

Arriva GARR-X: l'alta capacità a casa degli utenti

La rete, gli utenti al tempo di GARR-Giganet

Com'è cambiata la rete e come sono cambiati gli utenti

Massimo Carboni - GARR

The GARR Network

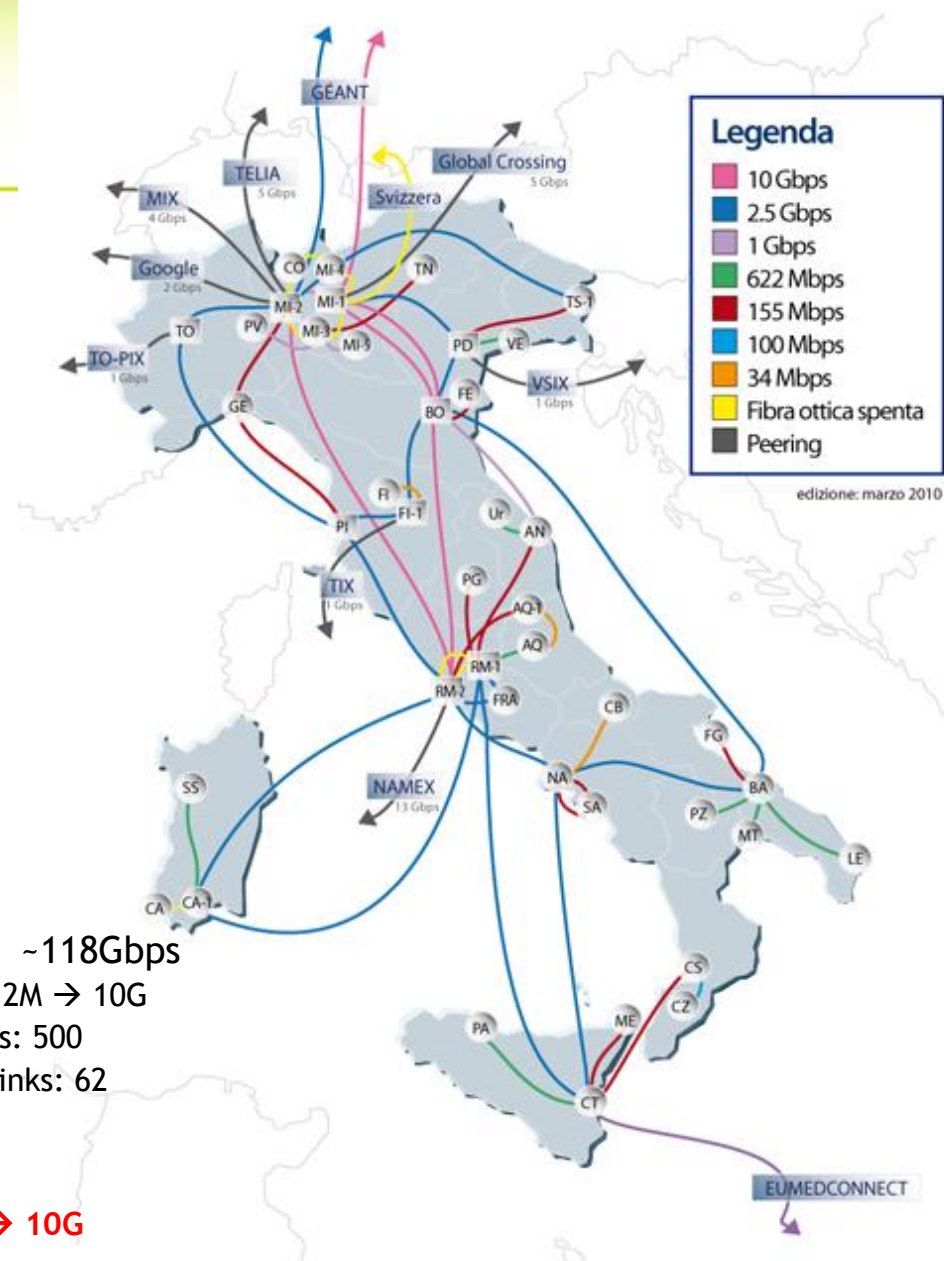
- La rete GARR collega 500 sedi utente
 - Università (Pubbliche and private), Enti di Ricerca (CNR, ENEA, INFN, INAF, etc.) e Istituzioni Culturali
 - La Rete GARR è connessa con le altre Reti della Ricerca attraverso GÈANT2 (the European Research Network) e attraverso il Global Internet



GARR User Community



La rete GARR



❑ **43 IP POPs** (University and Research Centre)

❑ **PEERING: 76 Gbps**

❑ **52.5Gbps** vs GEANT2

- ❑ 10G + 2.5G IP Access
- ❑ 3*10GE E2E links
- ❑ 9*1GE E2E links

❑ **4x2.5Gbps** IP Transit

- ❑ 2 Milan

❑ **7x1Gbps+10Gbps** National PEERING

❑ **2x1Gbps** diretto con GOOGLE

- ❑ A Milano (ipv4 e Ipv6)

❑ **BackBone Capacity ~110Gbps**

❑ **7 TLC Operators**

- ❑ Telecom Italia
- ❑ Infracom (ex Autostrade TLC)
- ❑ Fastweb
- ❑ Interoute (ex Eurostrada)
- ❑ WIND
- ❑ BT-Italia (ex Albacom)
- ❑ COLT-Telecom

