I AM #ROOT

HELPING US TO FIND RIGHT PICTURES

ALEX VISHNYAKOV

- MIKROTIK TRAINER
- SPLYNX BILLING SOFTWARE
- BGP, OSPF, MPLS, OTHER MAGIC
- CISCO-JUNIPER-UBNT-HUAWEI
- RUSSIAN-CZECH-ENGLISH-SPANISH

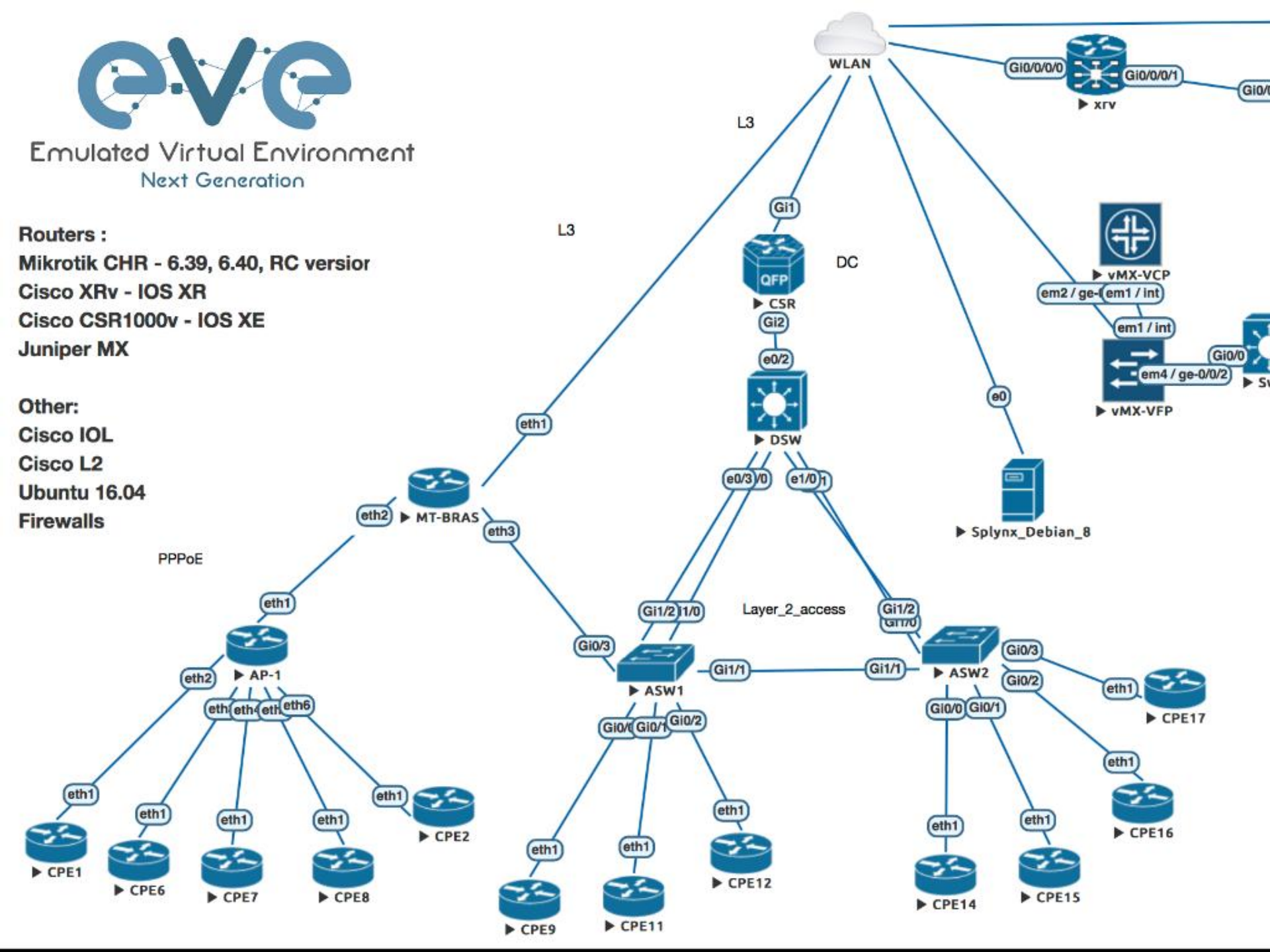
Raccoon

USED TOOLS

MARVEL

USED TOOLS

- MIKROTIK CHR
- VIRTUAL BOX
- EVE-NG LABS
- UBUNTU WITH SPLYNX
- MIKROTIK API


Emulated Virtual Environment
Next Generation
Routers :
Mikrotik CHR - 6.39, 6.40, RC versior
Cisco XRv - IOS XR
Cisco CSR1000v - IOS XE
Juniper MX
Other:
Cisco IOL
Cisco L2
Ubuntu 16.04
Firewalls
WLAN
L3
L3
DC
Gi1
QFP
CSR
Gi2
e0/2
DSW
eth1
eth2
MT-BRAS
eth3
PPPoE
eth1
AP-1
eth2
eth6
eth1
CPE1
eth1
CPE6
eth1
CPE7
eth1
CPE8
eth1
CPE2
Gi0/3
e0/3
e1/0
Gi1/2
Layer_2_access
ASW1
Gi1/1
Gi0/0
Gi0/1
Gi0/2
eth1
CPE9
eth1
CPE11
eth1
CPE12
Gi1/2
Gi1/1
ASW2
Gi0/3
Gi0/2
Gi0/0
Gi0/1
eth1
CPE14
eth1
CPE15
eth1
CPE16
eth1
CPE17
e0
Splynx_Debian_8
vMX-VCP
em2 / ge-
em1 / int
em1 / int
em4 / ge-0/0/2
vMX-VFP
Gi0/0
xrv
Gi0/0/0/0
Gi0/0/0/1


READY ?
LET'S START !

