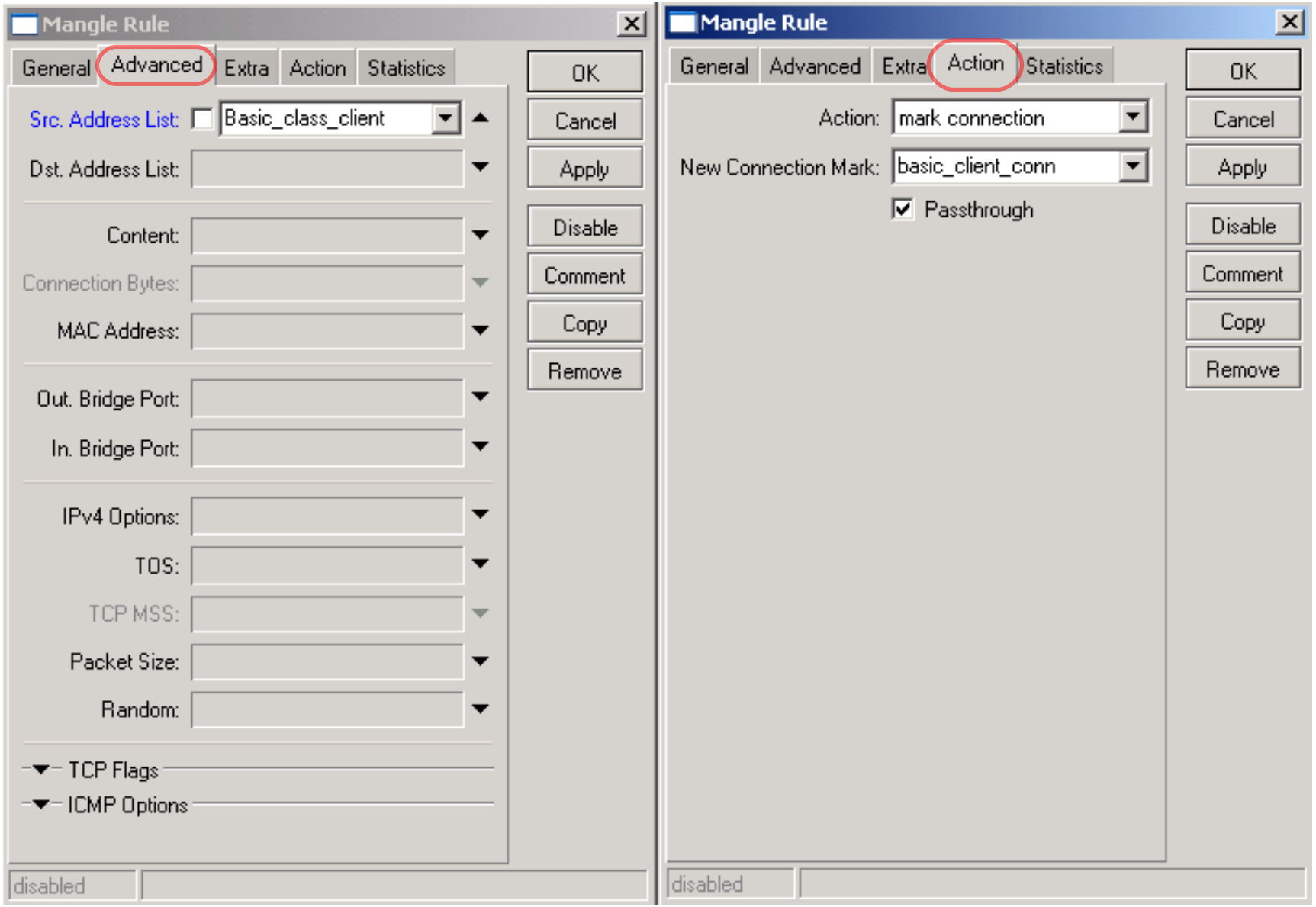
Connection-mark rule