❑ **3 International IP Carrier**

- ❑ Global Crossing
- ❑ Telia

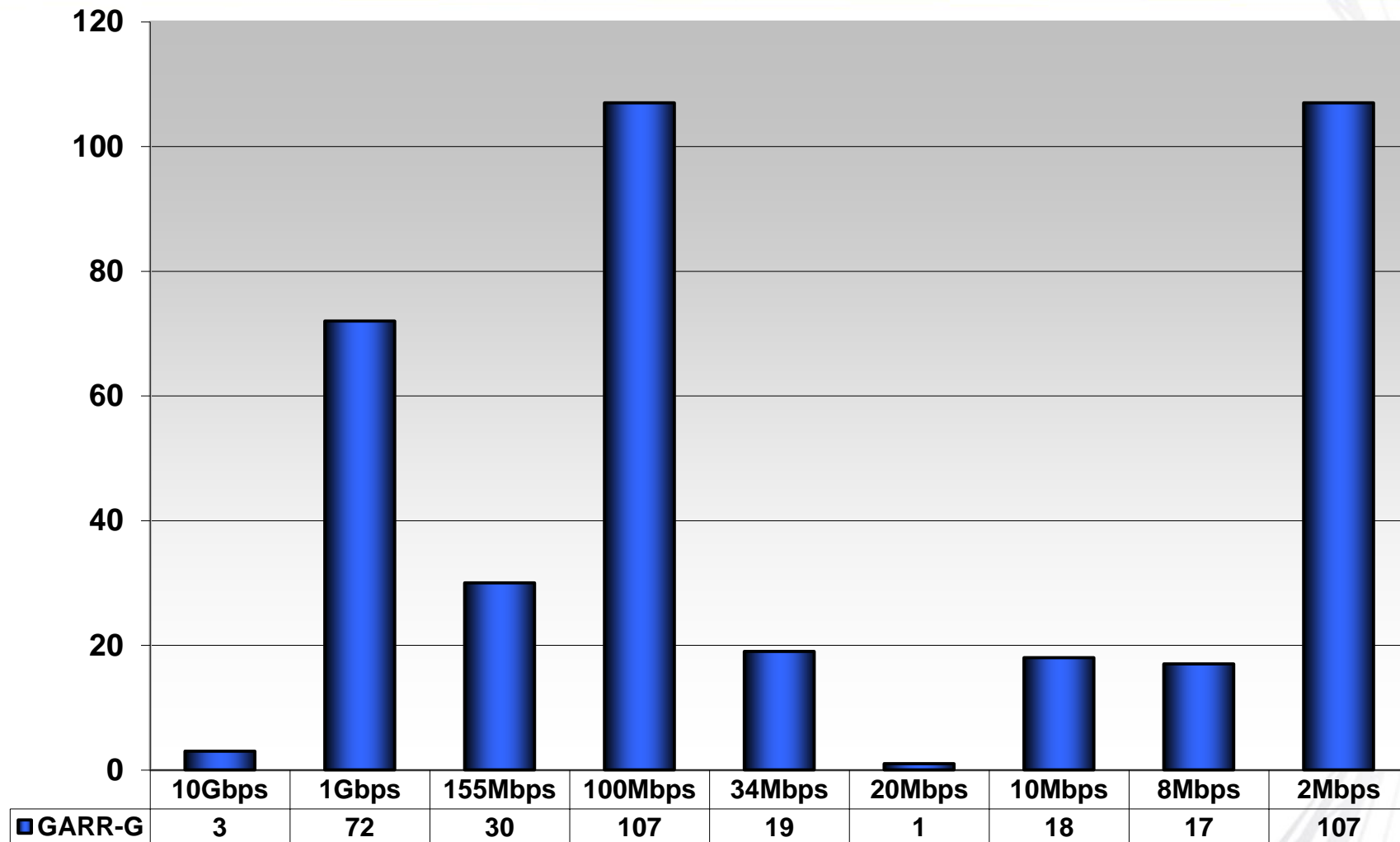
❑ **Access Capacity: ~118Gbps**

- ❑ Starting from 2M → 10G
- ❑ N.Access Links: 500
- ❑ N.Backbone Links: 62

❑ **E2E Capacity:**

- ❑ **~40Gbps**
from 1G → 10G

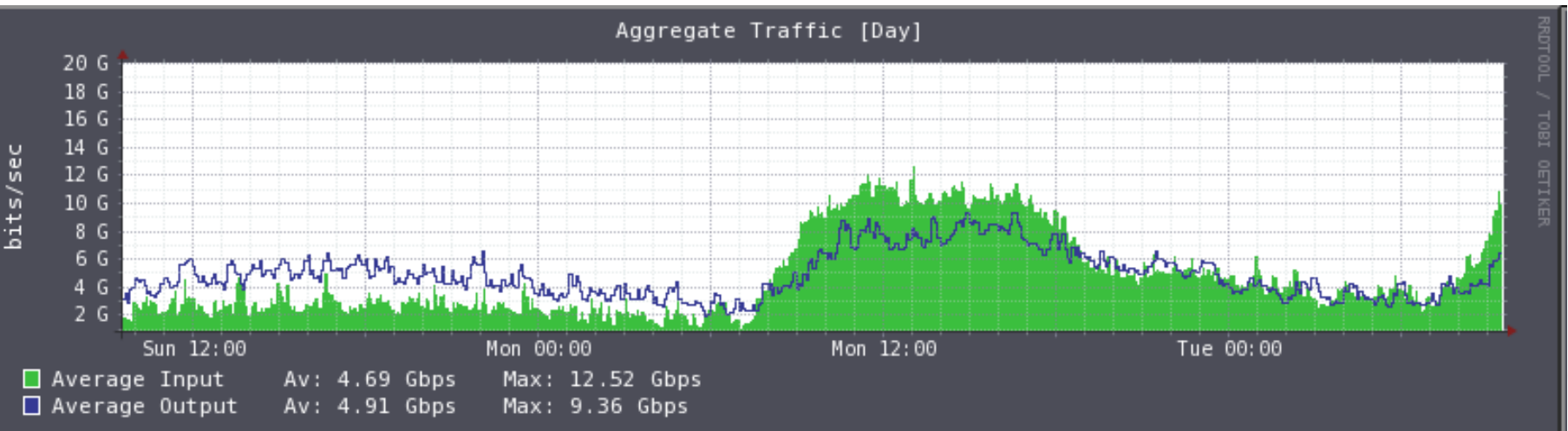
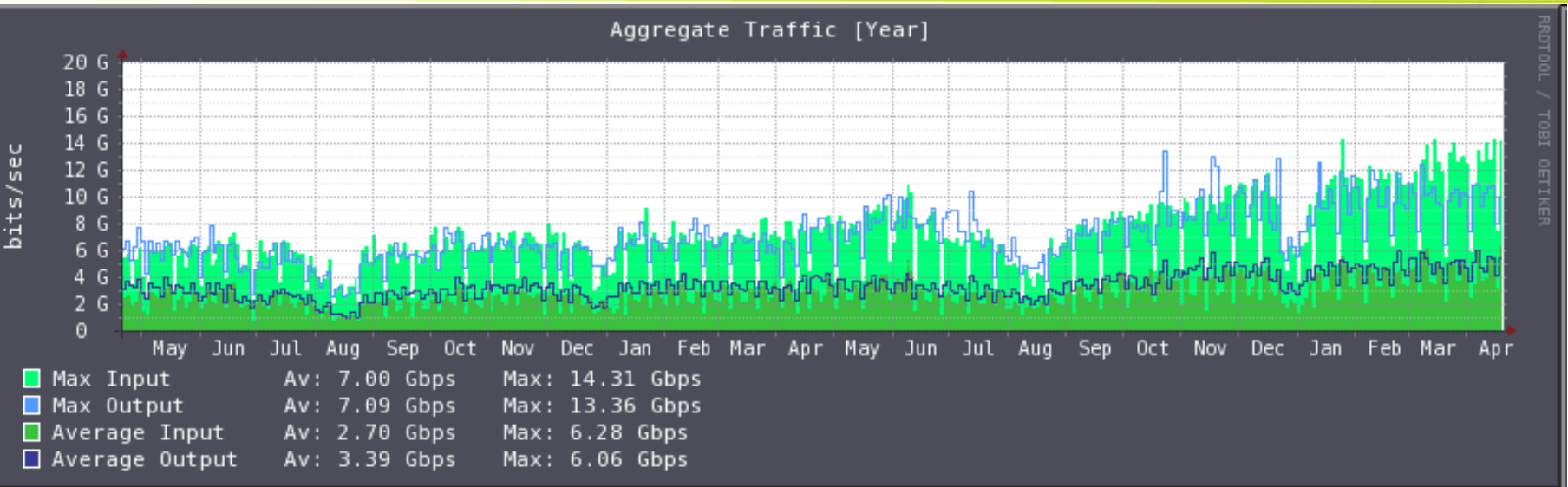
GARR User's Access Capacity



GARR Main Research Projects

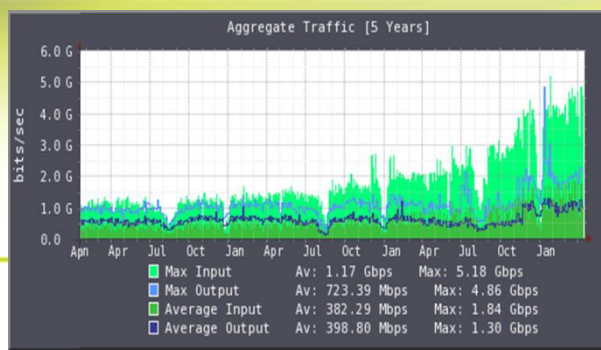
- [INFN] LHC Project
 - 1*T1 + 5*T2: 2*10GE + 7*GE
- [CINECA] DEISA Project
 - High Performance Computing: 10GE
- [INAF] e-VLBI Project
 - European VLBI Network: 1GE to Dwingeloo (NL)
- [GRISU] Grid in South Italy
 - 3*1GE on dedicated lambda
- [FEDERICA] EC Project
 - 3*1GE on GEANT2 Infrastructure

Evoluzione del traffico



Type of Traffic

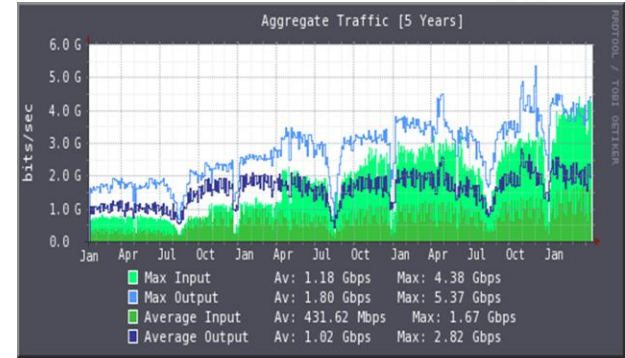
- IPv4 best effort
- Ipv6 best effort
- Ipv4 Multicast
- MPLS L3 VPN
 - Customer Private network
 - HA applications
- E2E Circuits
 - on GN2+ Infrastructure
 - on GARR CWDM equipment
- IP Premium (EF Traffic)



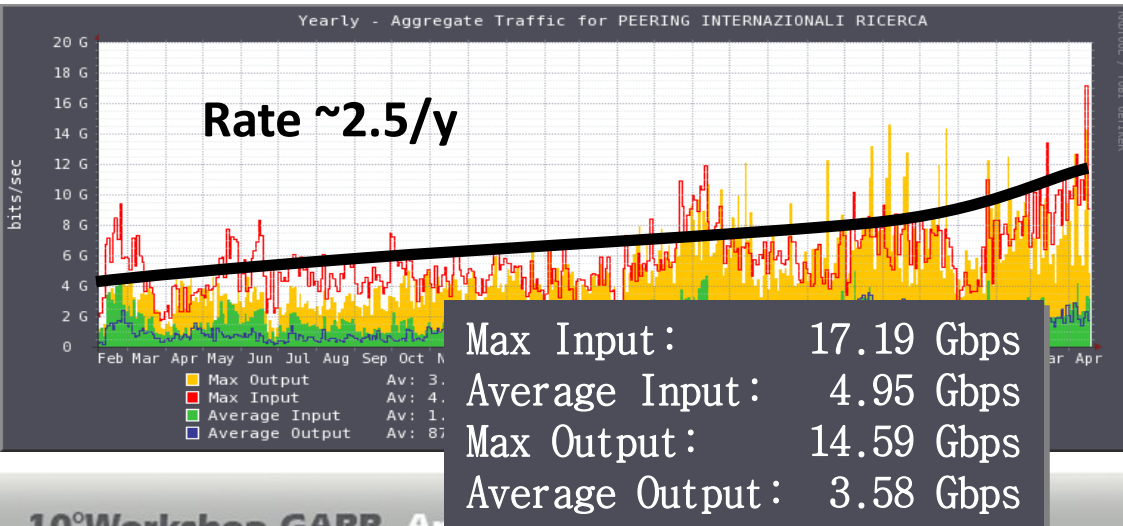
- IPv4 best effort
- Ipv6 best effort

National Peering

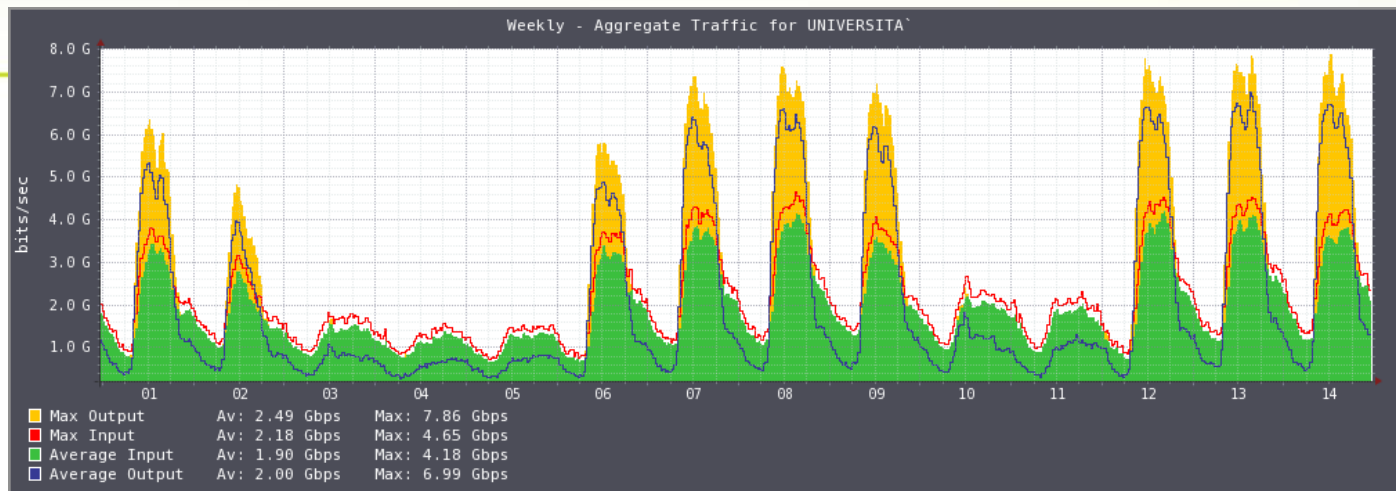
Global Internet



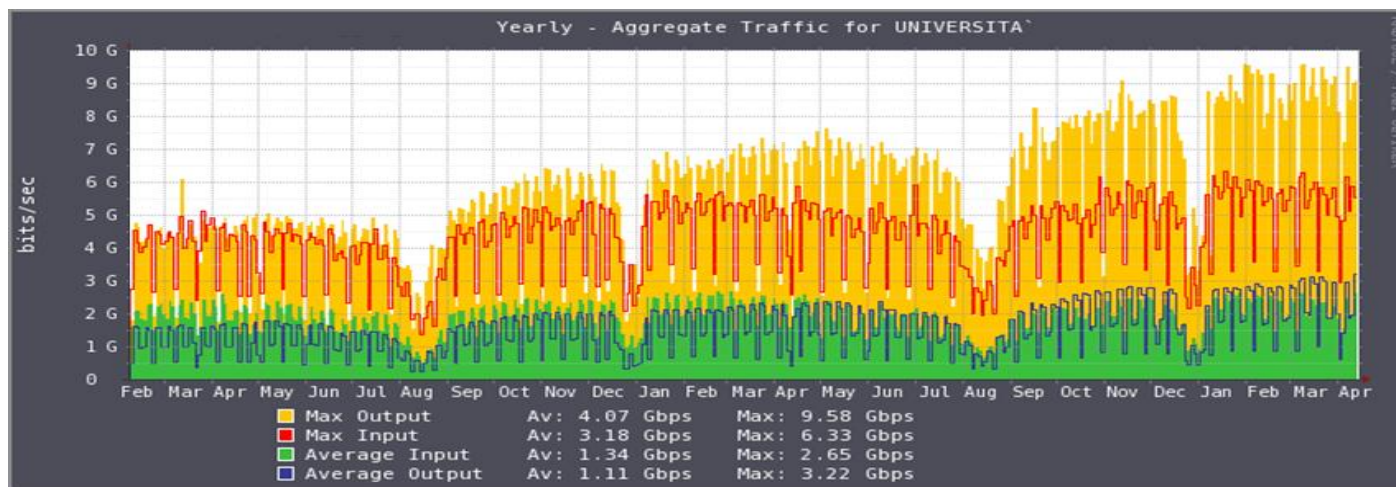
- GEANT2 Links:
 - 10G primary access (Milan)
 - 2.5G backup access (Genève)
- E2E on 10G Links:
 - DEISA Milano-Frankfur
 - LHC Milan-CERN
 - LHC Milan-Karlsruhe (CBF)
- E2E on 1G Links:
 - EXPRes Milan-JIVE