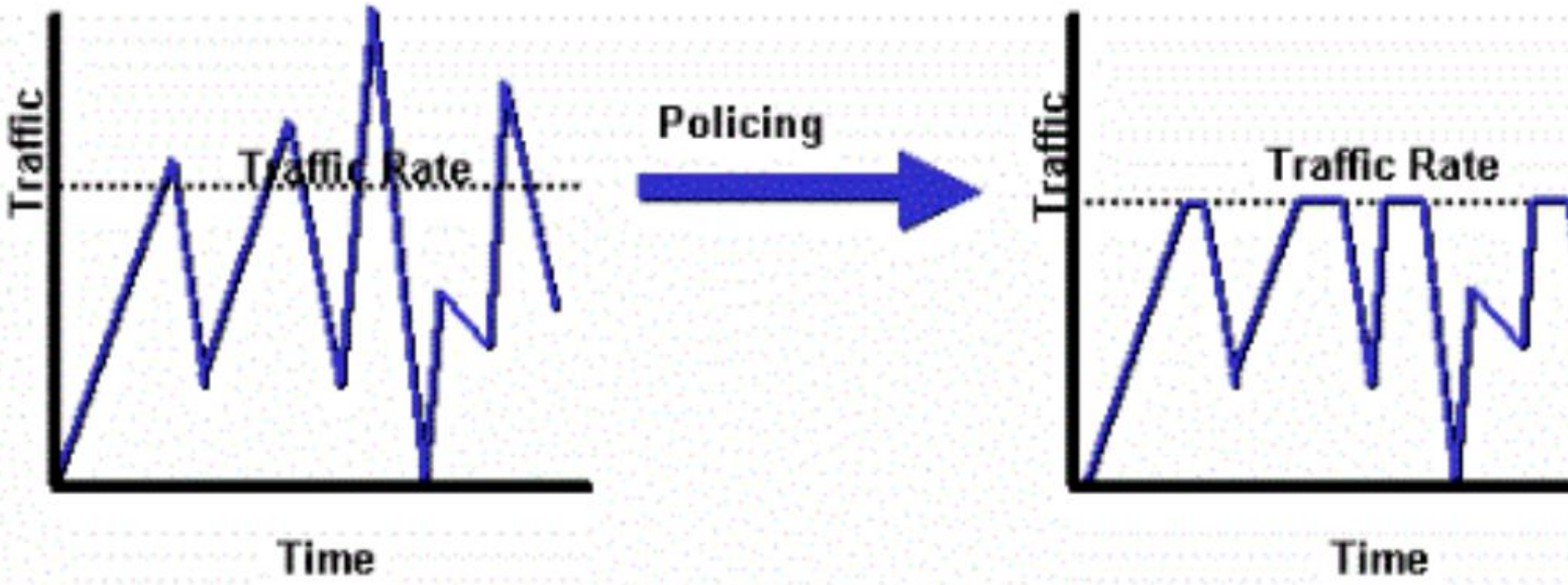
POLICING AND SHAPING

CHAINS, QUEUES

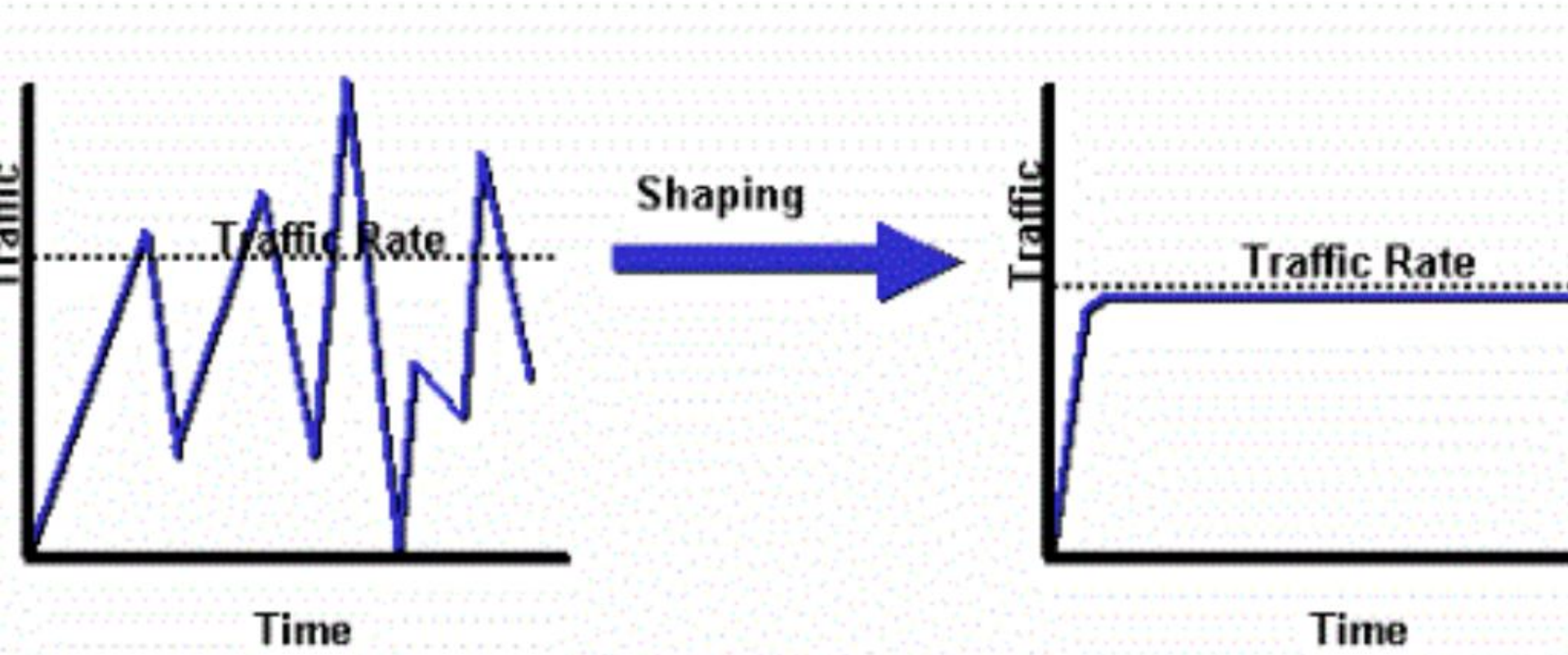

POLITICS AND SHAKING
CeBIT


POLITICIANS SHAKING CHAIN

POLICING

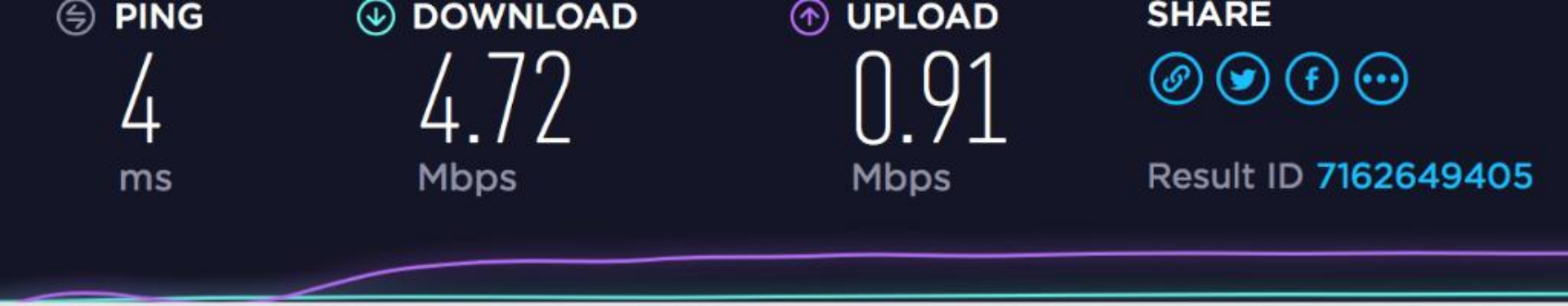

Traffic
Traffic Rate
Time
Policing
Traffic
Traffic Rate
Time

SHAPING


Traffic
Traffic Rate
Time
Shaping
Traffic
Traffic Rate
Time

POLICING

- DROP PACKETS ABOVE ALLOWED LIMIT
- QUEUE SIZE = 1
- TCP RE-ESTABLISH
- UDP PACKETS ARE LOST

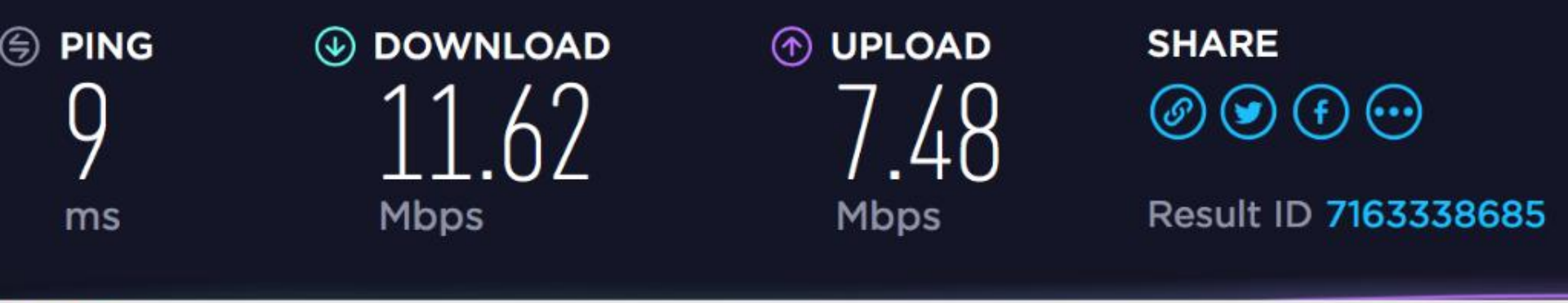


1. alexcherry@Alexs-MacBook-Pro: ~ (zsh)

```
bytes from 109.205.245.1: icmp_seq=29 ttl=55 time=16.850 ms
bytes from 109.205.245.1: icmp_seq=30 ttl=55 time=15.495 ms
bytes from 109.205.245.1: icmp_seq=31 ttl=55 time=16.115 ms
bytes from 109.205.245.1: icmp_seq=32 ttl=55 time=15.540 ms
bytes from 109.205.245.1: icmp_seq=33 ttl=55 time=15.151 ms
bytes from 109.205.245.1: icmp_seq=34 ttl=55 time=17.171 ms
uest timeout for icmp_seq 35
bytes from 109.205.245.1: icmp_seq=36 ttl=55 time=15.916 ms
uest timeout for icmp_seq 37
bytes from 109.205.245.1: icmp_seq=38 ttl=55 time=15.350 ms
bytes from 109.205.245.1: icmp_seq=39 ttl=55 time=15.482 ms
uest timeout for icmp_seq 40
bytes from 109.205.245.1: icmp_seq=41 ttl=55 time=15.618 ms
bytes from 109.205.245.1: icmp_seq=42 ttl=55 time=15.123 ms
bytes from 109.205.245.1: icmp_seq=43 ttl=55 time=15.438 ms

 109.205.245.1 ping statistics ---
packets transmitted, 35 packets received, 22.2% packet loss
nd-trip min/avg/max/stddev = 15.123/15.892/20.629/1.008 ms
```

