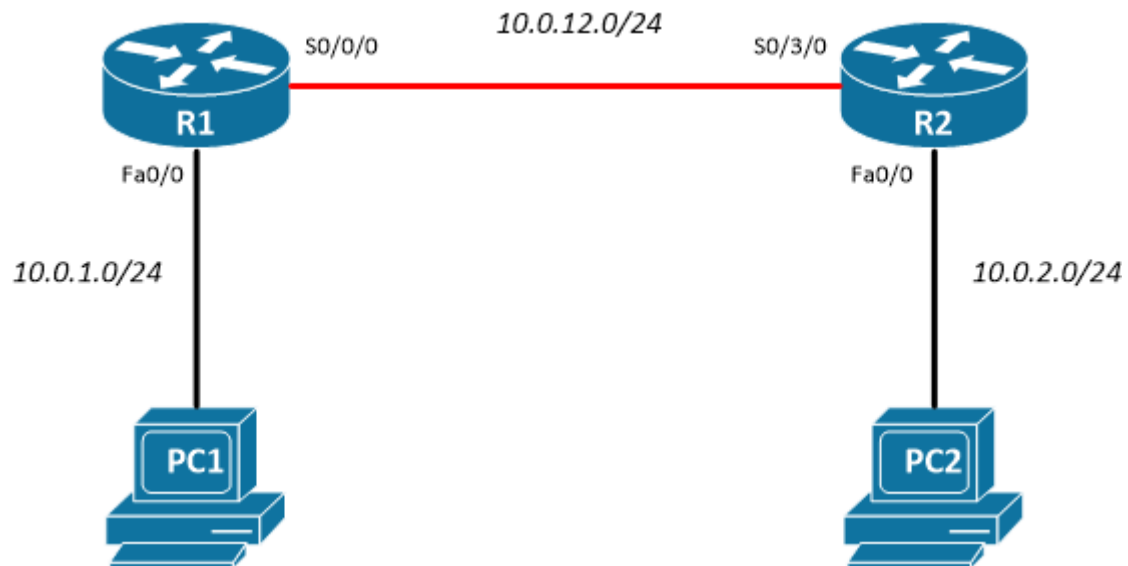


## Policing a shaping

Vypracovali: Dočár Miroslav, Drozdík Martin

### Topológia



### Generované toky

Tok: kolísavý okolo: a.) aj b.) 84 kb/s UDP, c.) 112kbps (kolísavý chceme preto, aby sme videli obmedzovanie a tvarovanie/vyhladzovanie prevádzky)

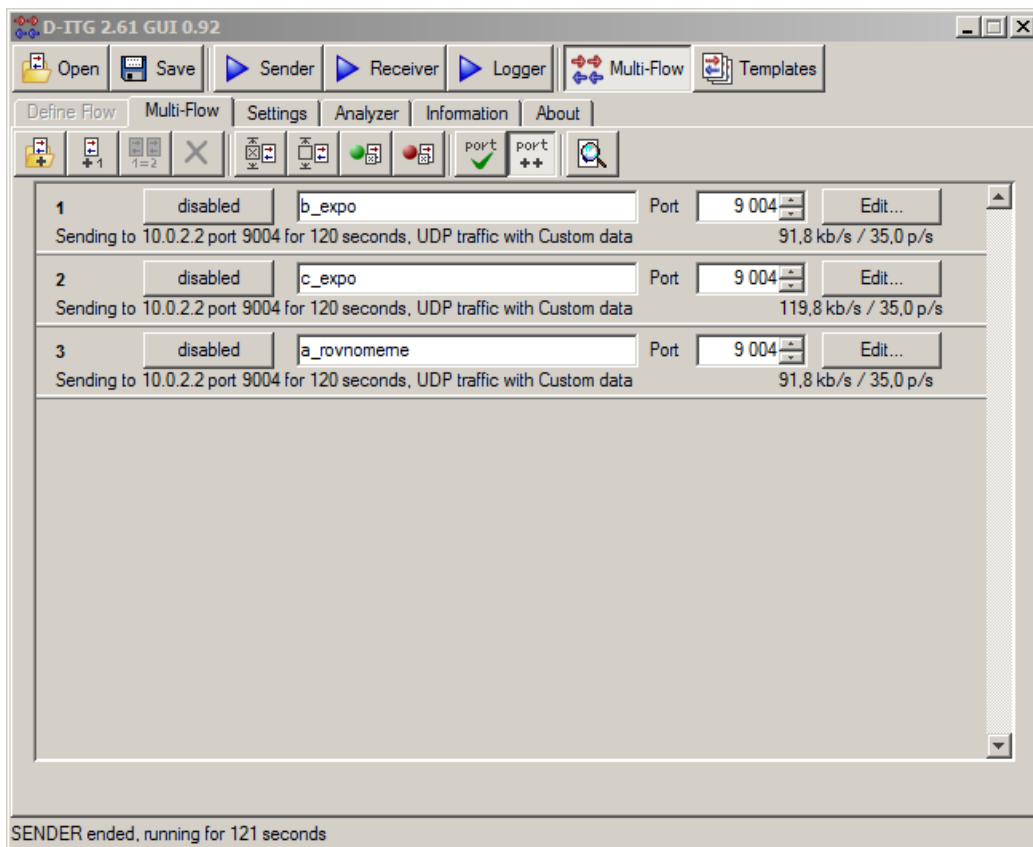
o Intenzita: 35 pak/s - náhodné časy príchodov s expon. rozdelením, pričom priemerne bude chodiť 35 pak/s

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

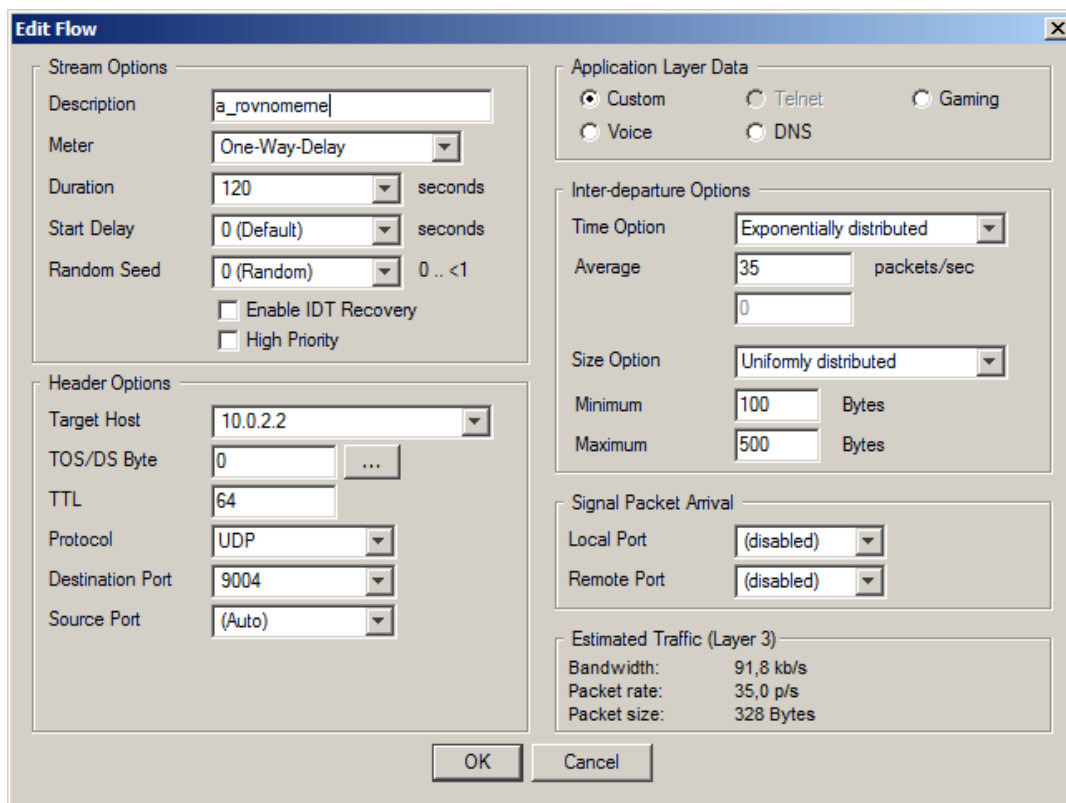
a.) s rovnomerným rozdelením = uniform od 100 do 500 B

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

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



Obrázok 1 Generované toky v DITG



Obrázok 2 Tok s rovnomerným rozdelením (variant a)

**Edit Flow**

**Stream Options**

Description:

Meter:

Duration:  seconds

Start Delay:  seconds

Random Seed:  0 .. <1

☐ Enable IDT Recovery

☐ High Priority

**Header Options**

Target Host:

TOS/DS Byte:  ...

TTL:

Protocol:

Destination Port:

Source Port:

**Application Layer Data**

☒ Custom ☐ Telnet ☐ Gaming

☐ Voice ☐ DNS

**Inter-departure Options**

Time Option:

Average:  packets/sec

Size Option:

Average:  Bytes

**Signal Packet Arrival**

Local Port:

Remote Port:

**Estimated Traffic (Layer 3)**

Bandwidth: 91,8 kb/s

Packet rate: 35,0 p/s

Packet size: 328 Bytes

OK Cancel

Obrázok 3 Tok s exponenciálnym rozdelením (variant b)

**Edit Flow**

**Stream Options**

Description:

Meter:

Duration:  seconds

Start Delay:  seconds

Random Seed:  0 .. <1

☐ Enable IDT Recovery

☐ High Priority

**Header Options**

Target Host:

TOS/DS Byte:  ...