Universities Traffic



Rate ~ 1.50 /year



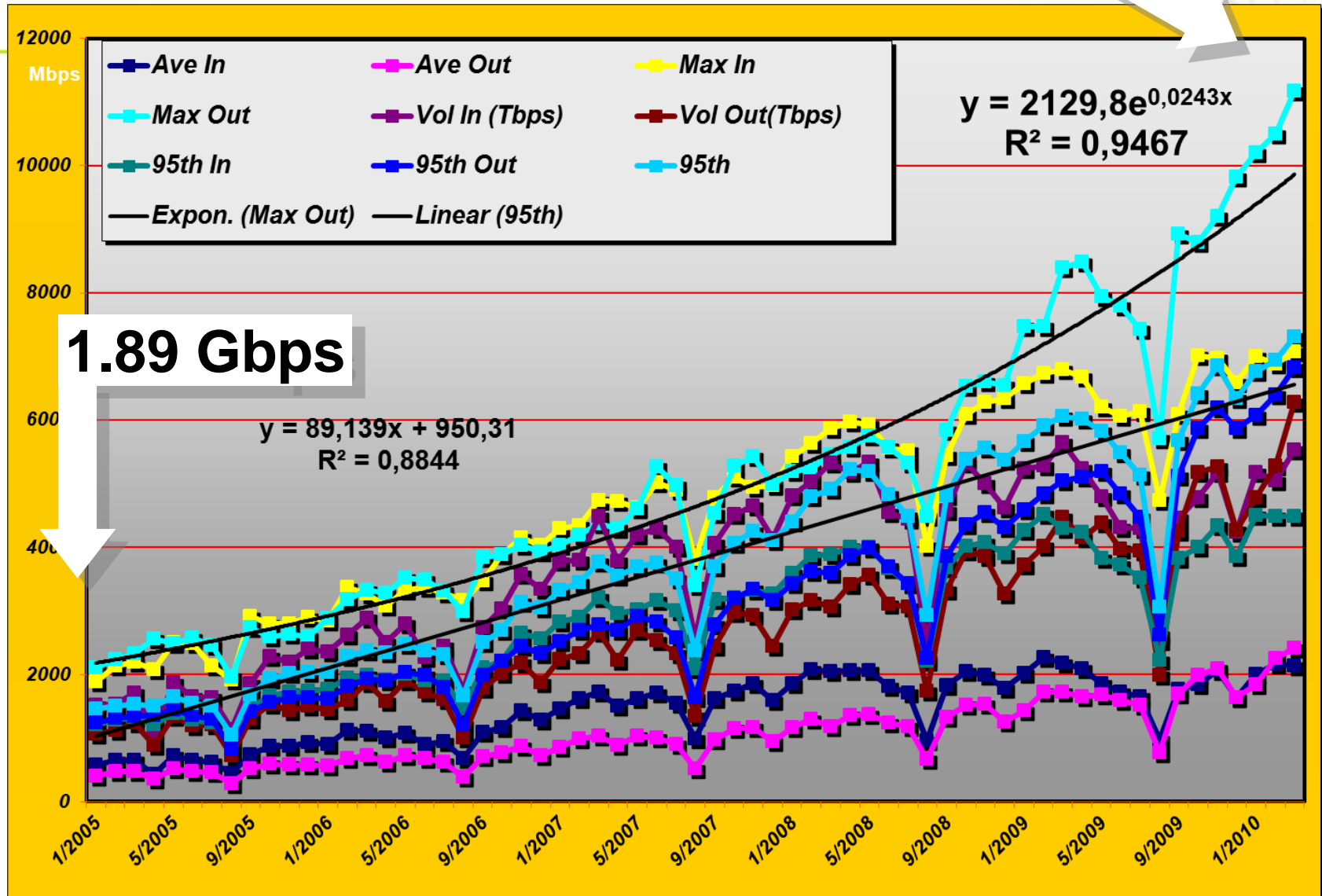
Legenda: Statistics Info

 Ave In	 Ave Out	 Max In
 Max Out	 Vol In (Tbps)	 Vol Out(Tbps)
 95th In	 95th Out	 95th

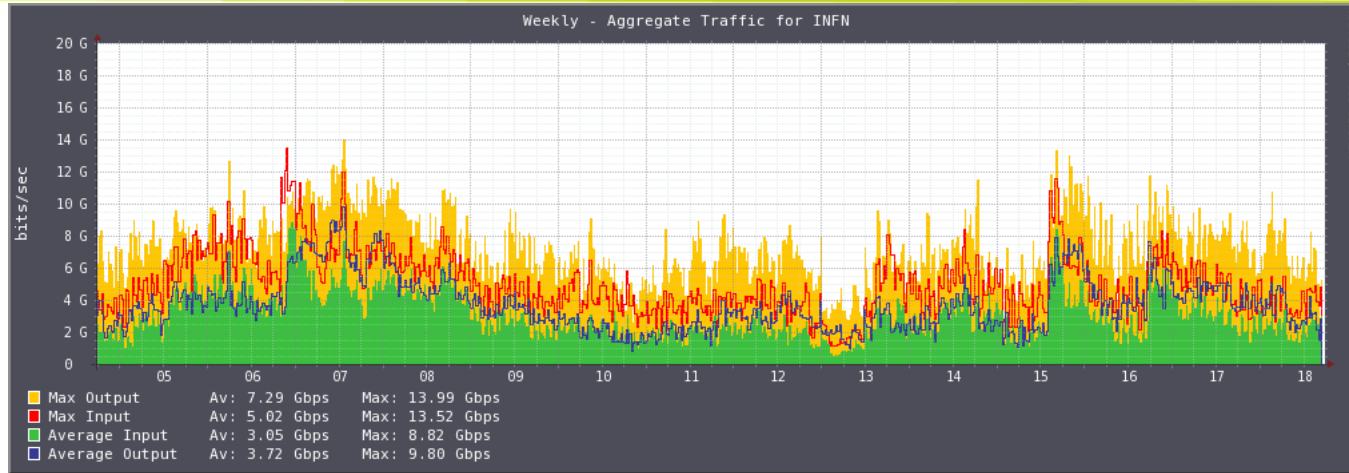
- **Ave In:** Average/Month in Input from the Users to the Network
- **Ave Out:** Average/Month in Output from the Network to the User
- **Max In:** Peak Traffic coming from the Users to the Network
- **Max Out:** Peak Traffic coming from the Network to the User
- **Vol In:** Volume Tbit/Month in Input from the Users to the Network
- **Vol Out:** Volume Tbit/Month in Output from the Network to the User
- **95th In:** 95 percentile in Input from the Users to the Network
- **95th Out:** 95 percentile in Output from the Network to the User
- **95th:** is the maximum between 95th In and 95th Out

Universities

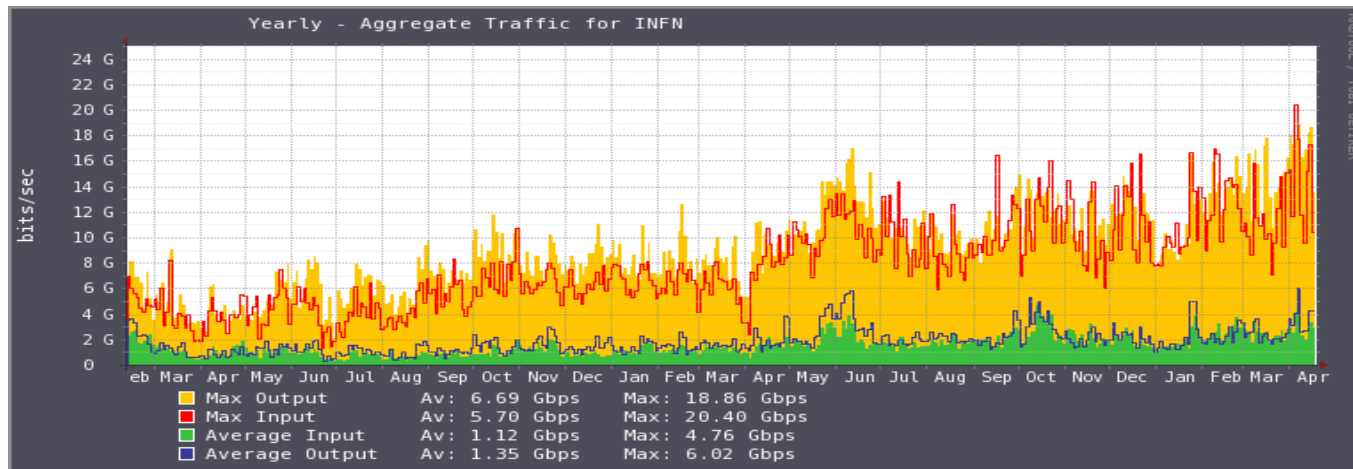
11.49 Gbps



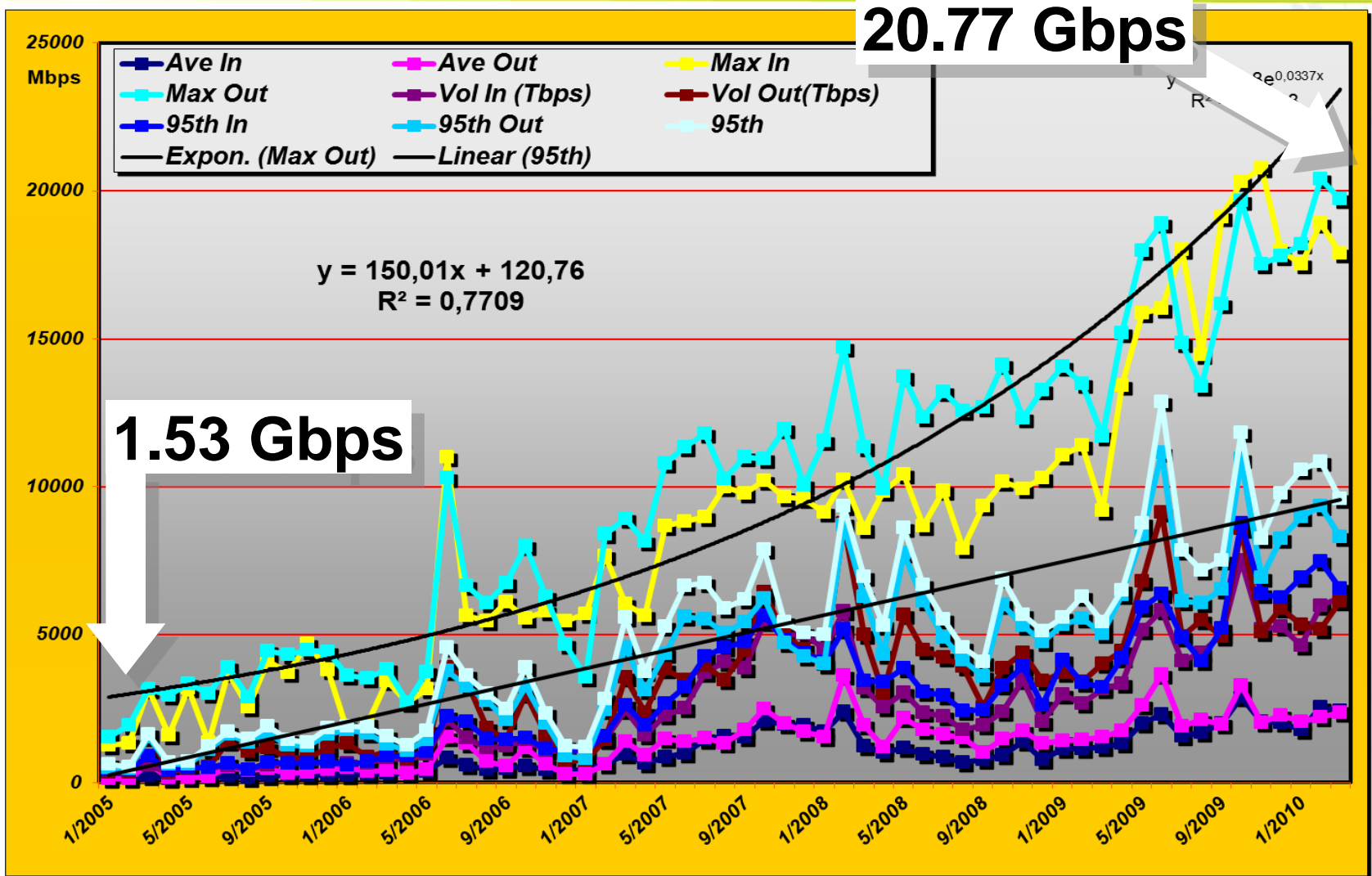
INFN (HEP)



