Ταξινόμηση, παρακολούθηση και περιορισμός χρησιμοποιούμενου εύρους ζώνης εφαρμογών στο Δίκτυο Δεδομένων ΑΠΘ.

Δημήτριος Α Αδάμος

ΚΛ&ΔΔ ΑΠΘ

Agenda

- Λειτουργικές αδυναμίες δικτύου
- Μέτρα
- Διαγράμματα
- Unknown traffic
- Συμπεράσματα

Λειτουργικές αδυναμίες δικτύου

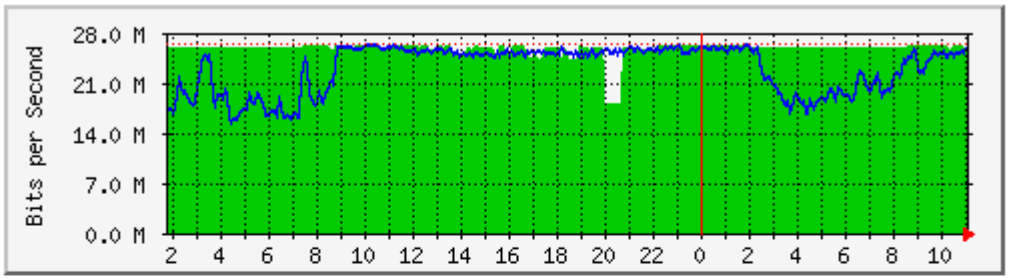
Web Service

- ~ 10KB/sec σε ώρες αιχμής
- Καθυστέρηση στην απόκριση
- Άμεσα ορατή η υποβάθμιση της ποιότητας στους χρήστες

Λειτουργικές αδυναμίες δικτύου

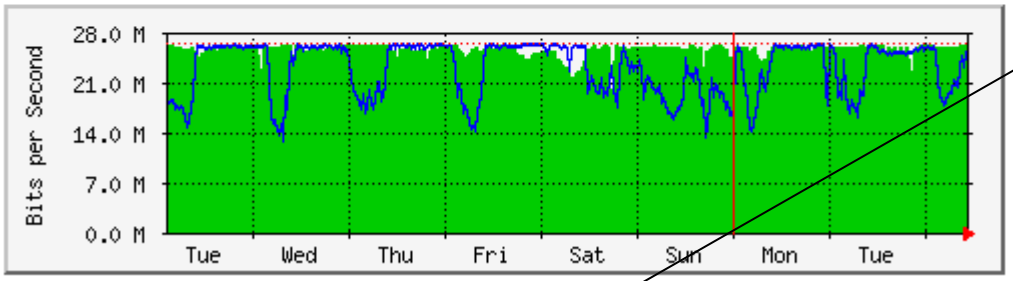
Συμφόρηση στη σύνδεση με ΕΔΕΤ

`Daily' Graph (5 Minute Average)



Max In:26.6 Mb/s (100.0%) Average In:26.0 Mb/s (97.8%) Current In:25.6 Mb/s (96.3%)
Max Out:26.5 Mb/s (99.7%) Average Out:23.2 Mb/s (87.4%) Current Out:25.9 Mb/s (97.4%)

`Weekly' Graph (30 Minute Average)



Max In:26.6 Mb/s (100.0%) Average In:25.7 Mb/s (96.6%) Current In:26.2 Mb/s (98.5%)
Max Out:26.5 Mb/s (99.9%) Average Out:23.1 Mb/s (86.9%) Current Out:25.1 Mb/s (94.4%)

