Experimenty MLP s LFI

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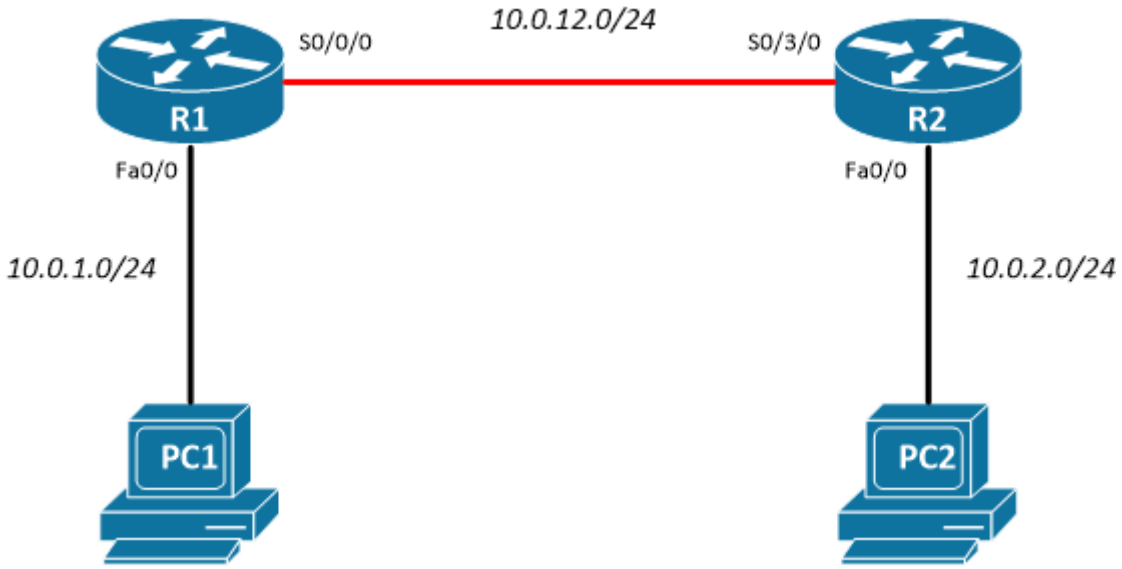
Topológia



Generované toky

Pre úlohu 1 - vygenerujte 2 UDP toky cez D-ITG:

- hlasový tok: konštantný, intenzita 50 pak/s; veľkosti paketov: konšt., 160B telo (s hlavičkami 218B) o využite možnosť v D-ITG vybrať application – Voice s kodekom G.711 (2 samples per packet)
- dátový tok: náhodný – exponenciálny, intenzita 6 pak/s; veľkosť paketov: konštantná, 700B

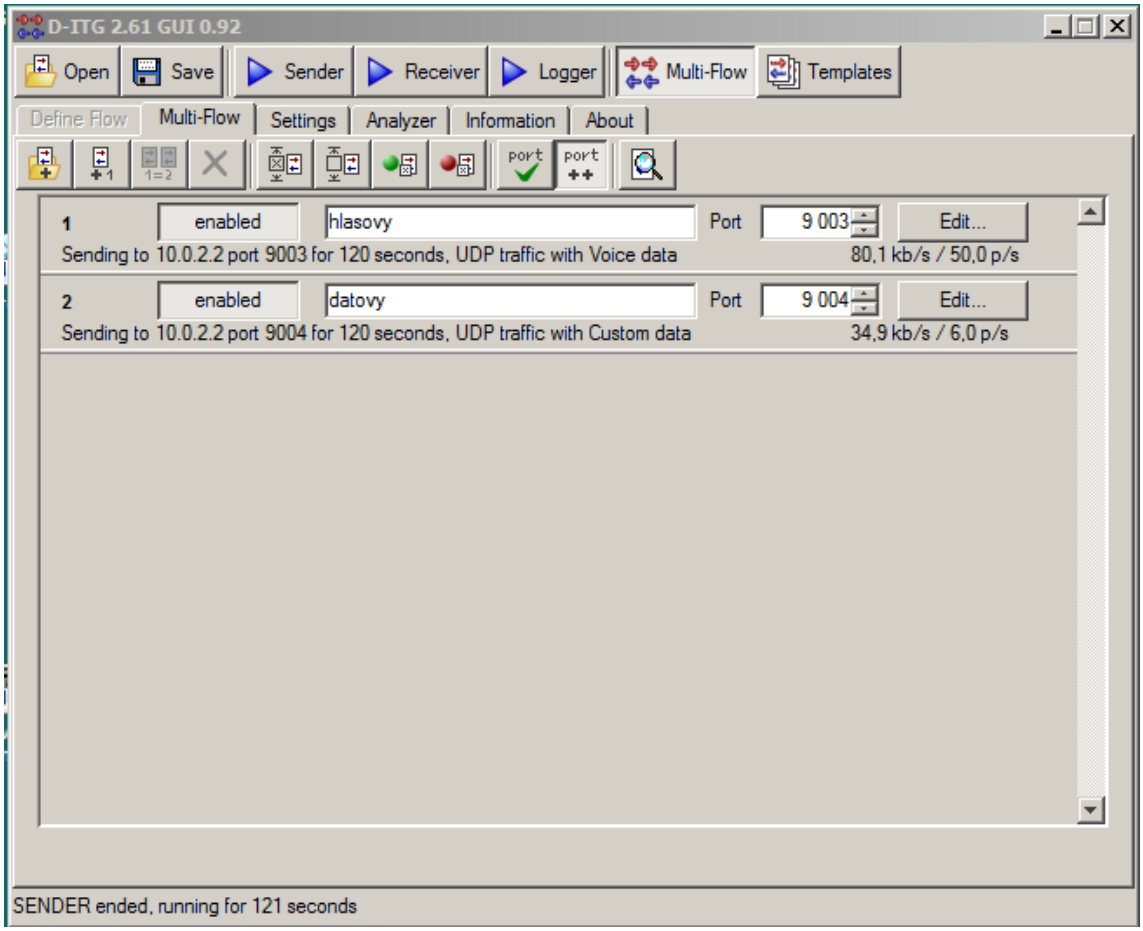
Pre úlohu 2 – preneste 1 súbor cez TFTP z PC1 na PC2, D-ITG nám netreba