TTL:

Protocol:

Destination Port:

Source Port:

**Application Layer Data**

☒ Custom ☐ Telnet ☐ Gaming

☐ Voice ☐ DNS

**Inter-departure Options**

Time Option:

Average:  packets/sec

Size Option:

Average:  Bytes

**Signal Packet Arrival**

Local Port:

Remote Port:

**Estimated Traffic (Layer 3)**

Bandwidth: 119,8 kb/s

Packet rate: 35,0 p/s

Packet size: 428 Bytes

OK Cancel

Obrázok 4 Tok s exponenciálnym rozdelením (variant c)

## Scenáre pre experimenty s policingom

### Scenár 1 – Single rate two color (jednoduchý token bucket)

a)

```
class-map match-all ZAKAZNIK
match access-group 100
!
policy-map POLICING1_DROP
class ZAKAZNIK
set dscp 2
police cir 84000
conform-action transmit
exceed-action drop
!
interface FastEthernet0/0
ip address 10.0.1.1 255.255.255.0
duplex auto
speed auto
service-policy input POLICING1_DROP

access-list 100 permit udp any any eq 9004
```

```
sh policy-map interface fa0/0
FastEthernet0/0

Service-policy input: POLICING1_DROP

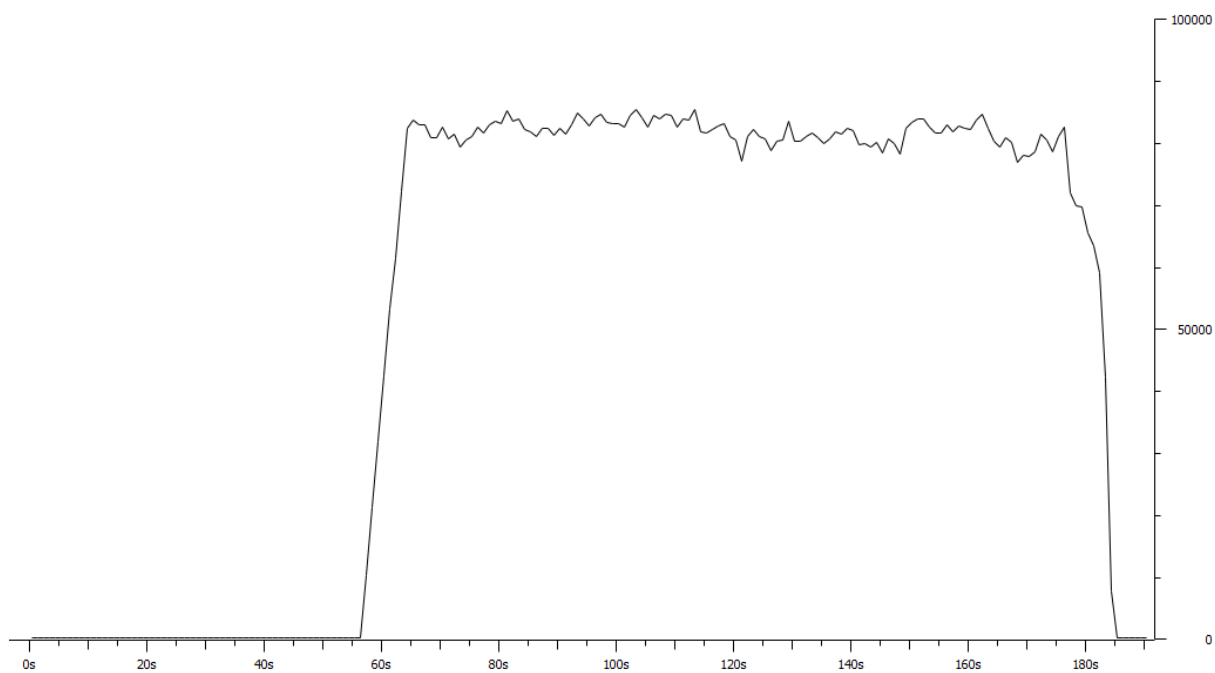
Class-map: ZAKAZNIK (match-all)
  0 packets, 0 bytes
  5 minute offered rate 0000 bps, drop rate 0000 bps
  Match: access-group 100
  QoS Set
    dscp 2
    Packets marked 0
  police:
    cir 84000 bps, bc 2625 bytes
    conformed 0 packets, 0 bytes; actions:
      transmit
    exceeded 0 packets, 0 bytes; actions:
      drop
    conformed 0000 bps, exceeded 0000 bps

Class-map: class-default (match-any)
  0 packets, 0 bytes
  5 minute offered rate 0000 bps, drop rate 0000 bps
  Match: any
```

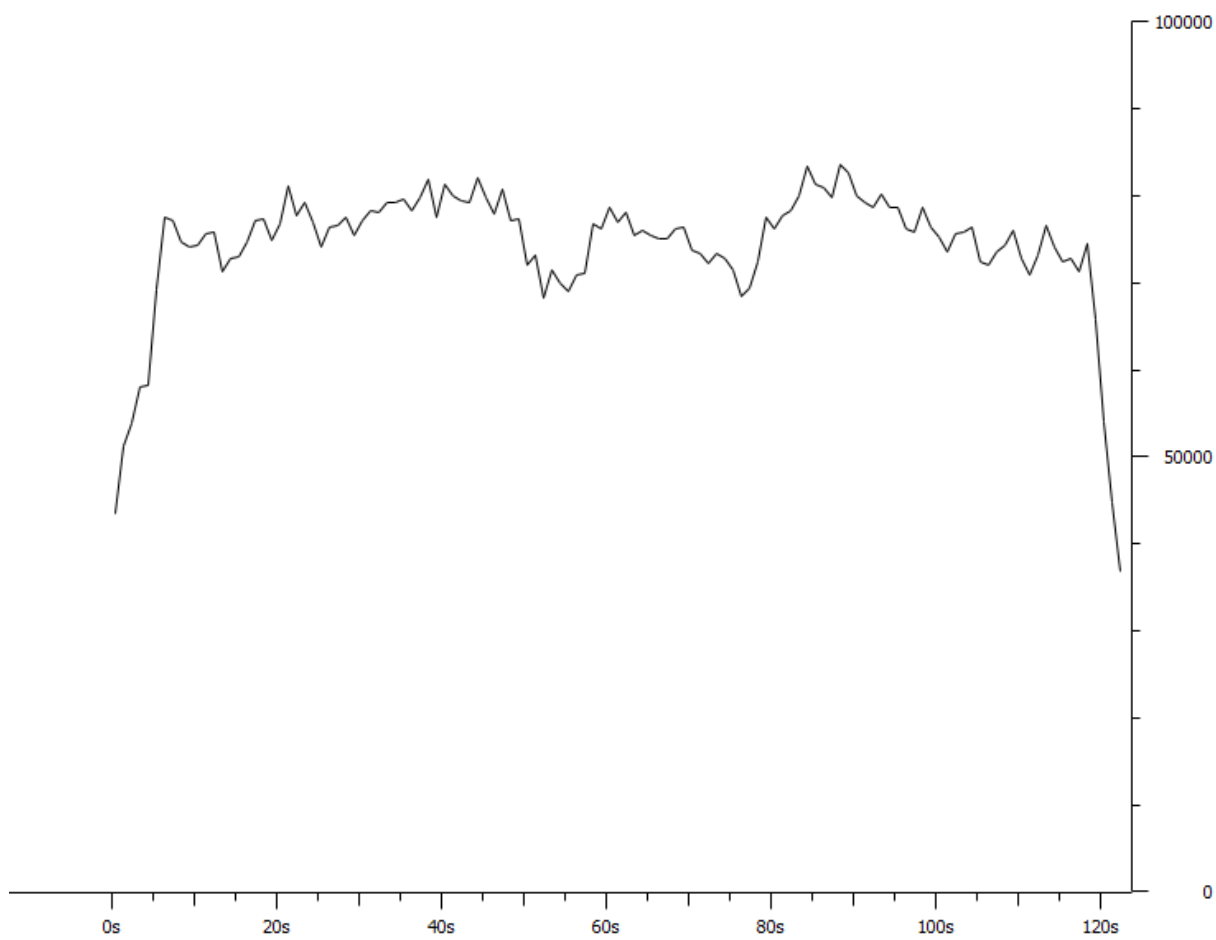
$bc = 2625 \text{ bytes} * 8 = \mathbf{21000 \text{ bits}}$

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

$1 / Tc = 1 / 0,25 = \mathbf{4 \text{ doplnení/sek.}}$



Obrázok 5 Tok podľa variantu a



Obrázok 6 Tok podľa variantu b

```
do sh policy-map int fa0/0
```

FastEthernet0/0

Service-policy input: POLICING1\_DROP

Class-map: ZAKAZNIK (match-all)

28690 packets, 10915849 bytes

5 minute offered rate 53000 bps, drop rate 44000 bps

Match: access-group 100

QoS Set

dscp 2

Packets marked 28690

police:

**cir 112000 bps, bc 3500 bytes**

conformed 25218 packets, 8516011 bytes; actions:

transmit

exceeded 3472 packets, 2399838 bytes; actions:

drop

conformed 43000 bps, exceeded 9000 bps

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

68 packets, 4281 bytes

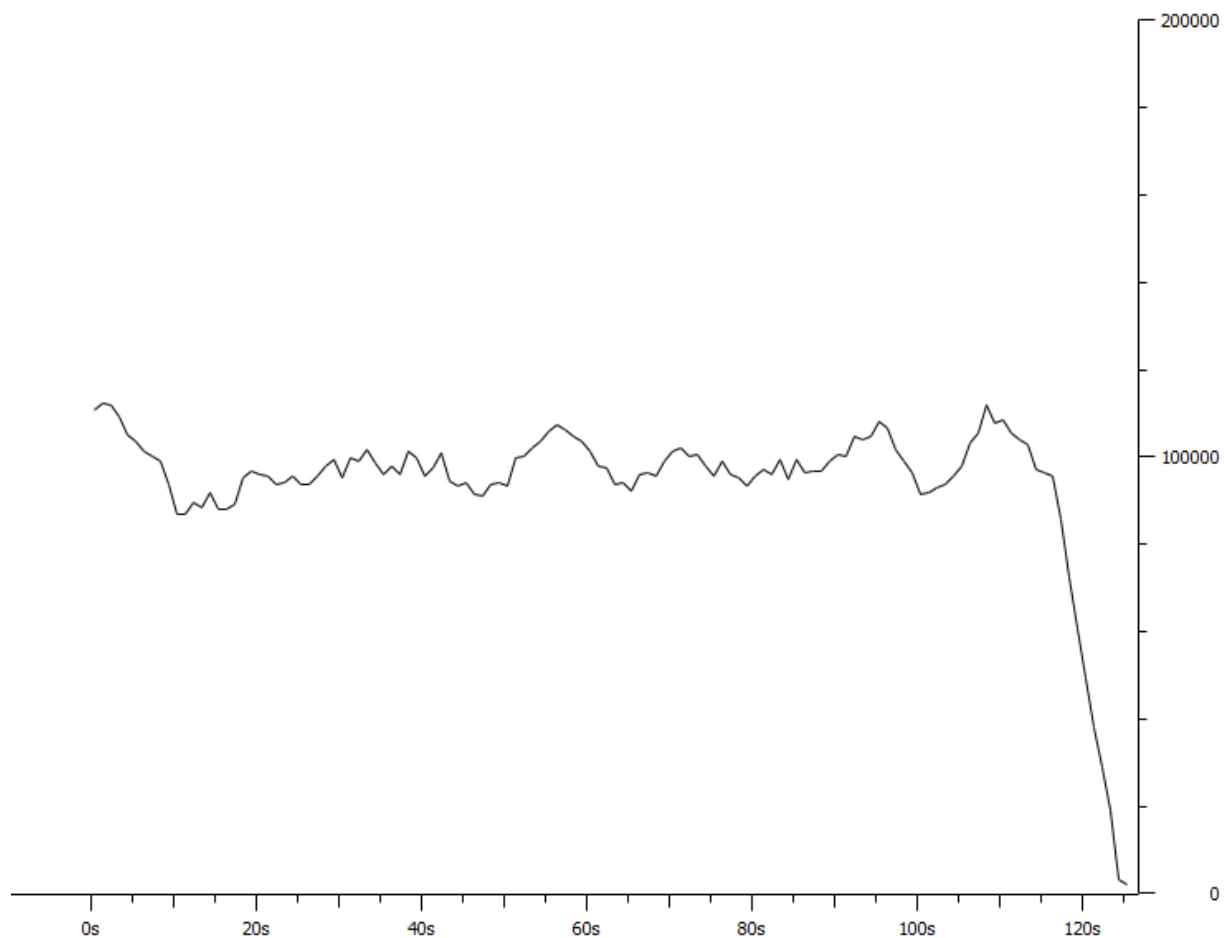
5 minute offered rate 0000 bps, drop rate 0000 bps