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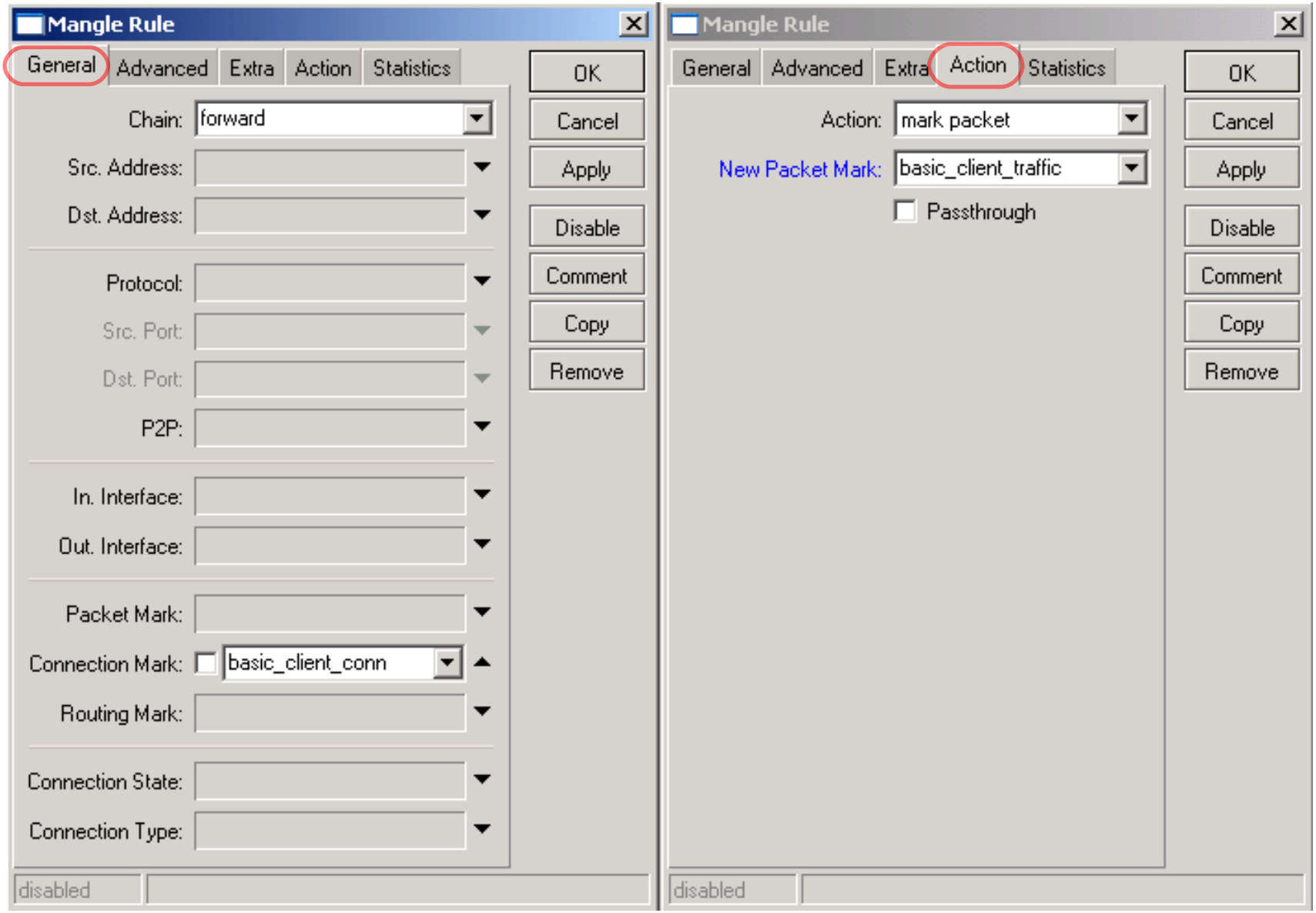
Packet-mark rule