1.tok
Konštantný hlasový tok s kodekom G.711

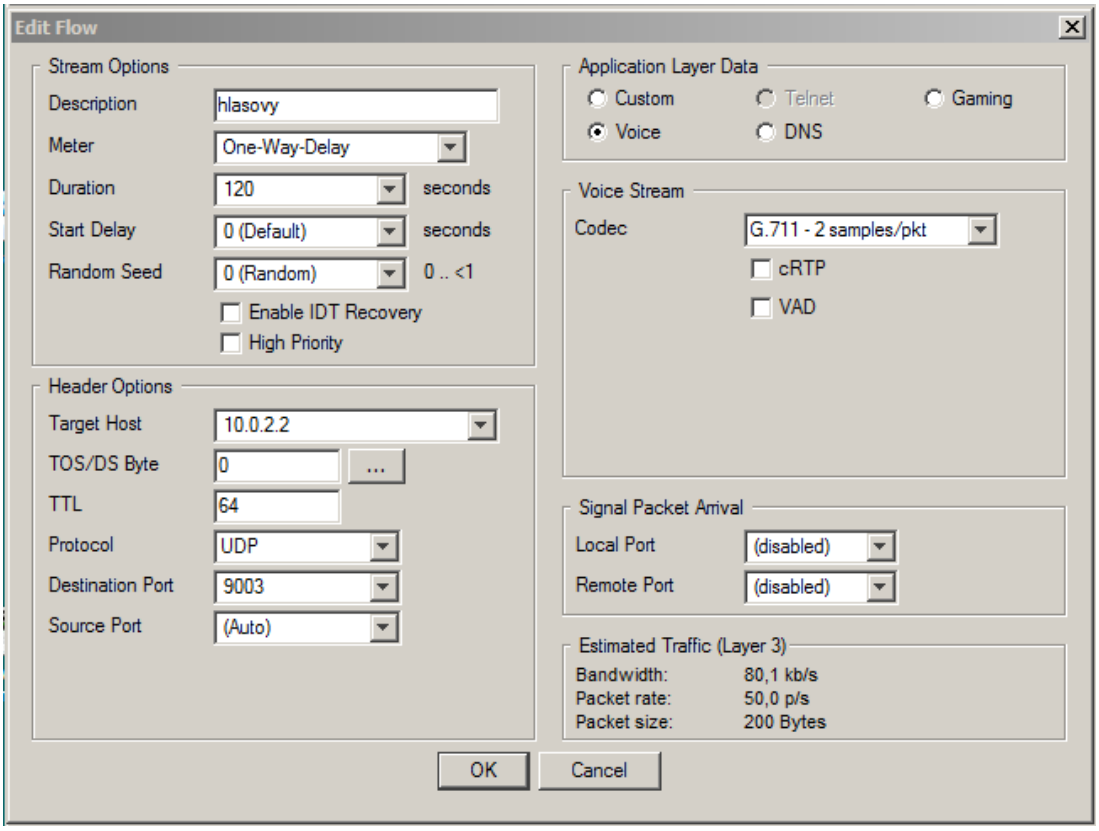
- intenzita 50 p/s
- veľkosť paketu 200B

2.tok
Náhodný dátový tok

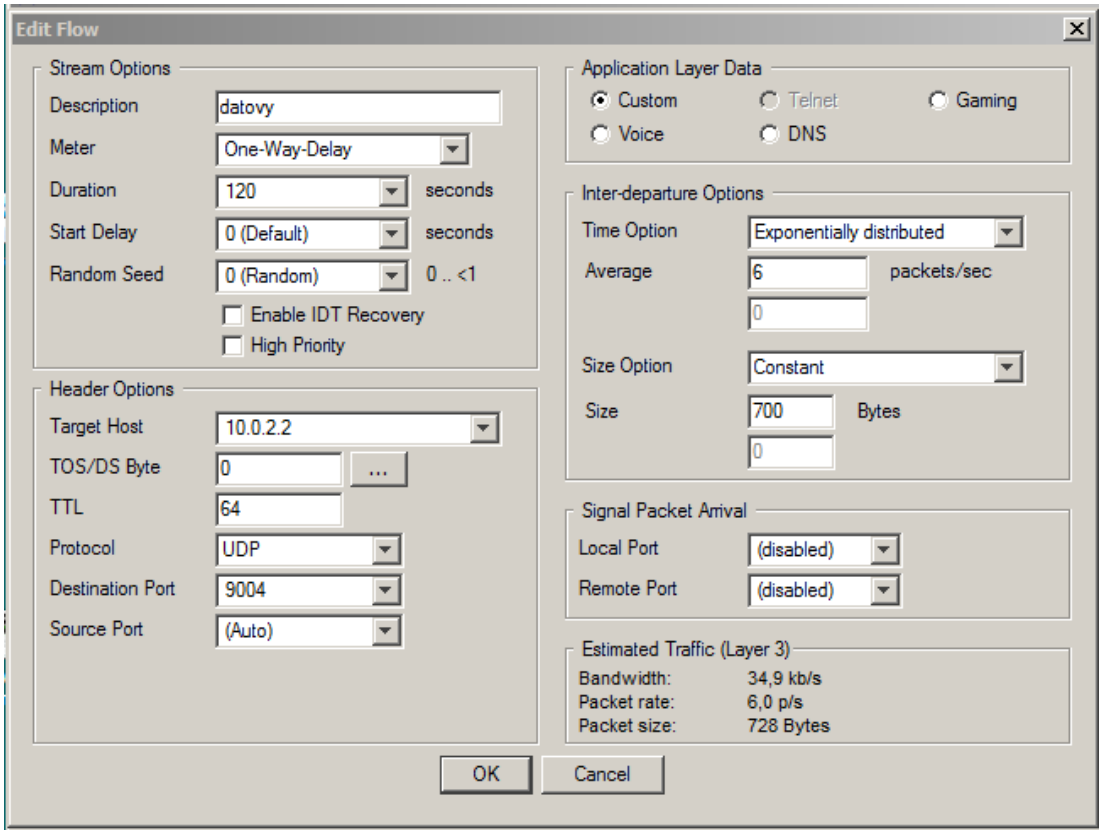
- intenzita 6 p/s
- veľkosť 700B



Obrázok 1 Nastavenie Multiflow



Obrázok 2 Generovanie VOICE



Obrázok 3 Generovanie DATA

Úloha 1

1) Scenár

- bez použitia LFI
- bez prioritizácie VoIP paketov
- iba enkapsulácia PPP

Výpis pred konfiguráciou:

```
R1(config-if)#do sh int s0/0/0
Serial0/0/0 is up, line protocol is down
  Hardware is GT96K Serial
  Internet address is 10.0.12.1/24
  MTU 1500 bytes, BW 128 Kbit/sec, DLY 20000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation HDLC, loopback not set
  Keepalive set (10 sec)
  Last input 00:00:00, output 00:00:03, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     222 packets input, 11898 bytes, 0 no buffer
     Received 215 broadcasts (0 IP multicasts)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     151 packets output, 11755 bytes, 0 underruns
     0 output errors, 0 collisions, 13 interface resets
     98 unknown protocol drops
     0 output buffer failures, 0 output buffers swapped out
     36 carrier transitions
     DCD=up  DSR=up  DTR=up  RTS=up  CTS=up
```

Tu vidíme, že defaultne je zapnutá enkapsulácia na sériovej linke HDLC.