Match: any

$B_c = 3500 * 8 = \mathbf{28000 \text{ bits}}$

$T_c = B_c / CIR = 28000 / 112000 = \mathbf{0,25 \text{ sek}}$

$1 / T_c = 1 / 0,25 = \mathbf{4 \text{ doplnení/sek.}}$



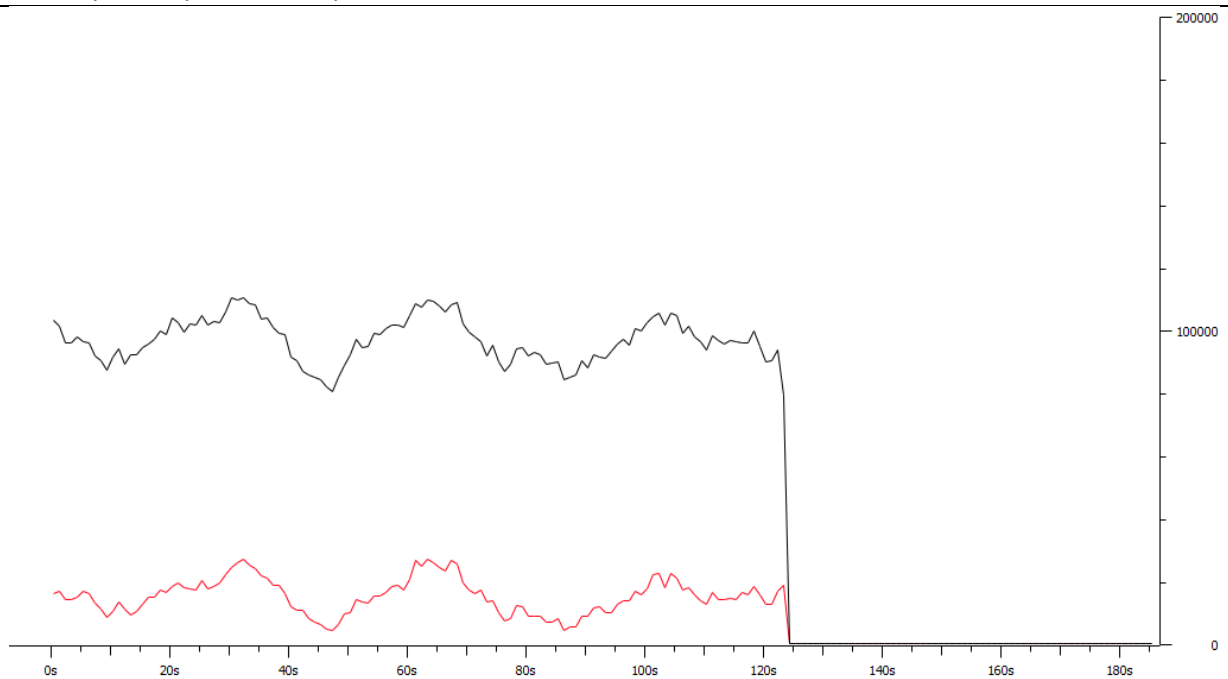
Obrázok 7 Tok podľa variantu c

b)

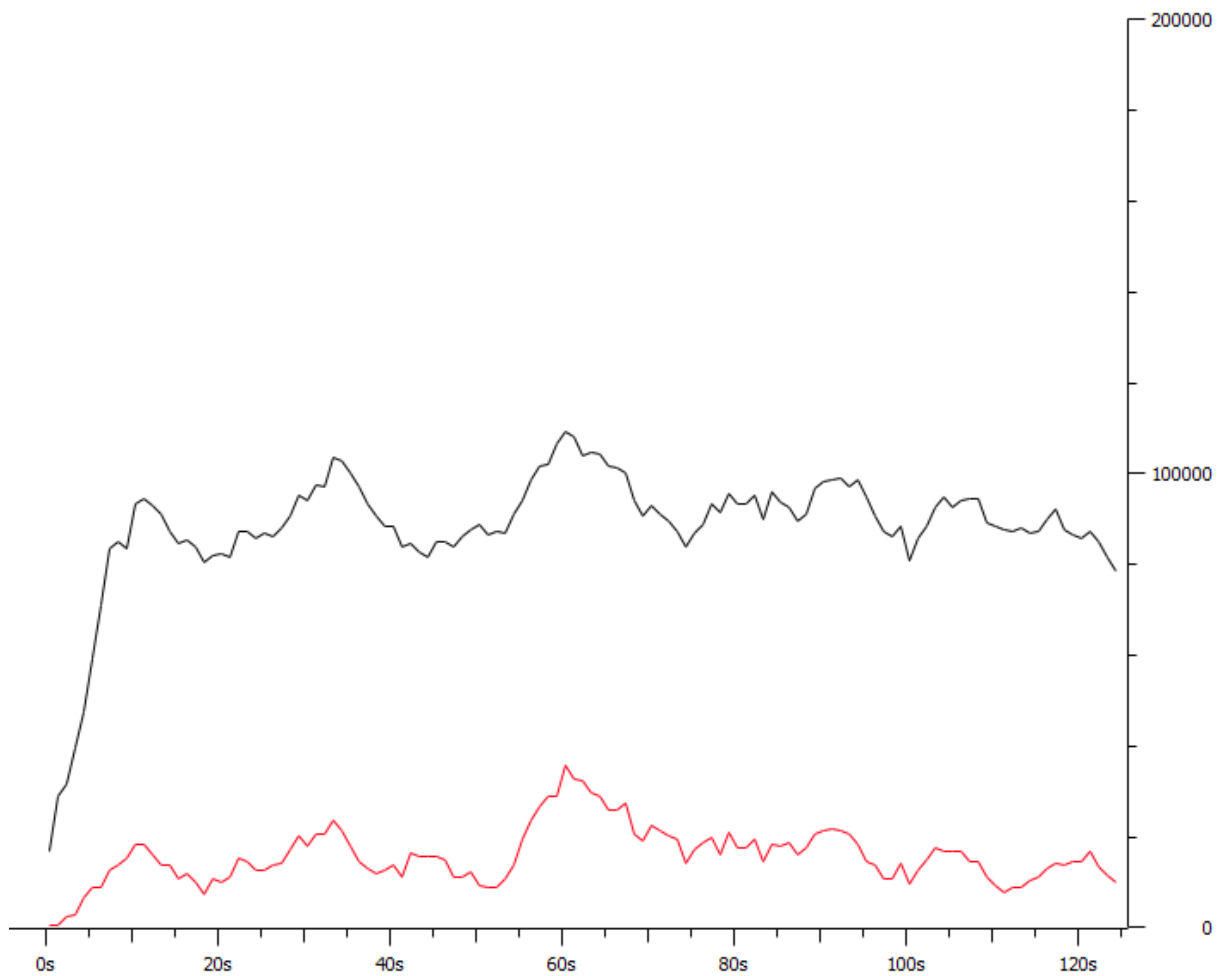
```
class-map match-all ZAKAZNIK
match access-group 100
!
policy-map POLICING1_FARBI
class ZAKAZNIK
set dscp 2
police cir 84000
conform-action transmit
exceed-action set-dscp-transmit af12
!
interface FastEthernet0/0
ip address 10.0.1.1 255.255.255.0
duplex auto
speed auto
service-policy input POLICING1_FARBI

access-list 100 permit udp any any eq 9004
```