Average in: 96.6%

Average out: 86.9%

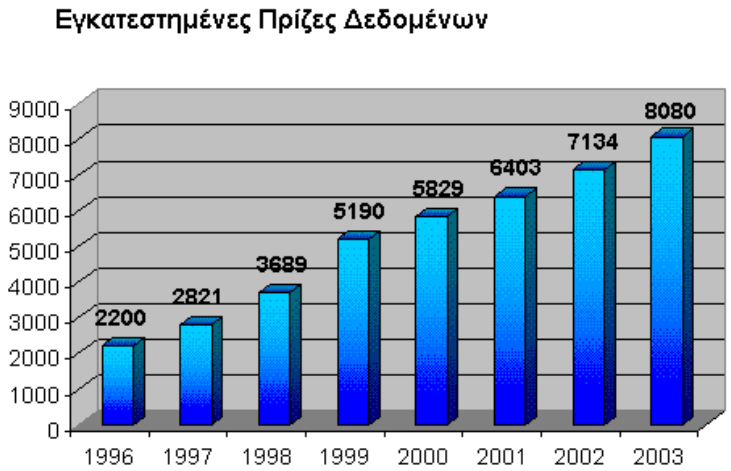
Λειτουργικές αδυναμίες δικτύου

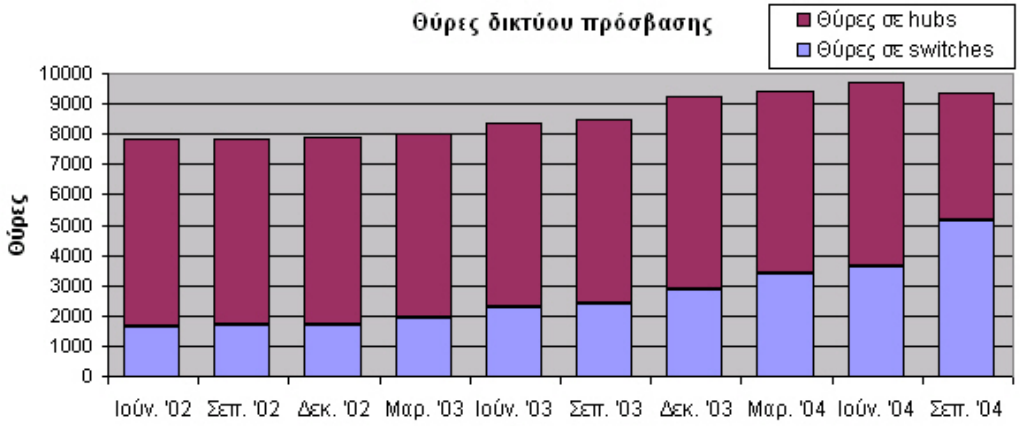
Μεγέθη

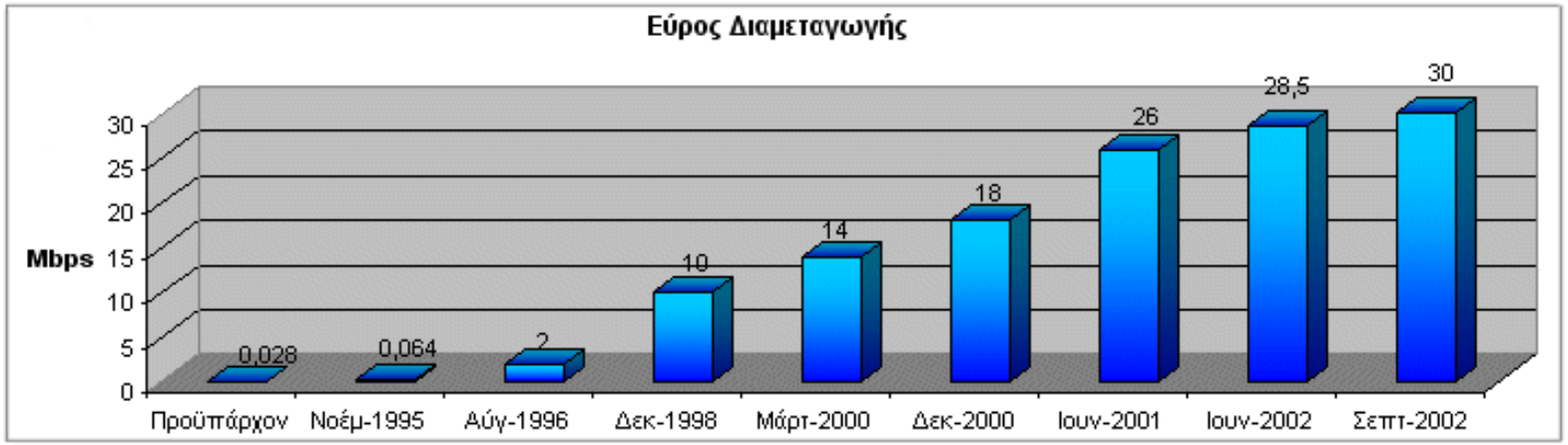
- **12000 ενεργοί χρήστες**
- **9000 πρίζες δικτύου**
- **8326 καταχωρημένοι υπολογιστές**

Λειτουργικές αδυναμίες δικτύου

Μεγέθη







Λειτουργικές αδυναμίες δικτύου

Νέες εφαρμογές?

- **P2P**

  Napster,

  Kazaa &kazaalite

  Gnutella

  Fasttrack

  Edonkey

  Shareaza

  Emule

  DC++

  Torrent

  Soulseek

  Blubster

  Imesh

  LimeWire

  Morpheus

  ...

Λειτουργικές αδυναμίες δικτύου

Συμπέρασμα

- Τυχαία και σαφώς μη δίκαιη κατανομή δικτυακών πόρων μεταξύ εφαρμογών και χρηστών
- Αδυναμία διαχειριστικής εποπτείας και επέμβασης

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Μέτρα

Νέος συνοριακός δρομολογητής

+

- **Ταξινόμηση ενεργών εφαρμογών**
- **Αποτύπωση – Εποπτεία**
- **Περιορισμοί**

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- Λειτουργικές αδυναμίες δικτύου
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Ταξινόμηση ενεργών εφαρμογών

- Κατηγοριοποίηση και ομαδοποίηση ενεργών flows ανάλογα με το είδος των εφαρμογών από τις οποίες προέρχονται
- Cisco NBAR (Network-based Application Recognition):
  - Identify applications and protocols from Layer 4 through Layer 7
  - NBAR can now inspect the full packet payload
- Ενημέρωση με κατάλληλα Packet Description Language Modules (PDLM)

Ταξινόμηση ενεργών εφαρμογών

```
class-map match-any p2p
  description Catch all p2p traffic
  match protocol kazaa2 file-transfer "*"
  match protocol fasttrack file-transfer "*"
  match protocol gnutella file-transfer "*"
  match protocol napster
  match protocol http url "\.hash=*"
  match protocol custom-01
  match protocol custom-02
  match protocol custom-05
  match protocol custom-07

ip nbar port-map custom-03 udp 1863 5190 6901 4000
ip nbar port-map custom-03 tcp 1863 6901 20000 20019 20039 20059
ip nbar port-map custom-02 udp 4660 4661 4662 4663 4664 4665 6661 6662 6665
ip nbar port-map custom-02 tcp 4660 4661 4662 4663 4664 4665 6661 6662 6665
ip nbar port-map custom-01 udp 4672 4673 6257 6346 6347 3531 4246 3191
ip nbar port-map custom-01 tcp 6881 6882 6883 6884 6885 6886 6887 6888 6889
ip nbar port-map irc udp 194 6667 6668 6669
ip nbar port-map irc tcp 194 6667 6668 6669
```


