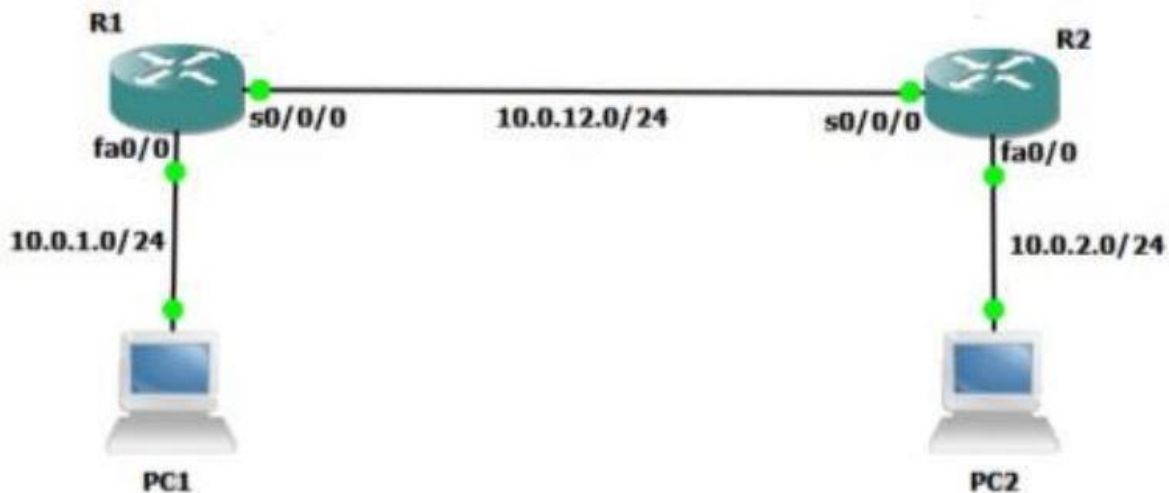


Dokumentácia k cvičeniu č.8

Tomáš Pikna, Stanislav Rusnák

Topológia



Generovanie tokov

Toky: kolísavý okolo: a.) aj b.) 84 kb/s UDP, c.) 112kbps

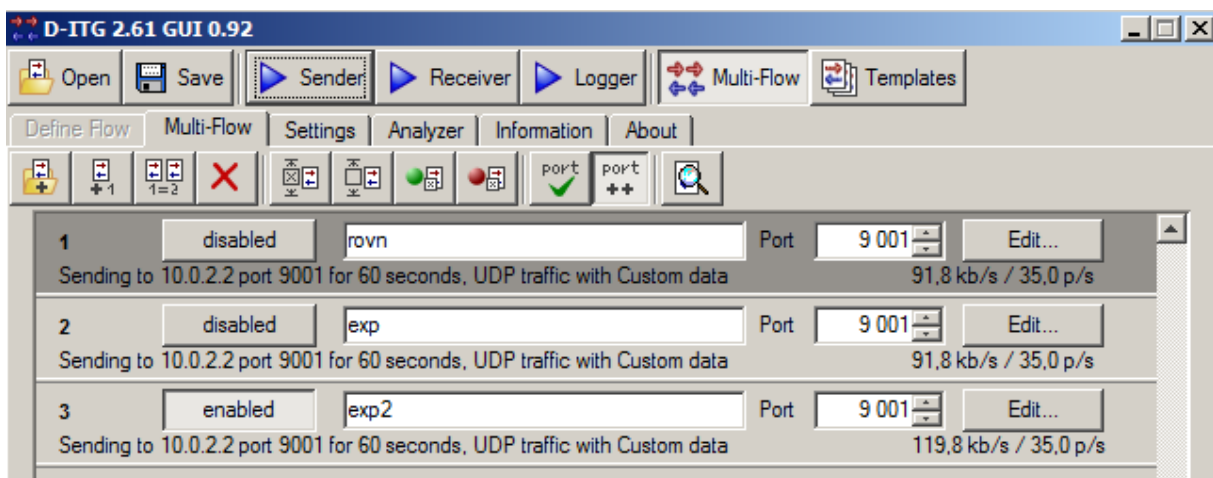
o Intenzita: 35 pak/s - náhodné časy príchodov s expon. rozdelením, pričom priemerne bude chodiť 35 pak/s

o Veľkosť paketov náhodná - spravte pre každý scenár (viď nižšie) tieto 3 varianty:

* a.) s rovnomerným rozdelením = uniform od 100 do 500 B

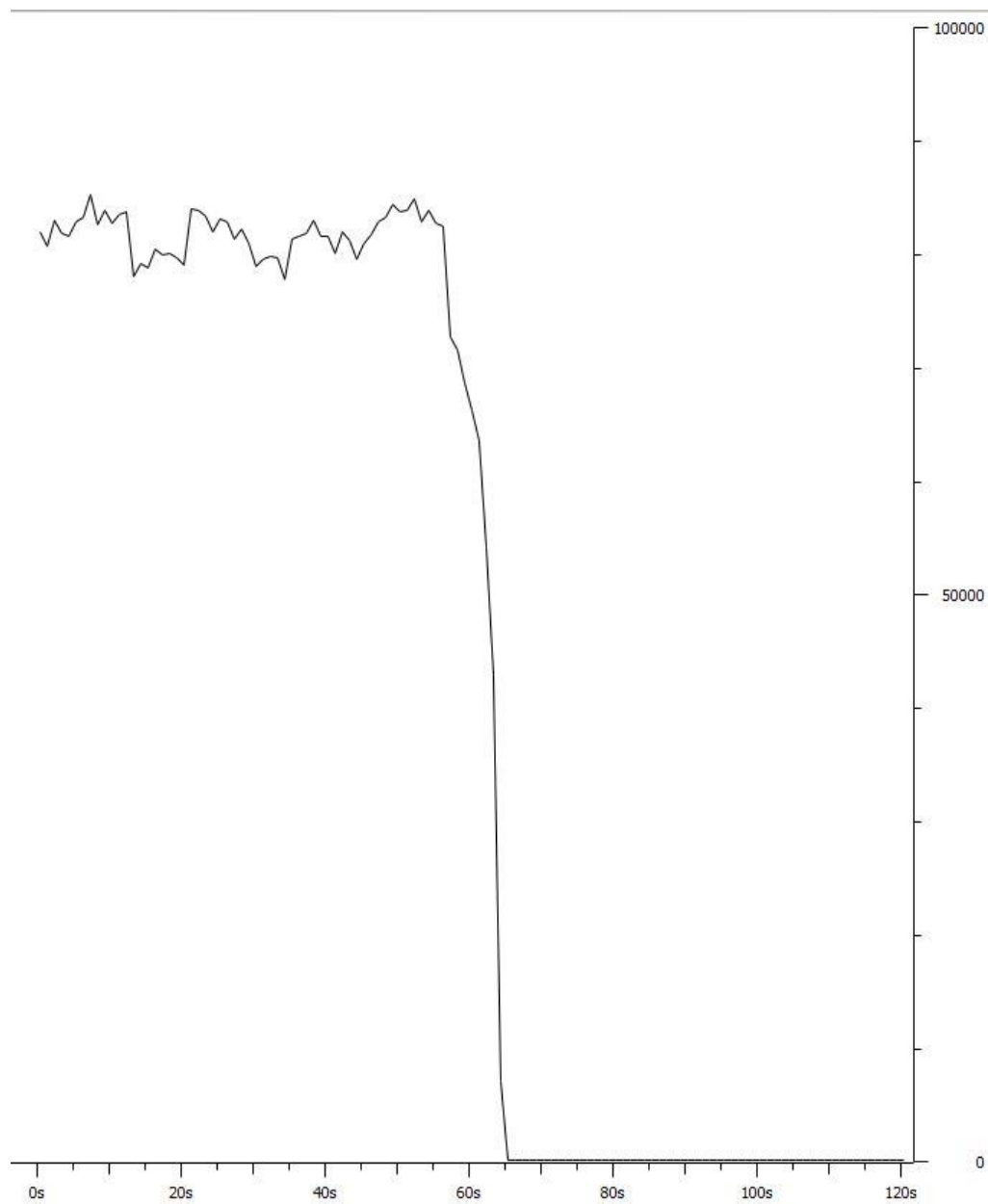
* b.) s exponenciálnym rozdelením so strednou veľkosťou paketu 300 B