čierny tok – udp.dstport == 9004  
červený tok – ip.dsfield.dscp == 12



Obrázok 8 Tok podľa variantu a

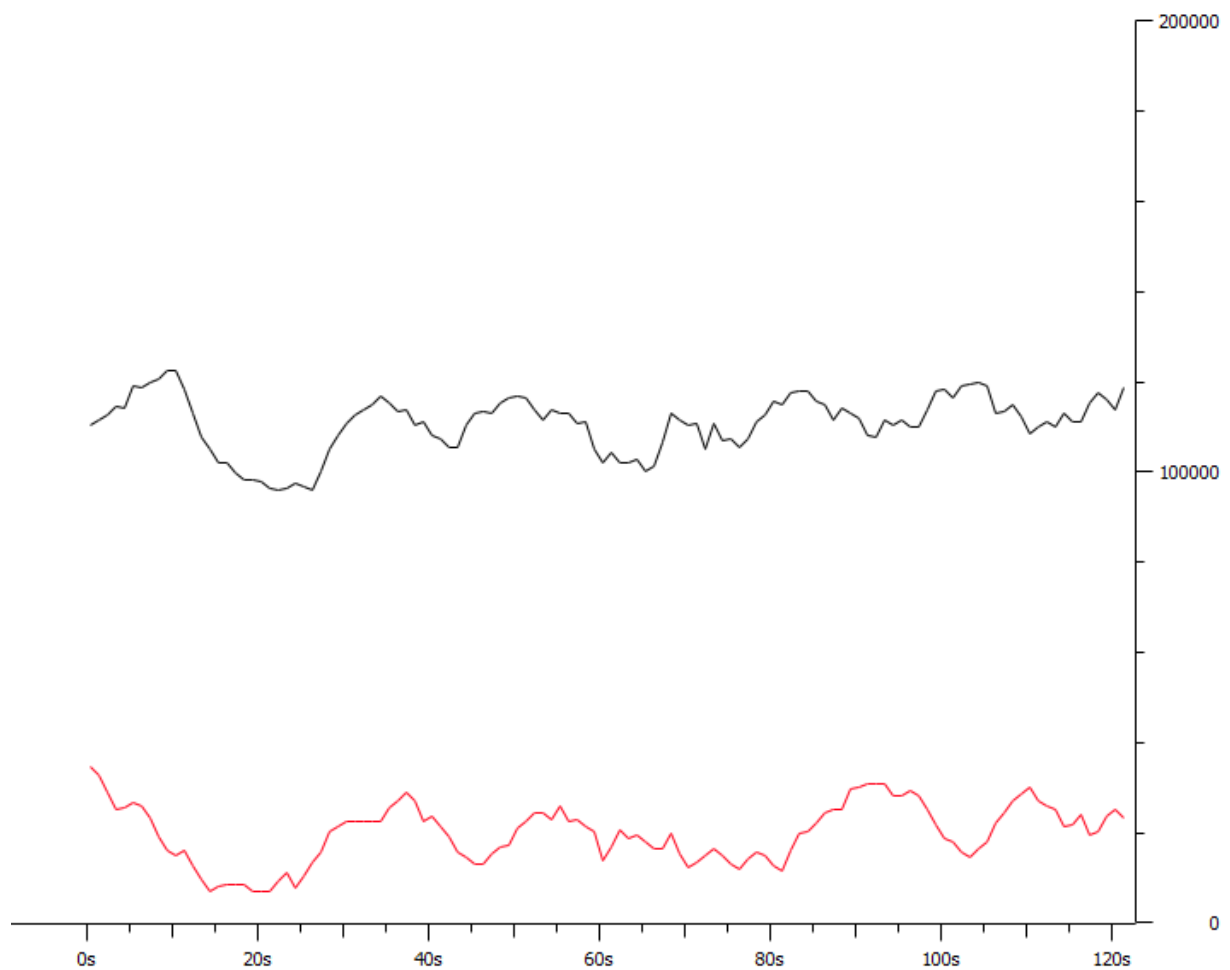


Obrázok 9 Tok podľa variantu b

```
class-map match-all ZAKAZNIK
match access-group 100
!
policy-map POLICING1_FARBI
class ZAKAZNIK
set dscp 2
police cir 112000
conform-action transmit
exceed-action set-dscp-transmit af12
!
interface FastEthernet0/0
ip address 10.0.1.1 255.255.255.0
duplex auto
speed auto
service-policy input POLICING1_FARBI

access-list 100 permit udp any any eq 9004
```





Obrázok 10 Tok podľa variantu c

c)

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

Service-policy input: POLICING1_FARBI

Class-map: ZAKAZNIK (match-all)
 33793 packets, 13121990 bytes
 5 minute offered rate 46000 bps, drop rate 1000 bps
 Match: access-group 100
 QoS Set
  dscp 2
   Packets marked 33793
 police:
   cir 8000 bps, bc 1500 bytes
   conformed 29927 packets, 10373940 bytes; actions:
     transmit
   exceeded 3866 packets, 2748050 bytes; actions:
     set-dscp-transmit af12
   conformed 36000 bps, exceeded 3000 bps

Class-map: class-default (match-any)
 87 packets, 5460 bytes
 5 minute offered rate 0000 bps, drop rate 0000 bps
```

Match: any

Náš smerovač povoľoval najmenšiu hodnotu CIR 8000. Bc sa nám zmenilo na hodnotu 1500 bytes čo je 12000 bitov.

## Scenár 2 – Single rate three color marker (srTCM)

a)

```
policy-map POLICING2_srTCM
class ZAKAZNIK
set dscp 2
police cir 84000 bc 3000 be 3000
conform-action transmit
exceed-action set-dscp-transmit af12
violate-action set-dscp-transmit af13
```

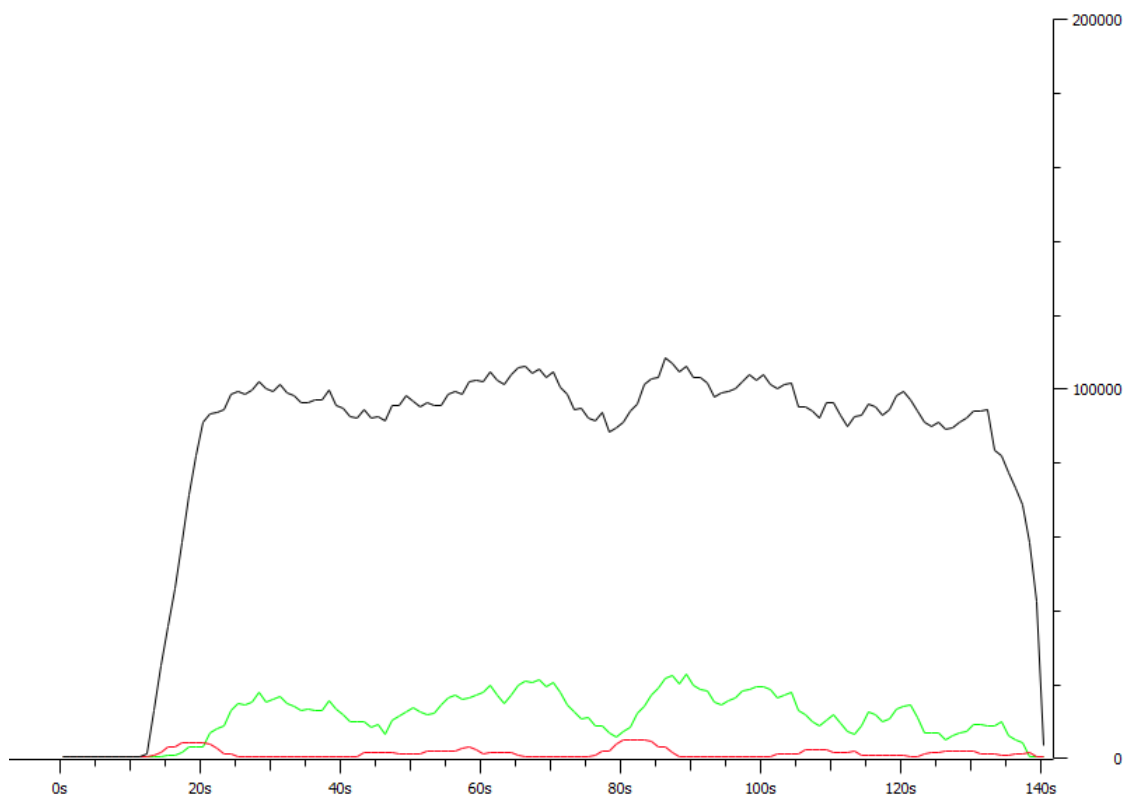
```
sh policy-map int fa0/0
FastEthernet0/0

Service-policy input: POLICING2_srTCM

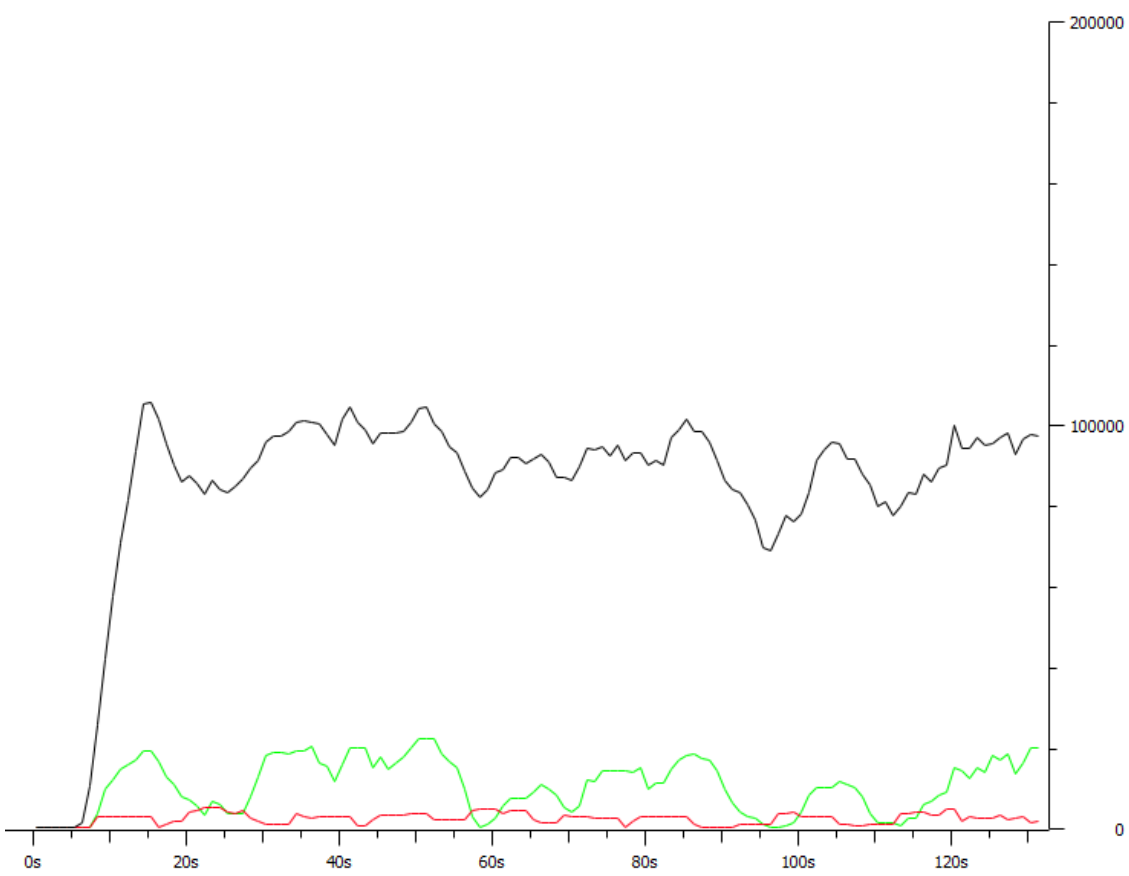
Class-map: ZAKAZNIK (match-all)
 37833 packets, 14498719 bytes
 5 minute offered rate 38000 bps, drop rate 0000 bps
 Match: access-group 100
  QoS Set
   dscp 2
   Packets marked 37833
 police:
   cir 84000 bps, bc 3000 bytes, be 3000 bytes
   conformed 33489 packets, 11553938 bytes; actions:
     transmit
   exceeded 3948 packets, 2779517 bytes; actions:
     set-dscp-transmit af12
   violated 396 packets, 165264 bytes; actions:
     set-dscp-transmit af13
   conformed 30000 bps, exceeded 1000 bps, violated 10000 bps