POLICING 5 MBPS



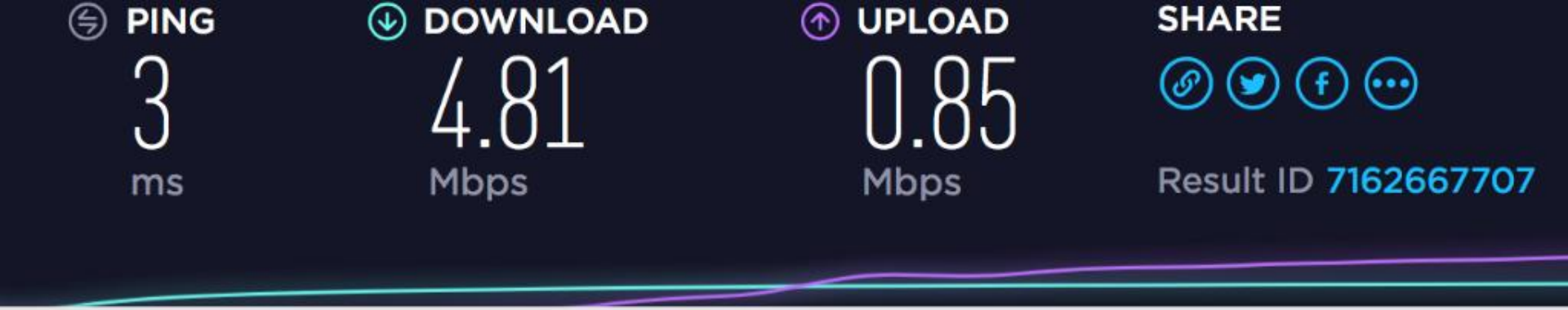
1. alexcherry@Alexs-MacBook-Pro: ~ (zsh)

```
4 bytes from 109.205.245.1: icmp_seq=19 ttl=56 time=14.097 ms
4 bytes from 109.205.245.1: icmp_seq=20 ttl=56 time=14.112 ms
4 bytes from 109.205.245.1: icmp_seq=21 ttl=56 time=14.074 ms
4 bytes from 109.205.245.1: icmp_seq=22 ttl=56 time=14.101 ms
4 bytes from 109.205.245.1: icmp_seq=23 ttl=56 time=14.[illegible] ms
4 bytes from 109.205.245.1: icmp_seq=24 ttl=56 time=14.[illegible] ms
4 bytes from 109.205.245.1: icmp_seq=25 ttl=56 time=14.162 ms
4 bytes from 109.205.245.1: icmp_seq=26 ttl=56 time=13.767 ms
4 bytes from 109.205.245.1: icmp_seq=27 ttl=56 time=13.398 ms
4 bytes from 109.205.245.1: icmp_seq=28 ttl=56 time=14.421 ms
4 bytes from 109.205.245.1: icmp_seq=29 ttl=56 time=13.403 ms
4 bytes from 109.205.245.1: icmp_seq=30 ttl=56 time=14.356 ms
4 bytes from 109.205.245.1: icmp_seq=31 ttl=56 time=14.145 ms
4 bytes from 109.205.245.1: icmp_seq=32 ttl=56 time=15.886 ms
4 bytes from 109.205.245.1: icmp_seq=33 ttl=56 time=14.926 ms
4 bytes from 109.205.245.1: icmp_seq=34 ttl=56 time=17.935 ms
4 bytes from 109.205.245.1: icmp_seq=35 ttl=56 time=14.191 ms
4 bytes from 109.205.245.1: icmp_seq=36 ttl=56 time=14.993 ms
```

POLICING 20 MBPS

SHAPING

- PACKETS PUT TO QUEUE
- TAKEN OUT BY CPU*
- PACKET ORDER IS IMPORTANT
  = QUEUE TYPE (FIFO, PCQ...)
- SET CORRECT QUEUE SIZE

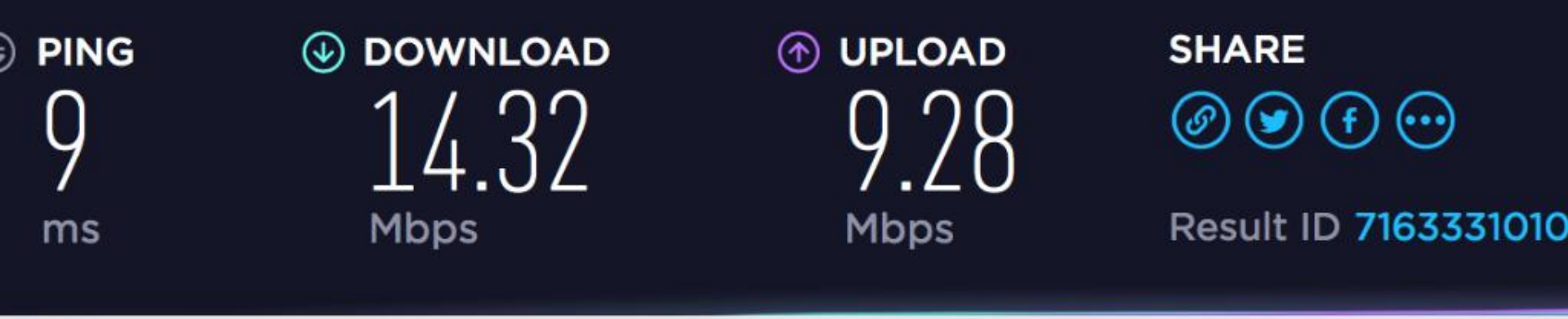


1. alexcherry@Alexs-MacBook-Pro: ~ (zsh)

bytes from 109.205.245.1: icmp_seq=30 ttl=55 time=17.126 ms
bytes from 109.205.245.1: icmp_seq=31 ttl=55 time=323.043 ms
bytes from 109.205.245.1: icmp_seq=32 ttl=55 time=239.366 ms
bytes from 109.205.245.1: icmp_seq=33 ttl=55 time=126.[illegible]
bytes from 109.205.245.1: icmp_seq=34 ttl=55 time=164.[illegible]
bytes from 109.205.245.1: icmp_seq=35 ttl=55 time=365.[illegible]
bytes from 109.205.245.1: icmp_seq=36 ttl=55 time=183.146 ms
bytes from 109.205.245.1: icmp_seq=37 ttl=55 time=371.995 ms
bytes from 109.205.245.1: icmp_seq=38 ttl=55 time=504.812 ms
bytes from 109.205.245.1: icmp_seq=39 ttl=55 time=509.404 ms
bytes from 109.205.245.1: icmp_seq=40 ttl=55 time=150.161 ms
quest timeout for icmp_seq 41
bytes from 109.205.245.1: icmp_seq=42 ttl=55 time=15.339 ms
bytes from 109.205.245.1: icmp_seq=43 ttl=55 time=16.207 ms
bytes from 109.205.245.1: icmp_seq=44 ttl=55 time=15.113 ms

- 109.205.245.1 ping statistics ---
packets transmitted, 43 packets received, 4.4% packet loss
und-trip min/avg/max/stddev = 15.113/127.486/572.786/143.050 ms

SHAPING 5 MBPS

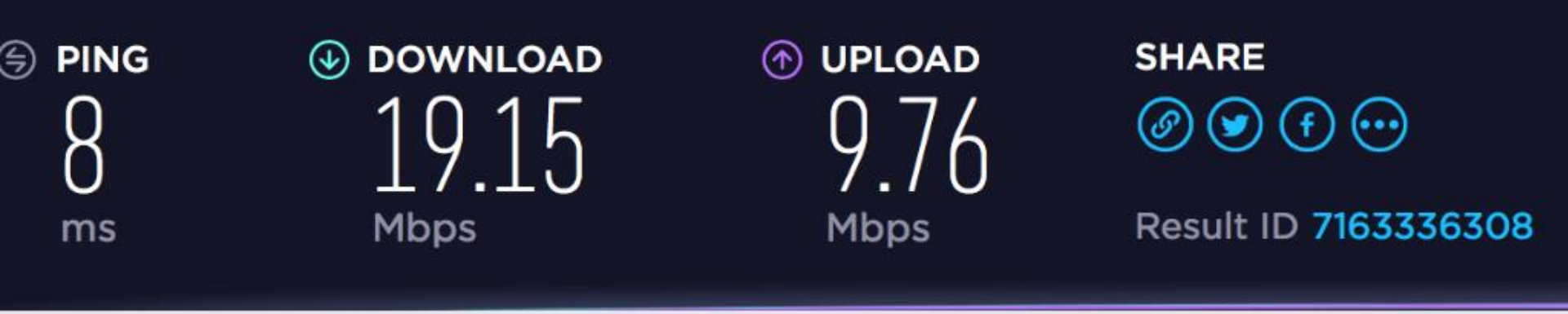


1. alexcherry@Alexs-MacBook-Pro: ~ (zsh)

```
bytes from 109.205.245.1: icmp_seq=31 ttl=56 time=18.144 ms
bytes from 109.205.245.1: icmp_seq=32 ttl=56 time=16.118 ms
bytes from 109.205.245.1: icmp_seq=33 ttl=56 time=20.938 ms
bytes from 109.205.245.1: icmp_seq=34 ttl=56 time=14.441 ms
bytes from 109.205.245.1: icmp_seq=35 ttl=56 time=30.[illegible] ms
bytes from 109.205.245.1: icmp_seq=36 ttl=56 time=16.491 ms
bytes from 109.205.245.1: icmp_seq=37 ttl=56 time=22.359 ms
bytes from 109.205.245.1: icmp_seq=38 ttl=56 time=[illegible] ms
bytes from 109.205.245.1: icmp_seq=39 ttl=56 time=14.292 ms
bytes from 109.205.245.1: icmp_seq=40 ttl=56 time=16.420 ms
bytes from 109.205.245.1: icmp_seq=41 ttl=56 time=25.011 ms
bytes from 109.205.245.1: icmp_seq=42 ttl=56 time=23.635 ms
bytes from 109.205.245.1: icmp_seq=43 ttl=56 time=31.156 ms
bytes from 109.205.245.1: icmp_seq=44 ttl=56 time=14.826 ms
bytes from 109.205.245.1: icmp_seq=45 ttl=56 time=16.882 ms
bytes from 109.205.245.1: icmp_seq=46 ttl=56 time=14.143 ms
bytes from 109.205.245.1: icmp_seq=47 ttl=56 time=14.191 ms
```

SHAPING 20 MBPS

DEFAULT SMALL (PPPOE)