* c.) s exp. rozdelením so strednou dĺžkou 400 B

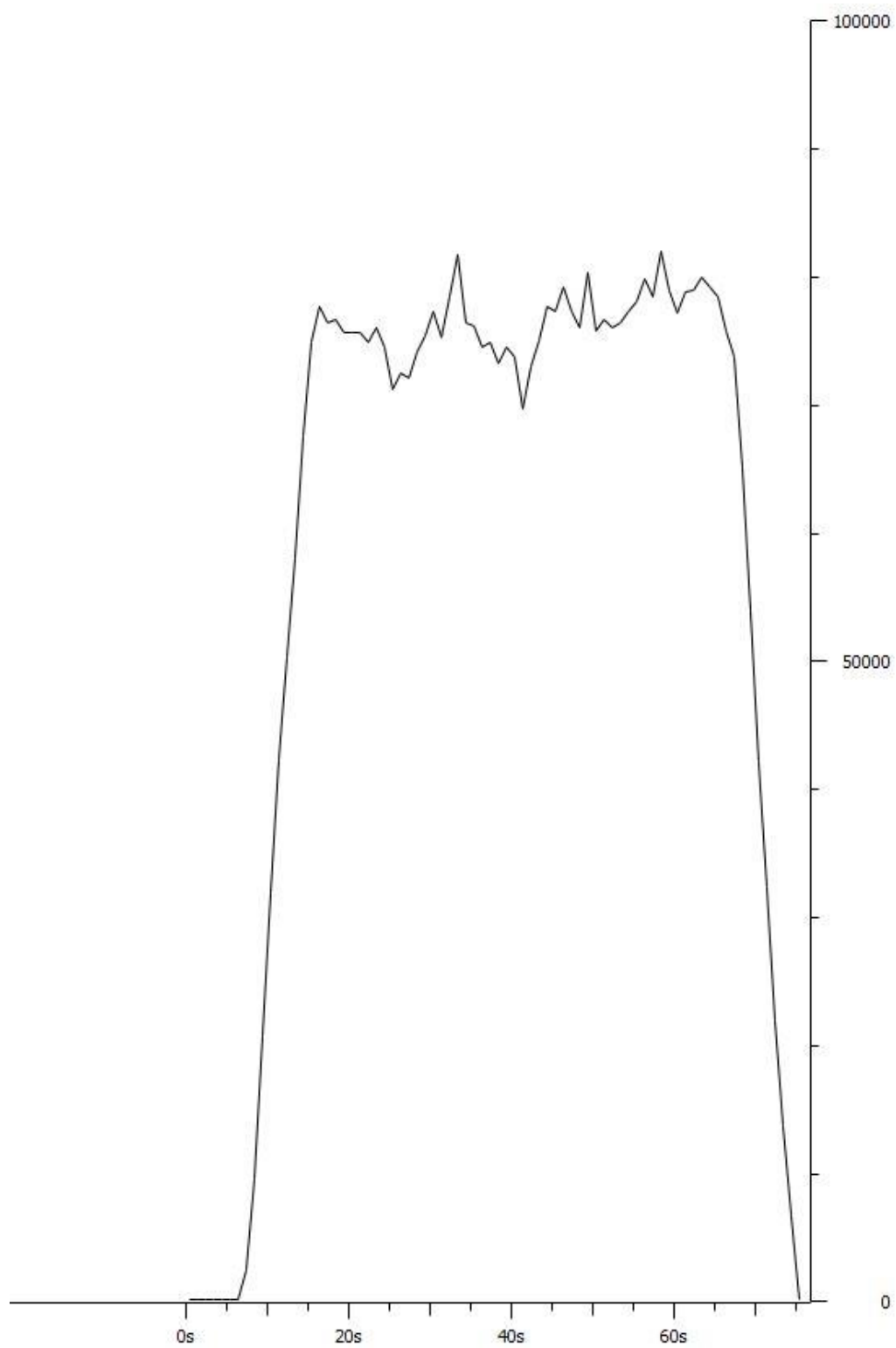


Policing - Single rate two color (jednoduchý token bucket)

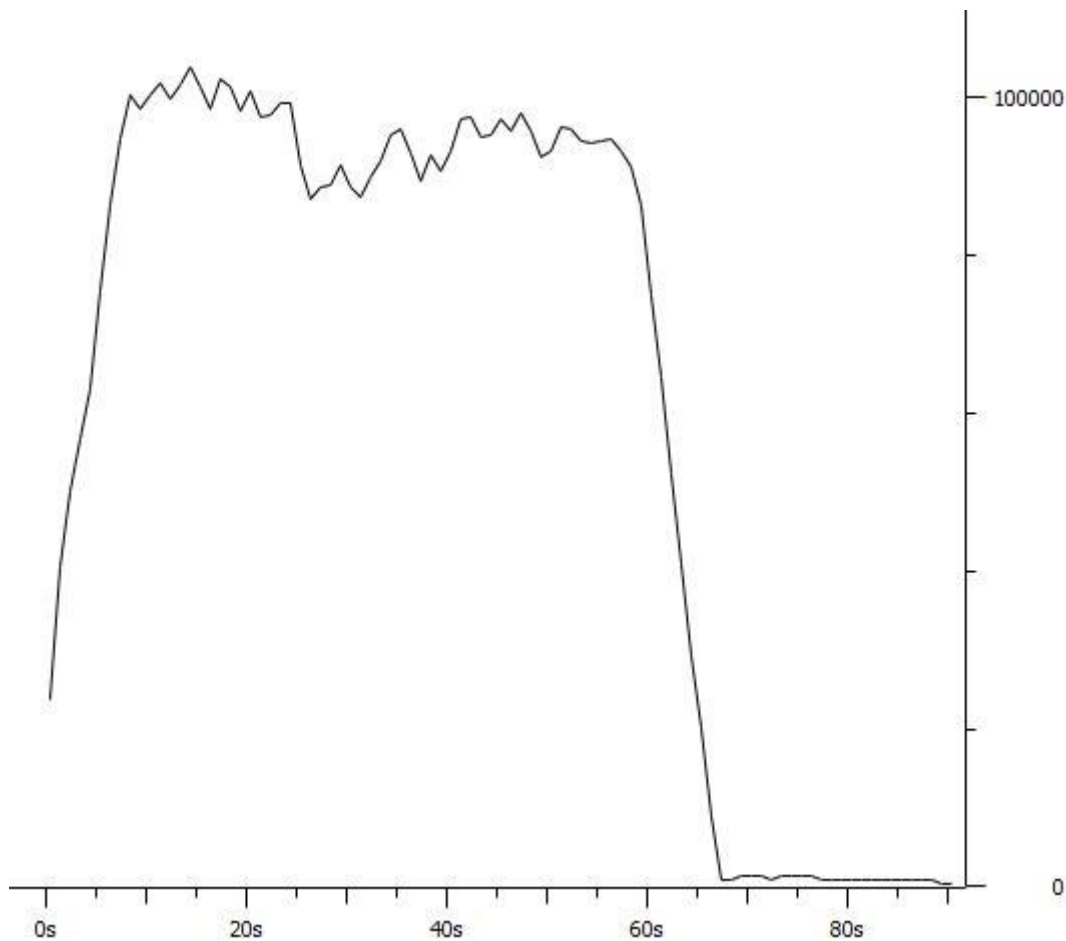
Vytvorenie triedy s následnou policy do ktorej pôjde všetok generovaný tok. V prvom prípade sa všetok tok označuje DSCP hodnotou 2 a pakety nad hodnotu 84kbps zahodí.



Obrázok 1 : Rovnomerný 84kbps



Obrázok 2 : Exponenciálny 84 kbps



Obrázok 3 : Exponenciálny 112 kbps

```
R1#sh policy-map int fa0/0
FastEthernet0/0
```

```
Service-policy input: zn
```

```
Class-map: tok1 (match-all)
```

```
2128 packets, 731802 bytes
```

```
5 minute offered rate 0000 bps, drop rate 0000 bps
```

```
Match: access-group 101
```

```
QoS Set
```

```
dscp 2
```

```
Packets marked 2128
```

```
police:
```

```
cir 84000 bps, bc 2625 bytes
```

```
conformed 1838 packets, 613636 bytes; actions:
transmit
```

```
exceeded 290 packets, 118166 bytes; actions:
drop
```

```
conformed 0000 bps, exceeded 0000 bps
```

```
Class-map: class-default (match-any)
```

```
9 packets, 567 bytes
```

```
5 minute offered rate 0000 bps, drop rate 0000 bps
```