Class-map: class-default (match-any)
 93 packets, 5847 bytes
 5 minute offered rate 0000 bps, drop rate 0000 bps
 Match: any
```

čierny tok	– udp.dstport == 9004
červený tok	– ip.dsfield.dscp == 12
zelený tok	- ip.dsfield.dscp == 13 (ip.dsfield == 56)



Obrázok 11 Tok podľa variantu a



Obrázok 12 Tok podľa variantu b

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

Service-policy input: POLICING2\_srTCM

Class-map: ZAKAZNIK (match-all)

43302 packets, 16419902 bytes

5 minute offered rate 45000 bps, drop rate 0000 bps

Match: access-group 100

QoS Set

dscp 2

Packets marked 43302

police:

**cir 112000 bps, bc 3000 bytes, be 3000 bytes**

conformed 38545 packets, 13183938 bytes; actions:

transmit

exceeded 4065 packets, 2855048 bytes; actions:

set-dscp-transmit af12

violated 692 packets, 380916 bytes; actions:

set-dscp-transmit af13

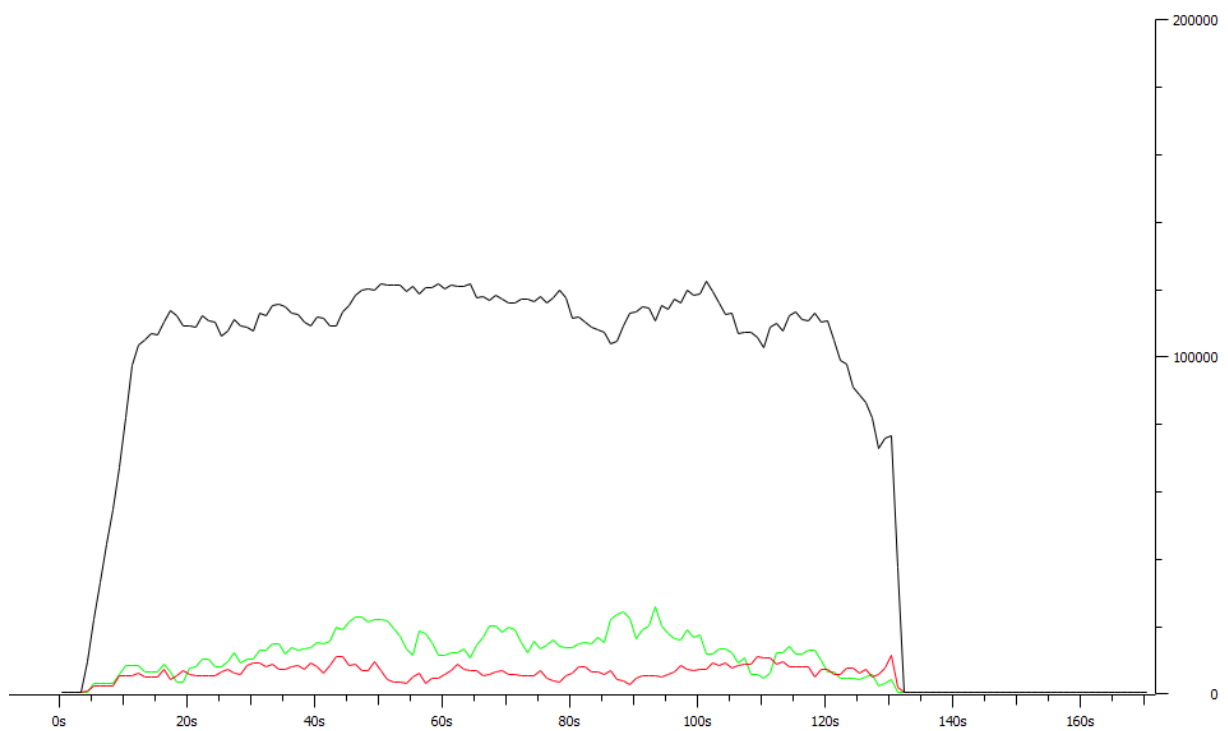
conformed 37000 bps, exceeded 3000 bps, violated 6000 bps

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

112 packets, 7041 bytes

5 minute offered rate 0000 bps, drop rate 0000 bps

Match: any



Obrázok 13 Tok podľa variantu c

### Scenár 3 – Two rate three color marker (trTCM)

a)

```
policy-map POLICING3_trTCM
class ZAKAZNIK
set dscp 2
police cir 60000 pir 84000
conform-action transmit
exceed-action set-dscp-transmit af12
violate-action set-dscp-transmit af13
```

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

Service-policy input: POLICING3_trTCM

Class-map: ZAKAZNIK (match-all)
 59699 packets, 22269176 bytes
 5 minute offered rate 46000 bps, drop rate 0000 bps
 Match: access-group 100
 QoS Set
   dscp 2
     Packets marked 59699
 police:
   cir 60000 bps, bc 1875 bytes
   pir 84000 bps, be 2625 bytes
   conformed 52490 packets, 17792038 bytes; actions:
     transmit
   exceeded 5139 packets, 3341254 bytes; actions:
     set-dscp-transmit af12
   violated 2070 packets, 1135884 bytes; actions:
     set-dscp-transmit af13
   conformed 31000 bps, exceeded 8000 bps, violated 5000 bps

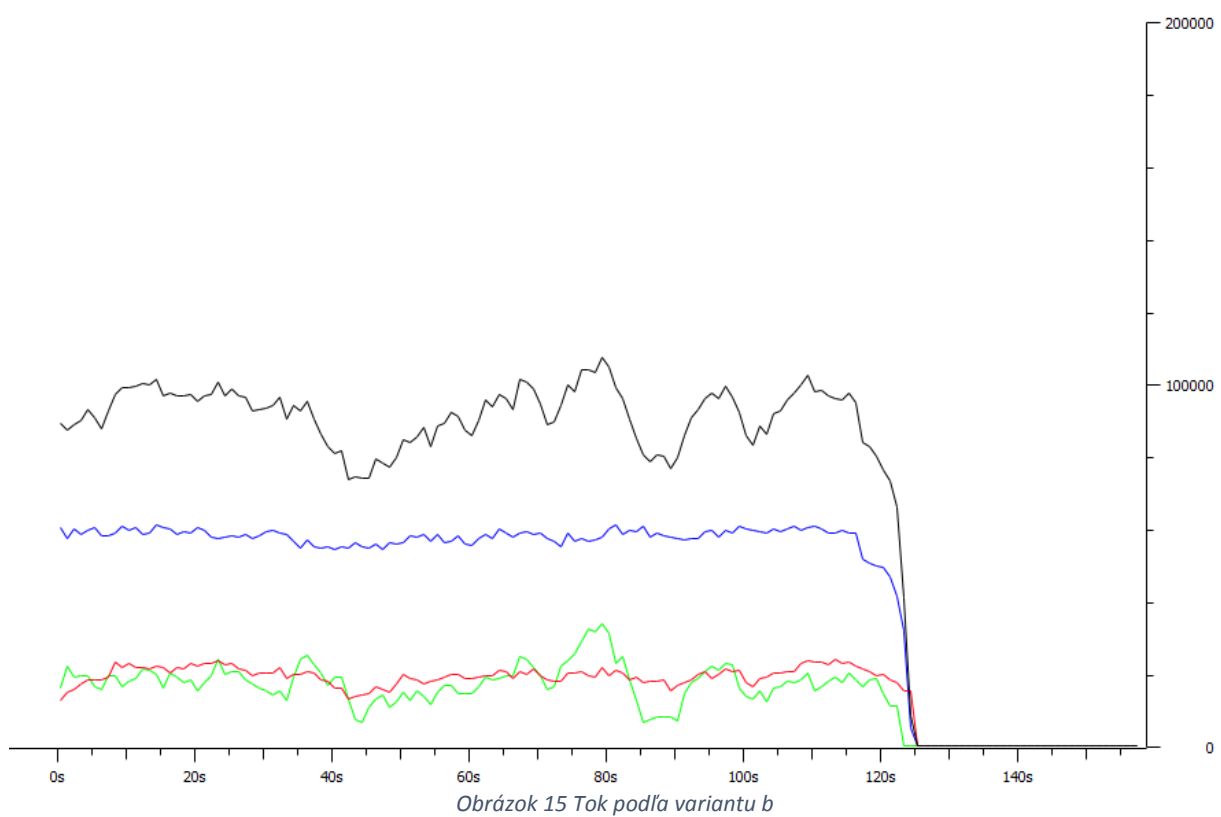
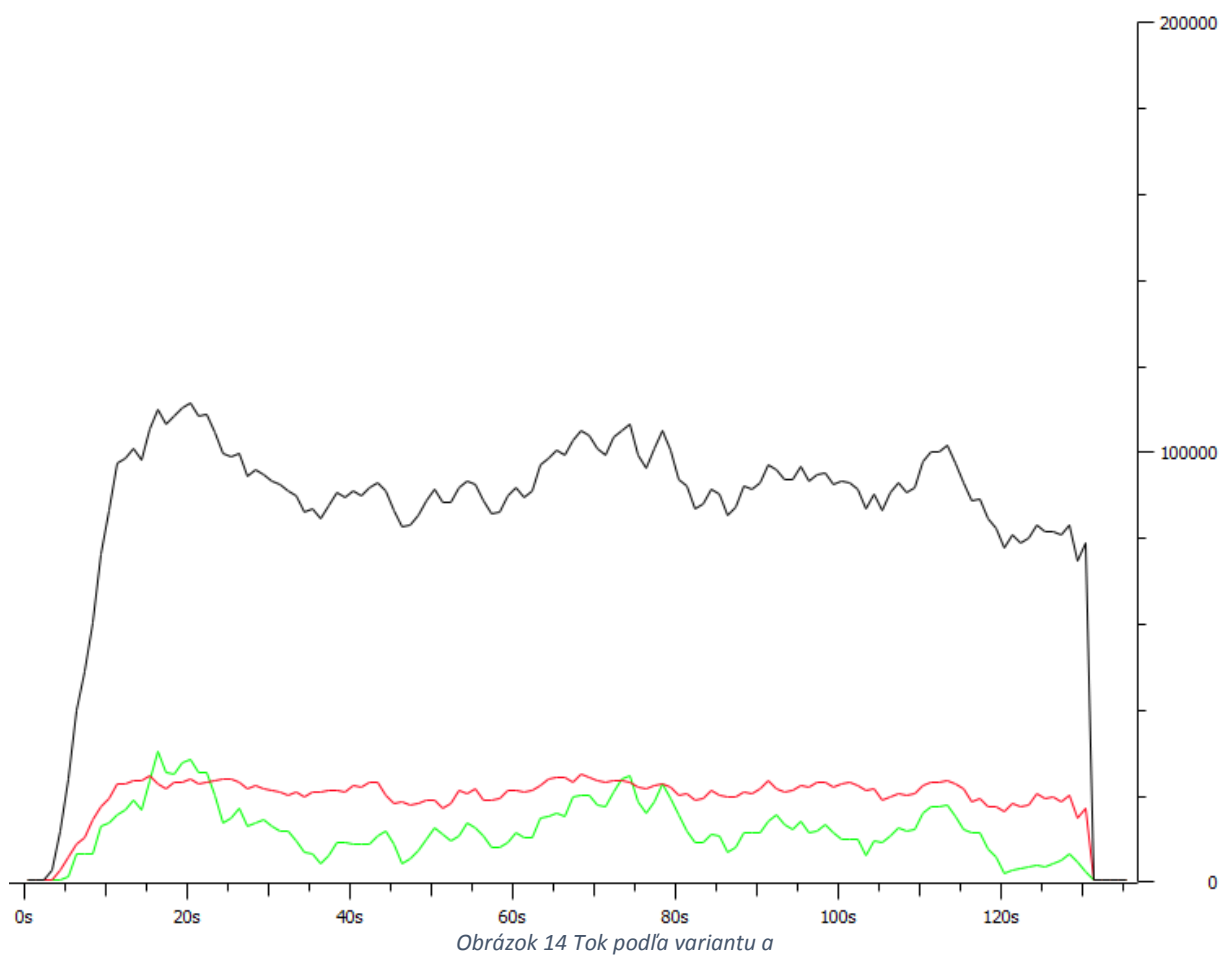
Class-map: class-default (match-any)
 156 packets, 9795 bytes
 5 minute offered rate 0000 bps, drop rate 0000 bps
 Match: any
```