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Αποτύπωση – Εποπτεία

Protocol	Input Packet Count Byte Count 5 minute bit rate (bps)	Output Packet Count Byte Count 5 minute bit rate (bps)
http	1528323249 1297001425866 7794000	1514213493 677735497595 3523000
custom-02	1206656356 416806148784 1425000	1246209229 521208337687 2647000
custom-01	774670322 298980974057 1418000	992924853 337103567045 2306000
ftp	597383938 248822703814 776000	712177631 809057380210 2662000
kazaa2	649681419 298136276584 1194000	401087768 293749338470 496000
gnutella	216767570 64811496604 557000	219361641 68505401267 447000
fasttrack	56998508 40330176133 681000	61659306 24009121644 152000
streamwork	204615100 27201303434 535000	28683 10144858 0
napster	83057094 50793262344 231000	76776786 32875114367 205000
ipsec	0 0 0	0 0 0
unknown	4068610233 1976850425333 9300000	4976958083 2950112539328 13711000
Total	10668368755 5171291599779 25127000	11118102058 5990685019474 27068000

Agenda

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Περιορισμοί

```
policy-map AUTH
 description Police p2p traffic
  class p2p
     police 4096000 128000 128000 conform-action transmit exceed-action drop
  class class-default
    fair-queue
    fair-queue queue-limit 50
class-map: p2p (match-any)
  713751332 packets, 319566136585 bytes
  5 minute offered rate 5495000 bps, drop rate 1326000 bps
  match: protocol kazaa2 file-transfer "*"
    15263410 packets, 17060100654 bytes
    5 minute rate 72000 bps
  match: protocol fasttrack file-transfer "*"
    8602951 packets, 7129084159 bytes
    5 minute rate 110000 bps
  match: protocol gnutella file-transfer "
    929457 packets, 793632017 bytes
    5 minute rate 0 bps
  match: protocol napster
    22285475 packets, 10522267173 bytes
    5 minute rate 255000 bps
  match: protocol http url "\.hash=*"
    250628 packets, 147057890 bytes
    5 minute rate 0 bps
  match: protocol custom-01
    297461350 packets, 104535773874 bytes
    5 minute rate 2257000 bps
  match: protocol custom-02
    343414330 packets, 170003176122 bytes
    5 minute rate 2602000 bps
  match: protocol custom-05
    7906219 packets, 2720750847 bytes
    5 minute rate 40000 bps
  match: protocol custom-07
    17637512 packets, 6654293849 bytes
    5 minute rate 147000 bps
```

```
  police:
    4096000 bps, 128000 limit, 128000 extended limit
    conformed 626509403 packets, 228967812568 bytes; action: transmit
    exceeded 86197173 packets, 89888451487 bytes; action: drop
    conformed 4126000 bps, exceed 1375000 bps violate 0 bps

class-map: class-default (match-any)
  2202663601 packets, 1270757327629 bytes
  5 minute offered rate 21449000 bps, drop rate 0 bps
  match: any
    2202663601 packets, 1270757327629 bytes
    5 minute rate 21449000 bps
  queue size 0, queue limit 3321
  packets output 0, packet drops 0
  tail/random drops 0, no buffer drops 0, other drops 0
  fair-queue: per-flow queue limit 50
```


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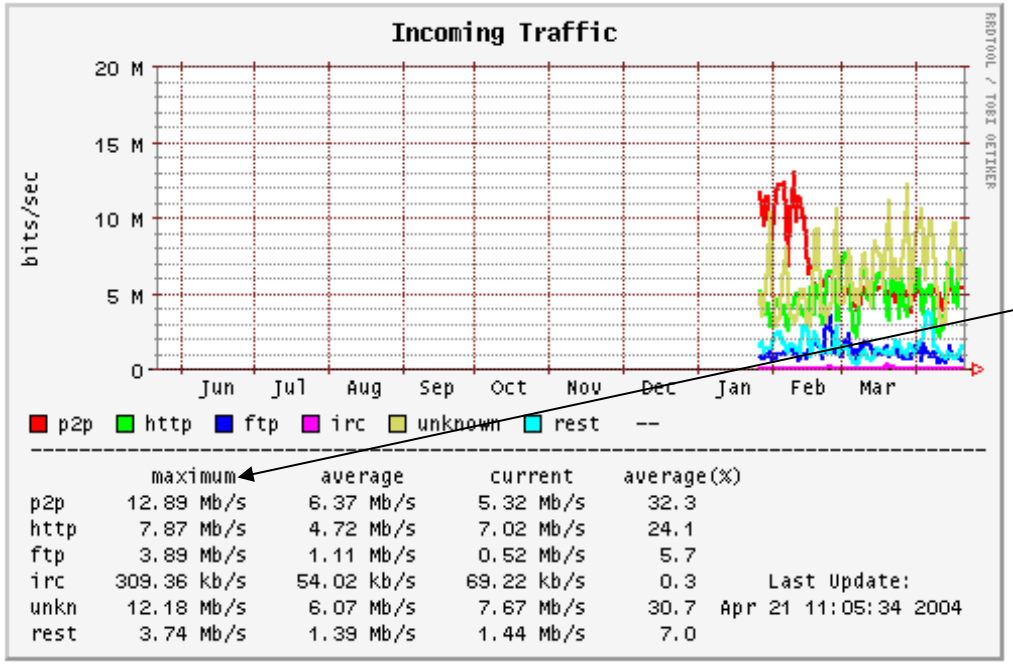
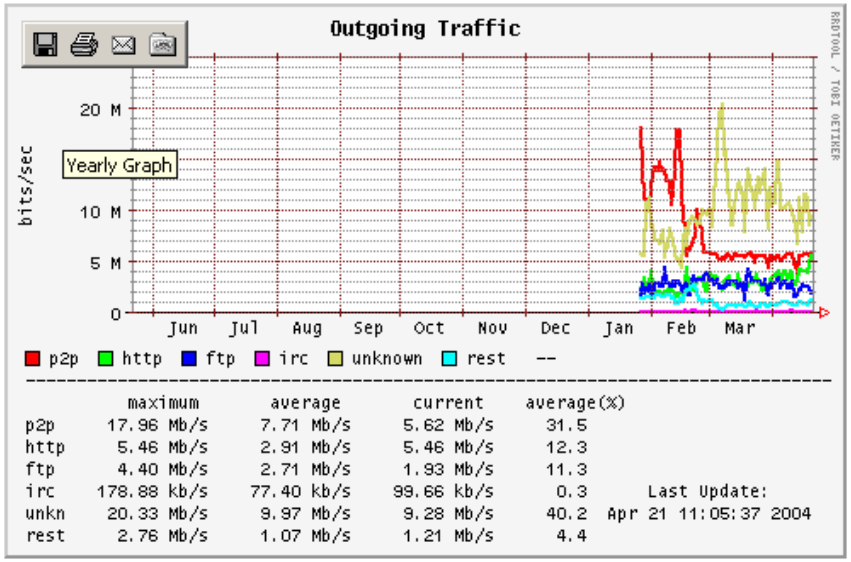
Διαγράμματα