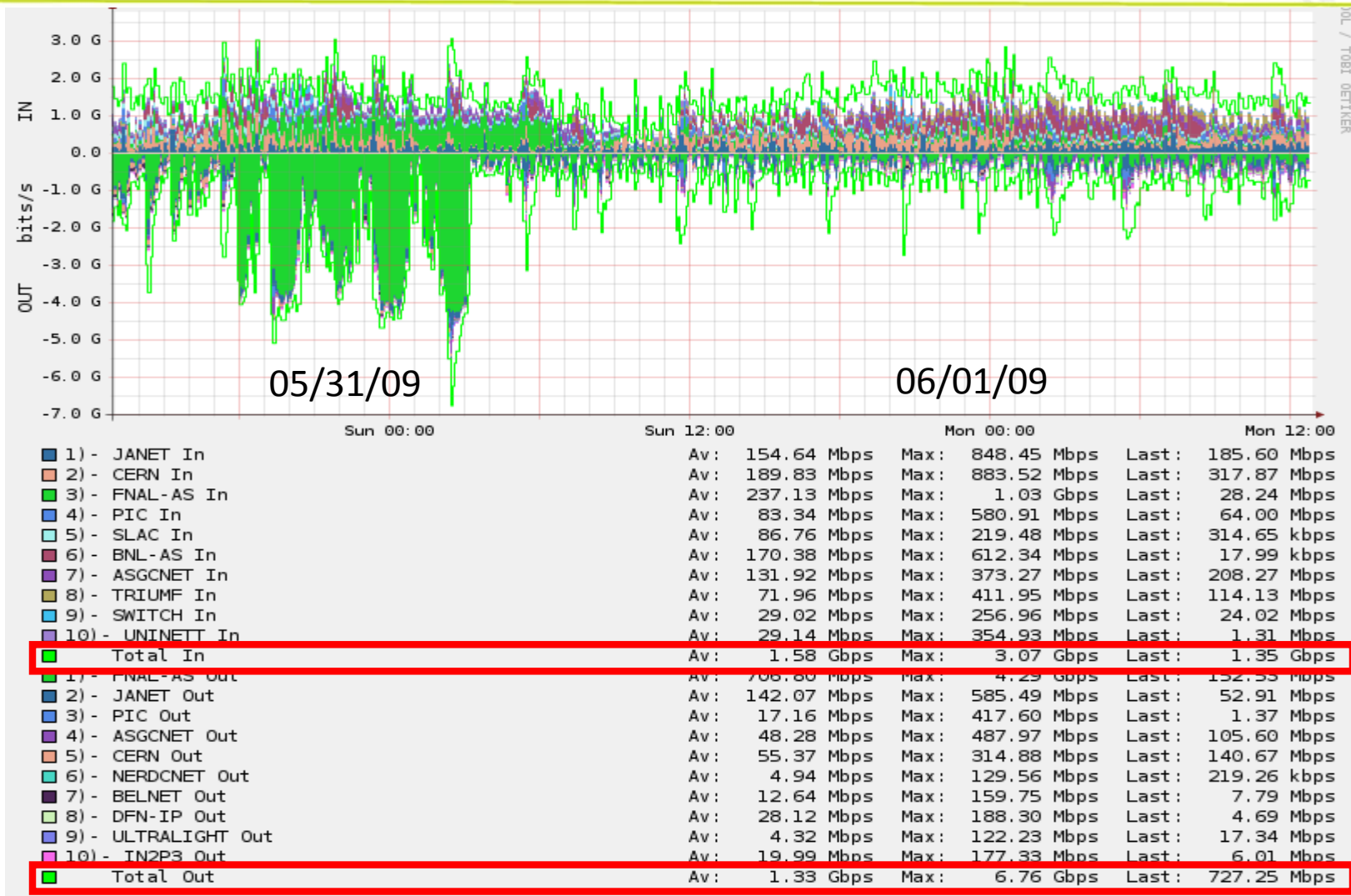
Rate \sim 2.20 /year



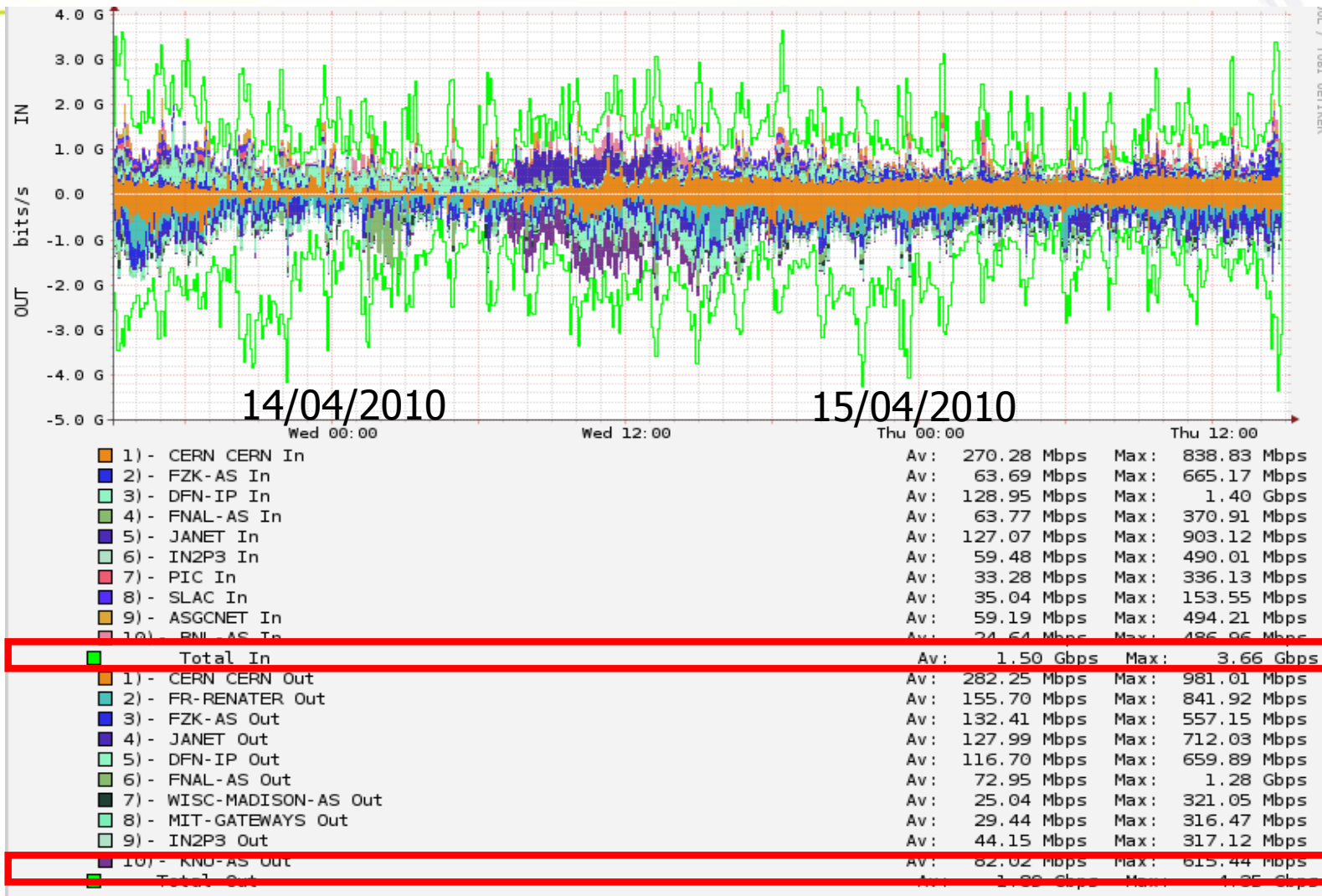
INFN (IP + E2E)



GEANT2 Primary Access (AS stats)

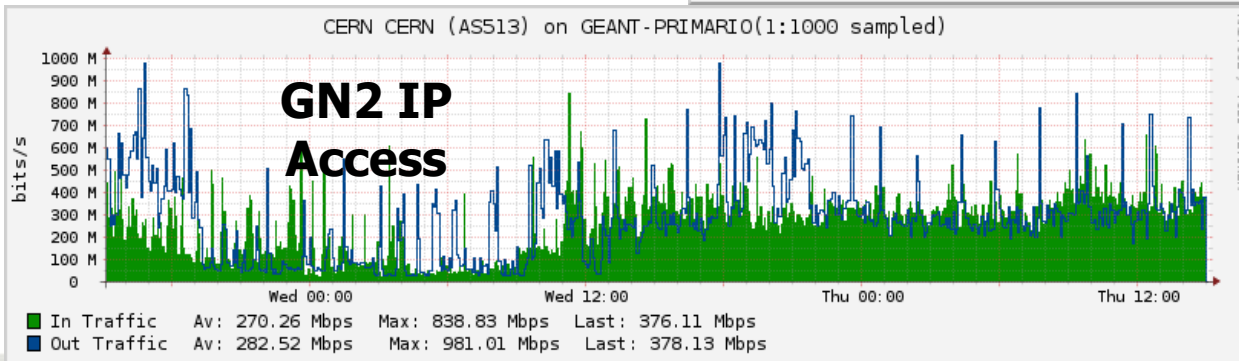
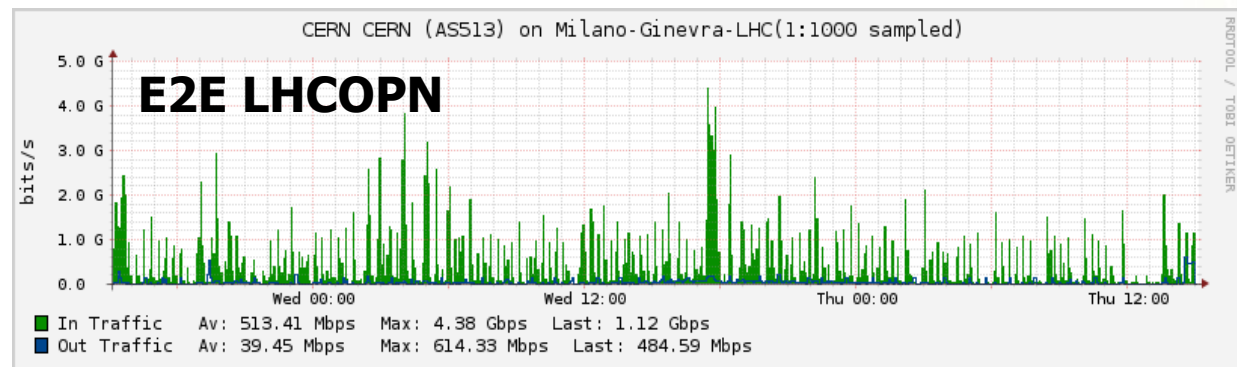
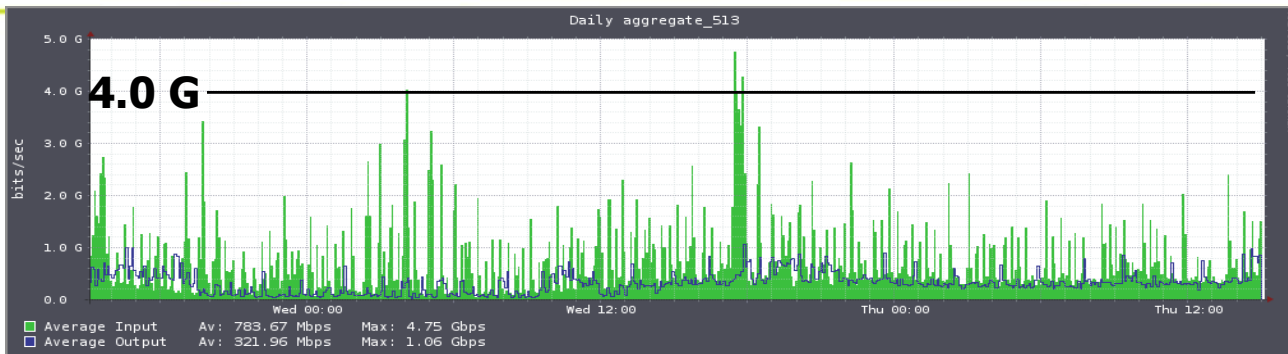