čierny tok	– udp.dstport == 9004
červený tok	– ip.dsfield.dscp == 12
zelený tok	– ip.dsfield.dscp == 13 (ip.dsfield == 56)
modrý tok	– ip.dsfield.dscp == 2

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

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

Intervaly doplnenia tokenov sú také isté.



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

Service-policy input: POLICING3\_trTCM

Class-map: ZAKAZNIK (match-all)

67614 packets, 25336820 bytes

5 minute offered rate 61000 bps, drop rate 0000 bps

Match: access-group 100

QoS Set

dscp 2

Packets marked 67614

police:

**cir 84000 bps, bc 2625 bytes**

**pir 120000 bps, be 3750 bytes**

conformed 58938 packets, 19771278 bytes; actions:

transmit

exceeded 6073 packets, 4003511 bytes; actions:

set-dscp-transmit af12

violated 2603 packets, 1562031 bytes; actions:

set-dscp-transmit af13

conformed 40000 bps, exceeded 16000 bps, violated 6000 bps

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

173 packets, 10842 bytes

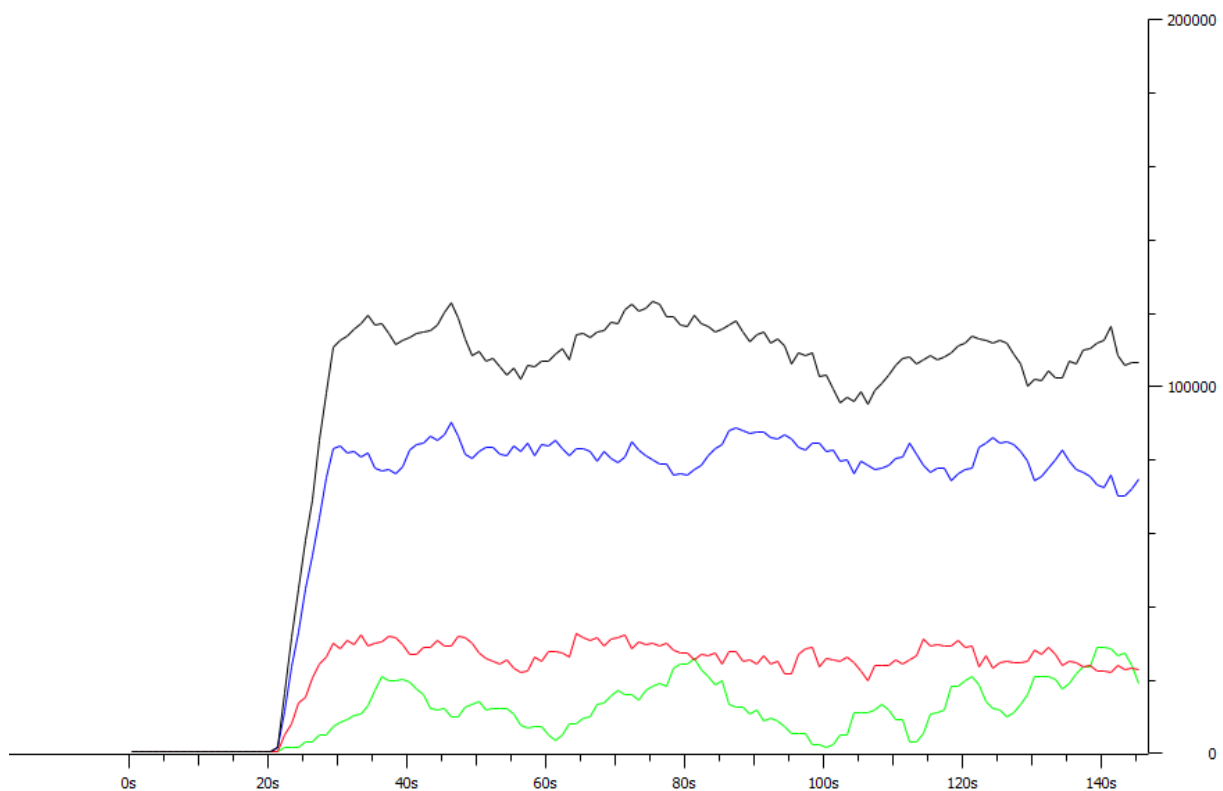
5 minute offered rate 0000 bps, drop rate 0000 bps

Match: any

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

$T_c = B_e / PIR = 3750 * 8 / 120000 = 0,25 \text{ sek}$

Intervaly doplnenia tokenov sú také isté.



Obrázok 16 Tok podľa variantu c

## Shaping

### Scenár 1

```
policy-map SHAPING_AVERAGE
class ZAKAZNIK
set dscp 2
shape average 84000
```

```
sh policy-map int s0/0/0
Serial0/0/0
```

Service-policy output: SHAPING\_AVERAGE

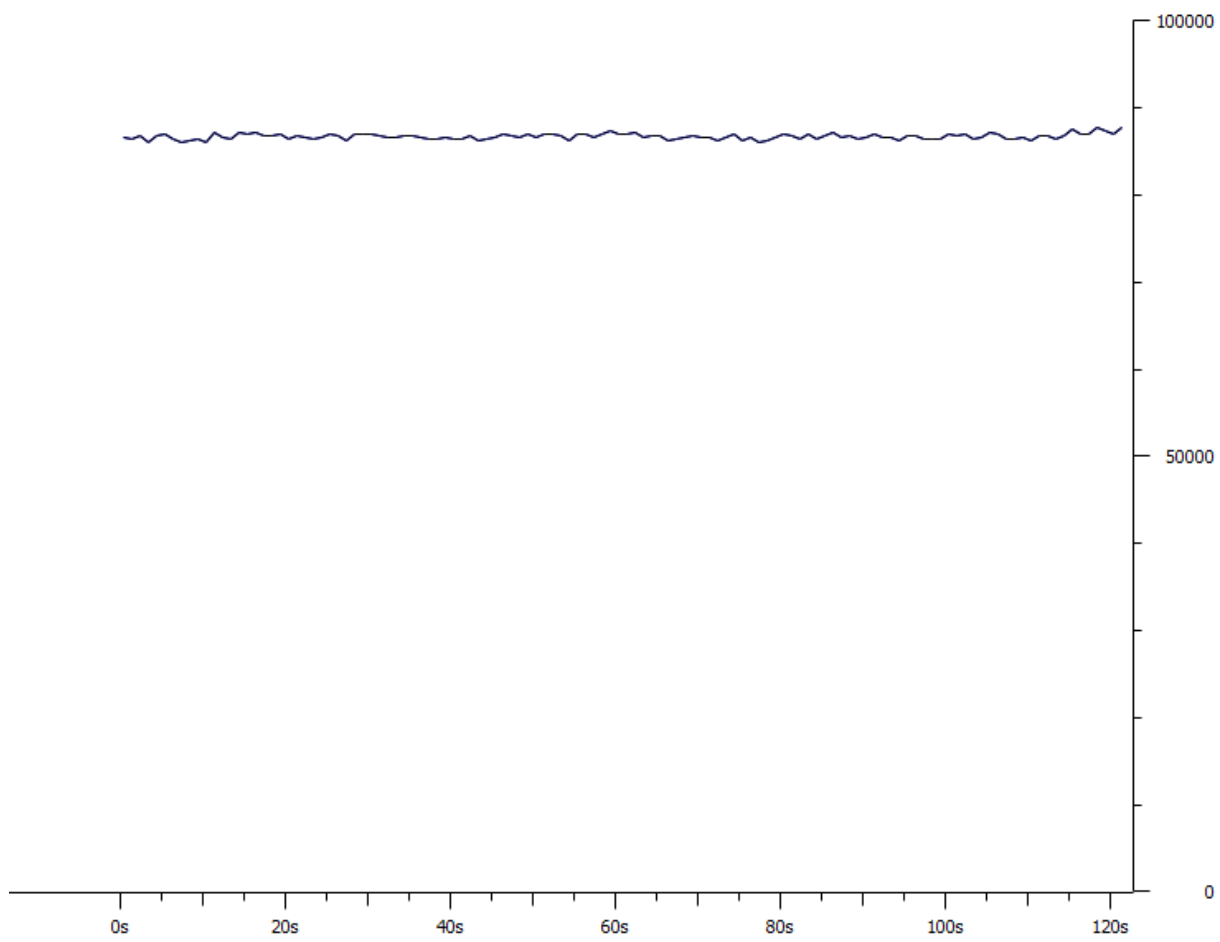
Class-map: ZAKAZNIK (match-all)  
562 packets, 185556 bytes  
5 minute offered rate 5000 bps, drop rate 1000 bps  
Match: access-group 100  
Queueing  
queue limit 64 packets  
(queue depth/total drops/no-buffer drops) 63/20/0  
(pkts output/bytes output) 542/180225  
QoS Set  
dscp 2  
Packets marked 562  
**shape (average) cir 84000, bc 336, be 336**  
**target shape rate 84000**