1. alexcherry@Alexs-MacBook-Pro: ~ (zsh)

```
4 bytes from 109.205.245.1: icmp_seq=23 ttl=56 time=68.823 ms
4 bytes from 109.205.245.1: icmp_seq=24 ttl=56 time=16.443 ms
4 bytes from 109.205.245.1: icmp_seq=25 ttl=56 time=55.966 ms
4 bytes from 109.205.245.1: icmp_seq=28 ttl=56 time=58.169 ms
4 bytes from 109.205.245.1: icmp_seq=29 ttl=56 time=71.563 ms
4 bytes from 109.205.245.1: icmp_seq=31 ttl=56 time=43.749 ms
4 bytes from 109.205.245.1: icmp_seq=32 ttl=56 time=45.261 ms
4 bytes from 109.205.245.1: icmp_seq=33 ttl=56 time=72.241 ms
4 bytes from 109.205.245.1: icmp_seq=34 ttl=56 time=68.991 ms
4 bytes from 109.205.245.1: icmp_seq=35 ttl=56 time=72.967 ms
4 bytes from 109.205.245.1: icmp_seq=36 ttl=56 time=63.182 ms
4 bytes from 109.205.245.1: icmp_seq=37 ttl=56 time=46.526 ms
4 bytes from 109.205.245.1: icmp_seq=38 ttl=56 time=14.470 ms
4 bytes from 109.205.245.1: icmp_seq=39 ttl=56 time=14.332 ms
4 bytes from 109.205.245.1: icmp_seq=40 ttl=56 time=18.208 ms
```

SHAPING 20 MBPS FIXED

SET QUEUE SIZE = 50 PACKETS

SHAPING

QUEUES. HTB. PCQ

WHAT TO MANAGE

- LIMIT CUSTOMER'S SPEED
- ALLOCATE BANDWIDTH TO APPLICATIONS
- PRIORITY FOR TYPE OF TRAFFIC

IT'S ALL ABOUT QUEUES

MIKROTIK SHAPING

1. QUEUE TREE
2. Q.TREE : PCQ + ADD.LIST
3. SIMPLE QUEUE
4. SIMPLE QUEUE + PARENTS

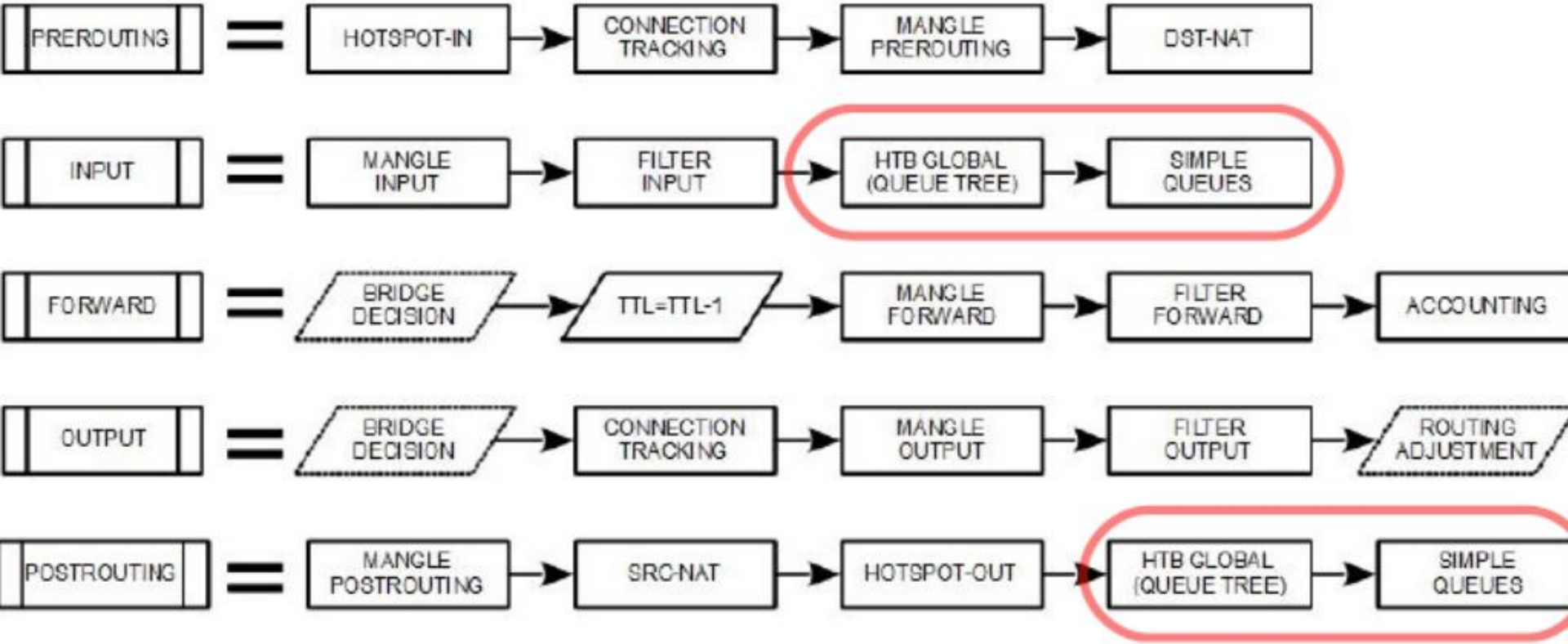

1. CUTE TREE

1. QUEUE TREE

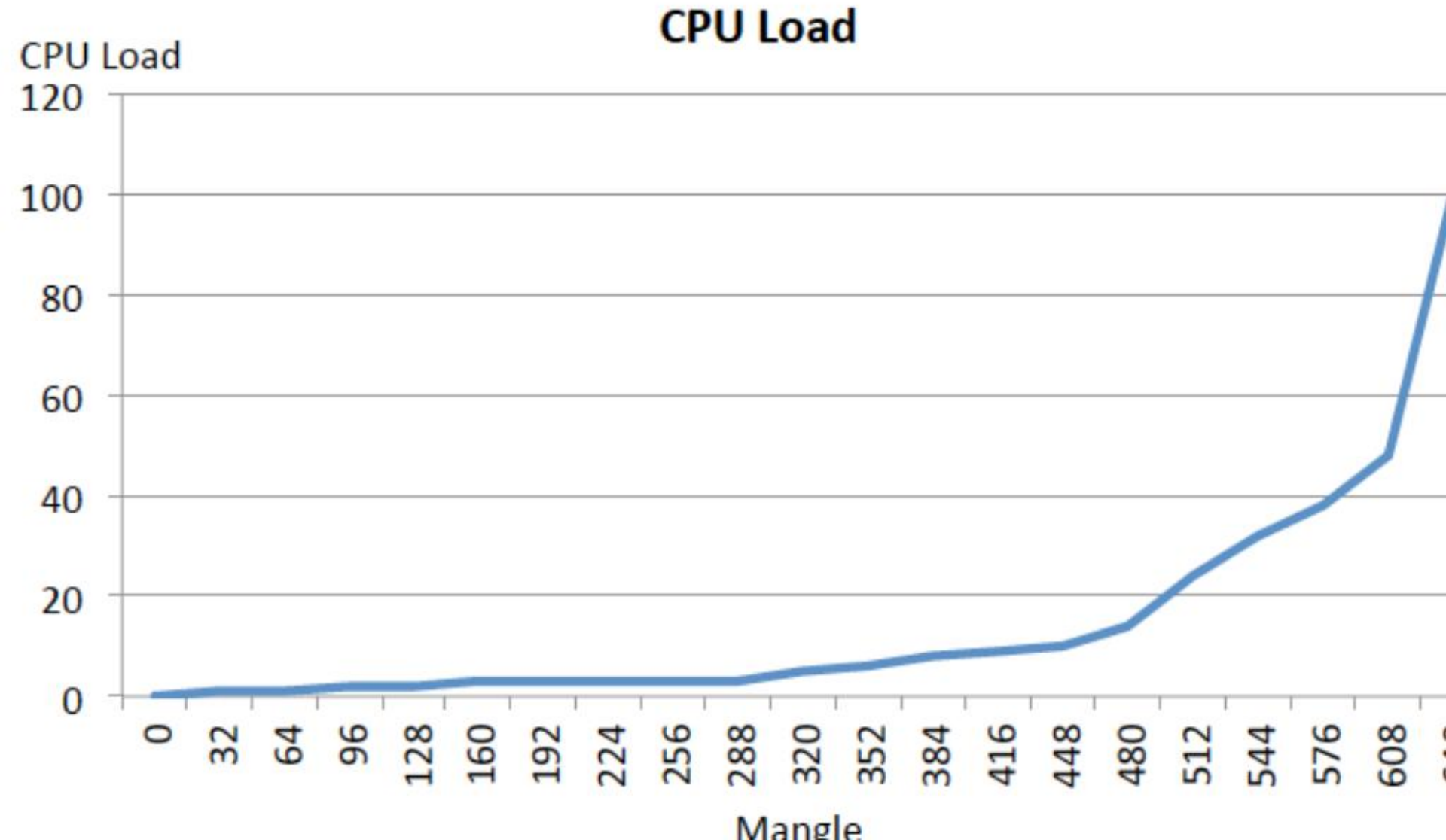
1. QUEUE TREE

- NEED TO MANGLE ALL (SLOW)
- TREE WITH MULTIPLE LEVELS
- USE IT FOR TRAFIC TYPE PRIORITISATION
- HTB GLOBAL IS USED FOR QUEUES