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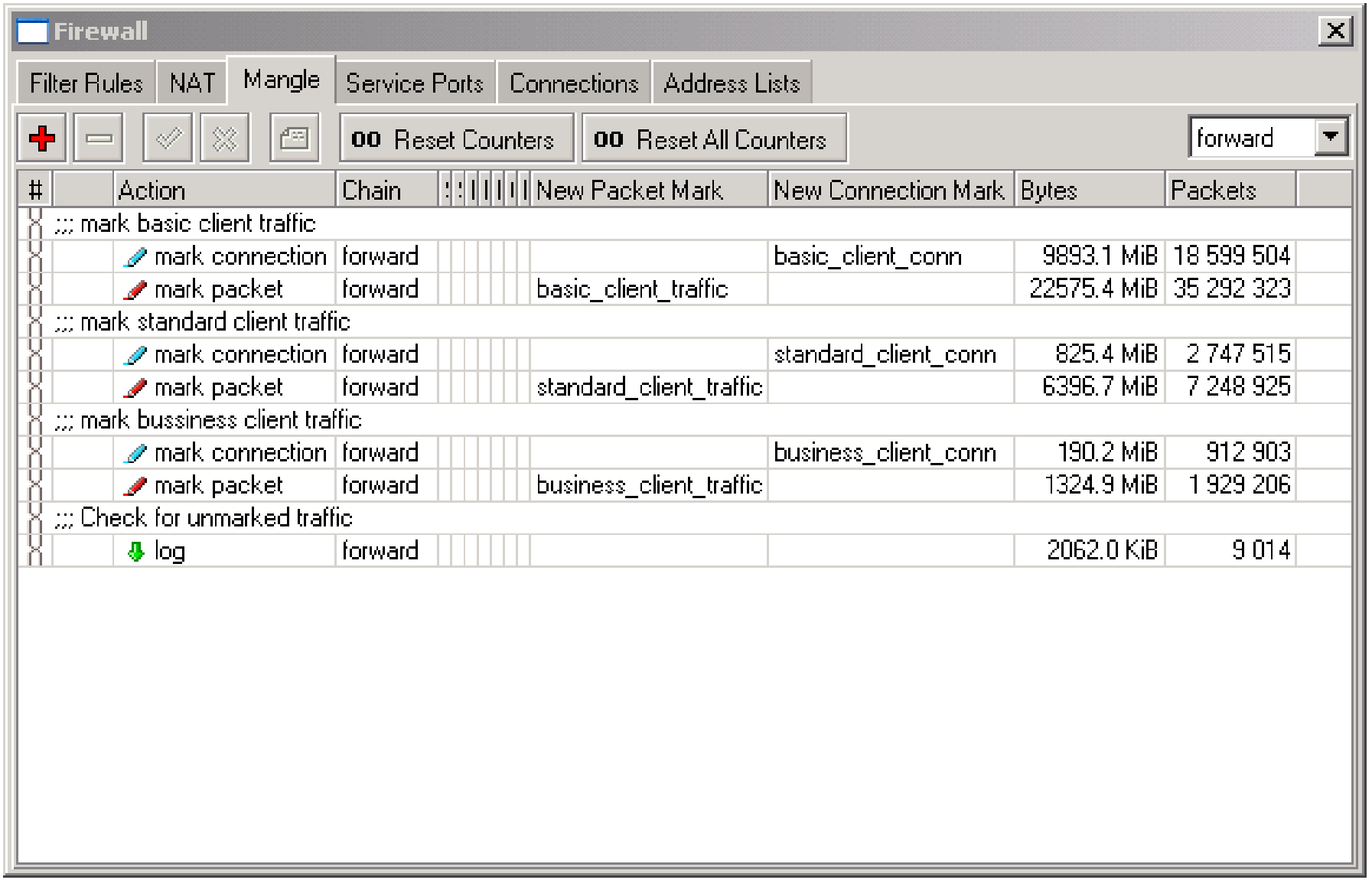
Working Mangle- Winbox view



#	Action	Chain	New Packet Mark	New Connection Mark	Bytes	Packets
;;; mark basic client traffic						
	mark connection	forward		basic_client_conn	9893.1 MiB	18 599 504
	mark packet	forward	basic_client_traffic		22575.4 MiB	35 292 323
;;; mark standard client traffic						
	mark connection	forward		standard_client_conn	825.4 MiB	2 747 515
	mark packet	forward	standard_client_traffic		6396.7 MiB	7 248 925
;;; mark bussiness client traffic						
	mark connection	forward		business_client_conn	190.2 MiB	912 903
	mark packet	forward	business_client_traffic		1324.9 MiB	1 929 206
;;; Check for unmarked traffic						
	log	forward			2062.0 KiB	9 014