GEANT2 Primary Access (AS stats)

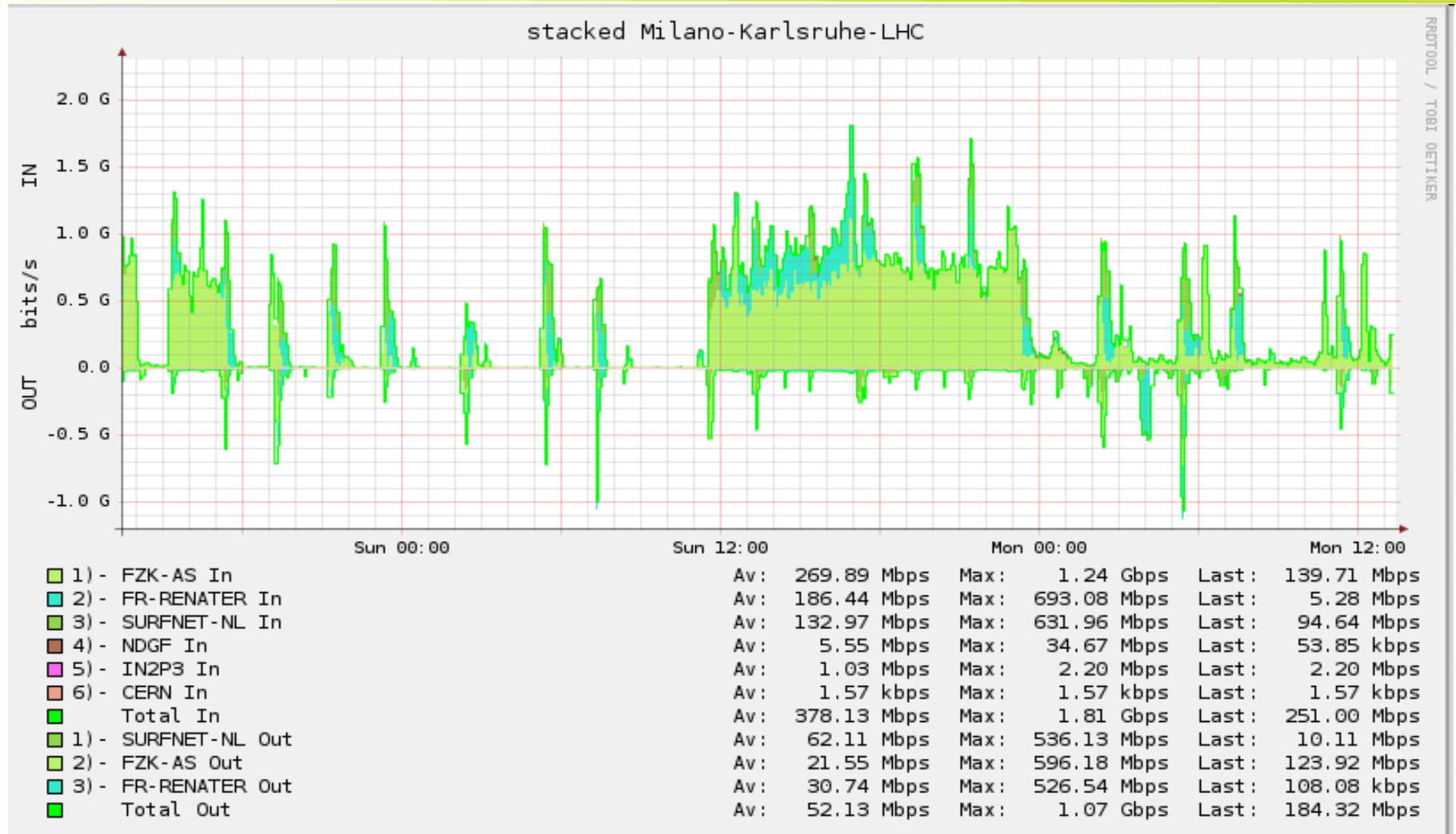


10/1 / TOBI OETIKER

CERN AS513 (E2E + IP access)



LHC T1-T1 traffic (on CBF)

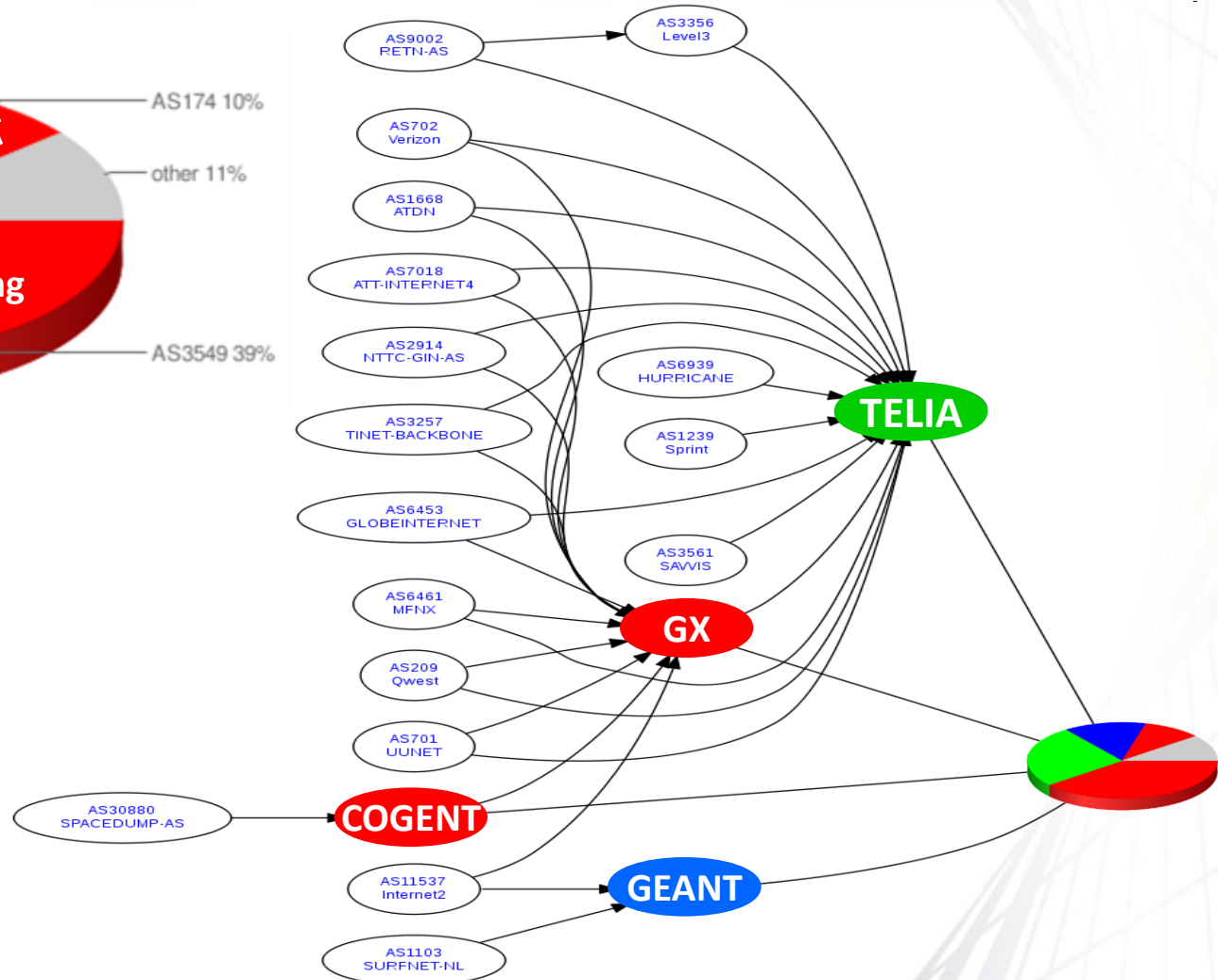
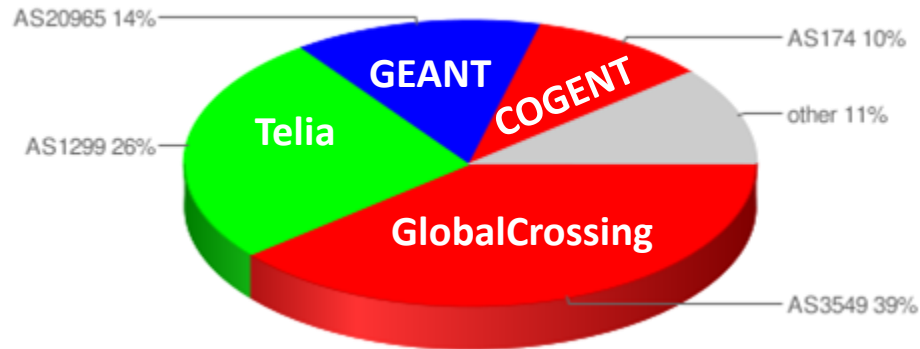