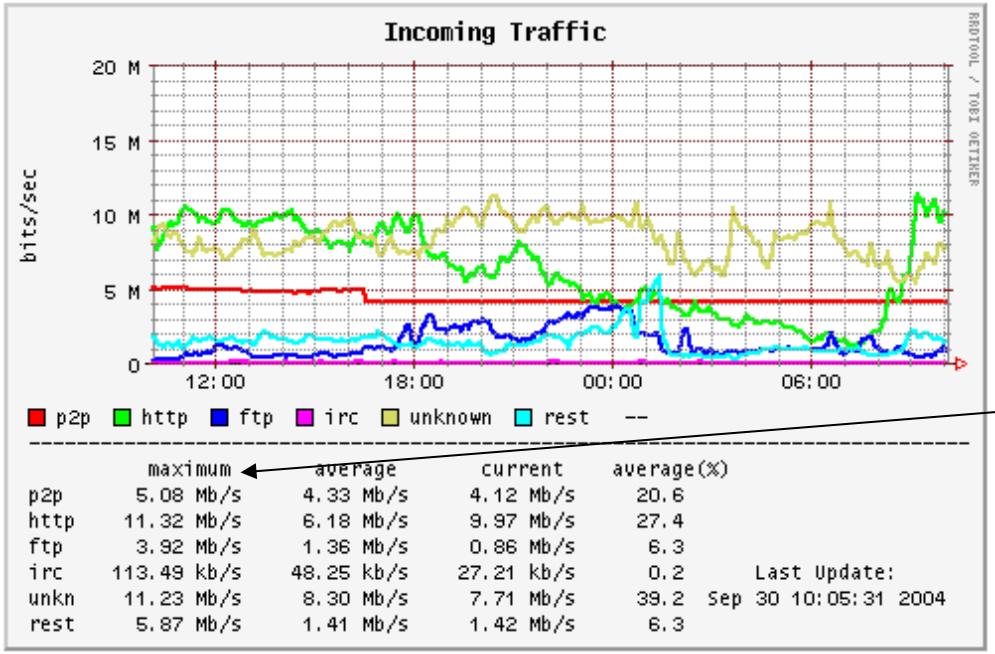


p2p ~ 12.89 Mbps

http ~ 7.87 Mbps



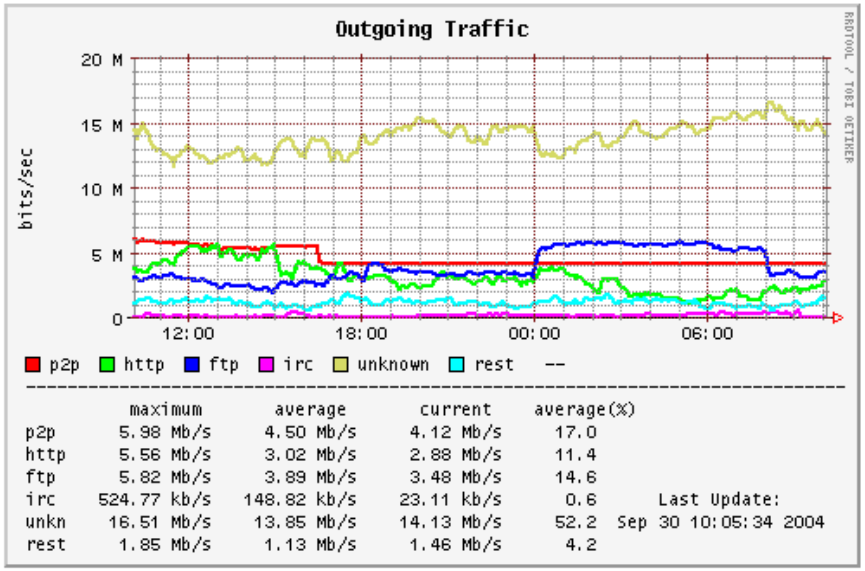
Διαγράμματα



p2p ~ 5.08 Mbps

http ~ 11.32 Mbps

unkn ~ 11.23 Mbps



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Unknown traffic

- **Update pdlm signatures**

NBAR Packet Description Language Modules

Select a File to Download

Sort by : Filename Go

Filename
WinMX.pdlm PDLM to classify WinMX traffic.
bittorrent.pdlm PDLM to classify Bittorrent traffic.
NBAR_bittorrent_pdlm_readme.pdf Please read prior to intalling and using bittorrent pdlm.
gnutella.pdlm PDLM to classify Gnutella traffic
NBAR_gnutella_pdlm_readme.pdf Please read prior to installing and using Gnutella PDLM.
NBAR_SAP_pdlm_readme.pdf Please read prior to installing and using SAP PDLM.
NBAR_WinMx_pdlm_readme.pdf Please read prior to installing and using WinMx PDLM.
NBAR_eDonkey_pdlm_readme.pdf Please read prior to installing and using eDonkey PDLM.
eDonkey.pdlm This PDLM is used for classifying P2P eDonkey and eMule traffic.
nbar_citrix_pdlm_readme.pdf Please read prior to loading and using the Citrix PDLM.

Unknown traffic

- **debug ip nbar unclassified-port-stats**

```
authnet-gw-ng#sh ip nbar unclassified-port-stats tcp top 15

  26906/tcp:299264011
  19069/tcp:253483399
   4642/tcp:213089170
   6890/tcp:151005408
   9176/tcp:122455967
  55555/tcp:112243125
  30374/tcp:106893589
     45/tcp:97490301
   5643/tcp:78696387
   4668/tcp:70962080
   6894/tcp:66554293
   5001/tcp:61215445
  33021/tcp:60417842
   6892/tcp:57436762
   6893/tcp:55581347
```