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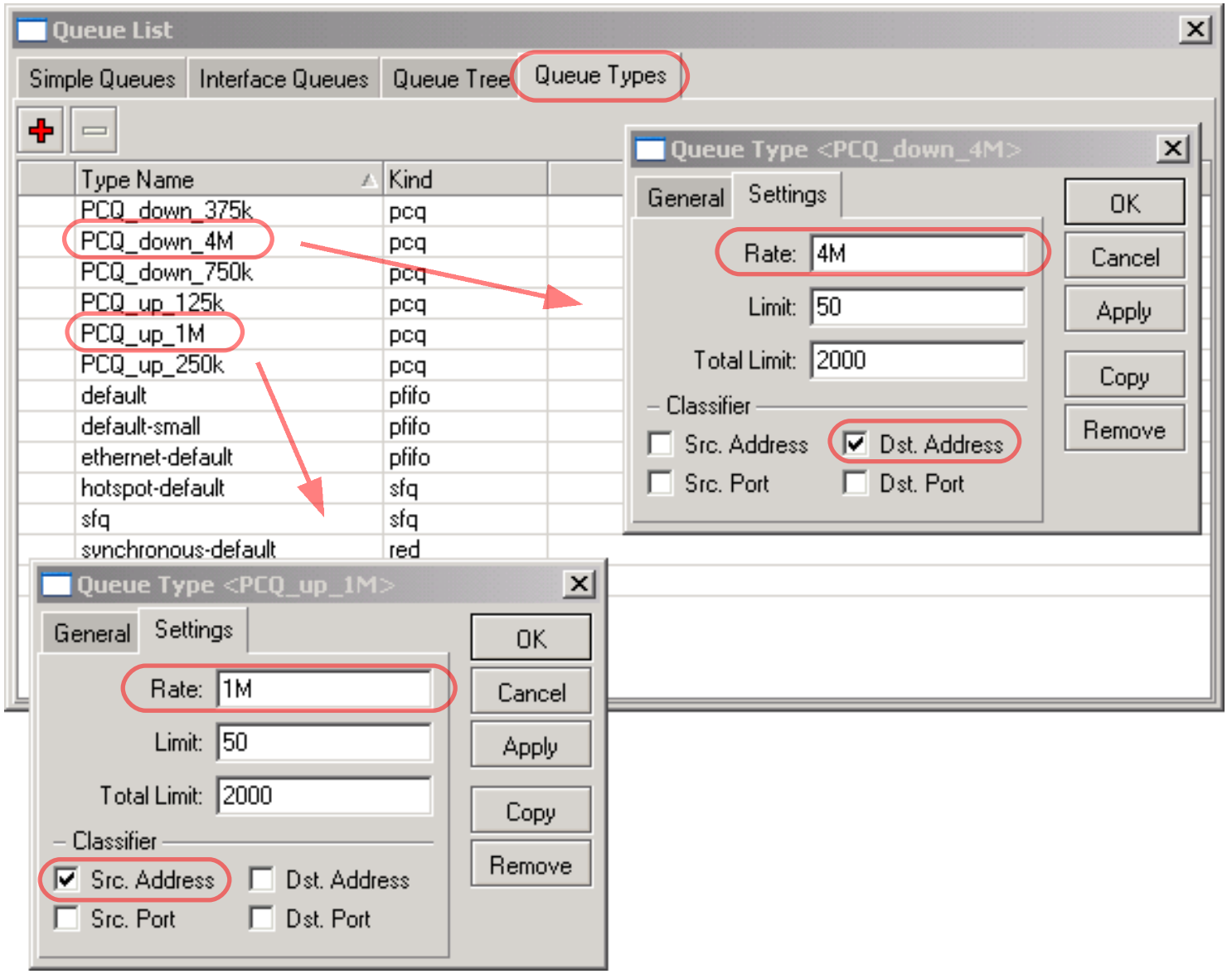
Working Mangle- Export view

```
/ ip firewall mangle
add chain=forward src-address-list=Basic_class_client action=mark-connection \
    new-connection-mark=basic_client_conn passthrough=yes comment="mark basic \
    client traffic" disabled=no
add chain=forward connection-mark=basic_client_conn action=mark-packet \
    new-packet-mark=basic_client_traffic passthrough=no comment="" disabled=no
add chain=forward src-address-list=Standard_class_client \
    action=mark-connection new-connection-mark=standard_client_conn \
    passthrough=yes comment="mark standard client traffic" disabled=no
add chain=forward connection-mark=standard_client_conn action=mark-packet \
    new-packet-mark=standard_client_traffic passthrough=no comment="" \
    disabled=no
add chain=forward src-address-list=Business_class_client \
    action=mark-connection new-connection-mark=business_client_conn \
    passthrough=yes comment="mark bussiness client traffic" disabled=no
add chain=forward connection-mark=business_client_conn action=mark-packet \
    new-packet-mark=business_client_traffic passthrough=no comment="" \
    disabled=no
add chain=forward action=log log-prefix="" comment="Check for unmarked \
    traffic" disabled=no
```