RRDTOOL / TOBI OETIKER

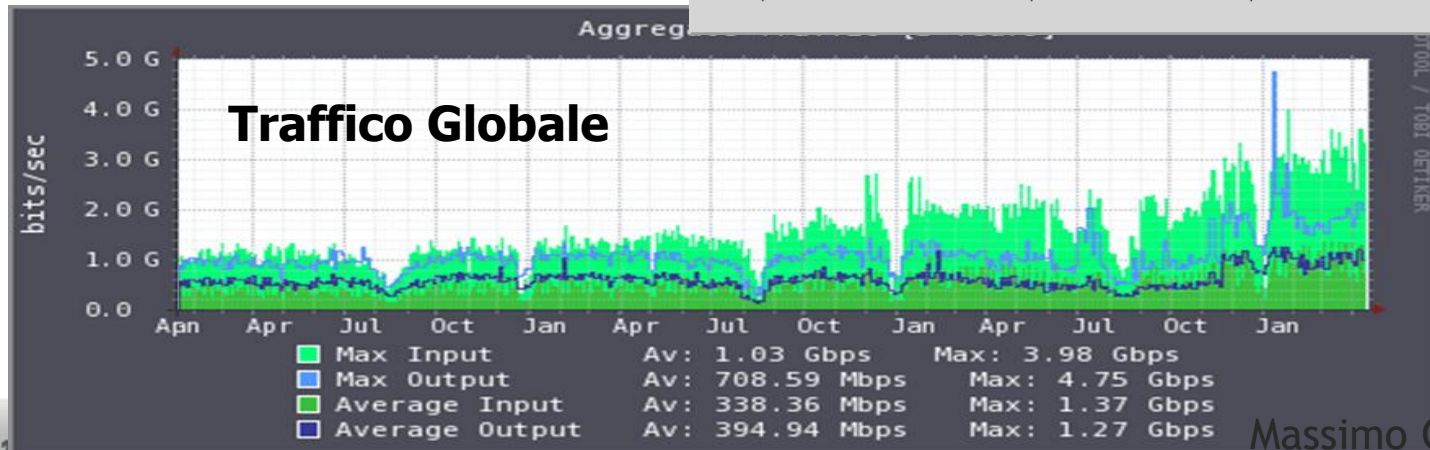
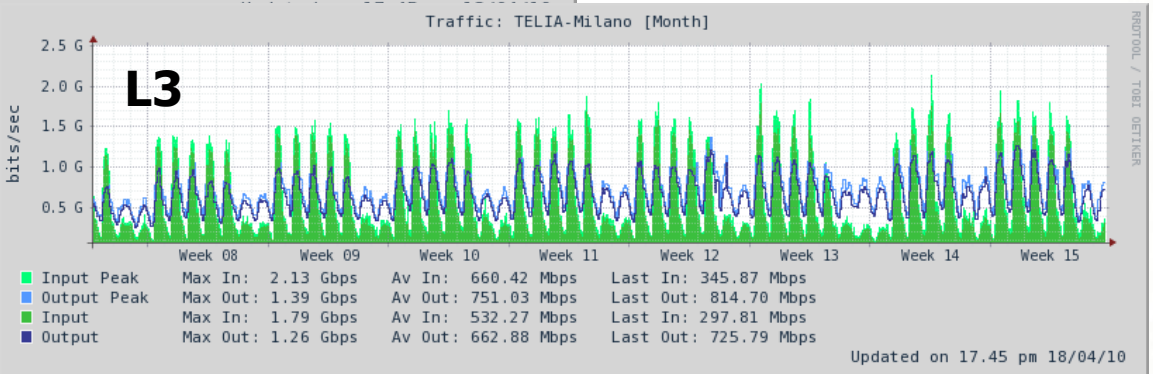
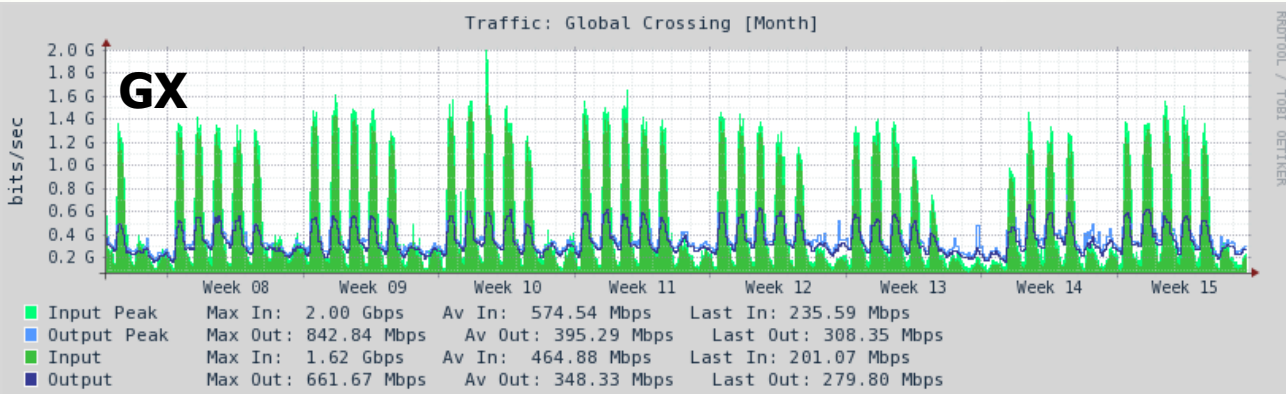
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Come evolve il resto del traffico ?

Le direttrici di traffico GARR (per numero di rotte IP ricevute)

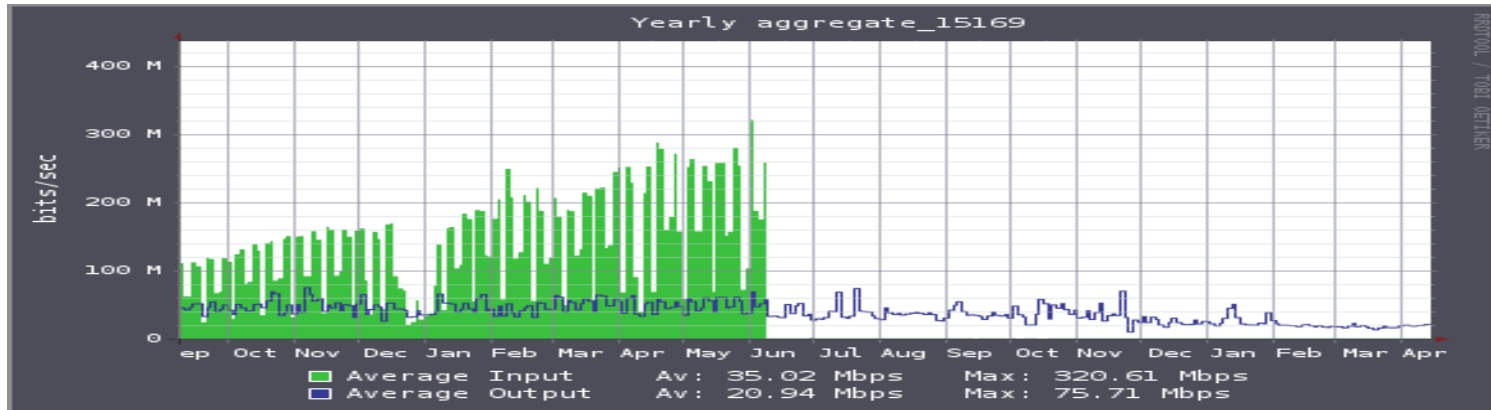


Global Internet: GX, Telia (4*2.5G)

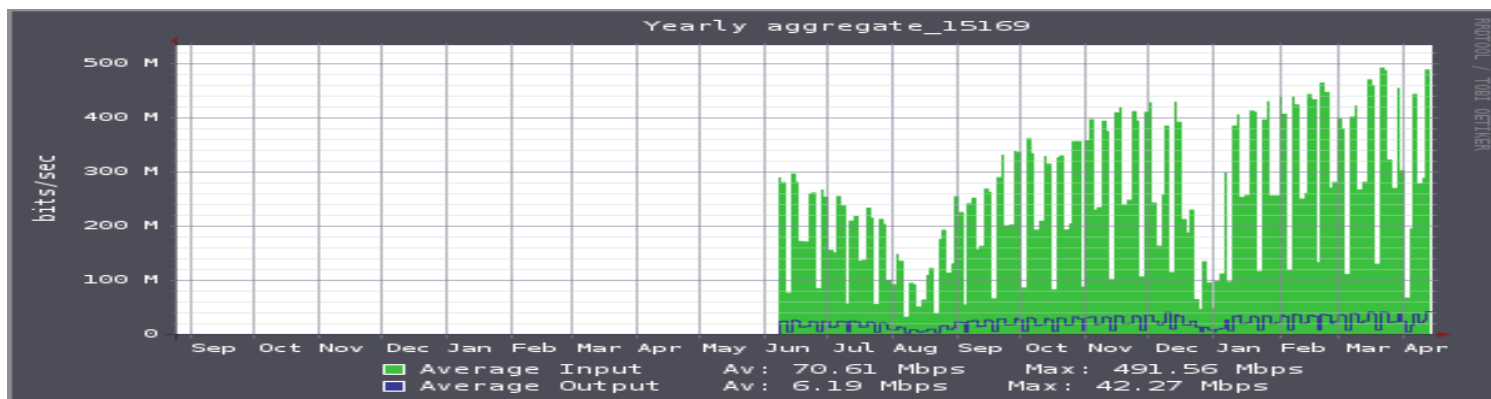


(AS Matrix) → Google Traffic

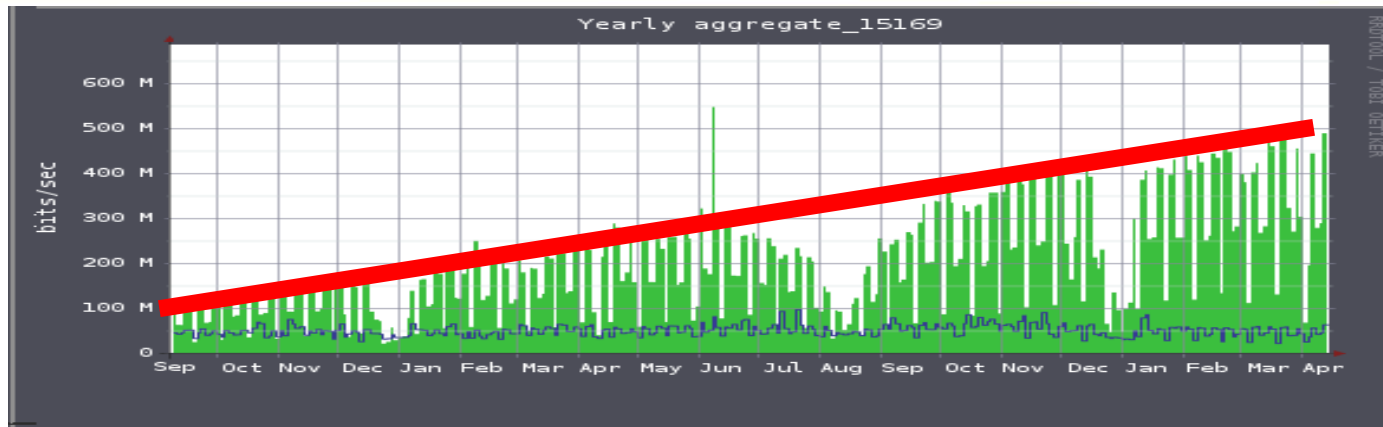
Traffico via GX+Telia+L3



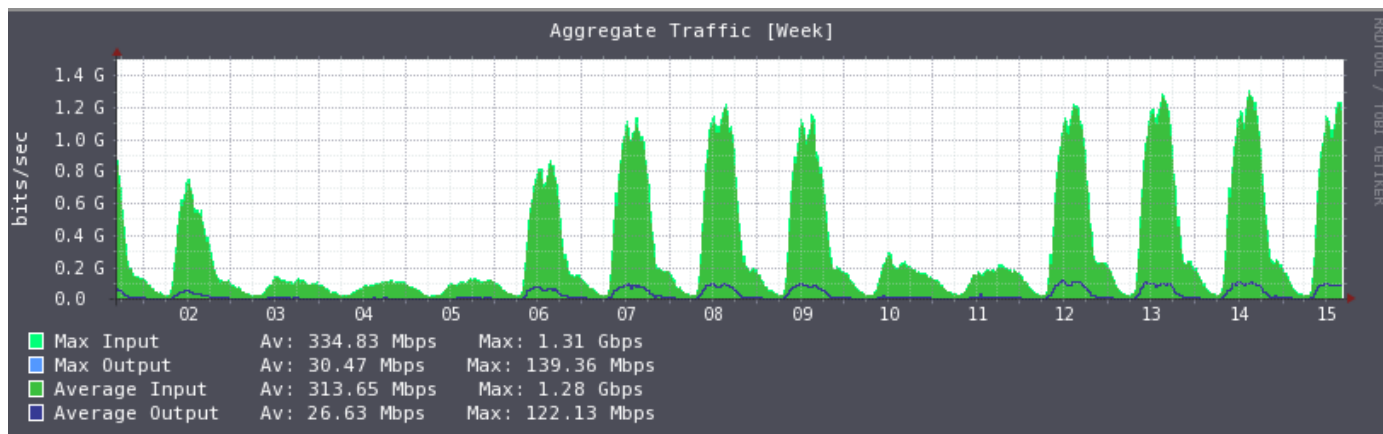
Peering Diretto (IPv4 e Ipv6)