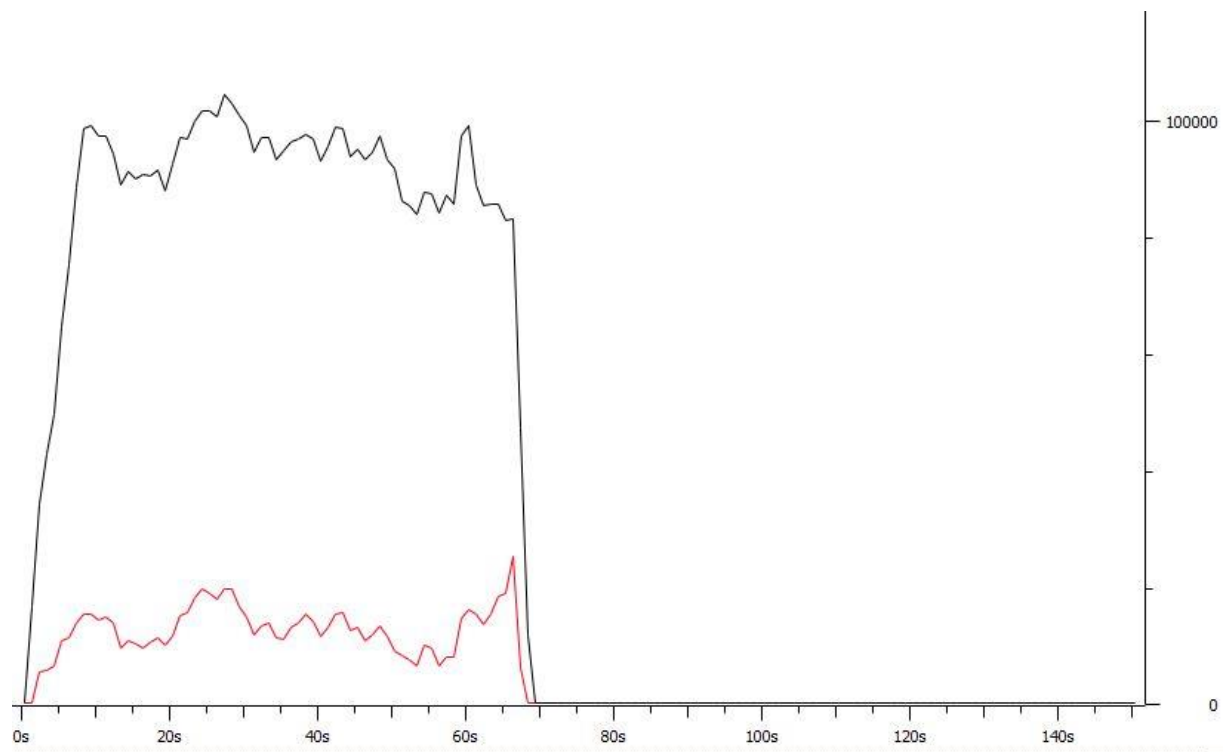
```
Match: any
```

$$bc = 2625 \text{ B} * 8 = 21000 \text{ b}$$

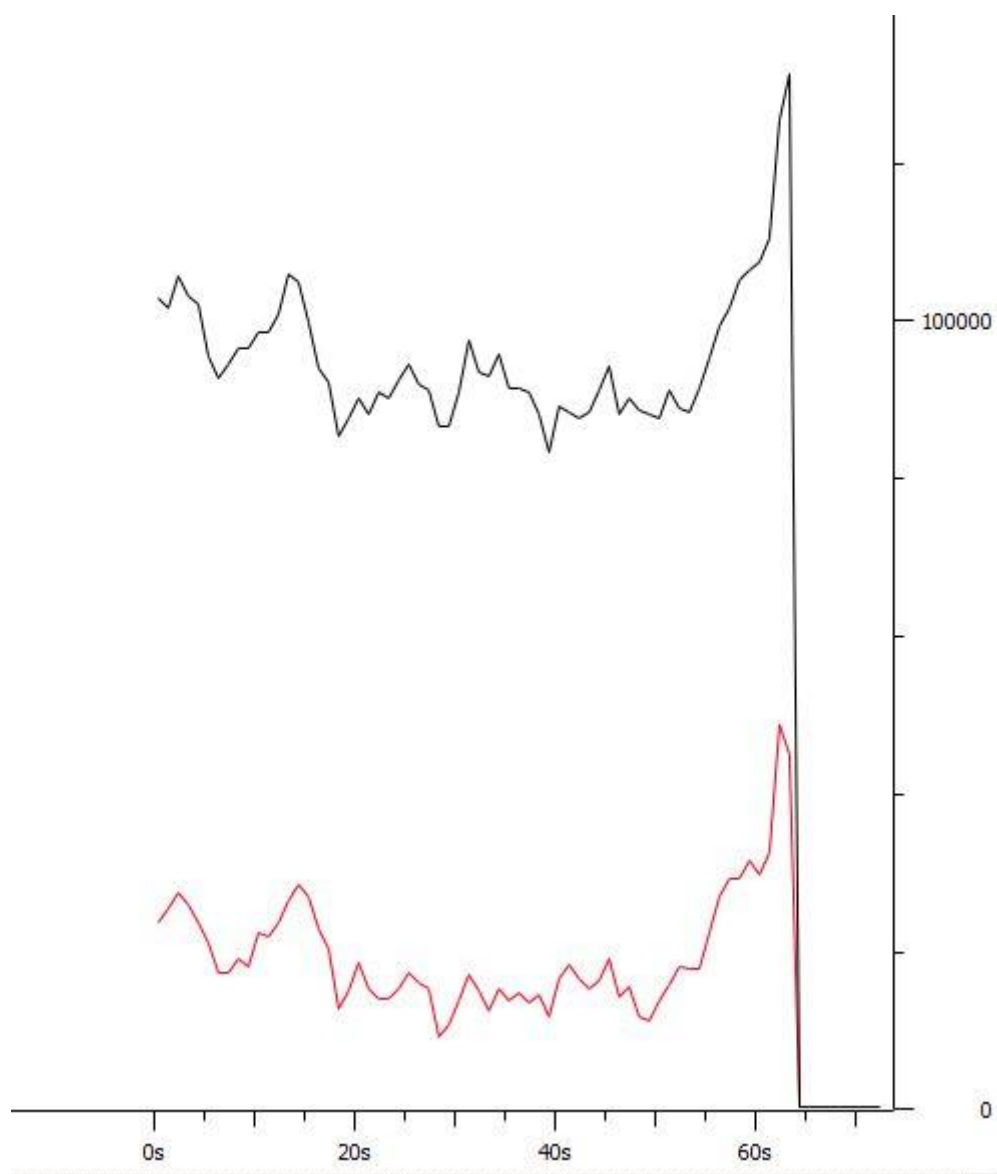
$$Tc = Bc / CIR = 21000 / 84000 = 0,25 \text{ s}$$

$$1 / Tc = 1 / 0,25 = 4 \text{ doplnení/s}$$

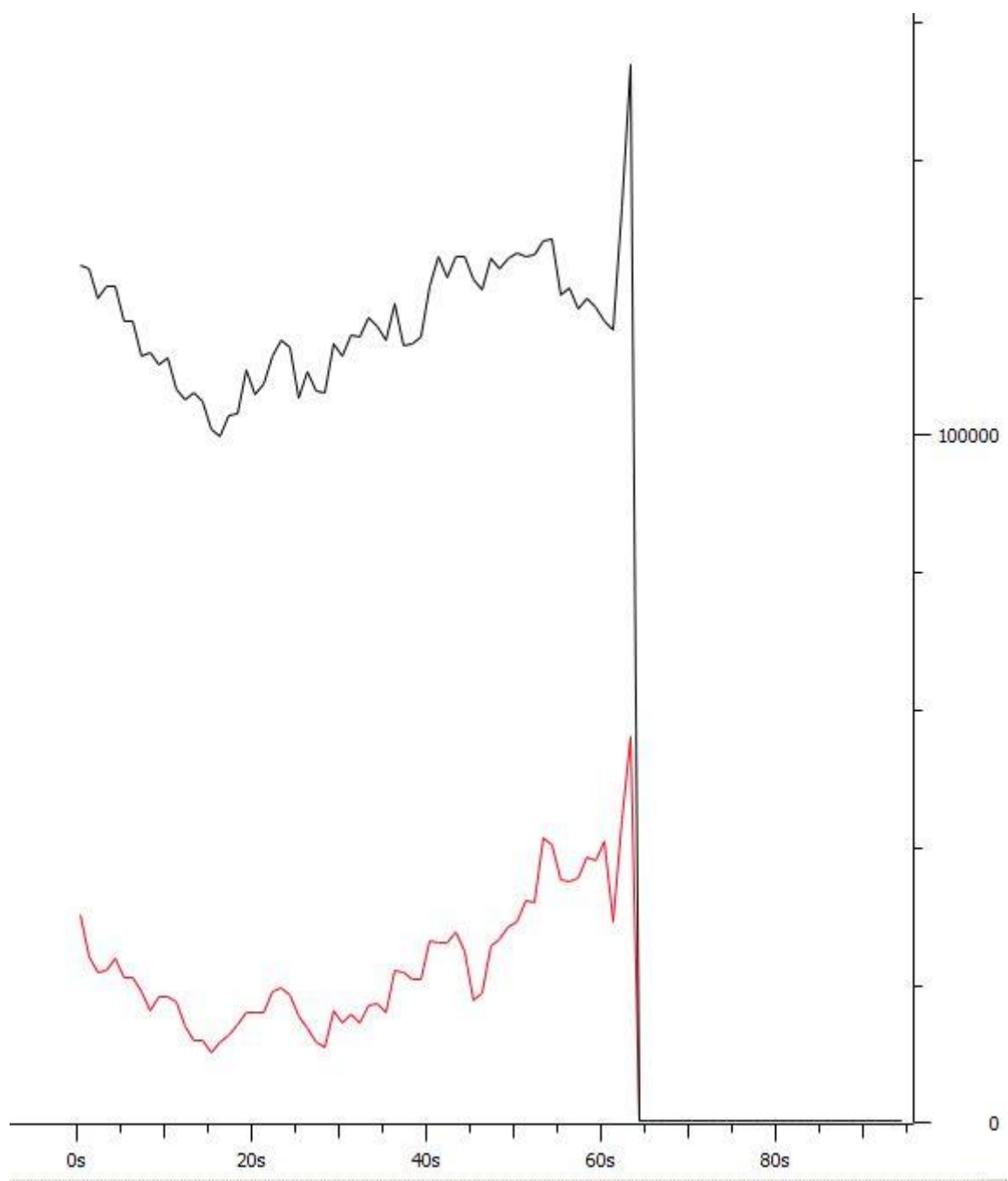
V druhom variante pakety nezahodí, ale preznačuje ich na *af12*. Červený tok znázorňuje tok preznačkovaný na *af12*.



Obrázok 4 : Rovnomerný 84kbps



Obrázok 5 : Exponenciálny 84kbps



Obrázok 6 : Exponenciálny 112kbps

Capturing from Cisco NIC [Wireshark 1.12.7 (v1.12.7-0-g7fc8978 from master-1.12)]

File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help

Filter: udp.port eq 9001 Expression... Clear Apply Save

No.	Time	Source	Destination	Protocol	Length	Info
62	1.60183400	10.0.1.2	10.0.2.2	UDP	530	Source port: 57619 Destination port: 9001
63	1.60677900	10.0.1.2	10.0.2.2	UDP	535	Source port: 57619 Destination port: 9001
64	1.62464200	10.0.1.2	10.0.2.2	UDP	192	Source port: 57619 Destination port: 9001
65	1.64714500	10.0.1.2	10.0.2.2	UDP	270	Source port: 57619 Destination port: 9001
66	1.64987200	10.0.1.2	10.0.2.2	UDP	317	Source port: 57619 Destination port: 9001
67	1.67432100	10.0.1.2	10.0.2.2	UDP	162	Source port: 57619 Destination port: 9001
68	1.72806100	10.0.1.2	10.0.2.2	UDP	474	Source port: 57619 Destination port: 9001
69	1.80099900	10.0.1.2	10.0.2.2	UDP	360	Source port: 57619 Destination port: 9001
70	1.80748500	10.0.1.2	10.0.2.2	UDP	291	Source port: 57619 Destination port: 9001
71	1.82683500	10.0.1.2	10.0.2.2	UDP	353	Source port: 57619 Destination port: 9001

Frame 63: 535 bytes on wire (4280 bits), 535 bytes captured (4280 bits) on interface 0

Ethernet II, Src: Cisco_c0:60:d0 (00:15:fa:c0:60:d0), Dst: 7a:b3:01:02:01:01 (7a:b3:01:02:01:01)

Internet Protocol Version 4, Src: 10.0.1.2 (10.0.1.2), Dst: 10.0.2.2 (10.0.2.2)

Version: 4

Header Length: 20 bytes

Differentiated Services Field: 0x30 (DSCP 0x0c: Assured Forwarding 12; ECN: 0x00: Not-ECT (Not ECN-Capable Transport))

Total Length: 521

Identification: 0x1a61 (6753)

Flags: 0x02 (Don't Fragment)

Fragment offset: 0

Time to live: 126

Protocol: UDP (17)

Header checksum: 0xc94f [validation disabled]

Source: 10.0.1.2 (10.0.1.2)

Destination: 10.0.2.2 (10.0.2.2)

[Source GeoIP: Unknown]

[Destination GeoIP: Unknown]

User Datagram Protocol, Src Port: 57619 (57619), Dst Port: 9001 (9001)

Data (493 bytes)

Policing - Single Rate Three Color Marker (srTCM)

V tomto scenári funguje dvojité token bucket. Pritekajúce tokeny, ktoré sa nezmestia do prvého vedra, ktorého veľkosť je B_c = conform burst, sa budú ukladať do druhého vedra veľkosti B_e = excess burst. Toky, ktoré sa nezmestia do prvého bucketu sa preznačkujú na af12 a ktoré sa nezmestia ani do druhého bucketu sa preznačia na af13.