Class-map: class-default (match-any)  
50 packets, 3678 bytes  
5 minute offered rate 0000 bps, drop rate 0000 bps  
Match: any

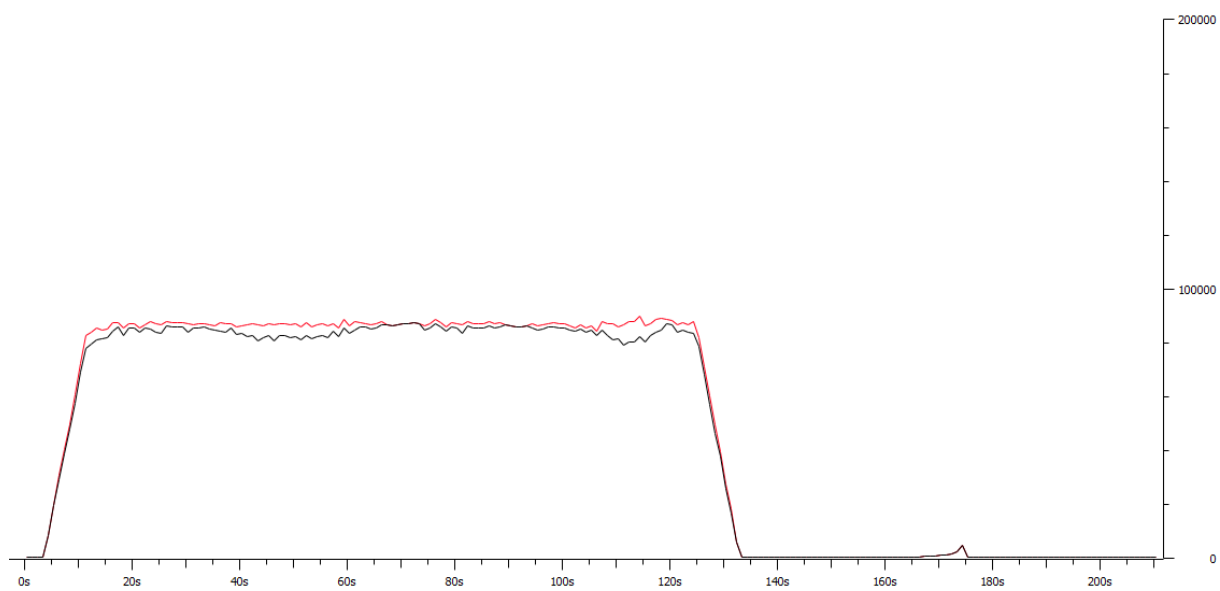
queue limit 64 packets  
(queue depth/total drops/no-buffer drops) 0/0/0  
(pkts output/bytes output) 46/3248

```
čierny tok      – udp.dstport == 9004
červený tok     – ip.dsfield.dscp == 2
```





Obrázok 17 Tok podľa variantu a



Obrázok 18 Tok podľa variantu b

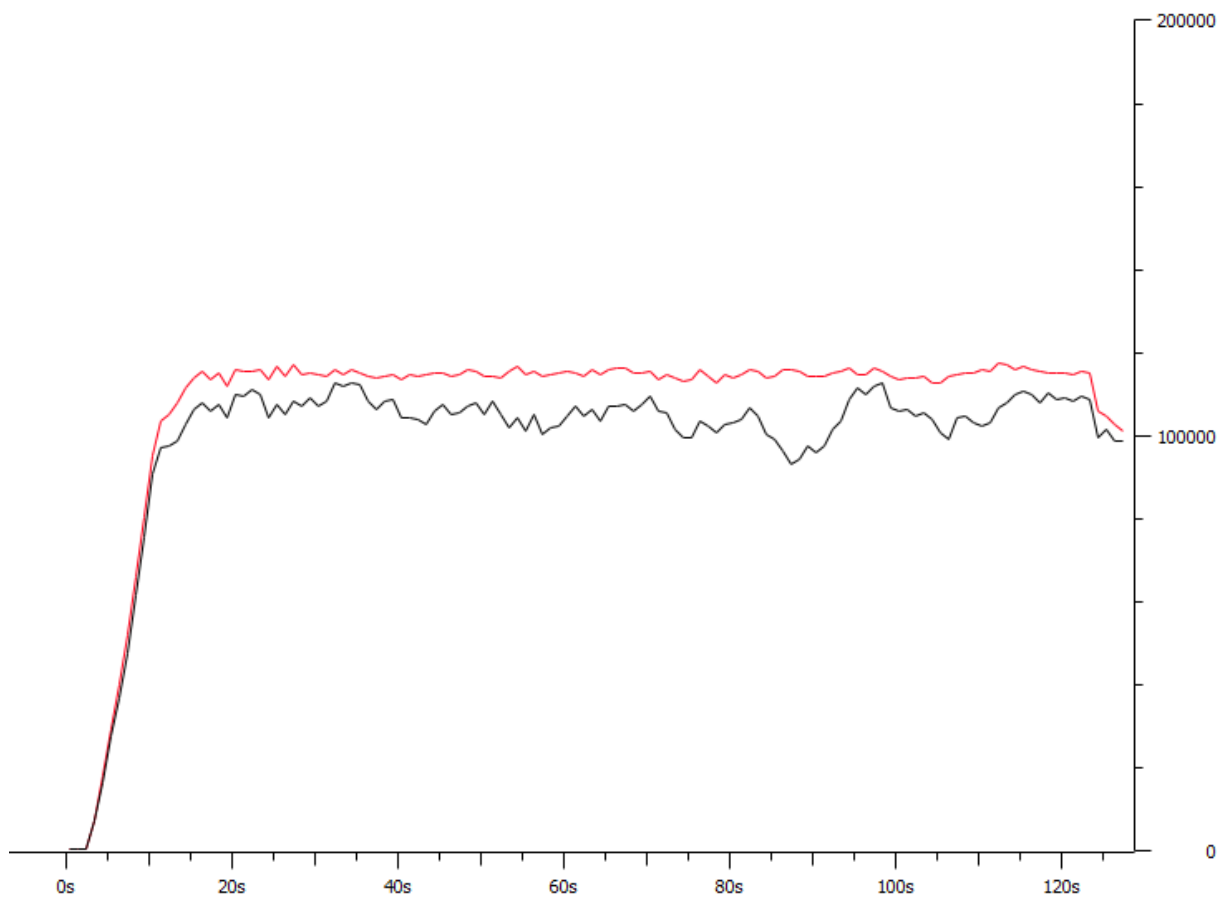
```
sh policy-map int s0/0/0
Serial0/0/0

Service-policy output: SHAPING_AVERAGE
```

Class-map: ZAKAZNIK (match-all)  
13843 packets, 4629943 bytes  
5 minute offered rate 42000 bps, drop rate 0000 bps  
Match: access-group 100  
Queueing  
queue limit 64 packets  
(queue depth/total drops/no-buffer drops) 64/1124/0  
(pkts output/bytes output) 12719/4265160  
QoS Set  
dscp 2  
Packets marked 13843  
**shape (average) cir 112000, bc 448, be 448**  
**target shape rate 112000**

Class-map: class-default (match-any)  
160 packets, 11067 bytes  
5 minute offered rate 0000 bps, drop rate 0000 bps  
Match: any

queue limit 64 packets  
(queue depth/total drops/no-buffer drops) 0/0/0  
(pkts output/bytes output) 156/10637