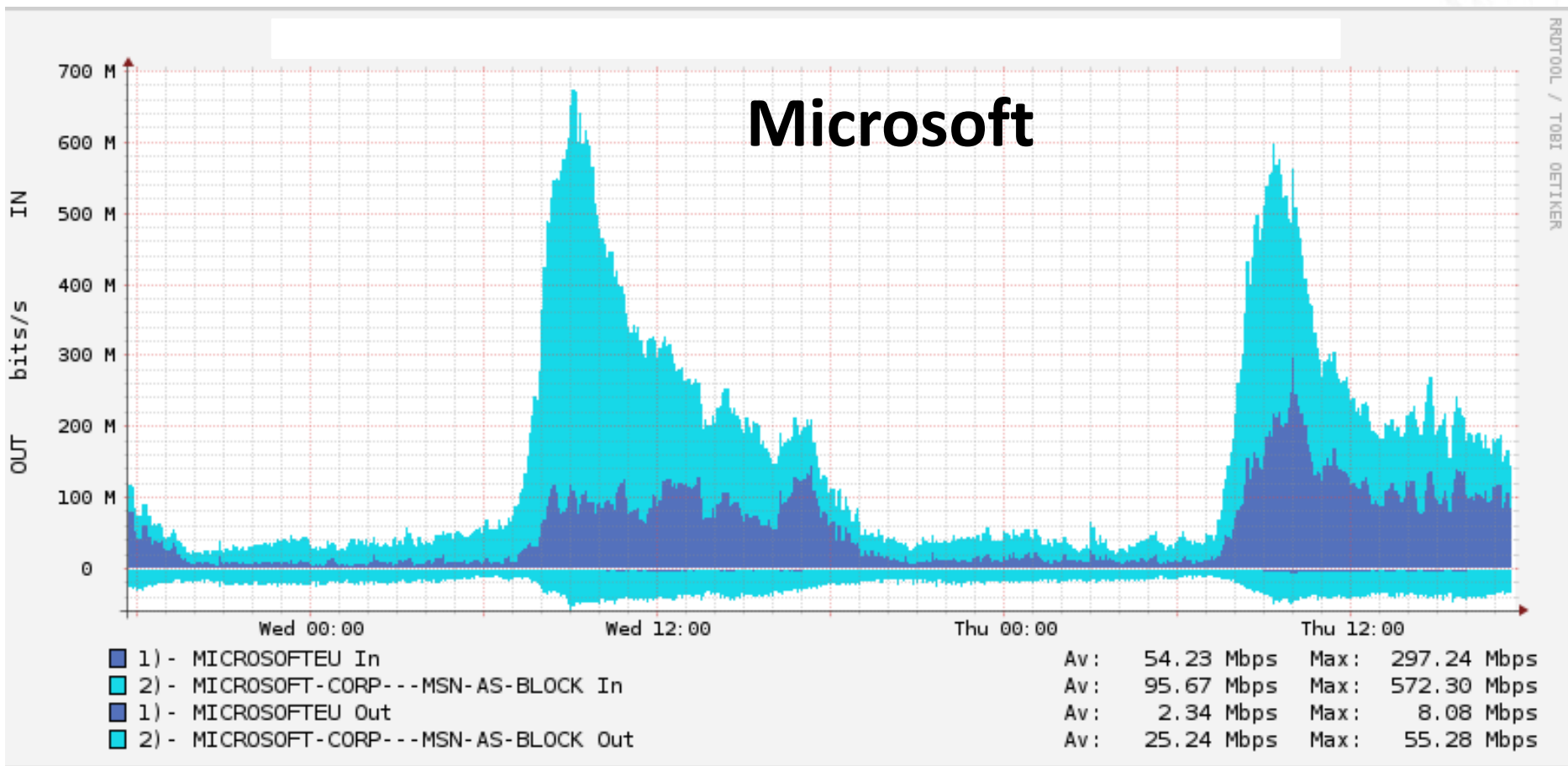
GOOGLE AS15169



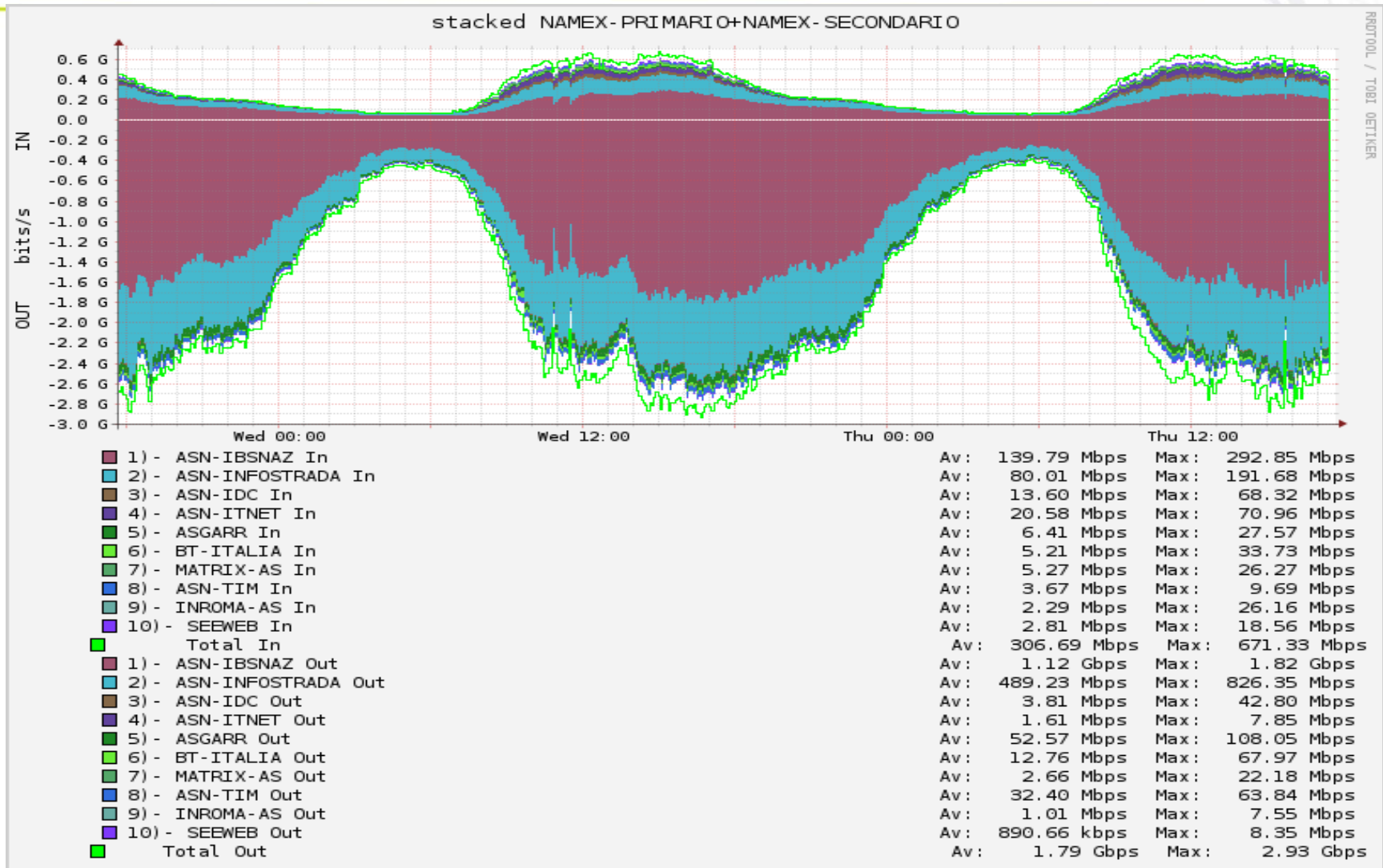
Growth Rate $\sim 3.3/y$
 $\sim 20\%$ of the Global Internet



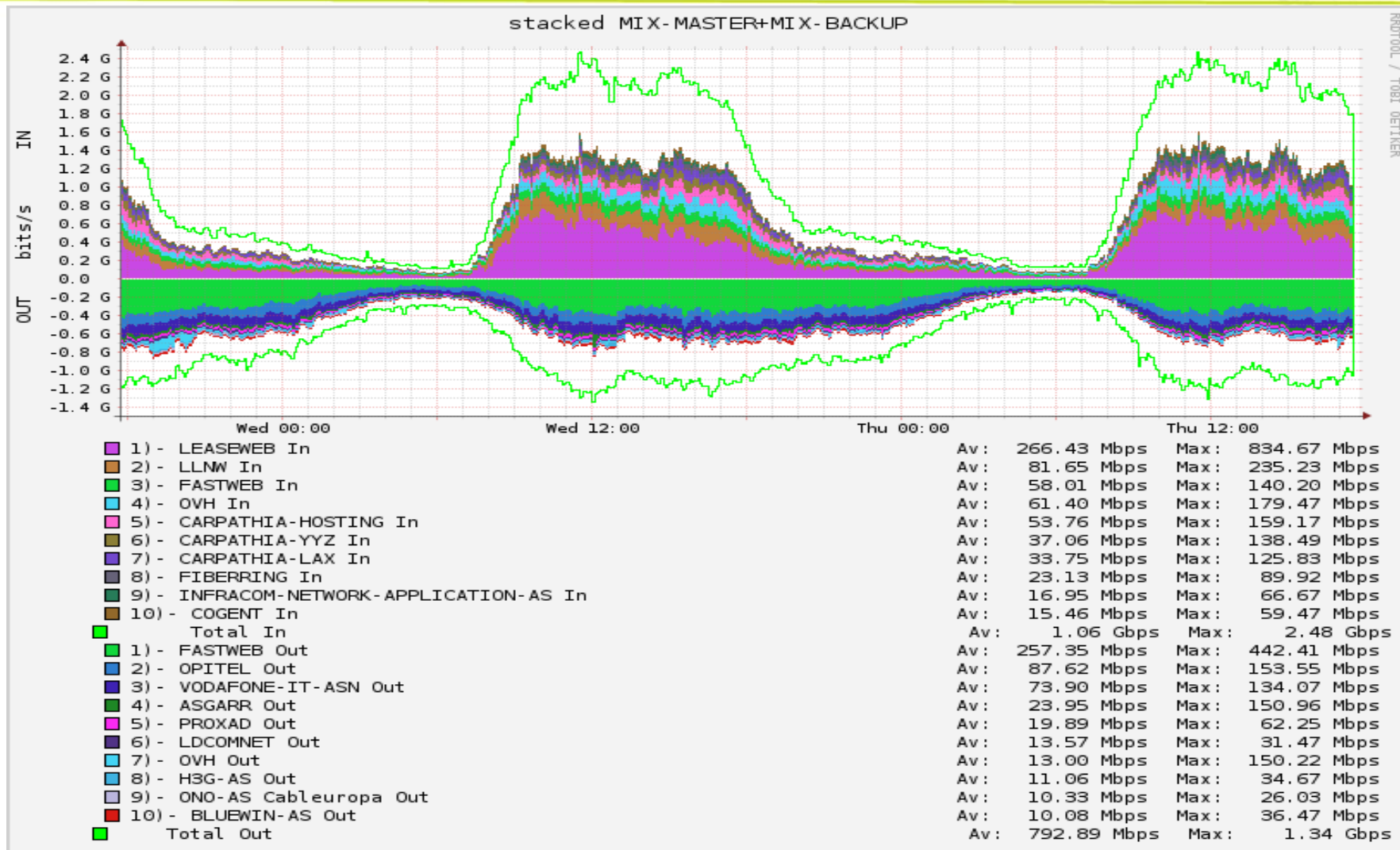
Chi e' il prossimo ?