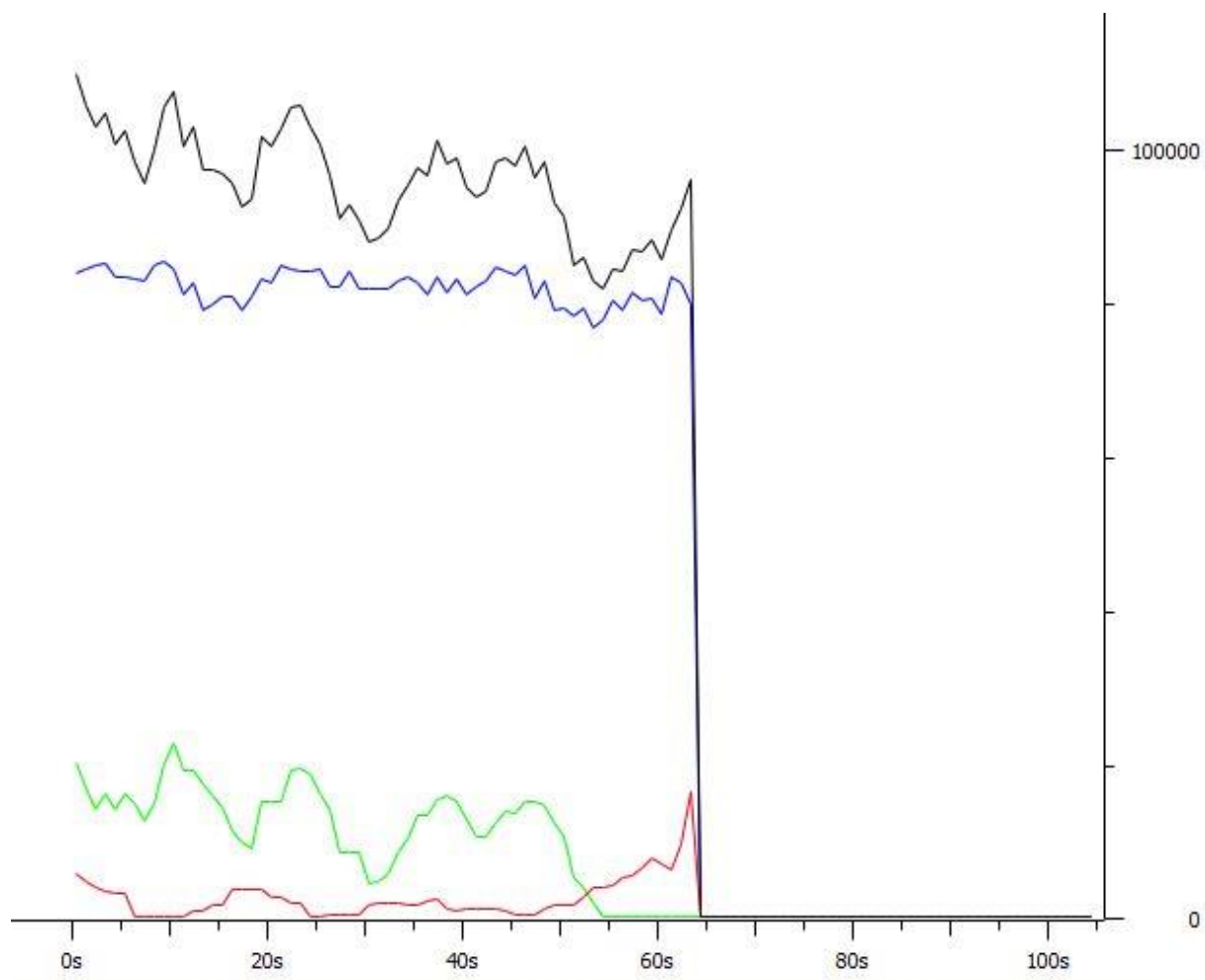
```
R1(config-pmap-c-police)#do sh policy-map int fa0/0
FastEthernet0/0
```

```
Service-policy input: zn
```

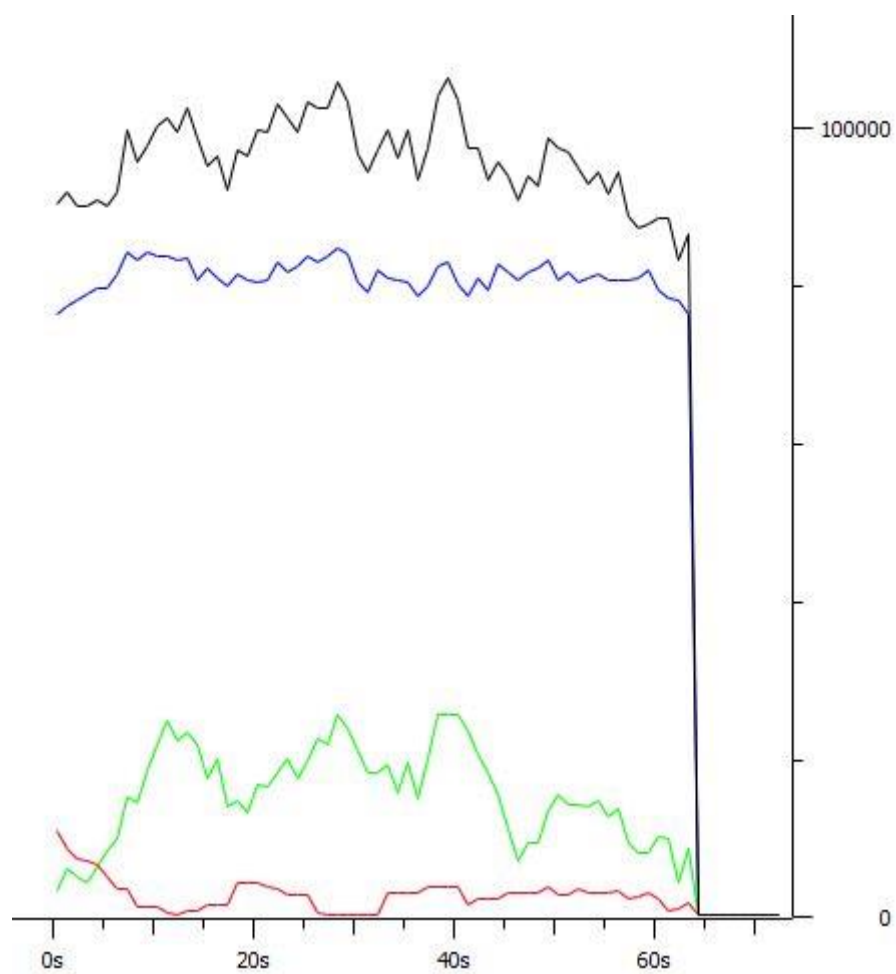
```
Class-map: tok1 (match-all)
  34087 packets, 12450517 bytes
  5 minute offered rate 25000 bps, drop rate 0000 bps
  Match: access-group 101
  QoS Set
    dscp 2
    Packets marked 34087
  police:
    cir 112000 bps, bc 3000 bytes, be 3000 bytes
    conformed 30346 packets, 10057305 bytes; actions:
      transmit
    exceeded 2389 packets, 1518245 bytes; actions:
      set-dscp-transmit af12
    violated 1352 packets, 874967 bytes; actions:
      set-dscp-transmit af13
    conformed 21000 bps, exceeded 0000 bps, violated 0000 bps

Class-map: class-default (match-any)
  150 packets, 9460 bytes
  5 minute offered rate 0000 bps, drop rate 0000 bps
  Match: any
```