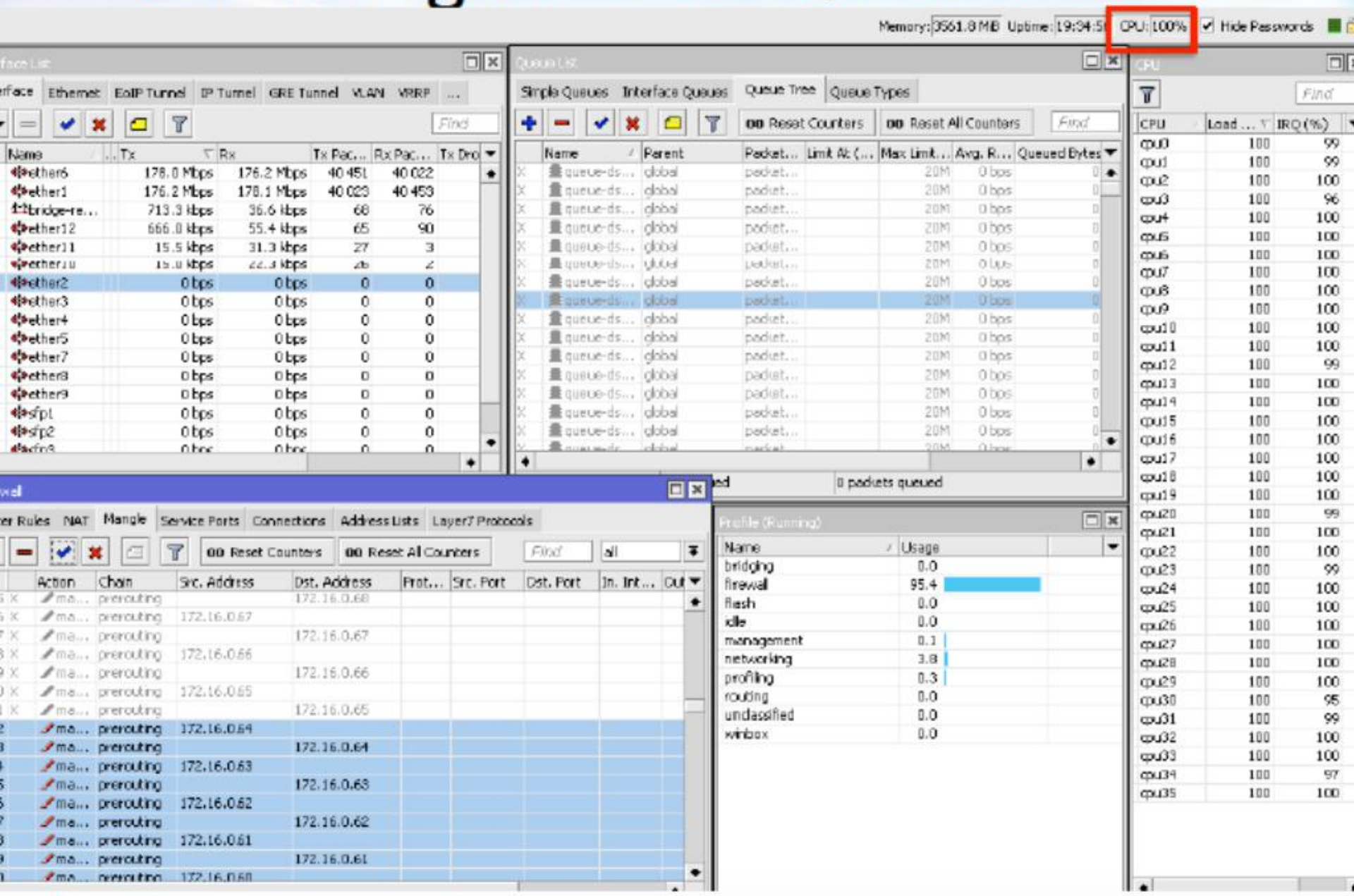
HTB in RouterOS v6



Graphs


CPU Load
CPU Load
120
100
80
60
40
20
0
0
32
64
96
128
160
192
224
256
288
320
352
384
416
448
480
512
544
576
608
Mangle

640 mangles → 100% CPU load




SHOWTIME

2. PCQ + ADDRESS LIST

IMPROVED QUEUE TREE

2. PCQ + ADDRESS LIST

- REALLY LESS MANGLES
- INTERNAL PCQ SUB QUEUES
- FAST ON X86 WITH POWERFUL CORES
- USED A LOT IN ROUTER OS 5.X
- FOR CCR NOT A GOOD OPTION

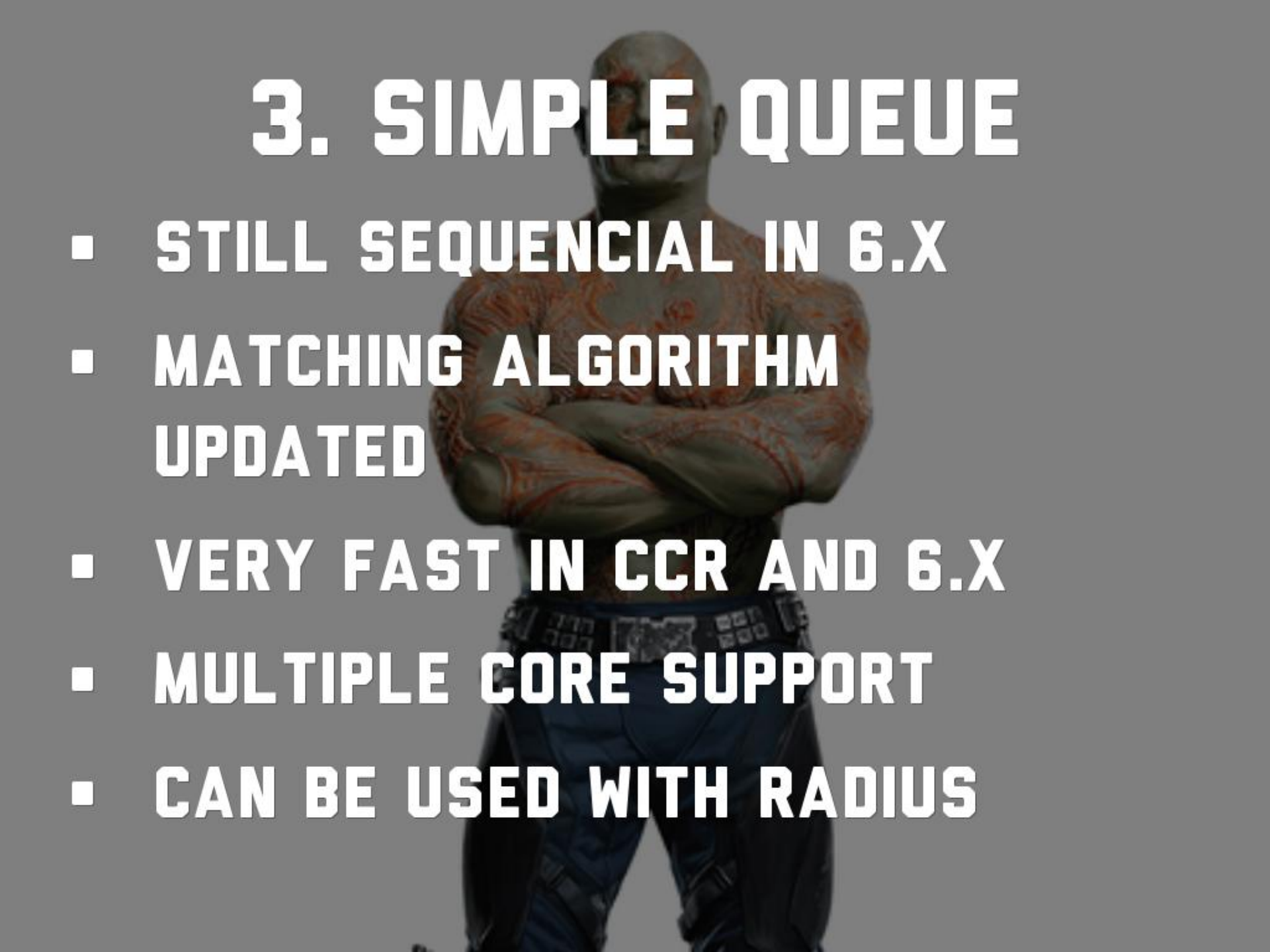
2. CCR LIMITATION :

- ONLY ONE CPU CORE CAN TAKE PACKETS OUT FROM HTB TREE
- MIKROTIK IS WORKING ON POSSIBLE UPDATE OF HTB ALGORITHM, OR INTRODUCING COMPLETELY NEW METHOD (V 7.0 ?)
- USE INTERFACE HTB AS MUCH AS POSSIBLE TO OFFLOAD TRAFFIC FROM HTB "GLOBAL" OR ... -> USE SIMPLE QUEUES


SHOWTIME

3. SIMPLE QUEUE

3. SIMPLE QUEUE



- STILL SEQUENCIAL IN 6.X
- MATCHING ALGORITHM UPDATED
- VERY FAST IN CCR AND 6.X
- MULTIPLE CORE SUPPORT
- CAN BE USED WITH RADIUS