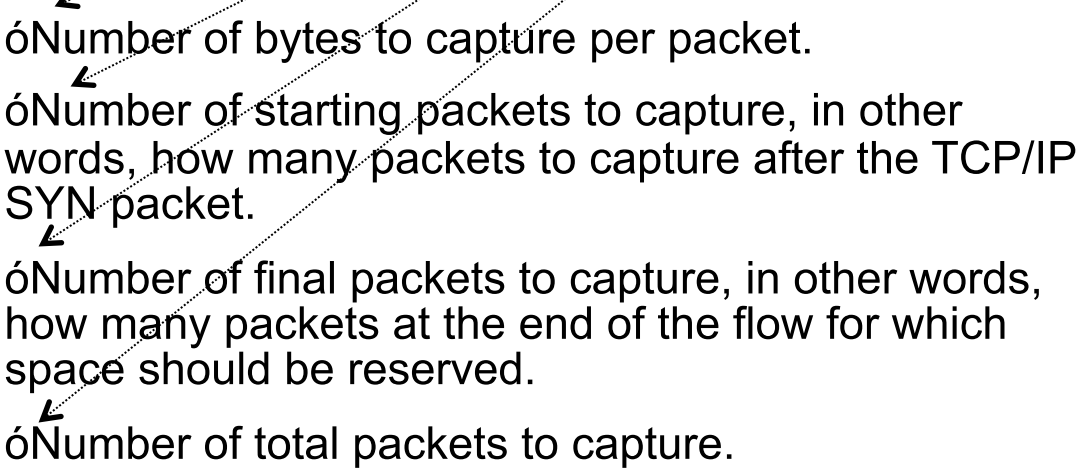
Unknown traffic

- **19069 (Dec) <=> 4A7D (HEX)**

```
authnet-gw-ng#sh ip cache flow | i 4A7D
Vl999          61.57.104.228   Vl100          155.207.20.97   11 8BFE 4A7D     2
Vl999          24.255.17.159   Vl100          155.207.20.97   11 6CCA 4A7D     1
Vl999          24.255.17.159   Vl100          155.207.20.97   11 6CDB 4A7D     1
Vl100          155.207.20.97   Vl999          172.184.22.185  11 4A7D 18CA     3
Vl999          24.255.17.159   Vl100          155.207.20.97   11 6CE6 4A7D     1
Vl999          24.255.17.159   Vl100          155.207.20.97   11 6CFE 4A7D     1
Vl999          24.255.17.159   Vl100          155.207.20.97   11 6CF4 4A7D     1
Vl999          200.88.55.189   Vl100          155.207.20.97   11 0D63 4A7D     1
Vl999          200.50.58.62    Vl100          155.207.20.97   11 0A7C 4A7D     1
Vl100          155.207.20.97   Vl999          81.69.185.219   11 4A7D 18CA     5
Vl999          80.15.145.99    Vl100          155.207.20.97   11 18CA 4A7D     3
Vl100          155.207.20.97   Vl999          82.123.182.134  11 4A7D 18CA     5
Vl100          155.207.20.97   Vl999          80.8.187.252    11 4A7D 18CA    11
Vl999          68.220.23.165   Vl100          155.207.20.97   11 3DAC 4A7D     1
Vl100          155.207.20.97   Vl999          200.232.191.39  11 4A7D 85C9     4
Vl999          131.215.240.203 Vl100          155.207.20.97   11 61AE 4A7D     1
Vl100          155.207.20.97   Vl999          84.26.246.229   11 4A7D 5408     3
Vl100          155.207.20.97   Vl999          83.114.178.238  11 4A7D 18CA     5
Vl999          161.6.222.189   Vl100          155.207.20.97   11 18CA 4A7D     6
Vl999          82.33.24.251    Vl100          155.207.20.97   11 A6C9 4A7D     5
Vl999          80.132.220.216  Vl100          155.207.20.97   11 0900 4A7D     1
Vl999          203.169.195.171 Vl100          155.207.20.97   11 18CA 4A7D     2
Vl999          212.202.77.50   Vl100          155.207.20.97   11 18CA 4A7D     1
Vl999          4.226.171.208   Vl100          155.207.20.97   06 0DEF 4A7D     6
Vl100          155.207.20.97   Vl999          213.89.45.248   11 4A7D 18CA     7
Vl999          24.77.246.74    Vl100          155.207.20.97   11 18CA 4A7D     1
Vl999          24.169.219.68   Vl100          155.207.20.97   11 5839 4A7D     1
Vl999          65.24.245.245   Vl100          155.207.20.97   11 18CA 4A7D     5
Vl999          211.30.121.200  Vl100          155.207.20.97   11 2B41 4A7D     1
Vl999          69.15.36.131    Vl100          155.207.20.97   11 18CA 4A7D     3
Vl100          155.207.20.97   Vl999          83.114.197.66   11 4A7D 18CA     5
Vl100          155.207.20.97   Vl999          82.228.197.20   11 4A7D 18CA     4
Vl999          81.185.192.230  Vl100          155.207.20.97   11 93F7 4A7D     1
Vl100          155.207.20.97   Vl999          62.16.152.151   11 4A7D 18CA     5
Vl100          155.207.20.97   Vl999          81.106.196.100  11 4A7D 18CA     1
Vl999          24.225.188.203  Vl100          155.207.20.97   11 18CA 4A7D     1
Vl100          155.207.20.97   Vl999          82.67.197.184   11 4A7D 18CA     5