Queuing Placement

- Limitation for in mangle chain “forward” marked traffic can be placed in the “global-out” or interface queue
- If queues will be placed in the interface queues
  - queues on the public interface will capture only client upload
  - queues on the local interface will capture only client's download
- If queues will be placed in global-out download and upload will be limited together (separate marks needed)

PCQ Types – Winbox View



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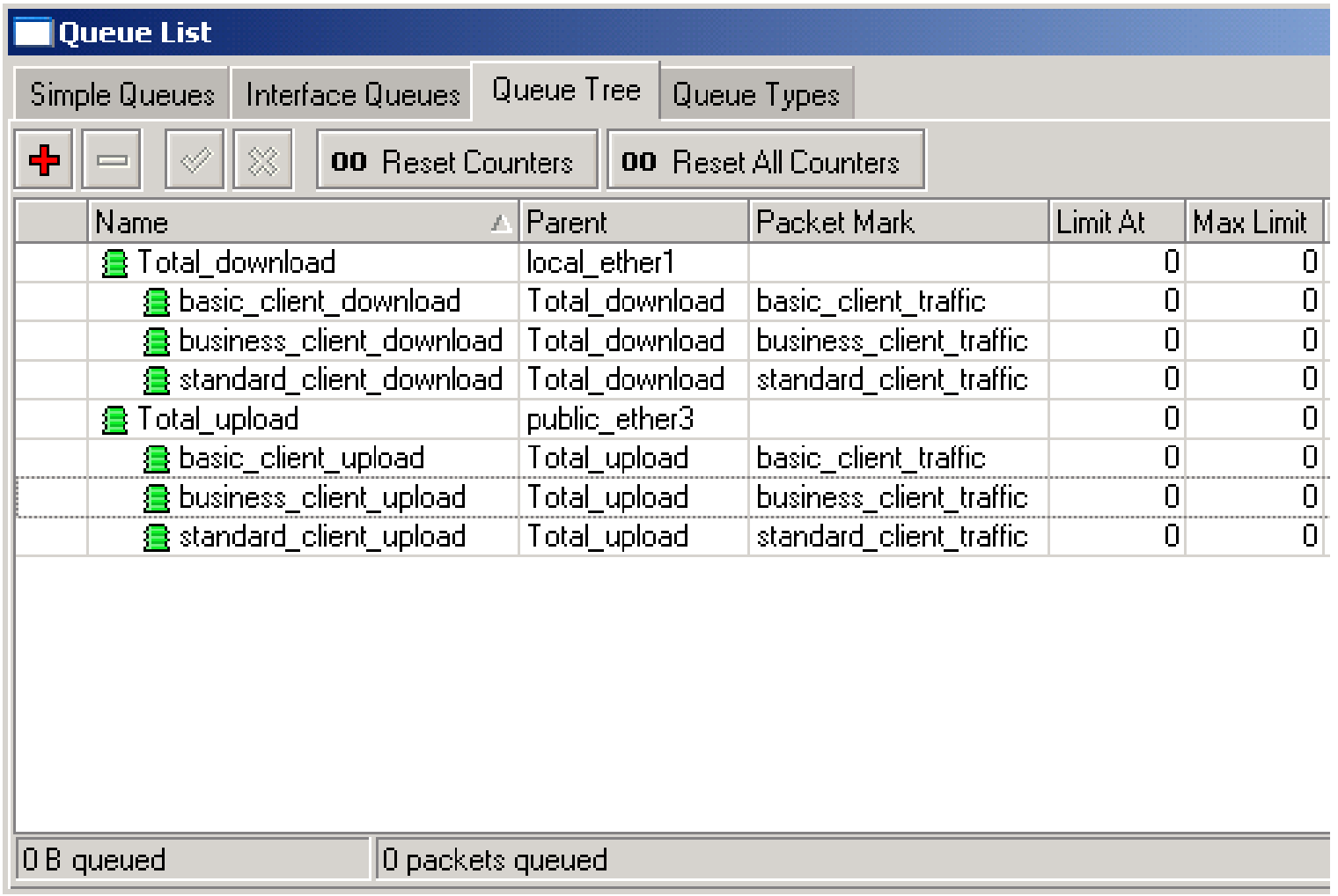
Queue Tree – Winbox View