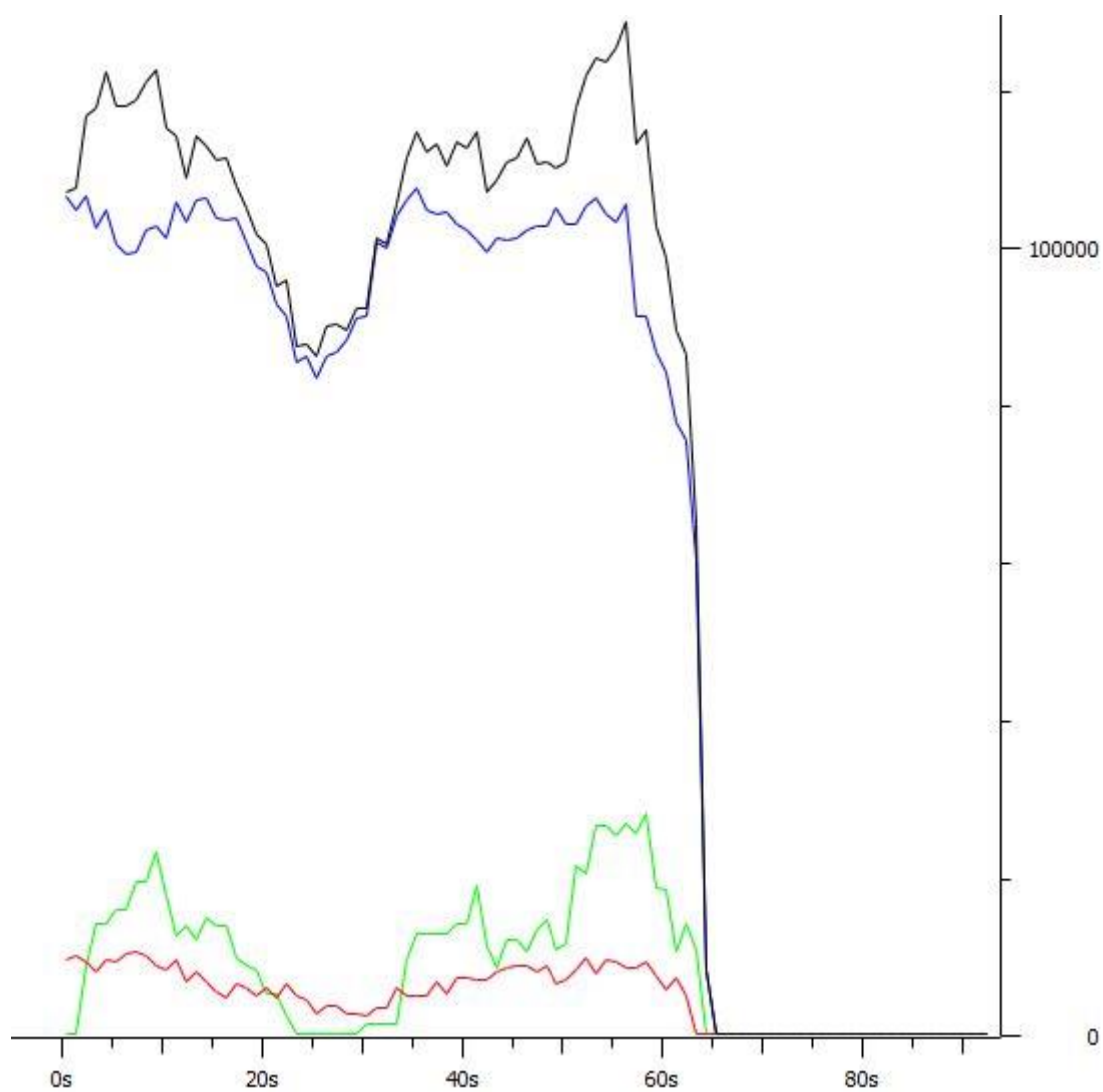

Graphs		
Graph 1	Color	Filter: <code>udp.port eq 9001</code>
Graph 2	Color	Filter: <code>ip.dsfield.dscp == 12</code>
Graph 3	Color	Filter: <code>ip.dsfield == 56</code>
Graph 4	Color	Filter: <code>ip.dsfield.dscp == 2</code>



Obrázok 7 : Rovnomerný 84kbps



Obrázok 8 : Exponenciálny 84kbps



Obrázok 9 : Exponenciálny 112kbps

Capturing from Cisco NIC [Wireshark 1.12.7 (v1.12.7-0-g7fc8978 from master-1.12)]

File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help

Filter: `udp.port eq 9001` Expression... Clear Apply Save

No.	Time	Source	Destination	Protocol	Length	Info
1944	55.7059620	10.0.1.2	10.0.2.2	UDP	291	Source port: 60364 Destination port: 9001
1945	55.7094240	10.0.1.2	10.0.2.2	UDP	168	Source port: 60364 Destination port: 9001
1946	55.7791940	10.0.1.2	10.0.2.2	UDP	250	Source port: 60364 Destination port: 9001
1947	55.7841980	10.0.1.2	10.0.2.2	UDP	293	Source port: 60364 Destination port: 9001
1948	55.8518940	10.0.1.2	10.0.2.2	UDP	285	Source port: 60364 Destination port: 9001
1949	55.8653490	10.0.1.2	10.0.2.2	UDP	445	Source port: 60364 Destination port: 9001
1950	55.8780470	10.0.1.2	10.0.2.2	UDP	535	Source port: 60364 Destination port: 9001
1951	55.9152990	10.0.1.2	10.0.2.2	UDP	445	Source port: 60364 Destination port: 9001
1952	55.9520700	10.0.1.2	10.0.2.2	UDP	314	Source port: 60364 Destination port: 9001
1953	56.0486940	10.0.1.2	10.0.2.2	UDP	426	Source port: 60364 Destination port: 9001

Frame 1945: 168 bytes on wire (1344 bits), 168 bytes captured (1344 bits) on interface 0

Ethernet II, Src: Cisco_c0:60:d0 (00:15:fa:c0:60:d0), Dst: 7a:b3:01:02:01:01 (7a:b3:01:02:01:01)

Internet Protocol Version 4, Src: 10.0.1.2 (10.0.1.2), Dst: 10.0.2.2 (10.0.2.2)

Version: 4

Header Length: 20 bytes

Differentiated Services Field: 0x30 (DSCP 0x0c: **Assured Forwarding 12**; ECN: 0x00: Not-ECT (Not ECN-Capable Transport))

Total Length: 154

Identification: 0x5399 (21401)

Flags: 0x02 (Don't Fragment)

Fragment offset: 0

Time to live: 126

Protocol: UDP (17)

Header checksum: 0x9186 [validation disabled]

Source: 10.0.1.2 (10.0.1.2)

Destination: 10.0.2.2 (10.0.2.2)

[Source GeoIP: Unknown]

[Destination GeoIP: Unknown]

User Datagram Protocol, Src Port: 60364 (60364), Dst Port: 9001 (9001)

Data (126 bytes)

Capturing from Cisco NIC [Wireshark 1.12.7 (v1.12.7-0-g7fc8978 from master-1.12)]

File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help

Filter: `udp.port eq 9001` Expression... Clear Apply Save

No.	Time	Source	Destination	Protocol	Length	Info
2054	58.7850690	10.0.1.2	10.0.2.2	UDP	266	Source port: 60364 Destination port: 9001
2055	58.8002340	10.0.1.2	10.0.2.2	UDP	341	Source port: 60364 Destination port: 9001
2056	58.8529270	10.0.1.2	10.0.2.2	UDP	257	Source port: 60364 Destination port: 9001
2057	58.8612800	10.0.1.2	10.0.2.2	UDP	520	Source port: 60364 Destination port: 9001
2058	58.8712320	10.0.1.2	10.0.2.2	UDP	504	Source port: 60364 Destination port: 9001
2059	58.8831520	10.0.1.2	10.0.2.2	UDP	263	Source port: 60364 Destination port: 9001
2060	58.8964030	10.0.1.2	10.0.2.2	UDP	485	Source port: 60364 Destination port: 9001
2061	58.9318170	10.0.1.2	10.0.2.2	UDP	492	Source port: 60364 Destination port: 9001
2062	58.9330260	10.0.1.2	10.0.2.2	UDP	321	Source port: 60364 Destination port: 9001
2063	58.9817850	10.0.1.2	10.0.2.2	UDP	397	Source port: 60364 Destination port: 9001

Frame 2060: 485 bytes on wire (3880 bits), 485 bytes captured (3880 bits) on interface 0

Ethernet II, Src: Cisco_c0:60:d0 (00:15:fa:c0:60:d0), Dst: 7a:b3:01:02:01:01 (7a:b3:01:02:01:01)

Internet Protocol Version 4, Src: 10.0.1.2 (10.0.1.2), Dst: 10.0.2.2 (10.0.2.2)

Version: 4

Header Length: 20 bytes

Differentiated Services Field: 0x38 (DSCP 0x0e: **Assured Forwarding 13**; ECN: 0x00: Not-ECT (Not ECN-Capable Transport))

Total Length: 471

Identification: 0x540c (21516)

Flags: 0x02 (Don't Fragment)

Fragment offset: 0

Time to live: 126

Protocol: UDP (17)

Header checksum: 0x8fce [validation disabled]

Source: 10.0.1.2 (10.0.1.2)

Destination: 10.0.2.2 (10.0.2.2)

[Source GeoIP: Unknown]

[Destination GeoIP: Unknown]

User Datagram Protocol, Src Port: 60364 (60364), Dst Port: 9001 (9001)

Data (443 bytes)

Policing - Two Rate Three Color Marker (trTCM)

Teraz chceme obmedziť tok na maximálnu ustálenú úroveň PIR=84kbps, ale pritom identifikovať jeho časť na ustálenej úrovni CIR=60kbps (CIR – ustálená rýchlosť na konformnej úrovni = conform = rýchlosť akou sa bude plniť prvé vedro, PIR – ustálená rýchlosť na maximálnej povolenej úrovni = peak = rýchlosť akou sa bude plniť druhé vedro). Každé vedro sa plní svojou rýchlosťou. Odoberanie

tokenov pre paket, ktorý príde vo chvíli, že sa preň nájde dostatok tokenov v jednom aj druhom vedre, sa deje z jedného aj druhého vedra a paket sa prepošle.

```
R1(config-pmap-c-police)#do sh policy-map int fa0/0
FastEthernet0/0
```