Vl100          155.207.20.97   Vl999          81.178.224.233  11 4A7D 7BA3     3
Vl100          155.207.20.97   Vl999          82.120.192.26   11 4A7D 18CA     1
```

Unknown traffic

- debug ip nbar filter destination_port 19609
- debug ip nbar trace 50
- debug ip nbar capture 200 10 10 20



Unknown traffic

- sh ip nbar trace

```
authnet-gw-ng#sh ip nbar trace
Session selected due to match on : Destination (TCP) Port (19069)
Session contains the following flows :
        69.178.13.143:2084 <--> 155.207.20.97:19069(tcp)

Session selected due to match on : Destination (TCP) Port (19069)
Session contains the following flows :
        67.162.171.61:62097 <--> 155.207.20.97:19069(tcp)

Session selected due to match on : Destination (TCP) Port (19069)
Session contains the following flows :
        82.156.210.230:3377 <--> 155.207.20.97:19069(tcp)
```


Unknown traffic

- **sh ip nbar capture**

```
authnet-gw-ng#sh ip nbar capture
Session selected due to match on : Destination (TCP) Port (19069)
Session contains the following flows :
         69.178.13.143:2084 <--> 155.207.20.97:19069(tcp)
FF[1   ] TCP 69.178.13.143(2084) -> 64.106.205.70(19069) SYN
         45 00 00 30 9a 87 40 00 6e 06 6e cf 45 b2 0d 8f   E..0..@.n.n.E...
         9b cf 14 61 08 24 4a 7d 82 47 fb e8 00 00 00 00   ...a.$J..G......
         70 02 ff ff ae dc 00 00 02 04 05 b4 01 01 04 02   p...............
FF[2   ] TCP 69.178.13.143(2084) -> 155.207.20.97(19069) SYN
         45 00 00 30 9a 87 40 00 6e 06 6e cf 45 b2 0d 8f   E..0..@.n.n.E...
         9b cf 14 61 08 24 4a 7d 82 47 fb e8 00 00 00 00   ...a.$J..G......
         70 02 ff ff ae dc 00 00 02 04 05 b4 01 01 04 02   p...............
FF[3   ] TCP 155.207.20.97(19069) -> 69.178.13.143(2084) ACK SYN
         45 00 00 30 01 9e 40 00 7f 06 f6 b8 9b cf 14 61   E..0..@........a
         45 b2 0d 8f 4a 7d 08 24 04 2d 7a 2c 82 47 fb e9   E...J..$.-z,.G..
         70 12 fa f0 35 81 00 00 02 04 05 b4 01 01 04 02   p...5...........
FF[4   ] TCP 155.207.20.97(19069) -> 69.178.13.143(2084) ACK SYN
         45 00 00 30 01 9e 40 00 7f 06 f6 b8 9b cf 14 61   E..0..@........a
         45 b2 0d 8f 4a 7d 08 24 04 2d 7a 2c 82 47 fb e9   E...J..$.-z,.G..
         70 12 fa f0 35 81 00 00 02 04 05 b4 01 01 04 02   p...5...........
FF[5   ] TCP 69.178.13.143(2084) -> 155.207.20.97(19069) ACK
         45 00 00 28 9a d6 40 00 6e 06 6e 88 45 b2 0d 8f   E..(..@.n.n.E...
         9b cf 14 61 08 24 4a 7d 82 47 fb e9 04 2d 7a 2d   ...a.$J..G...-z-
         50 10 ff ff 5d 36 00 00                           P...]6..
FF[6   ] TCP 69.178.13.143(2084) -> 80.59.198.201(19069) ACK
         45 00 00 28 9a d6 40 00 6e 06 6e 88 45 b2 0d 8f   E..(..@.n.n.E...

         9b cf 14 61 08 24 4a 7d 82 47 fb e9 04 2d 7a 2d   ...a.$J..G...-z-
         50 10 ff ff 5d 36 00 00                           P...]6..
FF[7   ] TCP 69.178.13.143(2084) -> 155.207.20.97(19069) ACK RST
         45 00 00 28 9a d7 40 00 6e 06 6e 87 45 b2 0d 8f   E..(..@.n.n.E...
         9b cf 14 61 08 24 4a 7d 82 47 fb e9 04 2d 7a 2d   ...a.$J..G...-z-
         50 14 00 00 5d 32 00 00                           P...]2..
```