3. SIMPLE QUEUE RADIUS

- AUTOMATIC CREATION
- RADIUS ATTRIBUTES USED
- ALLOWS TO CHANGE SPEEDS ON FLY (COA SUPPORT)
- ALLOWS CAP AND FUP IMPLEMENTATION

hboard

CPU: 4%

Queue List

Simple Queues | Interface Queues | Queue Tree | Queue Types

00 Reset Counters | 00 Reset All Counters | Find

#	Name	Target	Upload Max Limit	Download Max Limit	Packet Marks	Total Max Limit (b...
;;; 221092						
1...	SpLSQ_3949-5068	10.25.5.86	720k	920k		
;;; 221091						
1...	SpLSQ_3945-4972	10.25.5.85	720k	920k		
;;; 245634						
1...	SpLSQ_3944-4930	10.26.0.10	720k	920k		
;;; 003937						
996	SpLSQ_3938-4906	10.25.6.144	720k	920k		
;;; 251631						
1...	SpLSQ_3926-5401	10.25.1.159	920k	1520k		
;;; 003924						
984	SpLSQ_3924-4828	10.25.5.84	720k	920k		
;;; 251630						
983	SpLSQ_3923-4827	10.25.1.97	720k	920k		
;;; 251629						
981	SpLSQ_3922-4824	10.25.1.90	720k	920k		
;;; 265858						
973	SpLSQ_3920-4815	10.25.6.14	720k	920k		
;;; 003919						
1...	SpLSQ_3919-4983	10.25.5.50	720k	920k		
;;; 003917						
1...	SpLSQ_3917-5043	10.26.0.212	2048k	2048k		
;;; 002302						
1...	SpLSQ_3913-5501	10.25.1.206	1024k	1024k		
;;; 003911						
1...	SpLSQ_3911-4962	10.26.0.211	920k	1520k		
;;; 003908						
958	SpLSQ_3908-4753	10.25.7.177	360k	460k		
;;; 003907						
956	SpLSQ_3907-4750	10.25.7.176	360k	460k		
;;; 003903						
948	SpLSQ_3904-4733	10.26.0.207	360k	460k		
;;; 003901						
939	SpLSQ_3901-4570	10.26.0.210	360k	460k		
;;; 251628						
934	SpLSQ_3898-4561	10.25.1.103	720k	920k		

2251 items (1 selected) | 0 B queued | 0 packets queued

300 MBPS, 2K QUEUES

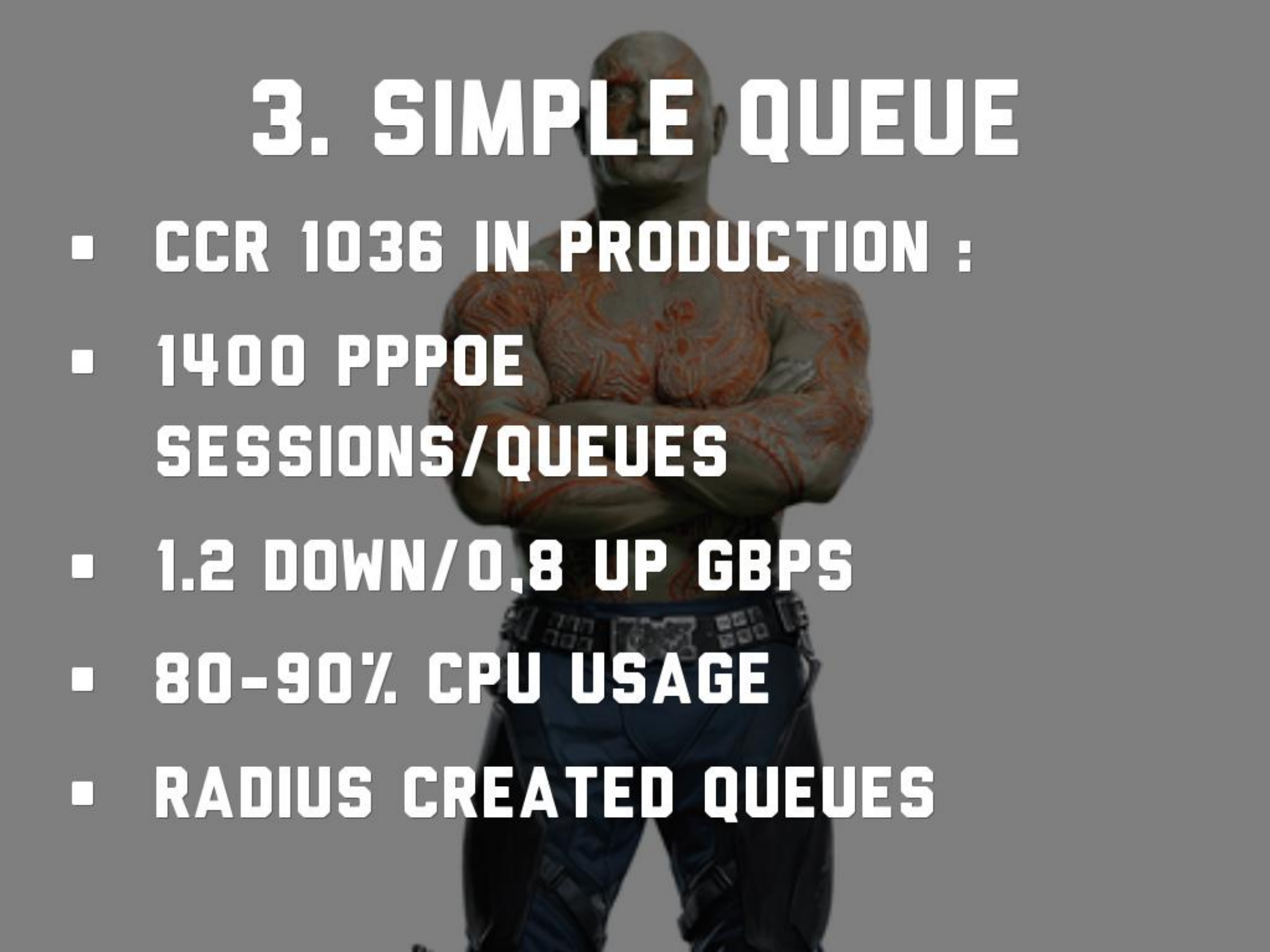
Profile (Running)

Name	
idle	64.9
firewall	17.0
queuing	10.5
networking	3.2
traffic-accounting	0.9
management	0.8
ethernet	0.5
bridging	0.4
ppp	0.3
profiling	0.2
radius	0.2
routing	0.2
unclassified	0.2
firewall-mgmt	0.0
logging	0.0
winbox	0.0

Resources

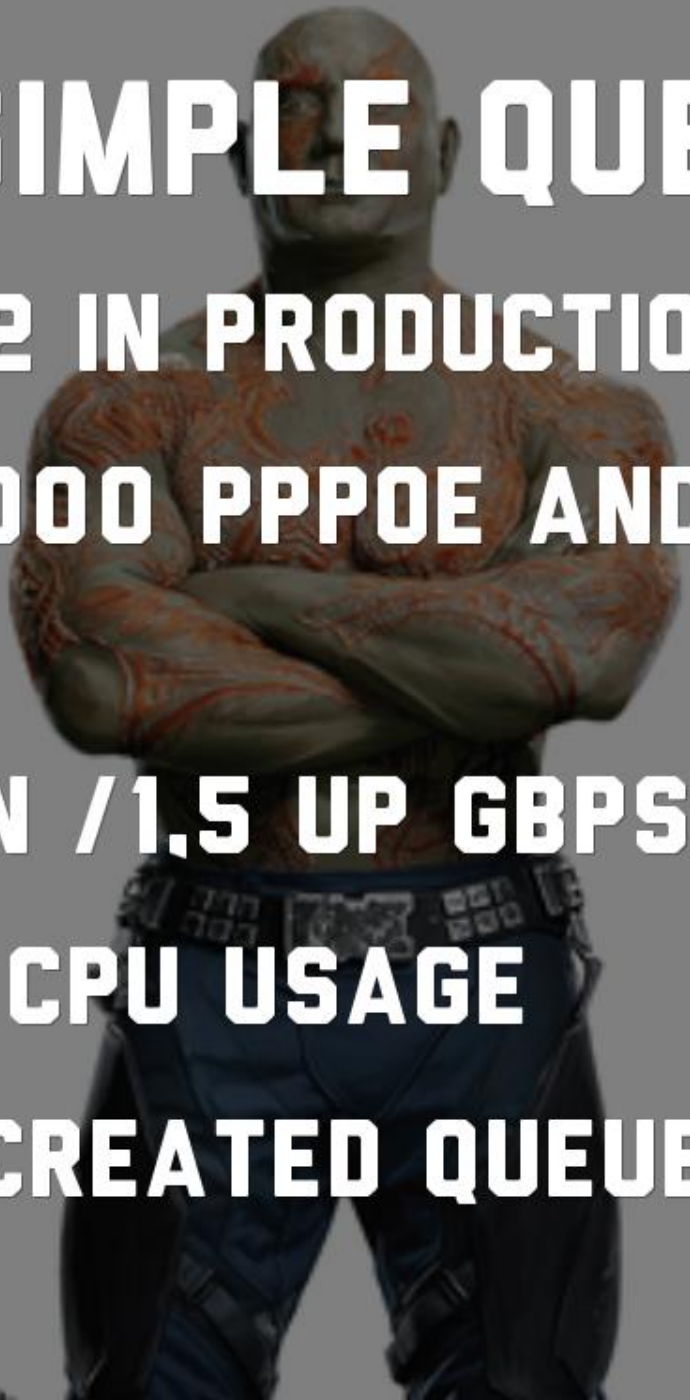
	d 02:10
Free Memory:	15.0 GiB
Total Memory:	15.9 GiB
CPU:	tilegx
CPU Count:	36
CPU Frequency:	1200 MHz
CPU Load:	12 %
Free HDD Space:	876.4 MiB
Total HDD Size:	1024.0 Mi