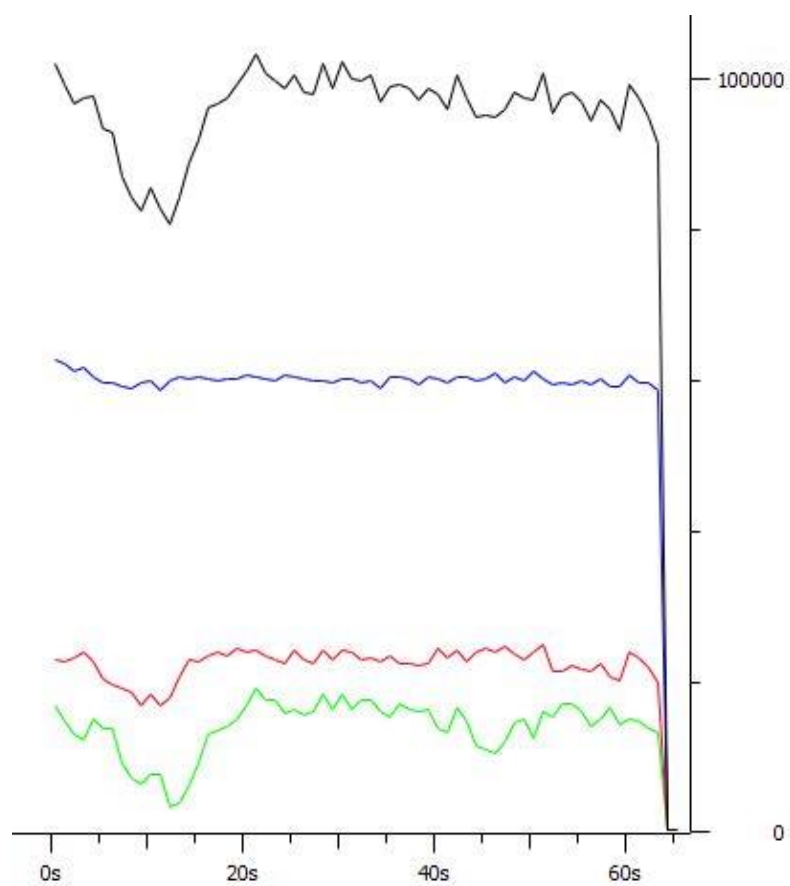
Service-policy input: zn

```
Class-map: tok1 (match-all)
 36196 packets, 13348486 bytes
 5 minute offered rate 21000 bps, drop rate 0000 bps
Match: access-group 101
QoS Set
  dscp 2
    Packets marked 36196
police:
  cir 60000 bps, bc 1875 bytes
  pir 84000 bps, be 2625 bytes
  conformed 32296 packets, 10813381 bytes; actions:
    transmit
  exceeded 2460 packets, 1570297 bytes; actions:
    set-dscp-transmit af12
  violated 1440 packets, 964808 bytes; actions:
    set-dscp-transmit af13
  conformed 18000 bps, exceeded 0000 bps, violated 0000 bps

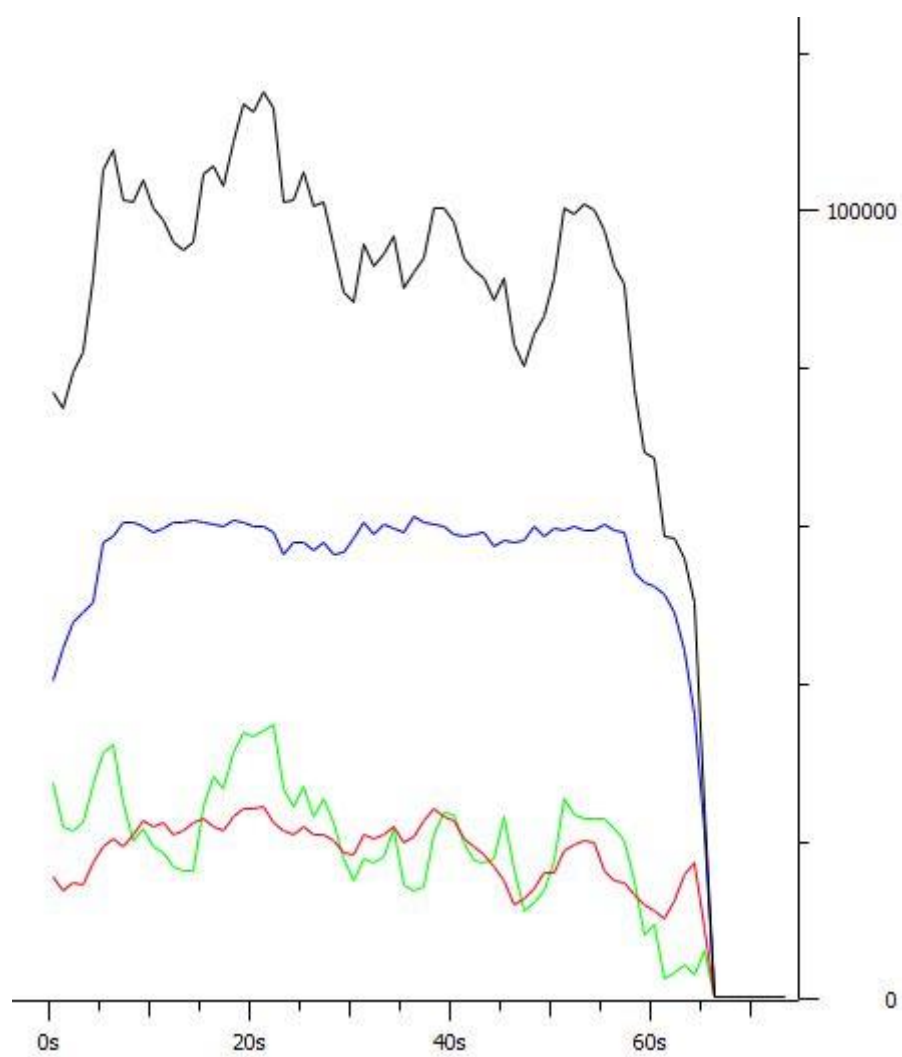
Class-map: class-default (match-any)
 159 packets, 10027 bytes
 5 minute offered rate 0000 bps, drop rate 0000 bps
Match: any
```

$T_c = B_c / CIR = 1875 * 8 / 60000 = 0,25 \text{ sek}$

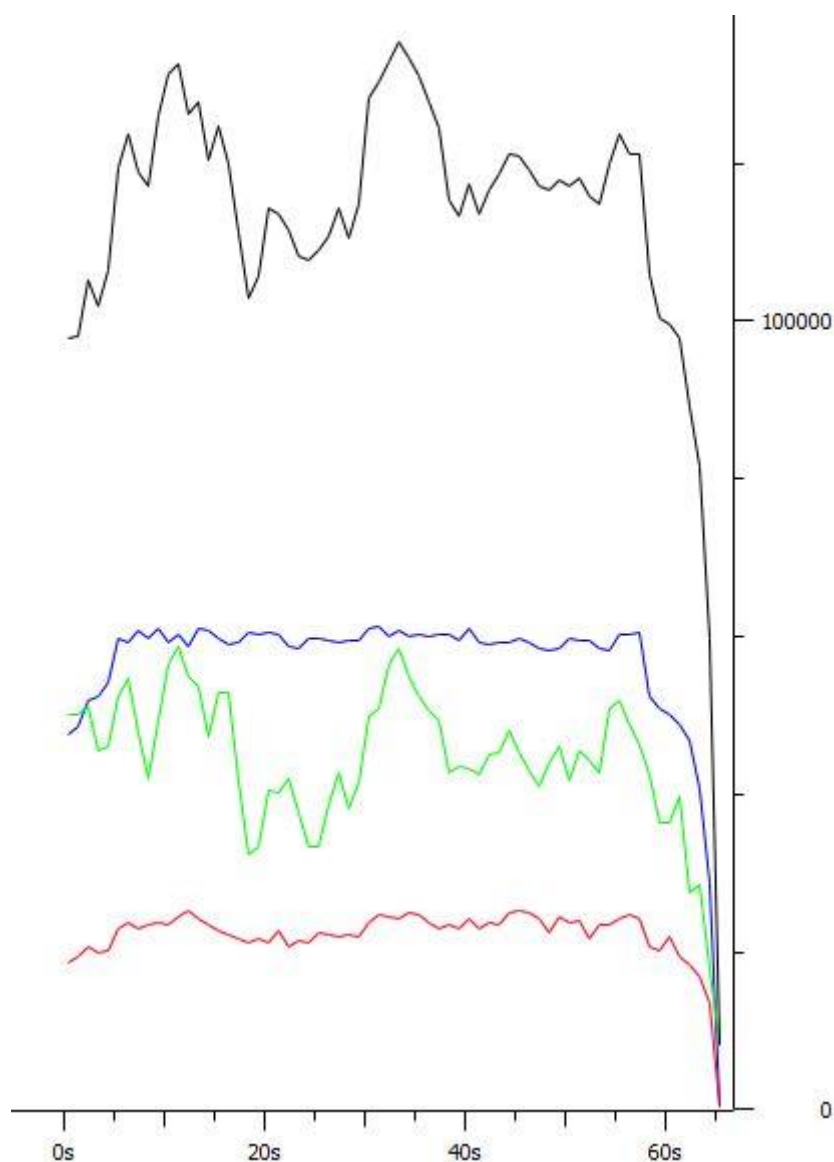
$T_c = B_e / PIR = 2625 * 8 / 84000 = 0,25 \text{ sek}$