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Queue Tree – Export View

```
/ queue tree
add name="Total_download" parent=local_ether1 packet-mark="" limit-at=0 \
    queue=default priority=1 max-limit=0 burst-limit=0 burst-threshold=0 \
    burst-time=0s disabled=no
add name="basic_client_download" parent=Total_download \
    packet-mark=basic_client_traffic limit-at=0 queue=PCQ_down_375k priority=8 \
    max-limit=0 burst-limit=0 burst-threshold=0 burst-time=0s disabled=no
add name="standard_client_download" parent=Total_download \
    packet-mark=standard_client_traffic limit-at=0 queue=PCQ_down_750k \
    priority=4 max-limit=0 burst-limit=0 burst-threshold=0 burst-time=0s \
    disabled=no
add name="business_client_download" parent=Total_download \
    packet-mark=business_client_traffic limit-at=0 queue=default priority=1 \
    max-limit=0 burst-limit=0 burst-threshold=0 burst-time=0s disabled=no
add name="Total_upload" parent=public_ether3 packet-mark="" limit-at=0 \
    queue=default priority=8 max-limit=0 burst-limit=0 burst-threshold=0 \
    burst-time=0s disabled=no
add name="basic_client_upload" parent=Total_upload \
    packet-mark=basic_client_traffic limit-at=0 queue=PCQ_up_125k priority=8 \
    max-limit=0 burst-limit=0 burst-threshold=0 burst-time=0s disabled=no
add name="standard_client_upload" parent=Total_upload \
    packet-mark=standard_client_traffic limit-at=0 queue=PCQ_up_250k \
    priority=4 max-limit=0 burst-limit=0 burst-threshold=0 burst-time=0s \
    disabled=no
add name="business_client_upload" parent=Total_upload \
    packet-mark=business_client_traffic limit-at=0 queue=PCQ_up_1M priority=1 \
    max-limit=0 burst-limit=0 burst-threshold=0 burst-time=0s disabled=no
```

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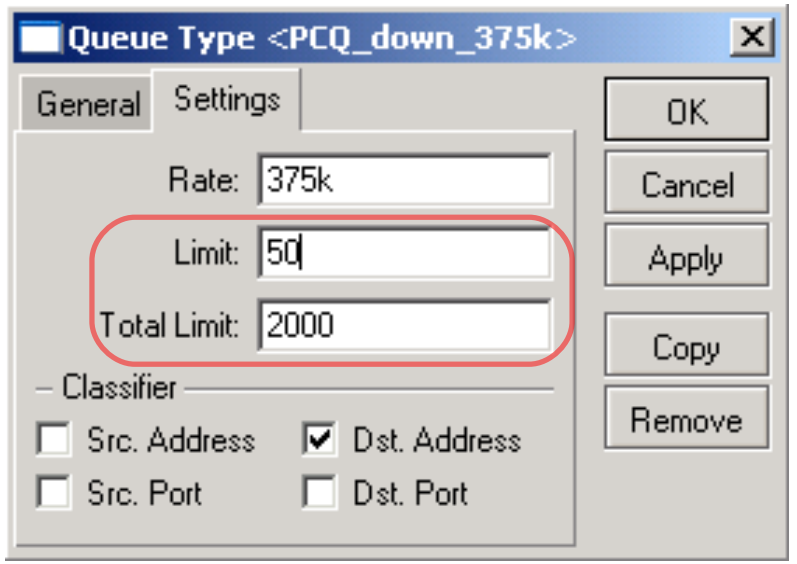
PCQ Queue Size



Total_limit = X can take up to
X*(2000 bytes + 200 bytes) of RAM

2000 bytes – buffer for 1 packet
200 bytes – service data for 1 packet

total_limit = 2000 =< 4,2MB RAM
total_limit = 5000 =< 10,5MB RAM

- It can take only 40 users to fill the queue

(because total_limit/limit = 2000/50 = 40)

- It is necessary to increase "total_limit" or (and) decrease the "limit" value
- There must be at least 10-20 packet places in queue available per user

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PCQ Adjustments

- There are ~340 Basic class clients so:
  - pcq_limit = 40
  - pcq_total_limit = 7000 (~20*340) (~15MB)
- There are ~40 Standard class clients so:
  - pcq_limit = 30
  - pcq_total_limit = 1000 (~20*40) (~2MB)
- There are ~20 Business class clients so:
  - pcq_limit = 20 (!!!)
  - pcq_total_limit = 500 (~20*20) (~1MB)