3. SIMPLE QUEUE



- CCR 1036 IN PRODUCTION :
- 1400 PPPOE SESSIONS/QUEUES
- 1.2 DOWN/0.8 UP GBPS
- 80-90% CPU USAGE
- RADIUS CREATED QUEUES

3. SIMPLE QUEUE



- CCR 1072 IN PRODUCTION :
- UP TO 3000 PPPOE AND QUEUES
- 2.5 DOWN /1.5 UP GBPS
- 80-90% CPU USAGE
- RADIUS CREATED QUEUES

Location: All Partn

3. SIMPLE QUEUE - DEPLOYMENT

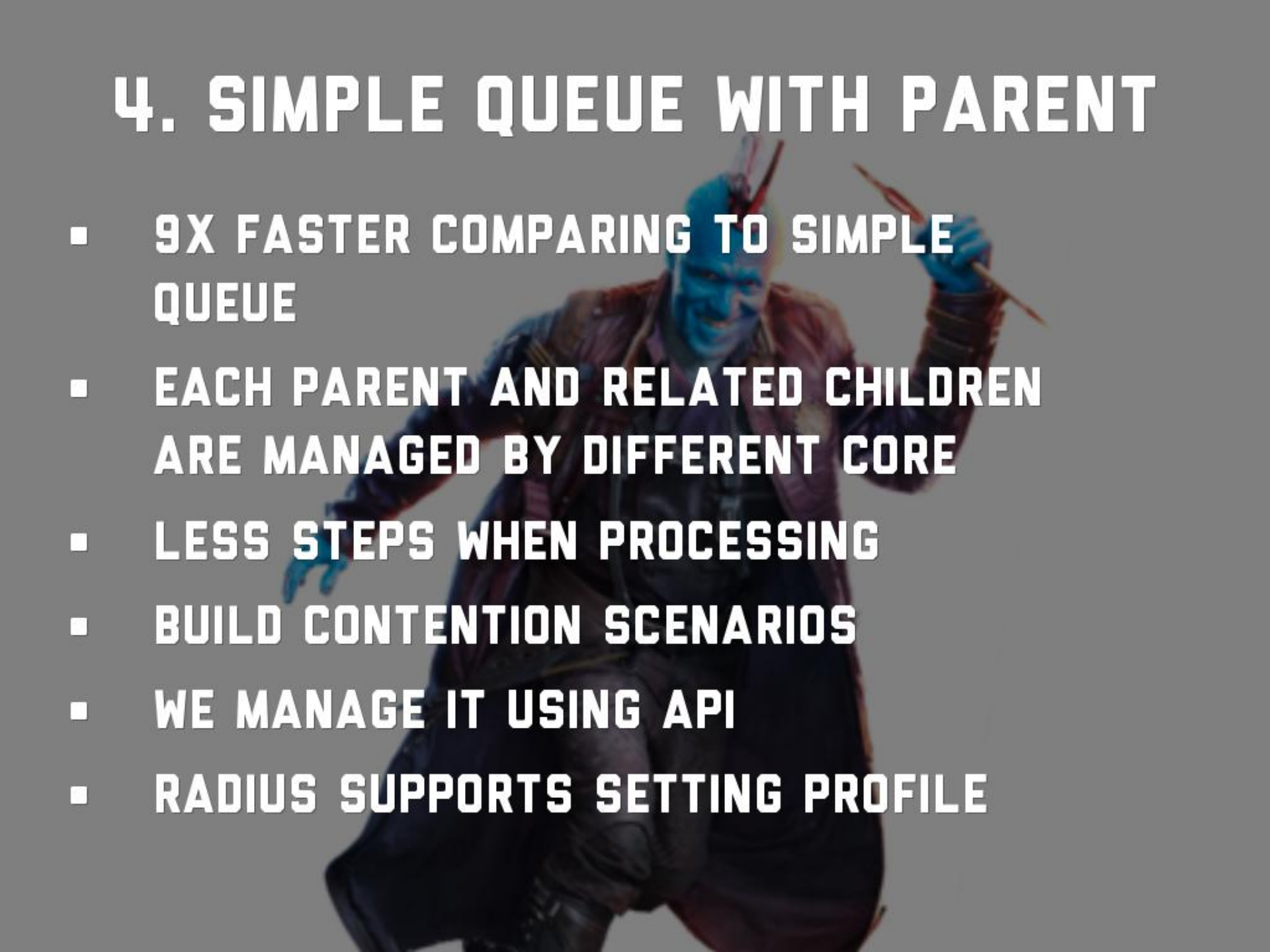
Routers

Producer/Model	Status	Customers online
1036-8G-2S+-EM	Radius	1101
1036-8G-2S+-EM	Radius	1066
1036-8G-2S+-EM	Radius	1065
1036-8G-2S+-EM	Radius	1059
1036-8G-2S+-EM	Radius	986
CCR1072-1G-8S+	Radius	0

4. SIMPLE QUEUE WITH PARENT

FASTEST SHAPING ON CCR

4. SIMPLE QUEUE WITH PARENT



- 9X FASTER COMPARING TO SIMPLE QUEUE
- EACH PARENT AND RELATED CHILDREN ARE MANAGED BY DIFFERENT CORE
- LESS STEPS WHEN PROCESSING
- BUILD CONTENTION SCENARIOS
- WE MANAGE IT USING API
- RADIUS SUPPORTS SETTING PROFILE