Obrázok 10 : Rovnomerný 84kbps



Obrázok 11 : Exponenciálny 84kbps



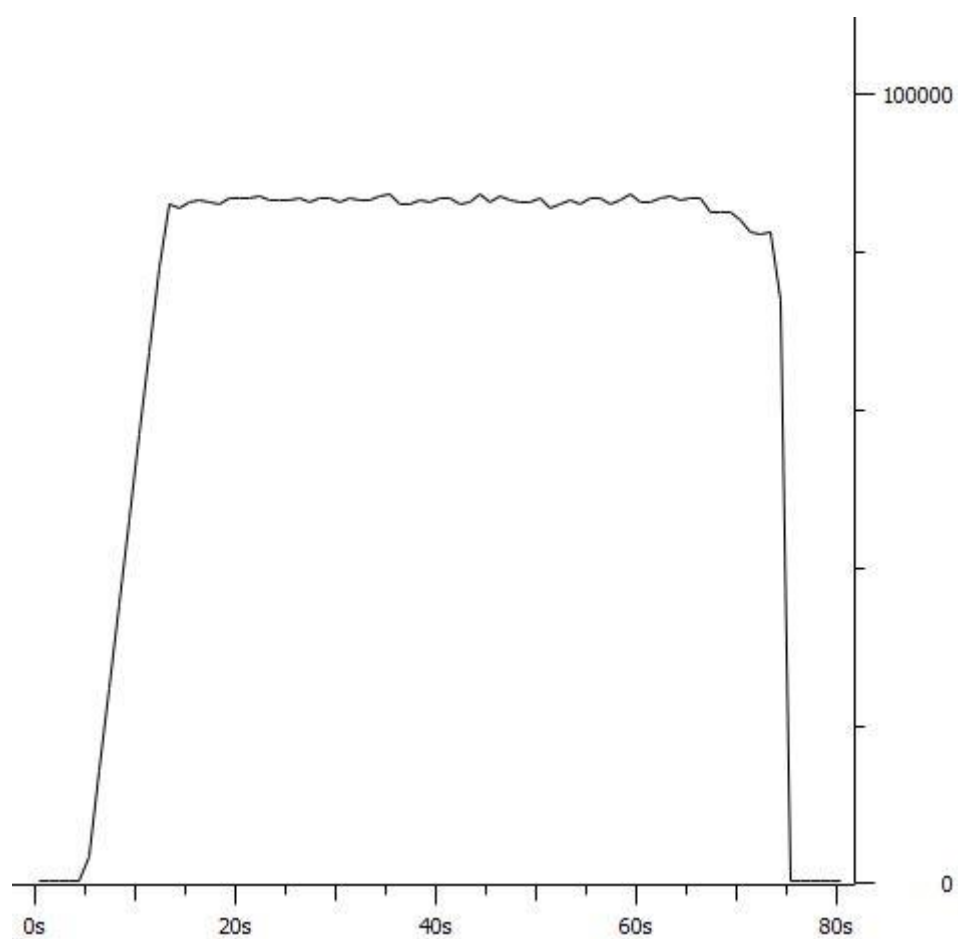
Obrázok 12 : Exponenciálny 112kbps

Shaping - vzhľadom na priemer - average - 84kbps

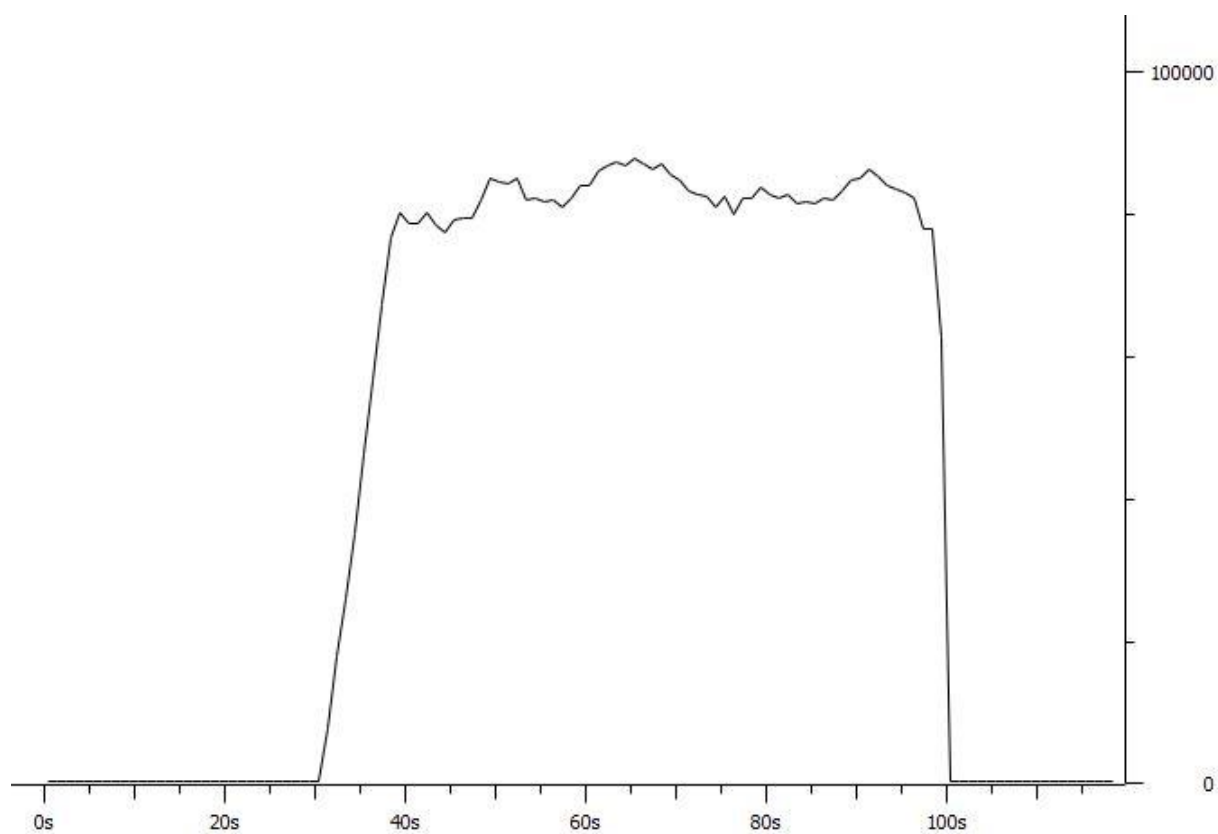
```
R1(config-if)#do sh policy-map int s0/0/0
Serial0/0/0
```

Service-policy output: vystup

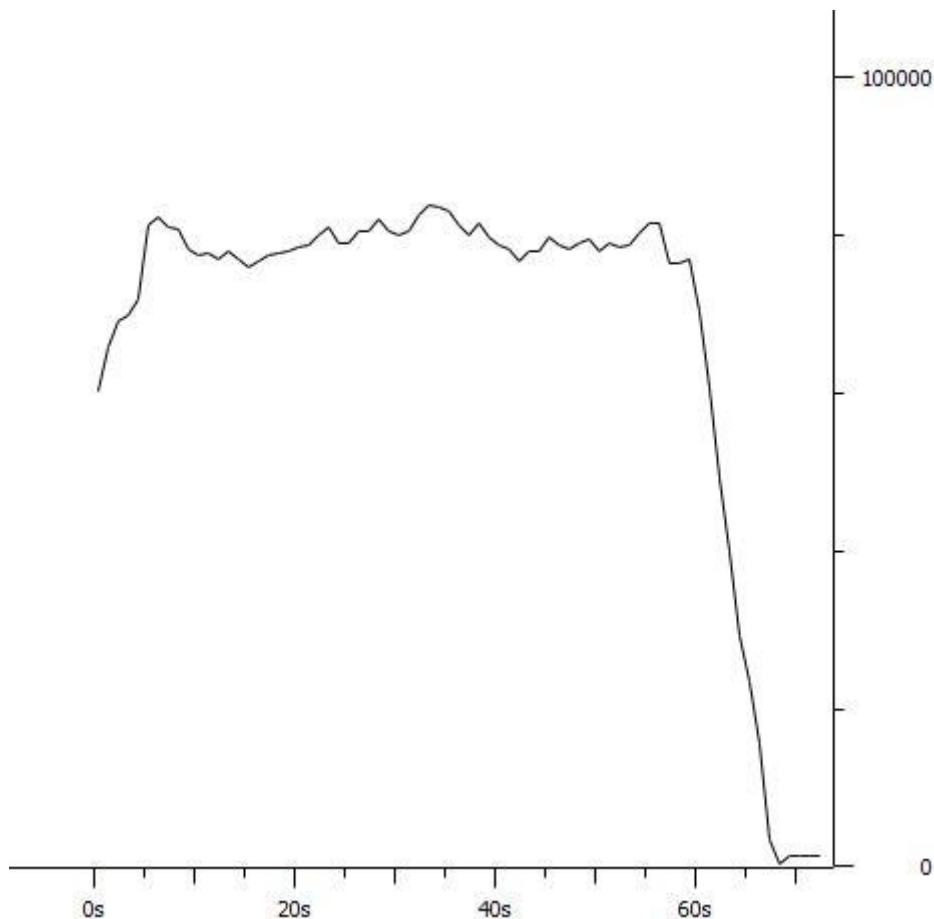
```
Class-map: class-default (match-any)
  6508 packets, 2209958 bytes
  5 minute offered rate 35000 bps, drop rate 3000 bps
Match: any
Queueing
queue limit 64 packets
(queue depth/total drops/no-buffer drops) 62/749/0
(pkts output/bytes output) 5759/1958354
shape (average) cir 84000, bc 336, be 336
target shape rate 84000
```