Obrázok 19 Tok podľa variantu c

## Scenár 2

policy-map SHAPING\_PEAK

```
class ZAKAZNIK
set dscp 2
shape peak 84000
```

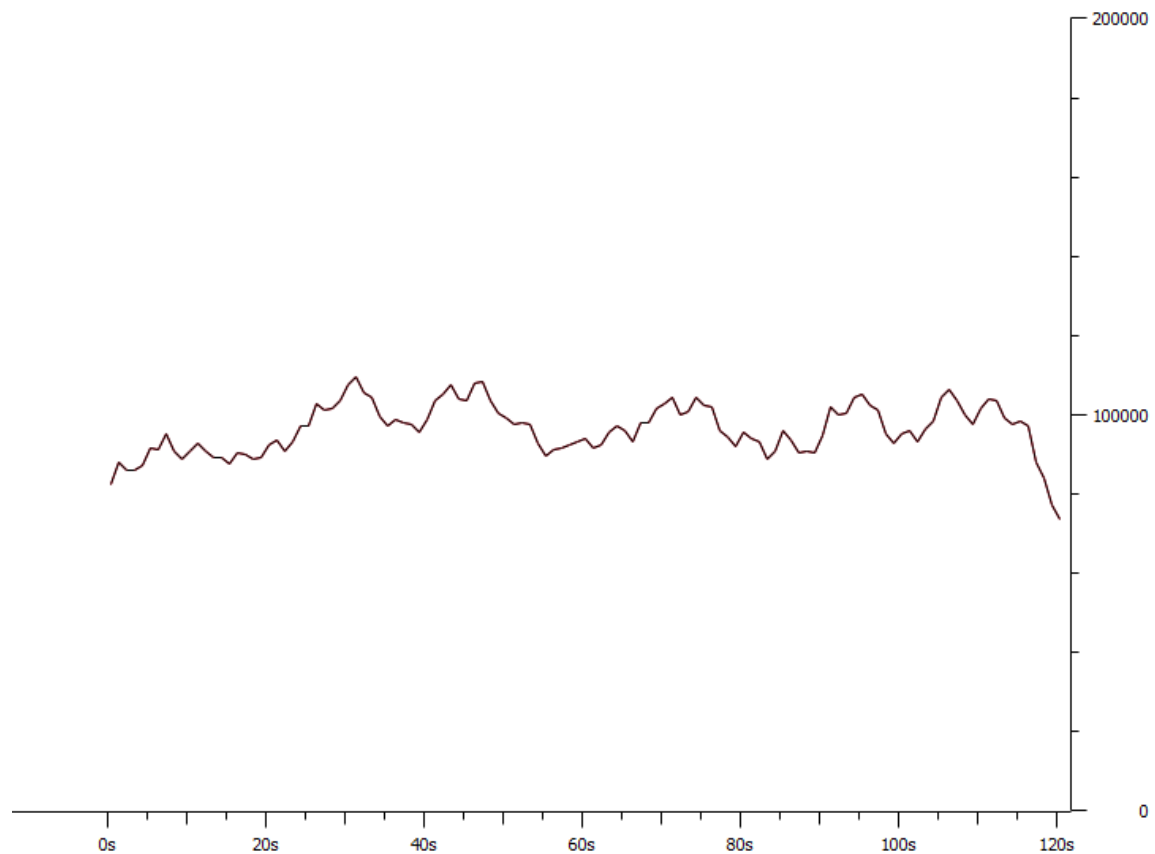
```
sh policy-map int s0/0/0
Serial0/0/0
```

Service-policy output: SHAPING\_PEAK

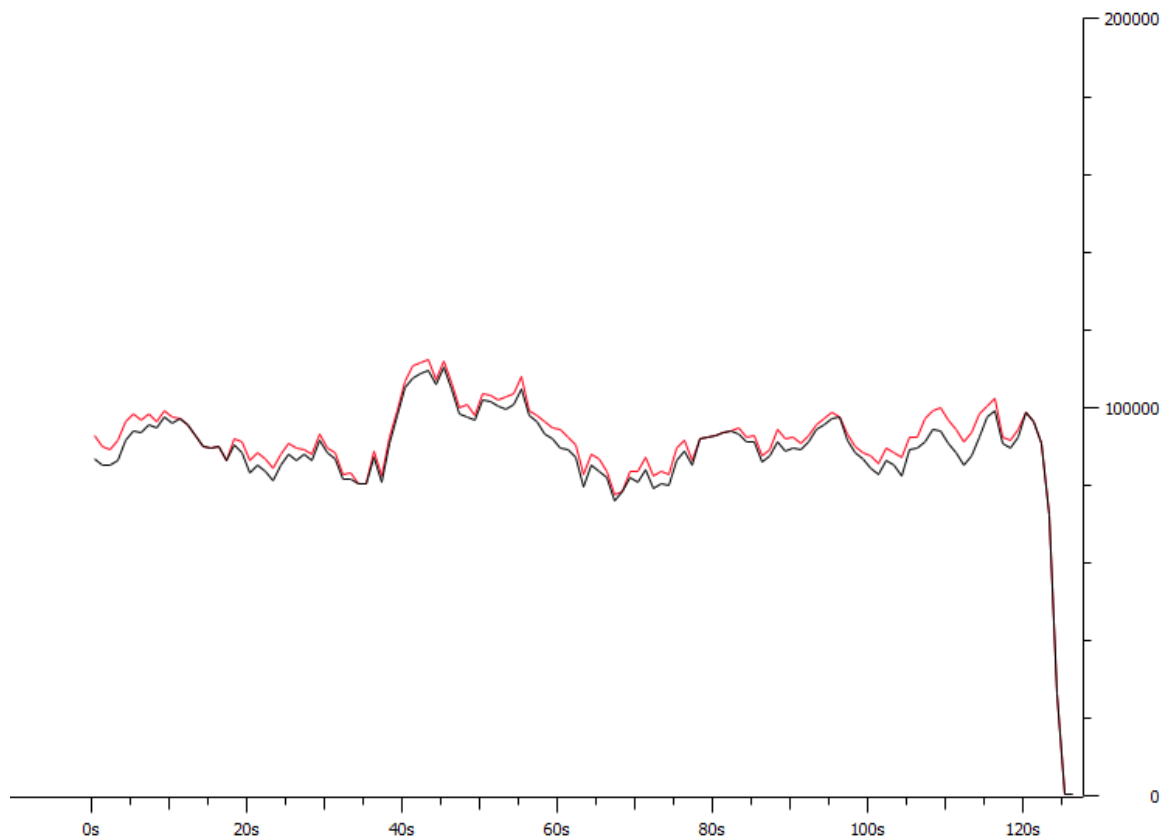
```
Class-map: ZAKAZNIK (match-all)
  21484 packets, 7444417 bytes
  5 minute offered rate 57000 bps, drop rate 0000 bps
  Match: access-group 100
  Queueing
    queue limit 64 packets
    (queue depth/total drops/no-buffer drops) 0/1377/0
    (pkts output/bytes output) 20107/6973625
  QoS Set
    dscp 2
    Packets marked 21484
  shape (peak) cir 84000, bc 336, be 336
  target shape rate 168000
```

```
Class-map: class-default (match-any)
  220 packets, 15026 bytes
  5 minute offered rate 0000 bps, drop rate 0000 bps
  Match: any
```

```
  queue limit 64 packets
  (queue depth/total drops/no-buffer drops) 0/0/0
  (pkts output/bytes output) 216/14596
```



Obrázok 20 Tok podľa variantu a



Obrázok 21 Tok podľa variantu b

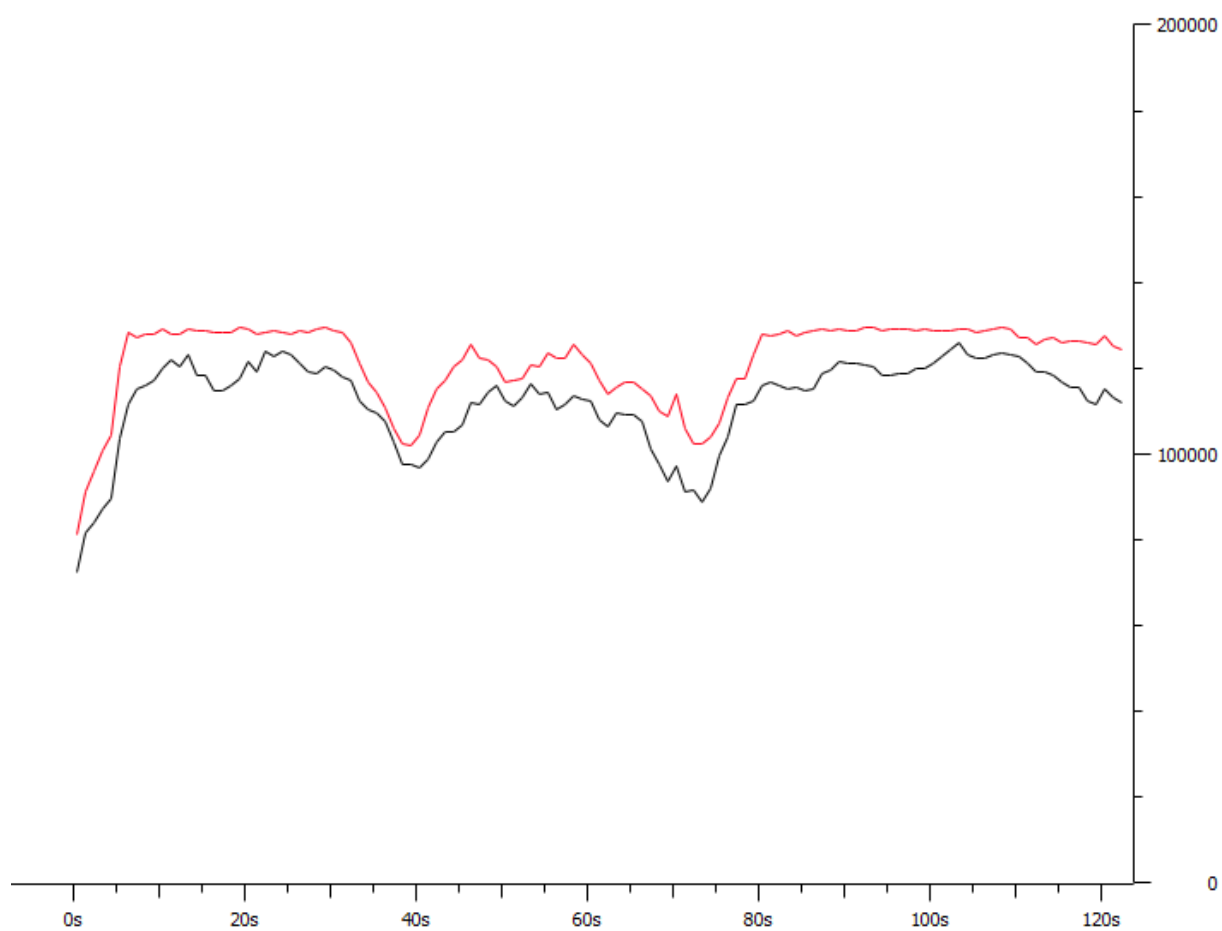
```
sh policy-map int s0/0/0
Serial0/0/0
```

Service-policy output: POLICING1\_DROP

```
Class-map: ZAKAZNIK (match-all)
  25775 packets, 8864919 bytes
  5 minute offered rate 61000 bps, drop rate 0000 bps
  Match: access-group 100
  Queueing
    queue limit 64 packets
    (queue depth/total drops/no-buffer drops) 24/1377/0
    (pkts output/bytes output) 24398/8394127
  QoS Set
    dscp 2
    Packets marked 25775
  shape (peak) cir 112000, bc 448, be 448
  target shape rate 224000
```

```
Class-map: class-default (match-any)
  249 packets, 16971 bytes
  5 minute offered rate 0000 bps, drop rate 0000 bps
  Match: any
```

```
  queue limit 64 packets
  (queue depth/total drops/no-buffer drops) 0/0/0
  (pkts output/bytes output) 245/16541
```



Obrázok 22 Tok podľa variantu c