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Traffic Prioritization

T3/E3 line

~40 Mbps
~5Mbps abroad

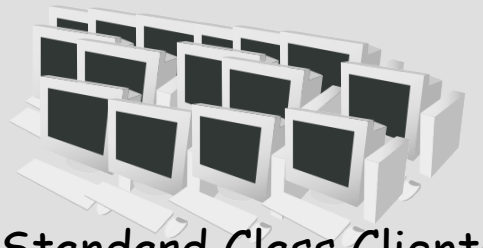
Business Class Clients

Basic Class Clients

You have problems with on-line communications (video, audio, VOIP, games)

Task:

Make necessary traffic prioritization



Standard Class Clients

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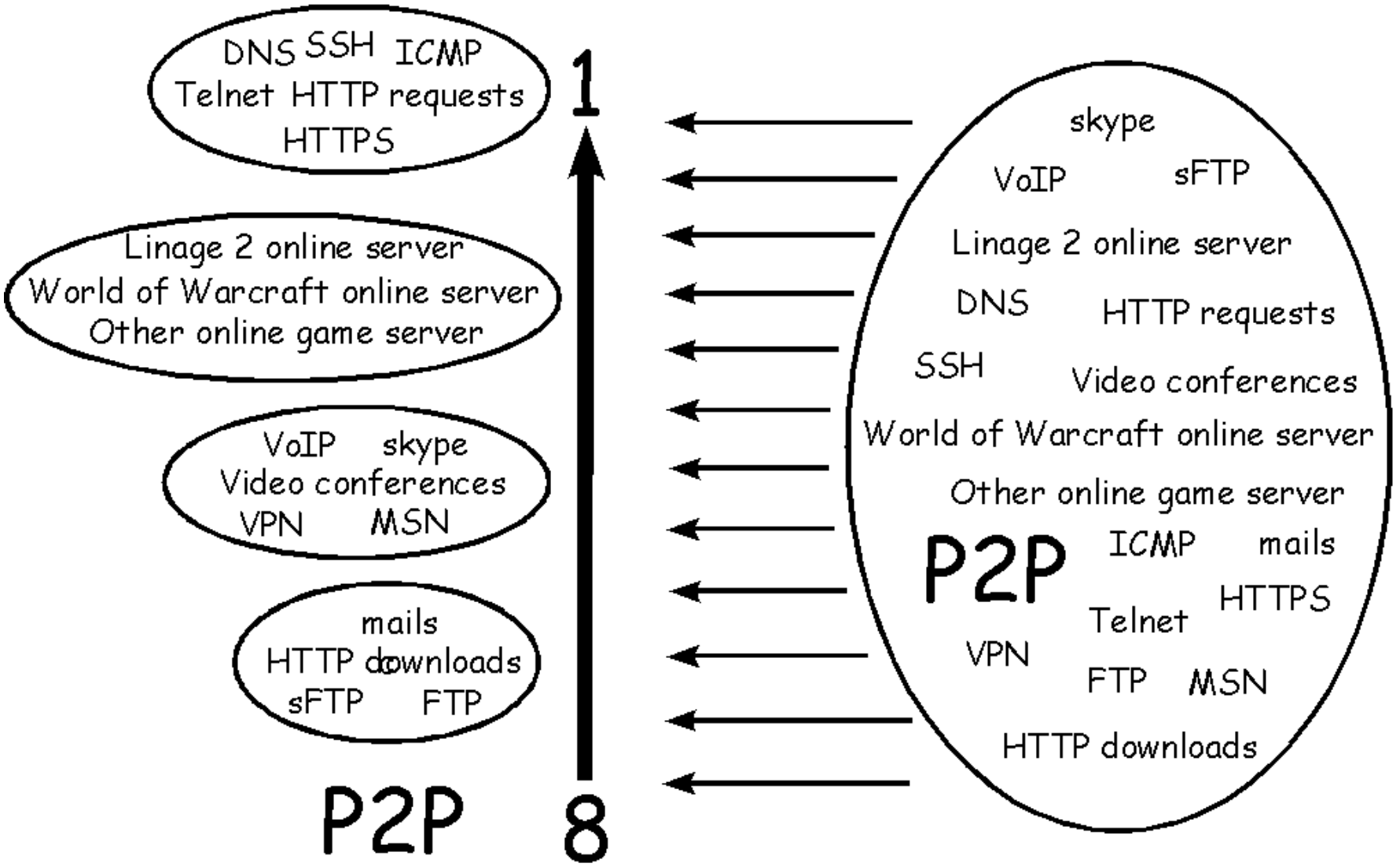
Prioritization plan



Where?