Konfigurácia pre tento scenár:

```
interface Serial0/0/0
 bandwidth 128
 ip address 10.0.12.1 255.255.255.0
 encapsulation ppp
```

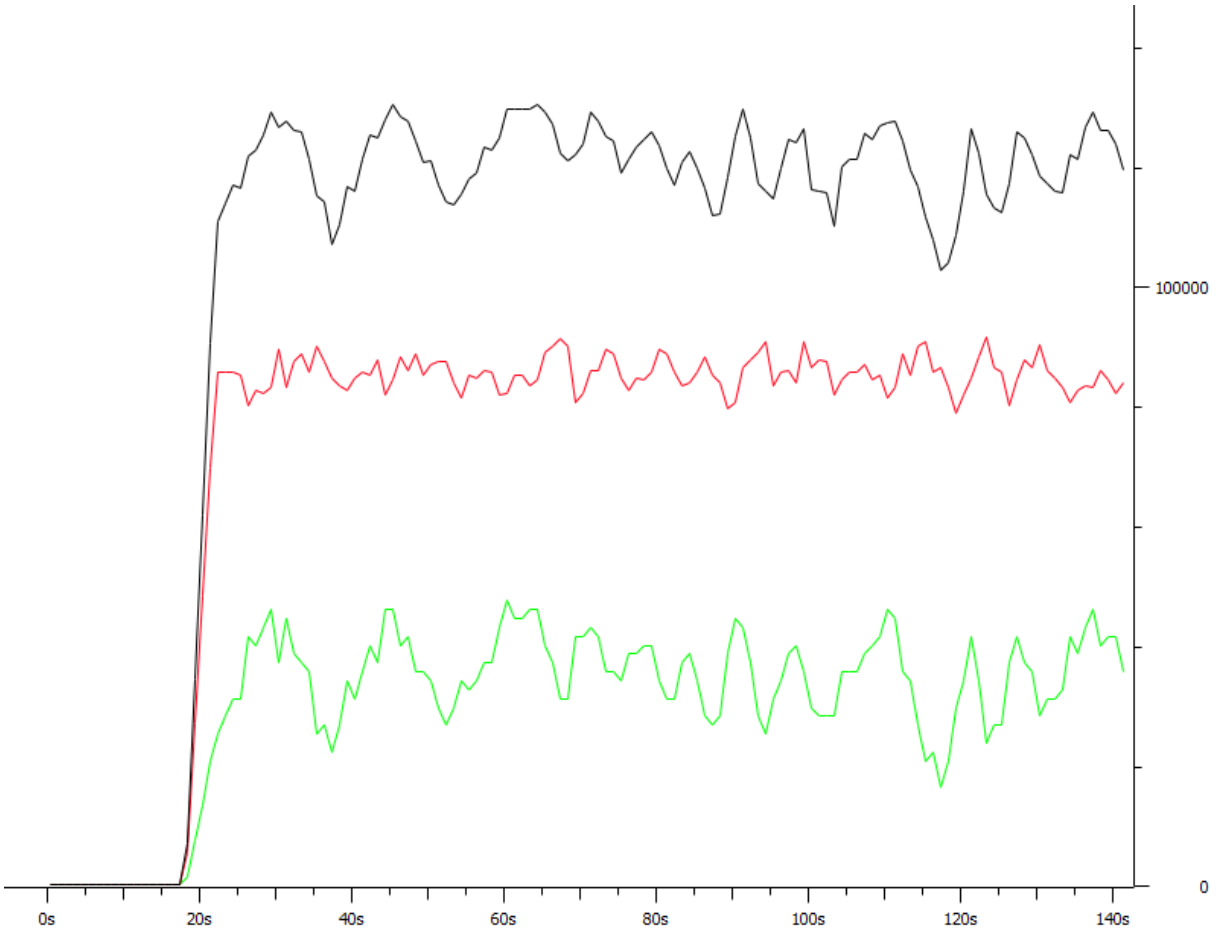
```
R1(config-if)#do sh int s0/0/0
Serial0/0/0 is up, line protocol is up
  Hardware is GT96K Serial
  Internet address is 10.0.12.1/24
  MTU 1500 bytes, BW 128 Kbit/sec, DLY 20000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation PPP, LCP Open
  Open: IPCP, CDPCP, loopback not set
  Keepalive set (10 sec)
  Last input 00:00:01, output 00:00:01, output hang never
  Last clearing of "show interface" counters 00:42:24
```

```
Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
Queueing strategy: Class-based queueing
Output queue: 0/1000/0 (size/max total/drops)
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
  607 packets input, 23766 bytes, 0 no buffer
  Received 0 broadcasts (0 IP multicasts)
  0 runts, 0 giants, 0 throttles
  0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
  20735 packets output, 4076294 bytes, 0 underruns
  0 output errors, 0 collisions, 1 interface resets
  0 unknown protocol drops
  0 output buffer failures, 0 output buffers swapped out
  2 carrier transitions
  DCD=up  DSR=up  DTR=up  RTS=up  CTS=up
```

Po konfigurácií PPP enkapsulácie vidíme, že sa zmenila aj vo výpise z HDLC na PPP

Generovanie tokov:

čierny tok – celkový tok
červený tok – VOICE UDP tok (port 9003)
zelený tok – DÁTOVY UDP tok (port 9004)