Obrázok 13 : Rovnomerný 84kbps



Obrázok 14 : Exponenciálny 84kbps



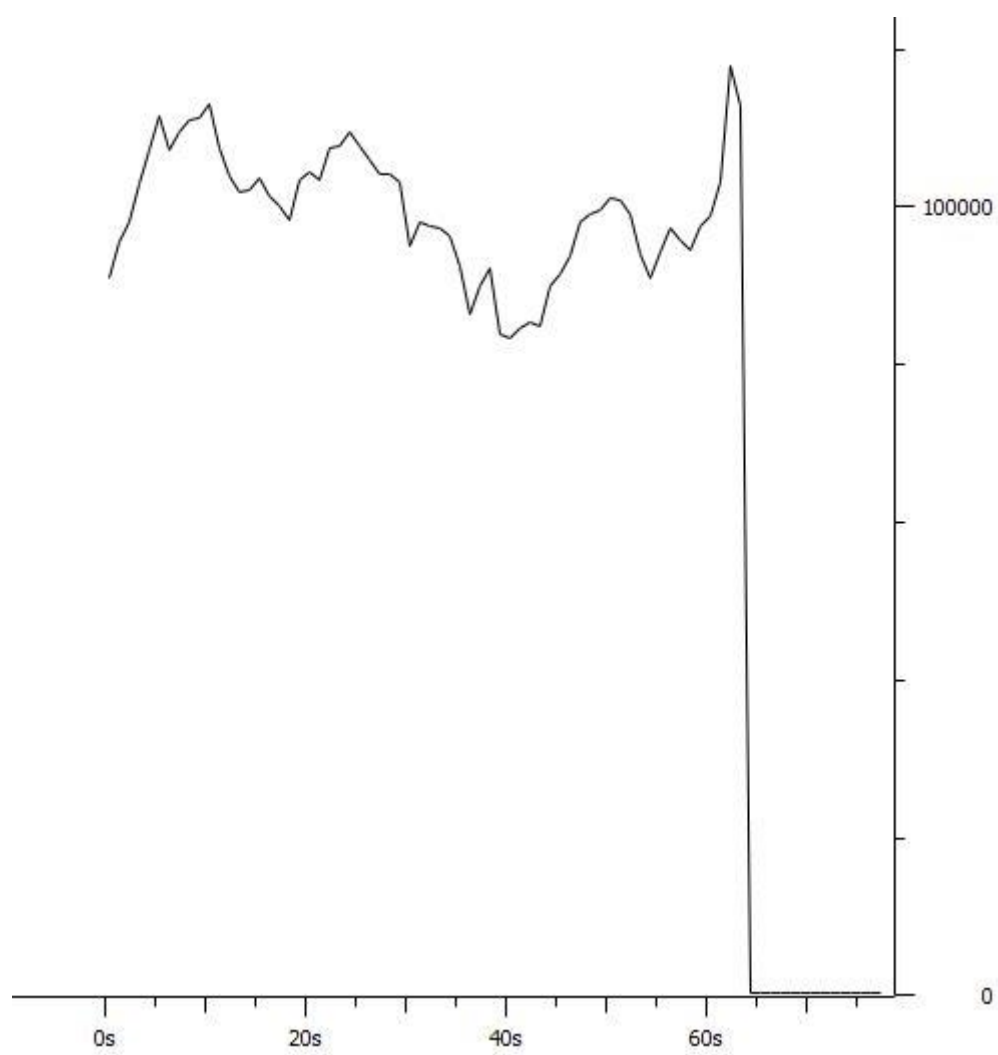
Obrázok 15 : Exponenciálny 112kbps

Shaping - vzhľadom na špičku - peak - 84kbps

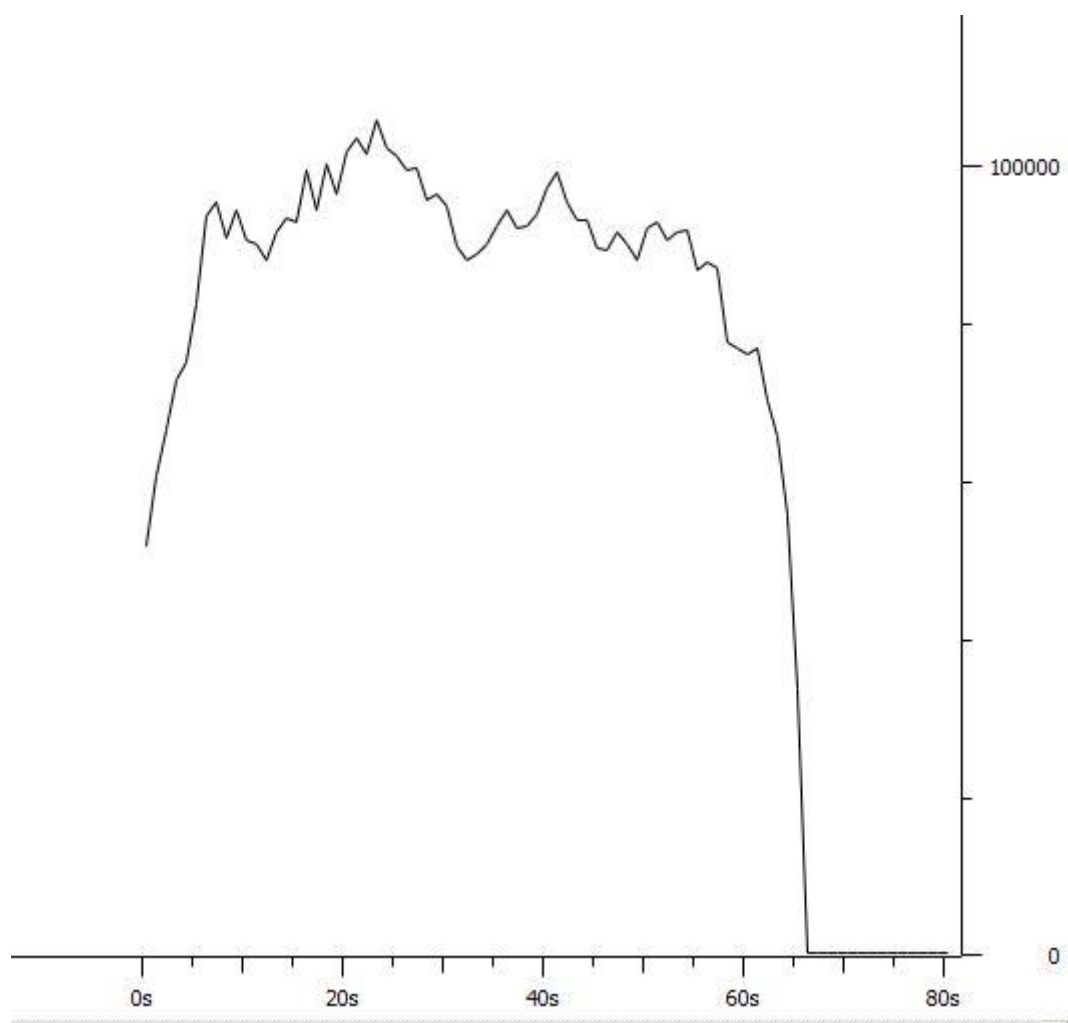
```
R1(config-pmap-c)#do sh policy-map int s0/0/0
Serial0/0/0
```

Service-policy output: vystup

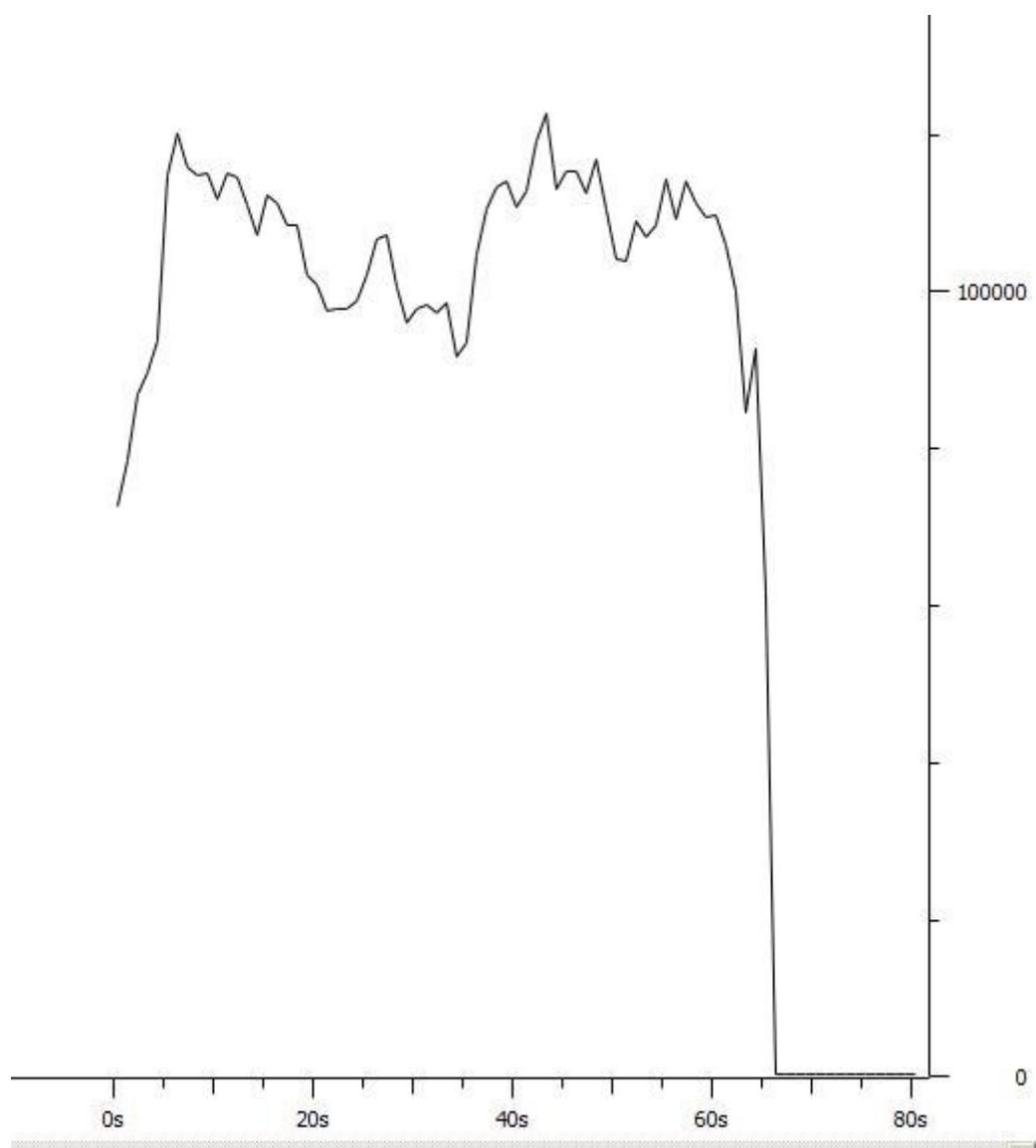
```
Class-map: class-default (match-any)
  10074 packets, 3513703 bytes
  5 minute offered rate 26000 bps, drop rate 0000 bps
Match: any
Queueing
  queue limit 64 packets
  (queue depth/total drops/no-buffer drops) 0/0/0
  (pkts output/bytes output) 1/24
  shape (peak) cir 84000, bc 336, be 336
  target shape rate 168000
```



Obrázok 16 : Rovnomerný 84kbps



Obrázok 17 : Exponenciálny 84kbps



Obrázok 18 : Exponenciálny 112kbps