CONTENTION PER PLAN

- 5 MBPS PLAN 1:5 CONTENTION
- DEFINE LIMIT-AT (1024 KBPS)
- CENTRAL SHAPING
- MAX. 128 IPS UNDER ONE PARENT

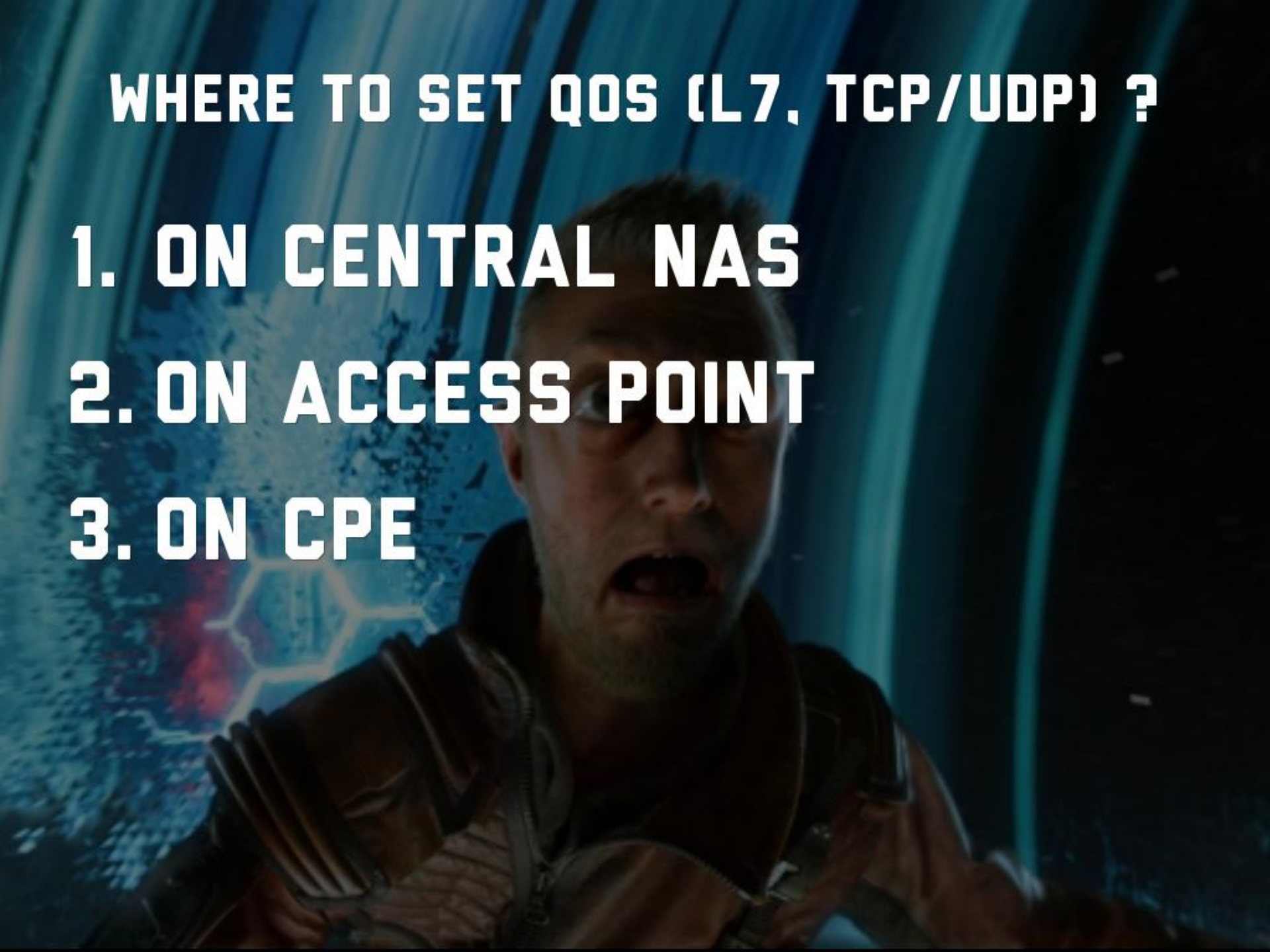
CONTENTION PER SECTOR

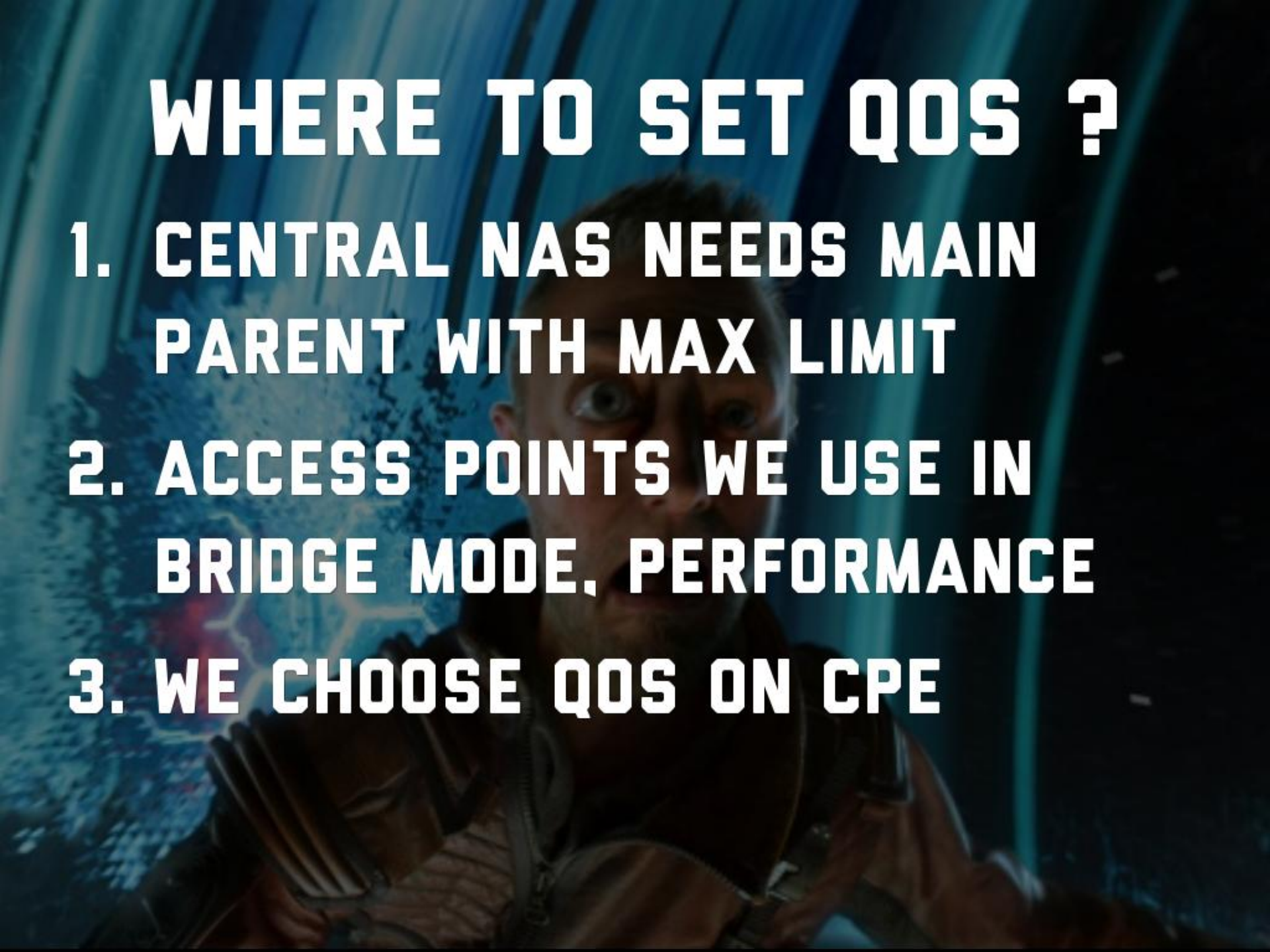
- DEFINE SECTOR MAX SPEEDS
- PUT CUSTOMERS UNDER SECTORS
- 10 MBPS SECTOR WITH 5 CUSTOMERS
- EACH CUSTOMER CAN HAVE DIFFERENT SPEED

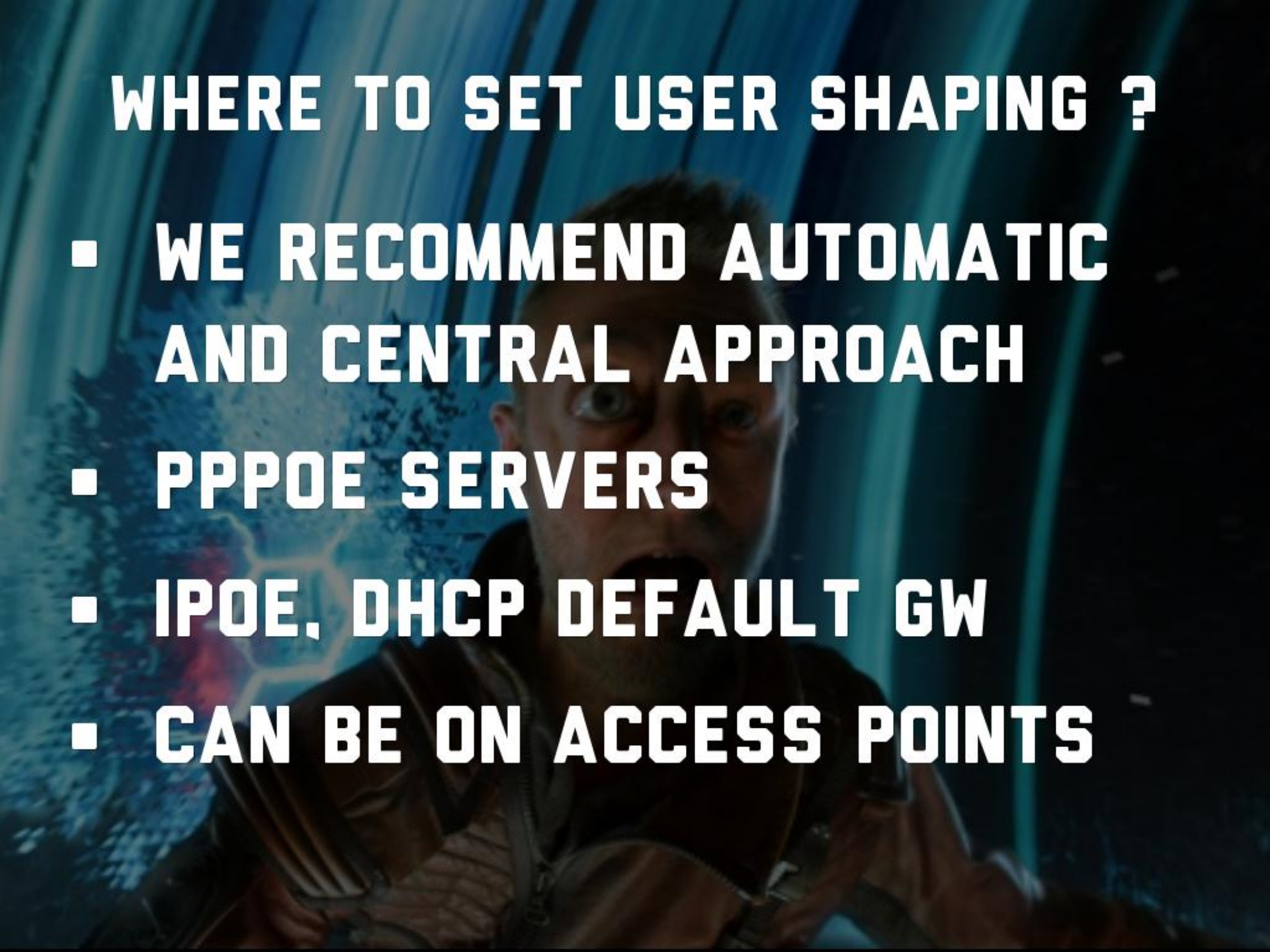

SHOWTIME

QOS AND ROUTEROS


OVERLOADED ?


WHERE TO SET QOS (L7, TCP/UDP) ?
1. ON CENTRAL NAS
2. ON ACCESS POINT
3. ON CPE


WHERE TO SET QOS ?
1. CENTRAL NAS NEEDS MAIN PARENT WITH MAX LIMIT
2. ACCESS POINTS WE USE IN BRIDGE MODE. PERFORMANCE
3. WE CHOOSE QOS ON CPE


WHERE TO SET USER SHAPING ?
WE RECOMMEND AUTOMATIC AND CENTRAL APPROACH
PPPOE SERVERS
IPOE, DHCP DEFAULT GW
CAN BE ON ACCESS POINTS


THAT'S ALL !

THANK YOU

- FOR YOUR TIME
- MIKROTIK FOR ROUTEROS
- VALENS RIYADI FOR FEW SLIDES
- #ROOT FOR PICTURES :-)

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QUESTIONS ?