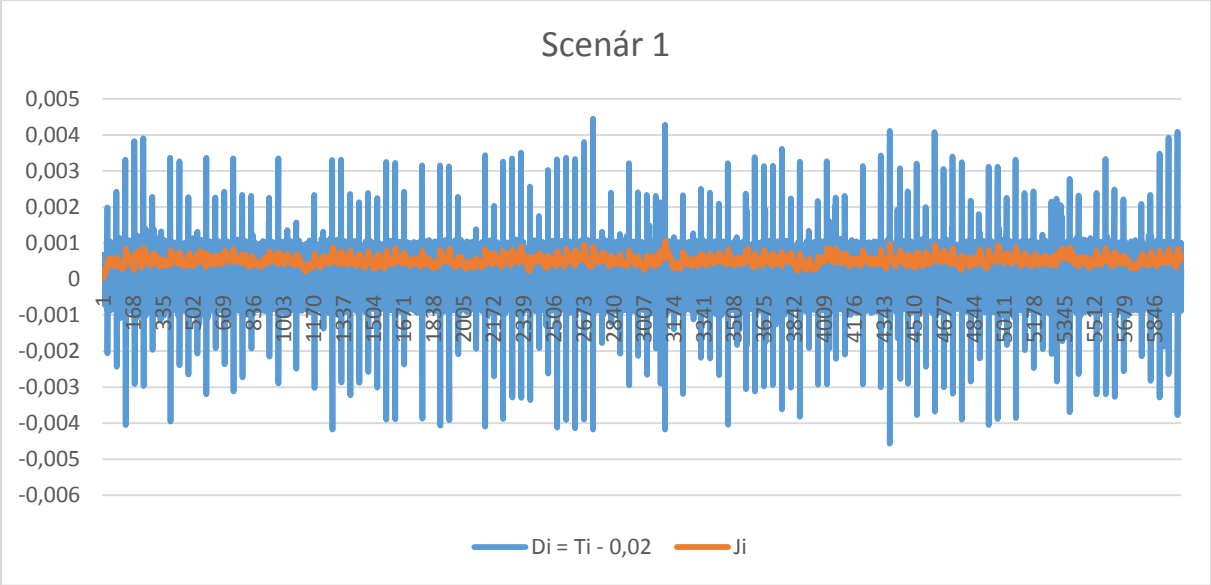
Obrázok 4 Scenár 1 - toky

Flow number: 1 **From 10.0.1.2:55850** **To 10.0.2.2:9003** --- Total time = 119.979000 s Total packets = 6000 Minimum delay = -92.065000 s Maximum delay = -91.661000 s Average delay = -91.998349 s Average jitter = 0.009444 s Delay standard deviation = 0.073014 s Bytes received = 1032000 Average bitrate = 68.812042 Kbit/s Average packet rate = 50.008752 pkt/s Packets dropped = 0 (0.00 %) Average loss-burst size = 0.000000 pkt	**Flow number: 2** **From 10.0.1.2:55851** **To 10.0.2.2:9004** --- Total time = 119.702000 s Total packets = 693 Minimum delay = -92.033000 s Maximum delay = -91.656000 s Average delay = -91.963779 s Average jitter = 0.027566 s Delay standard deviation = 0.071542 s Bytes received = 485100 Average bitrate = 32.420511 Kbit/s Average packet rate = 5.789377 pkt/s Packets dropped = 0 (0.00 %) Average loss-burst size = 0.000000 pkt

Jitter:

- odhad štatistického rozptylu časových intervalov medzi príchodmi paketov

Di – jitter (Ti -0,02)
Ti = Ri – Ri-1
Ri – čas príchodu paketu na prijímač
Ji – kolísanie oneskorenia



2) Scenár

- Bez použitia LFI
- S prioritizáciou VoIP paketov (priority 90)

Konfigurácia pre tento scenár:

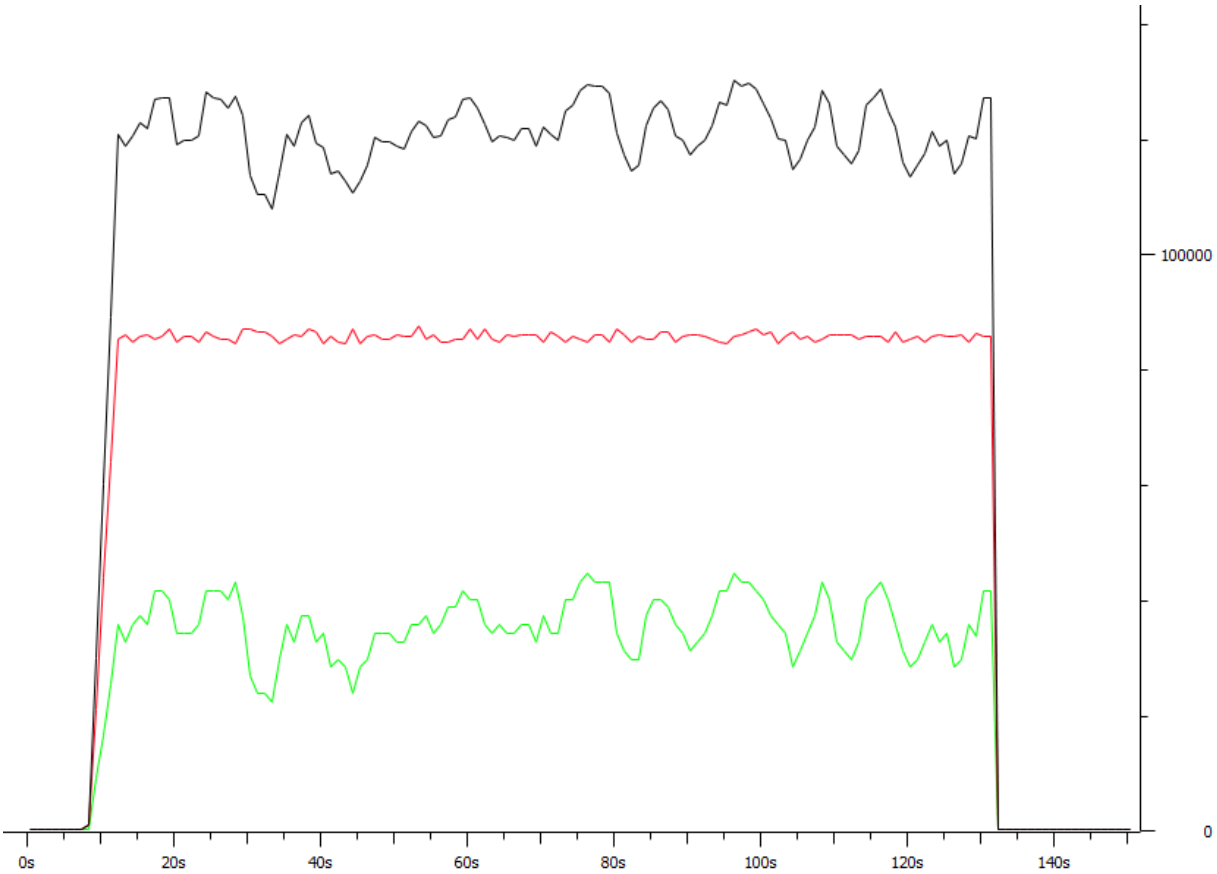
```
class-map match-all ZAKAZNIK
 match access-group 100
!
policy-map PRIORITApreHLAS
 class ZAKAZNIK
  priority 90

access-list 100 permit udp any any eq 9003

interface Serial0/0/0
 bandwidth 128
 ip address 10.0.12.1 255.255.255.0
 encapsulation ppp
 service-policy output PRIORITApreHLAS
```