Unknown traffic

```
        50 18 fa c7 64 9f 00 00 47 45 54 20 2f 75 72 69   P...d...GET /uri
        2d 72 65 73 2f 4e 32 52 3f 75 72 6e 3a 73 68 61   -res/N2R?urn:sha
        31 3a 58 32 4a 55 52 4f 46 52 50 59 47 45 48 52   1:X2JUROFRPYGEHR
        53 42 45 56 53 53 4d 55 37 56 57 51 59 33 55 4f   SBEVSSMU7VWQY3UO
        4e 56 20 48 54 54 50 2f 31 2e 31 0d 0a 48 6f 73   NV HTTP/1.1..Hos

        74 3a 20 38 32 2e 31 35 36 2e 32 31 30 2e 32 33   t: 82.156.210.23
        30 3a 36 33 34 36 0d 0a 58 2d 46 65 61 74 75 72   0:6346..X-Featur
        65 73 3a 20 67 32 2f 31 2e 30 0d 0a 52 61 6e 67   es: g2/1.0..Rang
        65 3a 20 62 79 74 65 73 3d 30 2d 36 35 35 33 35   e: bytes=0-65535
        0d 0a 55 73 65 72 2d 41 67 65 6e 74 3a 20 53 68   ..User-Agent: Sh
        61 72 65 61 7a 61 20 32                           areaza 2
LF[12 ] TCP 155.207.20.97(19069) -> 82.156.210.230(3377) ACK PSH
        45 00 01 27 09 85 40 00 7f 06 1b 99 9b cf 14 61   E..'..@........a
        52 9c d2 e6 4a 7d 0d 31 04 d0 7d 99 01 86 c4 cd   R...J..1........
        50 18 fa c7 64 9f 00 00 47 45 54 20 2f 75 72 69   P...d...GET /uri
        2d 72 65 73 2f 4e 32 52 3f 75 72 6e 3a 73 68 61   -res/N2R?urn:sha
        31 3a 58 32 4a 55 52 4f 46 52 50 59 47 45 48 52   1:X2JUROFRPYGEHR
        53 42 45 56 53 53 4d 55 37 56 57 51 59 33 55 4f   SBEVSSMU7VWQY3UO
        4e 56 20 48 54 54 50 2f 31 2e 31 0d 0a 48 6f 73   NV HTTP/1.1..Hos
        74 3a 20 38 32 2e 31 35 36 2e 32 31 30 2e 32 33   t: 82.156.210.23
        30 3a 36 33 34 36 0d 0a 58 2d 46 65 61 74 75 72   0:6346..X-Featur
        65 73 3a 20 67 32 2f 31 2e 30 0d 0a 52 61 6e 67   es: g2/1.0..Rang
        65 3a 20 62 79 74 65 73 3d 30 2d 36 35 35 33 35   e: bytes=0-65535
        0d 0a 55 73 65 72 2d 41 67 65 6e 74 3a 20 53 68   ..User-Agent: Sh
        61 72 65 61 7a 61 20 32                           areaza 2
LF[13 ] TCP 82.156.210.230(3377) -> 155.207.20.97(19069) ACK PSH
        45 00 05 5d b9 3c 00 00 72 06 b4 ab 52 9c d2 e6   E..].<..r...R...
        9b cf 14 61 0d 31 4a 7d 01 86 c4 cd 04 d0 7e 98   ...a.1J.......~.
        50 18 21 39 56 7a 00 00 48 54 54 50 2f 31 2e 31   P.!9Vz..HTTP/1.1
        20 35 30 33 20 42 75 73 79 20 51 75 65 75 65 64    503 Busy Queued

        0d 0a 53 65 72 76 65 72 3a 20 53 68 61 72 65 61   ..Server: Sharea
        7a 61 20 32 2e 31 2e 30 2e 30 0d 0a 43 6f 6e 6e   za 2.1.0.0..Conn
        65 63 74 69 6f 6e 3a 20 4b 65 65 70 2d 41 6c 69   ection: Keep-Ali
        76 65 0d 0a 41 63 63 65 70 74 2d 52 61 6e 67 65   ve..Accept-Range
        73 3a 20 62 79 74 65 73 0d 0a 4c 69 73 74 65 6e   s: bytes..Listen
        2d 49 50 3a 20 38 32 2e 31 35 36 2e 32 31 30 2e   -IP: 82.156.210.
        32 33 30 3a 36 33 34 36 0d 0a 58 2d 50 65 72 48   230:6346..X-PerH
        6f 73 74 3a 20 32 0d 0a 58 2d 4e 69 63 6b 3a 20   ost: 2..X-Nick:
        43 61 74 77 65 61 7a 6c                           Catweazl
```