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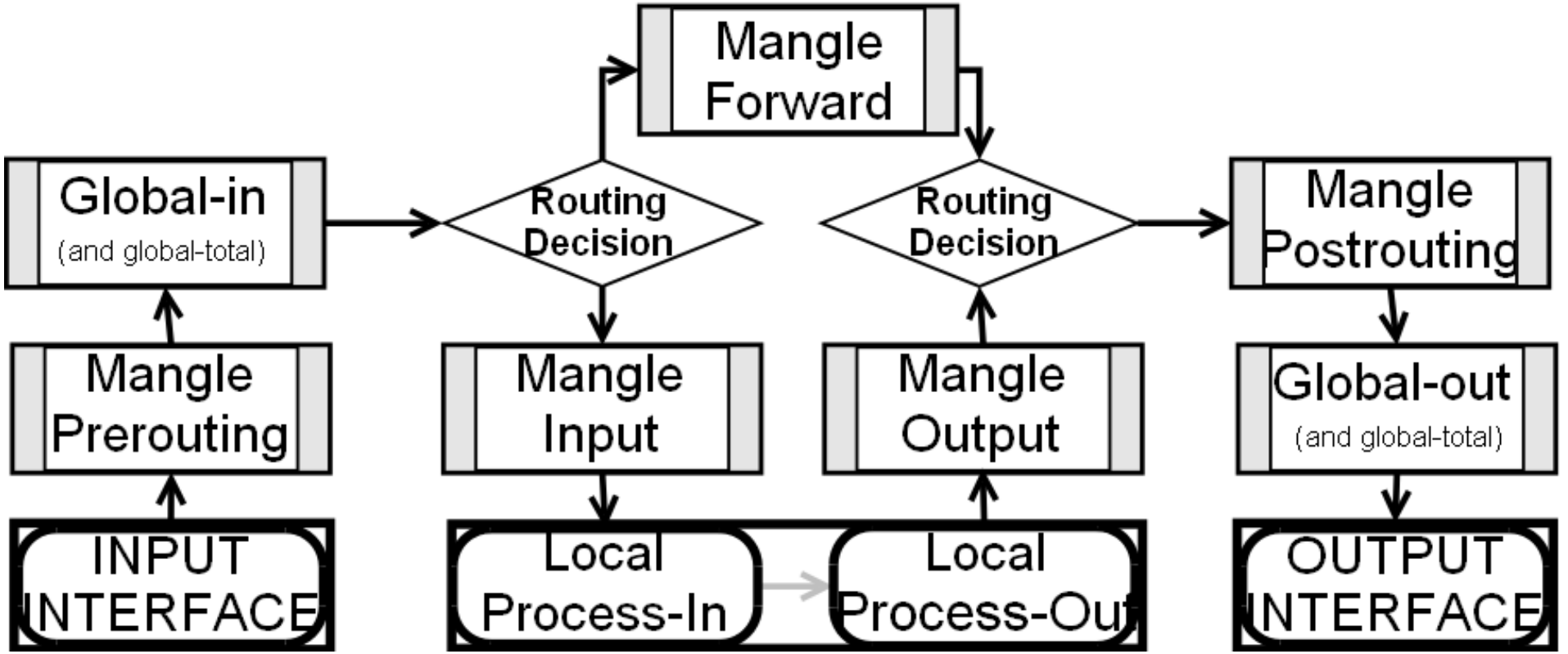
- There are 4 places to limit



How?

Group	Service	Protocol	Dst-Port	Other conditions
P2P_services	P2P			p2p=all-p2p
Download_services	Mails	TCP	110	
		TCP	995	
		TCP	143	
		TCP	993	
		TCP	25	
	HTTP downloads	TCP	80	Connection-bytes=500000-0
	FTP	TCP	20	
		TCP	21	
	SFTP	TCP	22	Packet-size=1400-1500
Ensign_services	DNS	TCP	53	
		UDP	53	
	ICMP	ICMP	-	
	HTTPS	TCP	443	
	Telnet	TCP	23	
	SSH	TCP	22	Packet-size=0-1400
	HTTP requests	TCP	80	Connection-bytes=0-500000
User_requests	Online game servers			Dst-address-list=user_requests
Communication_services	VoIP			
	Skype			
	Video conferences			
	VPN			
	MSN			

Priorities

- Create packet marks in the mangle chain “Prerouting” for traffic prioritization in the global-in queue
  - Ensign_services (Priority=1)
  - User_requests (Priority=3)
  - Communication_services (Priority=5)
  - Download_services (Priority=7)
  - P2P_services (Priority=8)