Generovanie tokov:

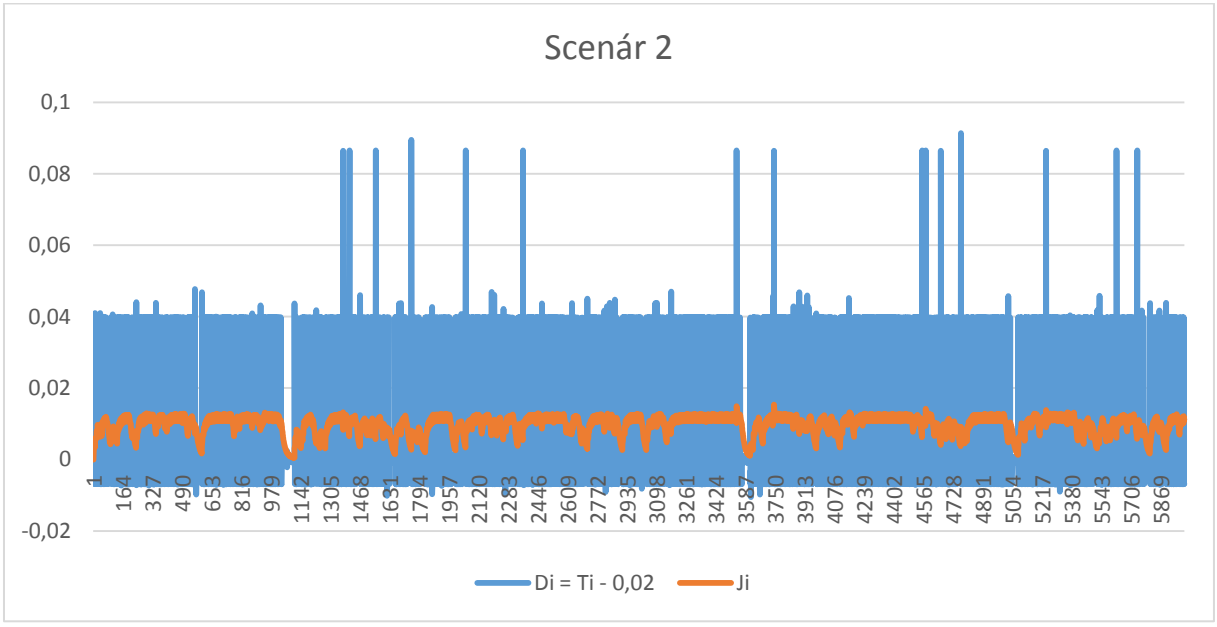
čierny tok – celkový tok
červený tok – VOICE UDP tok (port 9003)
zelený tok – DÁTOVY UDP tok (port 9004)



Obrázok 5 Scenár 2 - toky

Flow number: 1 **From 10.0.1.2:52592** **To 10.0.2.2:9003** ----------	**Flow number: 2** **From 10.0.1.2:52593** **To 10.0.2.2:9004** ----------
Total time = 120.031000 s	Total time = 119.910000 s
Total packets = 6000	Total packets = 718
Minimum delay = -92.525000 s	Minimum delay = -92.489000 s
Maximum delay = -92.418000 s	Maximum delay = -91.458000 s
Average delay = -92.487898 s	Average delay = -92.316475 s
Average jitter = 0.009698 s	Average jitter = 0.075110 s
Delay standard deviation = 0.023513 s	Delay standard deviation = 0.195620 s
Bytes received = 1032000	Bytes received = 502600
Average bitrate = 68.782231 Kbit/s	Average bitrate = 33.531816 Kbit/s
Average packet rate = 49.987087 pkt/s	Average packet rate = 5.987824 pkt/s
Packets dropped = 0 (0.00 %)	Packets dropped = 0 (0.00 %)
Average loss-burst size = 0.000000 pkt	Average loss-burst size = 0.000000 pkt

Jitter:



3) Scenár

- S použitím LFI
  - fragmentácia paketov (200B)
  - a ich prekladanie (interleave)
- S prioritizáciou VoIP paketov

Konfigurácia pre tento scenár:

```
interface Multilink1
 ip address 10.0.12.1 255.255.255.0
 ppp multilink
 ppp multilink interleave
 ppp multilink group 1
 ppp multilink fragment size 200
 service-policy output PRIORITApreHLAS

interface Serial0/0/0
 bandwidth 128
 no ip address
 encapsulation ppp
 ppp multilink
 ppp multilink group 1
```

Keďže LFI nie je podporované na samotnom interface, bolo nutné vytvoriť MULTILINK interface a konfigurovať dané nastavenia pre tento interface.
Súčasťou tohto Multilink interface bol v tomto scenári len jeden Serial Port:

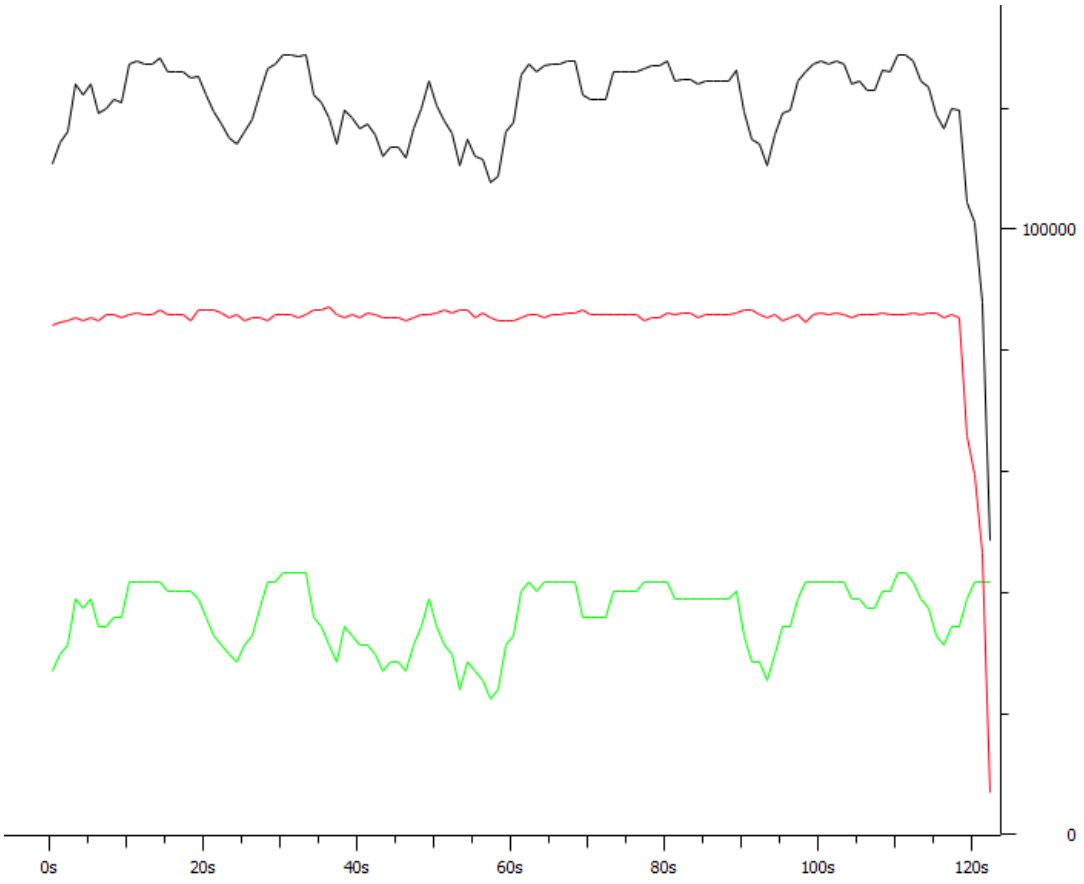
```
R1(config-if)# do sh int s0/0/0
Serial0/0/0 is up, line protocol is up
  Hardware is GT96K Serial
  MTU 1500 bytes, BW 128 Kbit/sec, DLY 20000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation PPP, LCP Open, multilink Open
  Link is a member of Multilink bundle Multilink1, loopback not set
  Keepalive set (10 sec)
  Last input 00:00:29, output 00:00:09, output hang never
  Last clearing of "show interface" counters 01:06:07
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     1011 packets input, 43437 bytes, 0 no buffer
     Received 0 broadcasts (0 IP multicasts)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     35877 packets output, 5931192 bytes, 0 underruns
     0 output errors, 0 collisions, 2 interface resets
     0 unknown protocol drops
     0 output buffer failures, 0 output buffers swapped out
     4 carrier transitions
     DCD=up  DSR=up  DTR=up  RTS=up  CTS=up
```

```
R1#sh interfaces multilink 1
Multilink1 is up, line protocol is up
  Hardware is multilink group interface
  Internet address is 10.0.12.1/24
```

MTU 1500 bytes, BW 1672 Kbit/sec, DLY 20000 usec,
reliability 255/255, txload 1/255, rxload 1/255
Encapsulation PPP, LCP Open, **multilink Open**
Open: IPCP, CDPCP, loopback not set
Keepalive set (10 sec)
DTR is pulsed for 2 seconds on reset
Last input 00:00:33, output never, output hang never
Last clearing of "show interface" counters 00:20:36
Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 43
Queueing strategy: fifo
Output queue: 0/40 (size/max)
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
106 packets input, 14575 bytes, 0 no buffer
Received 0 broadcasts (0 IP multicasts)
0 runts, 0 giants, 0 throttles
0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
6755 packets output, 1850129 bytes, 0 underruns
0 output errors, 0 collisions, 1 interface resets
0 unknown protocol drops
0 output buffer failures, 0 output buffers swapped out
0 carrier transitions

Generovanie tokov:

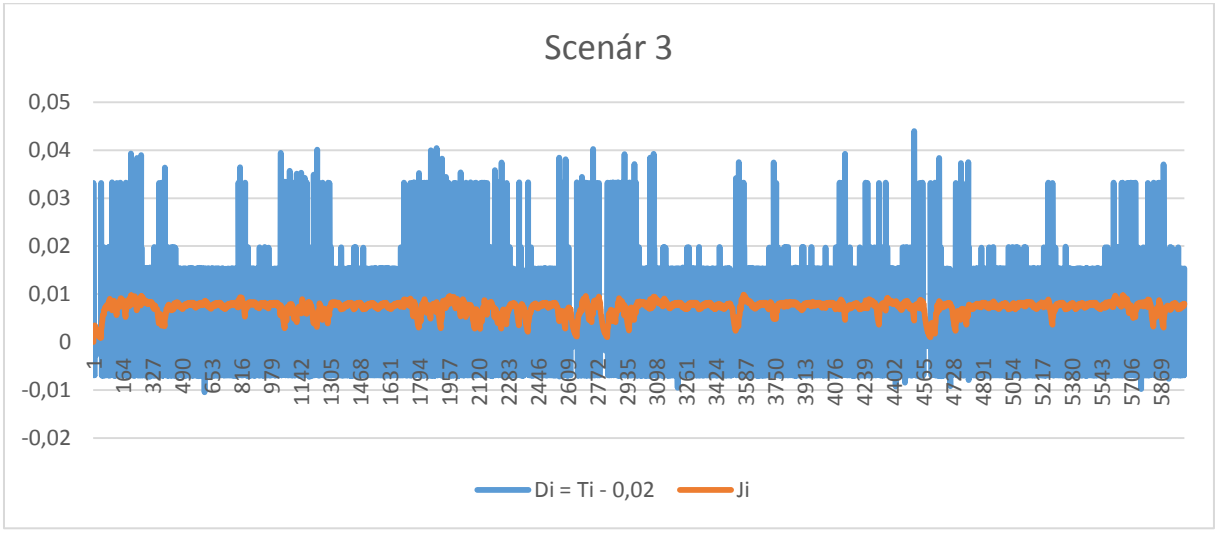
čierny tok – celkový tok
červený tok – VOICE UDP tok (port 9003)
zelený tok – DÁTOVY UDP tok (port 9004)