Unknown traffic

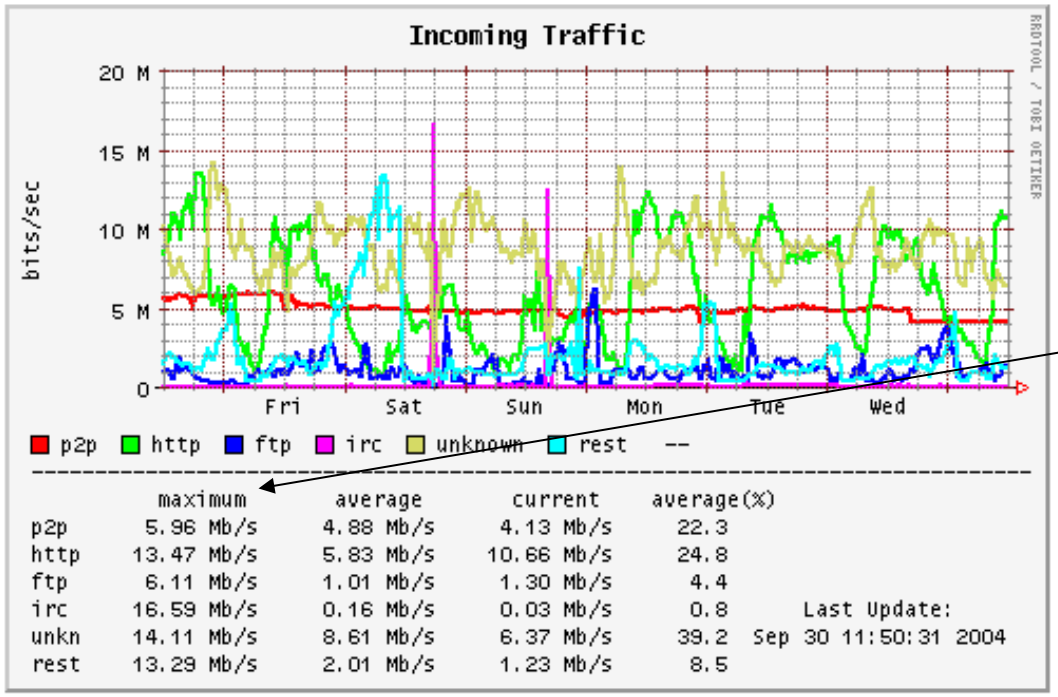
- **4642 (Dec) <=> 1222 (HEX)**

```
Session contains the following flows :
        218.162.151.8:4938 <--> 155.207.52.18:4642(tcp)
FF[23 ] TCP 155.207.52.18(4642) -> 168.95.5.142(4938) ACK PSH
        45 00 00 84 7b b1 00 00 7f 06 7e 36 9b cf 34 12   E...{.....6..4.
        da a2 97 08 12 22 13 4a 9f e7 af 0f b7 68 39 ca   .....".J.....h9.
        50 18 3f 4a 18 0b 00 00 e3 57 00 00 00 59 cd ad   P.?J.....W...Y..
        c6 7a 79 1d 62 20 ca e3 3a b3 17 f0 31 29 44 00   .zy.b ..:...1)D.
        5b 48 65 6e 74 61 69 5d 5b 61 6e 69 6d 65 5d 5b   [Hentai][anime][
        75 6e 63 65 6e 73 6f 72 5d 5b a9 5d b6 d4 af 66   uncensor][.]...f
        b4 c9 5d 4e 69 67 68 74 20 53 68 69 66 74 20 4e   ..]Night Shift N
        75 72 73 65 73 20 2d 20 4b 61 72 74 65 20 30 35   urses - Karte 05
        2e 61 76 69                                       .avi
FF[24 ] TCP 155.207.52.18(4642) -> 141.76.2.4(4938) ACK PSH
        45 00 00 84 7b b1 00 00 7f 06 7e 36 9b cf 34 12   E...{.....6..4.
        da a2 97 08 12 22 13 4a 9f e7 af 0f b7 68 39 ca   .....".J.....h9.
        50 18 3f 4a 18 0b 00 00 e3 57 00 00 00 59 cd ad   P.?J.....W...Y..
        c6 7a 79 1d 62 20 ca e3 3a b3 17 f0 31 29 44 00   .zy.b ..:...1)D.
        5b 48 65 6e 74 61 69 5d 5b 61 6e 69 6d 65 5d 5b   [Hentai][anime][
        75 6e 63 65 6e 73 6f 72 5d 5b a9 5d b6 d4 af 66   uncensor][.]...f
        b4 c9 5d 4e 69 67 68 74 20 53 68 69 66 74 20 4e   ..]Night Shift N
        75 72 73 65 73 20 2d 20 4b 61 72 74 65 20 30 35   urses - Karte 05
        2e 61 76 69                                       .avi
```

Agenda

- Λειτουργικές αδυναμίες δικτύου
- Μέτρα
  - Ταξινόμηση ενεργών εφαρμογών
  - Αποτύπωση – Εποπτεία
  - Περιορισμοί
- Διαγράμματα
- Unknown traffic
- Συμπεράσματα

Συμπεράσματα



p2p ~ 5.96 Mbps

http ~ 13.47 Mbps

ftp ~ 6.11 Mbps

unkn ~ 14.11 Mbps

rest ~ 13.29 Mbps

- Σημείο αναφοράς το congested link
- Στόχος η δίκαιη κατανομή πόρων
- Βιώσιμη και όχι βέλτιστη λύση
- «Ανάδραση» με εποπτεία


AuthNet


AuthNet