Obrázok 6 Scenár 3 - toky

Flow number: 1 **From 10.0.1.2:54415** **To 10.0.2.2:9003** --- Total time = 120.035000 s Total packets = 6000 Minimum delay = -91.630000 s Maximum delay = -91.562000 s Average delay = -91.589438 s Average jitter = 0.007174 s Delay standard deviation = 0.019376 s Bytes received = 1032000 Average bitrate = 68.779939 Kbit/s Average packet rate = 49.985421 pkt/s Packets dropped = 0 (0.00 %) Average loss-burst size = 0.000000 pkt	**Flow number: 2** **From 10.0.1.2:54416** **To 10.0.2.2:9004** --- Total time = 120.254000 s Total packets = 736 Minimum delay = -91.580000 s Maximum delay = -89.754000 s Average delay = -91.188636 s Average jitter = 0.094385 s Delay standard deviation = 0.376559 s Bytes received = 515200 Average bitrate = 34.274120 Kbit/s Average packet rate = 6.120379 pkt/s Packets dropped = 0 (0.00 %) Average loss-burst size = 0.000000 pkt

Jitter:



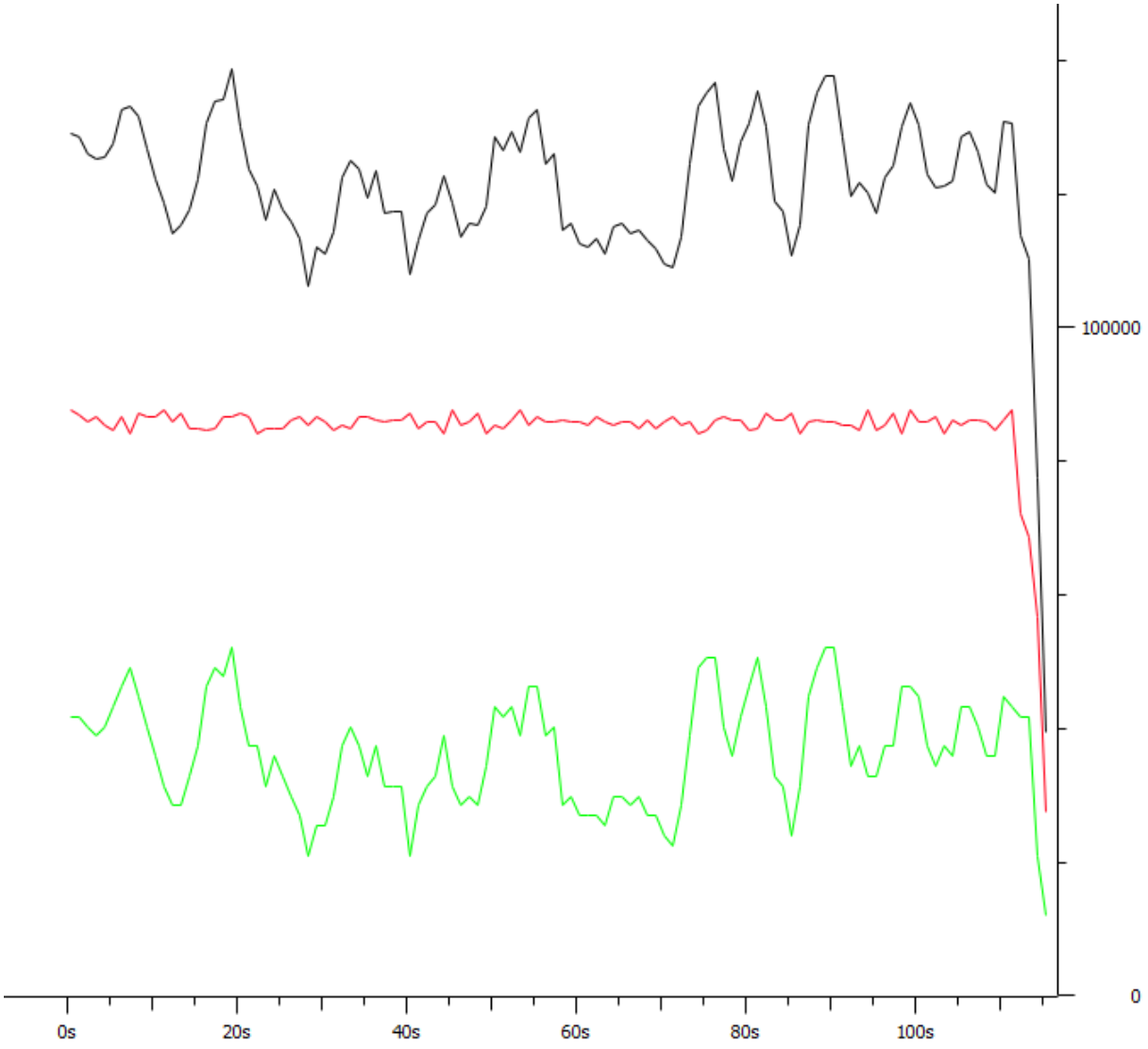
4) Scenár

V tomto scenári sme len zapojili druhú sériovú linku medzi smerovačmi a pridali sme ju do nášho Multilink interface.
Pôvodná konfigurácia ostáva:

- S použitím LFI
- S prioritizáciou VoIP paketov

Generovanie tokov:

čierny tok – celkový tok červený tok – VOICE UDP tok (port 9003) zelený tok – DÁTOVY UDP tok (port 9004)

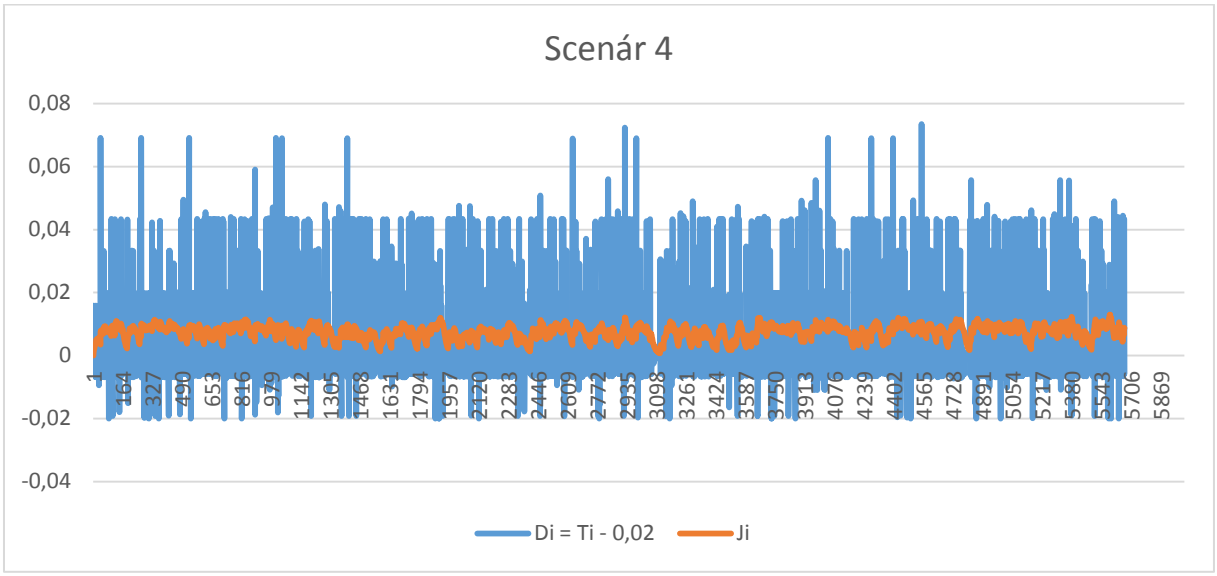


Obrázok 7 Scenár 4 - toky

Flow number: 1 **From 10.0.1.2:54414** **To 10.0.2.2:9003** --- Total time = 119.987000 s Total packets = 6000	**Flow number: 2** **From 10.0.1.2:54413** **To 10.0.2.2:9004** --- Total time = 119.973000 s Total packets = 731

Minimum delay = -91.675000 s Maximum delay = -91.567000 s Average delay = -91.636923 s Average jitter = 0.007810 s Delay standard deviation = 0.030982 s Bytes received = 1032000 Average bitrate = 68.807454 Kbit/s Average packet rate = 50.005417 pkt/s Packets dropped = 0 (0.00 %) Average loss-burst size = 0.000000 pkt	Minimum delay = -91.661000 s Maximum delay = -91.329000 s Average delay = -91.577620 s Average jitter = 0.043582 s Delay standard deviation = 0.064610 s Bytes received = 511700 Average bitrate = 34.121011 Kbit/s Average packet rate = 6.093038 pkt/s Packets dropped = 0 (0.00 %) Average loss-burst size = 0.000000 pkt

Jitter:

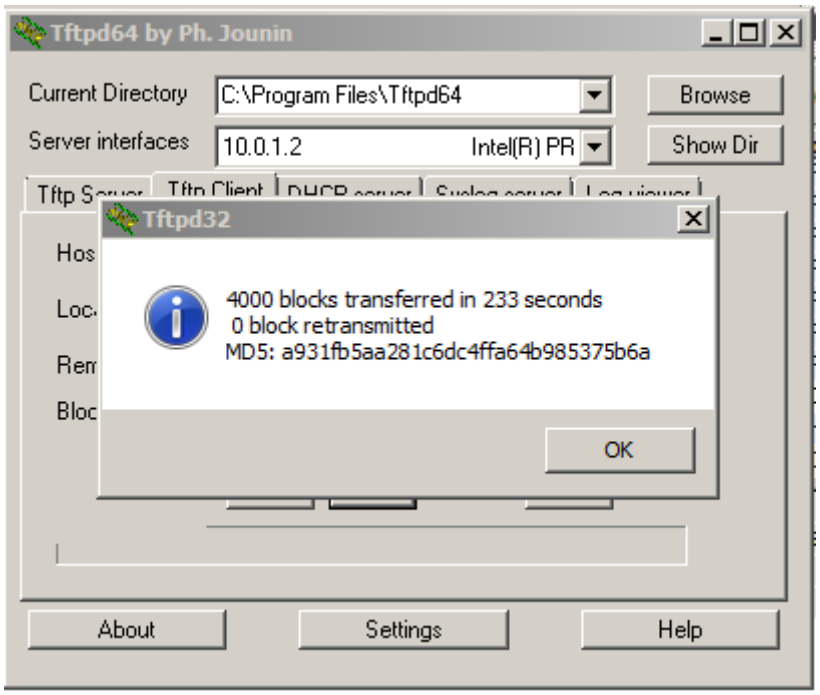


Úloha 2

- úlohou bolo preniesť súbor cez TFTP z PC1 na PC2

1) Scenár

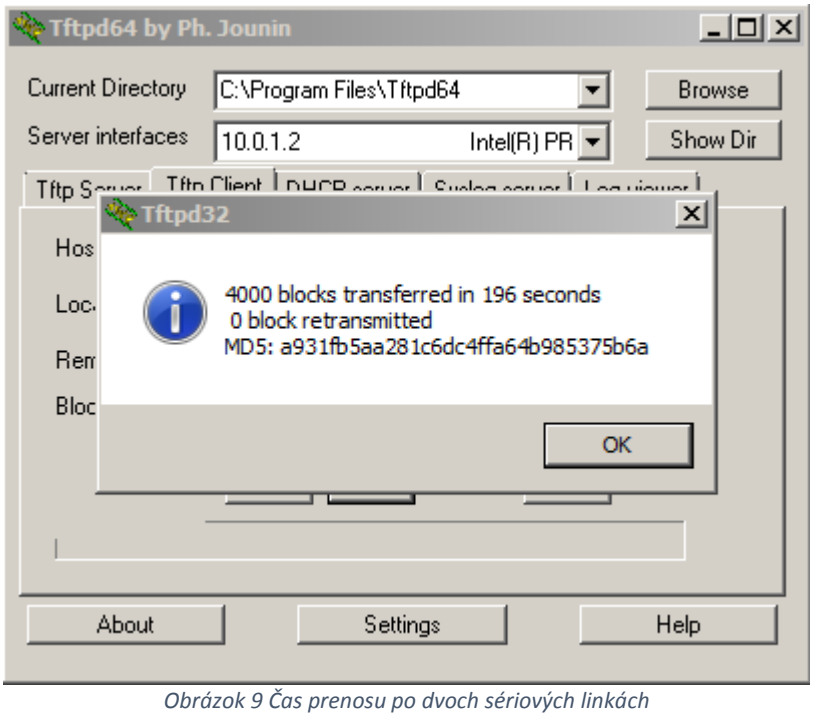
Prenášali sme 2 MB súbor. Cez jednu linku sa preniesol za 233 sekúnd.



Obrázok 8 Čas prenosu po jednej sériovej linke

2) Scenár

Cez dve sériové linky sa nám 2MB súbor preniesol za 196 sekúnd.



Obrázok 9 Čas prenosu po dvoch sériových linkách