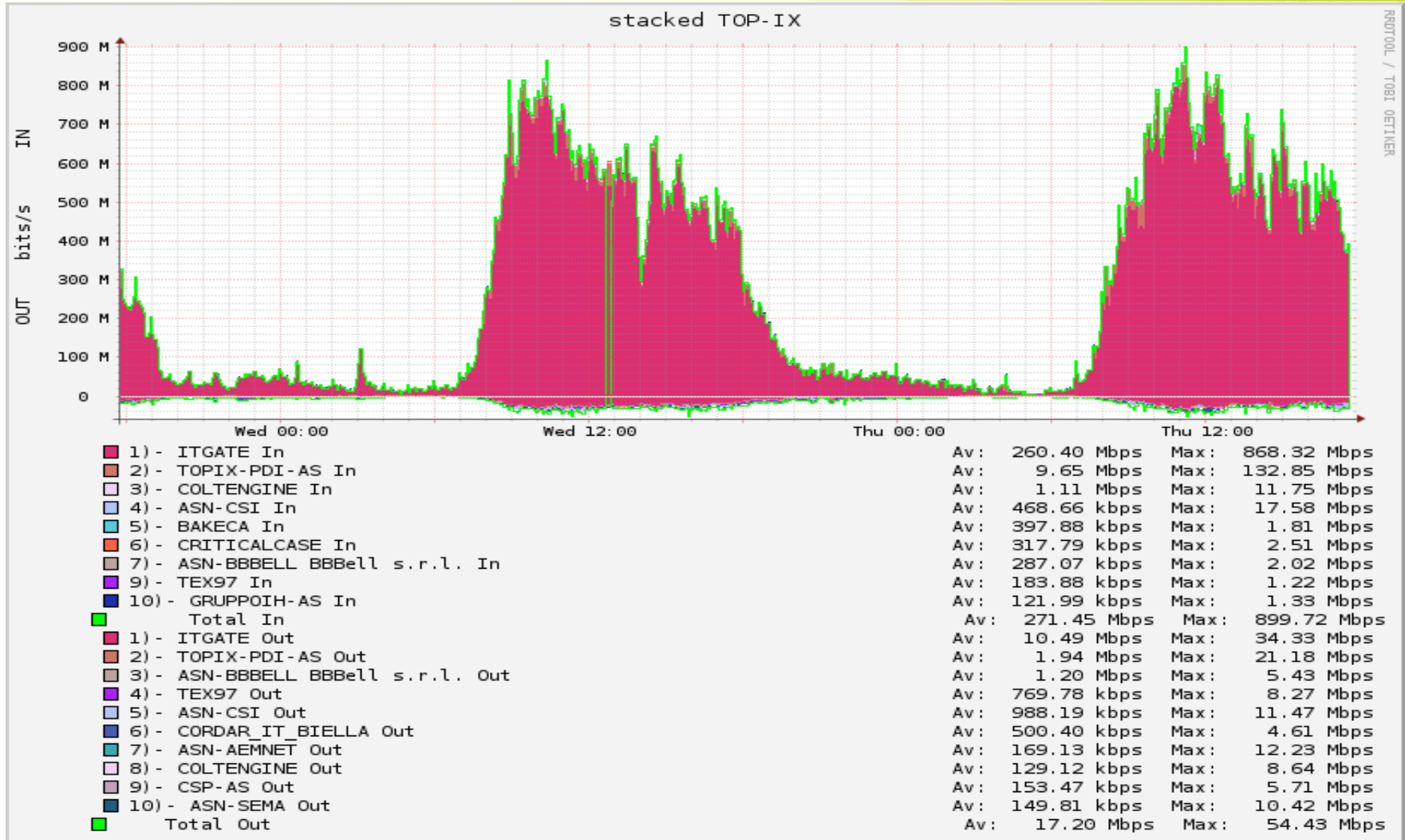
NAMEX: ISP → IB, WIND



MIX: ISP + CDN

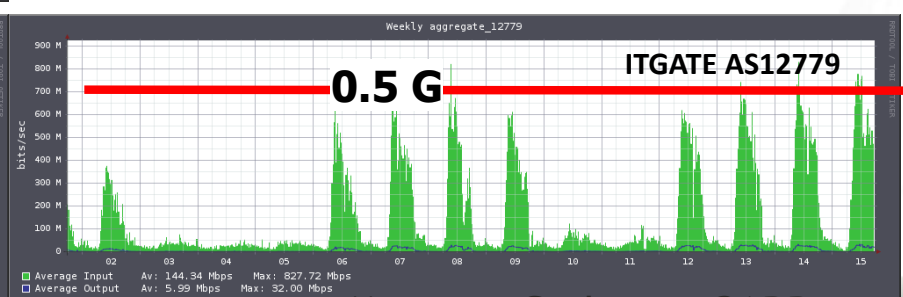
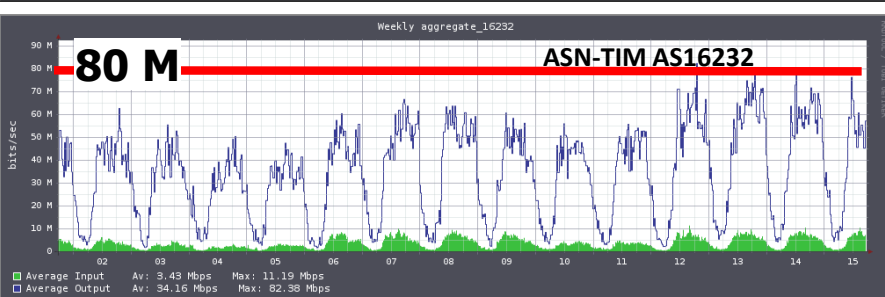
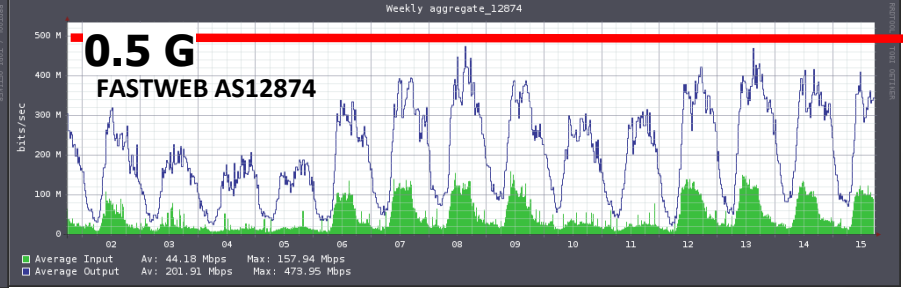
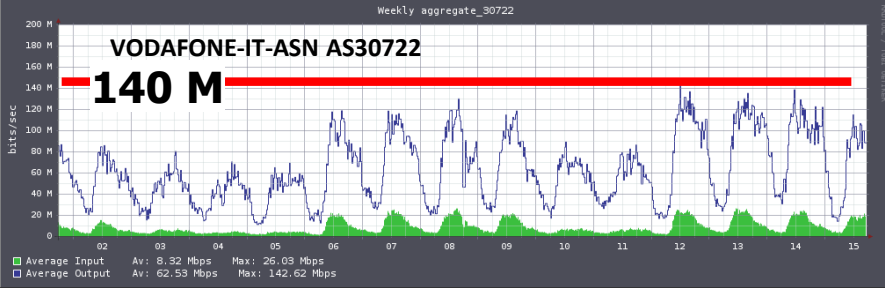
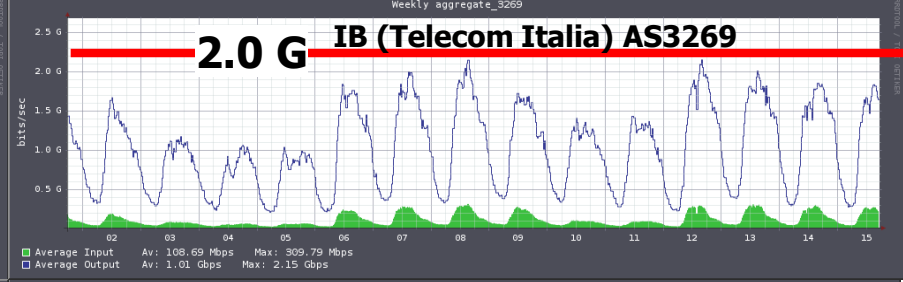
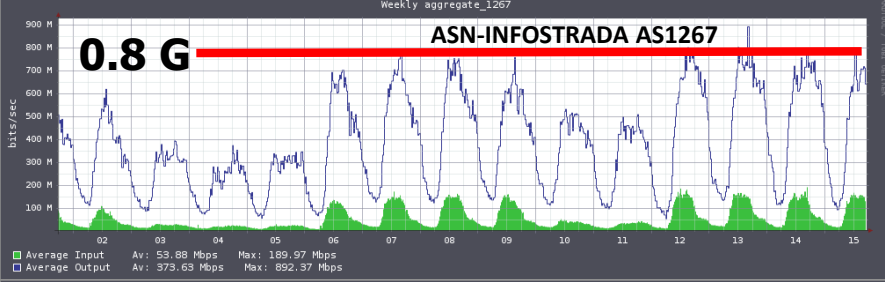
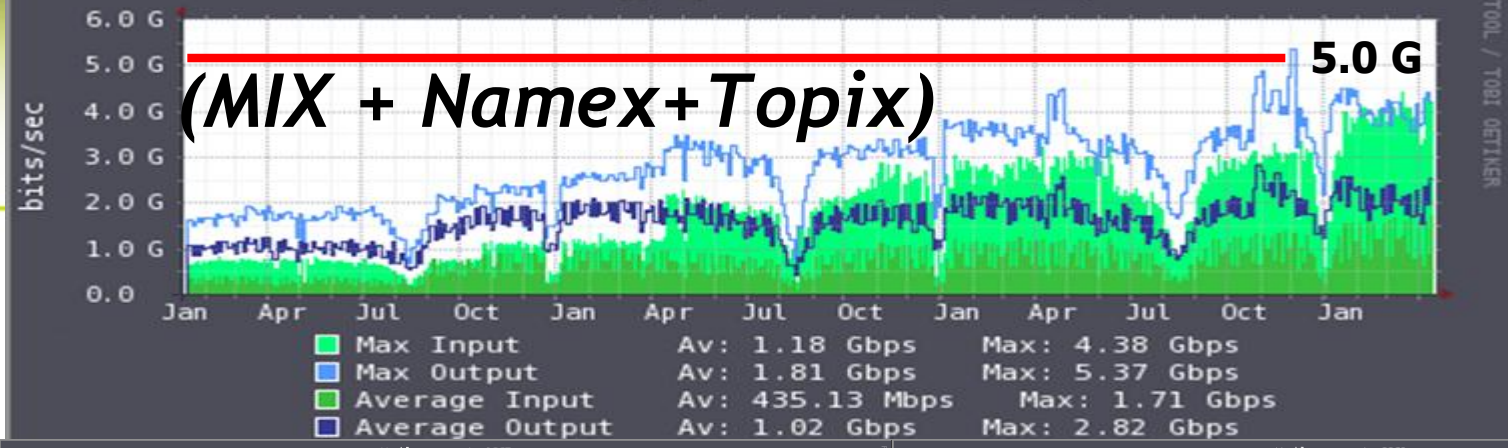


TOPIX: ITGATE (CDN → Akamai)



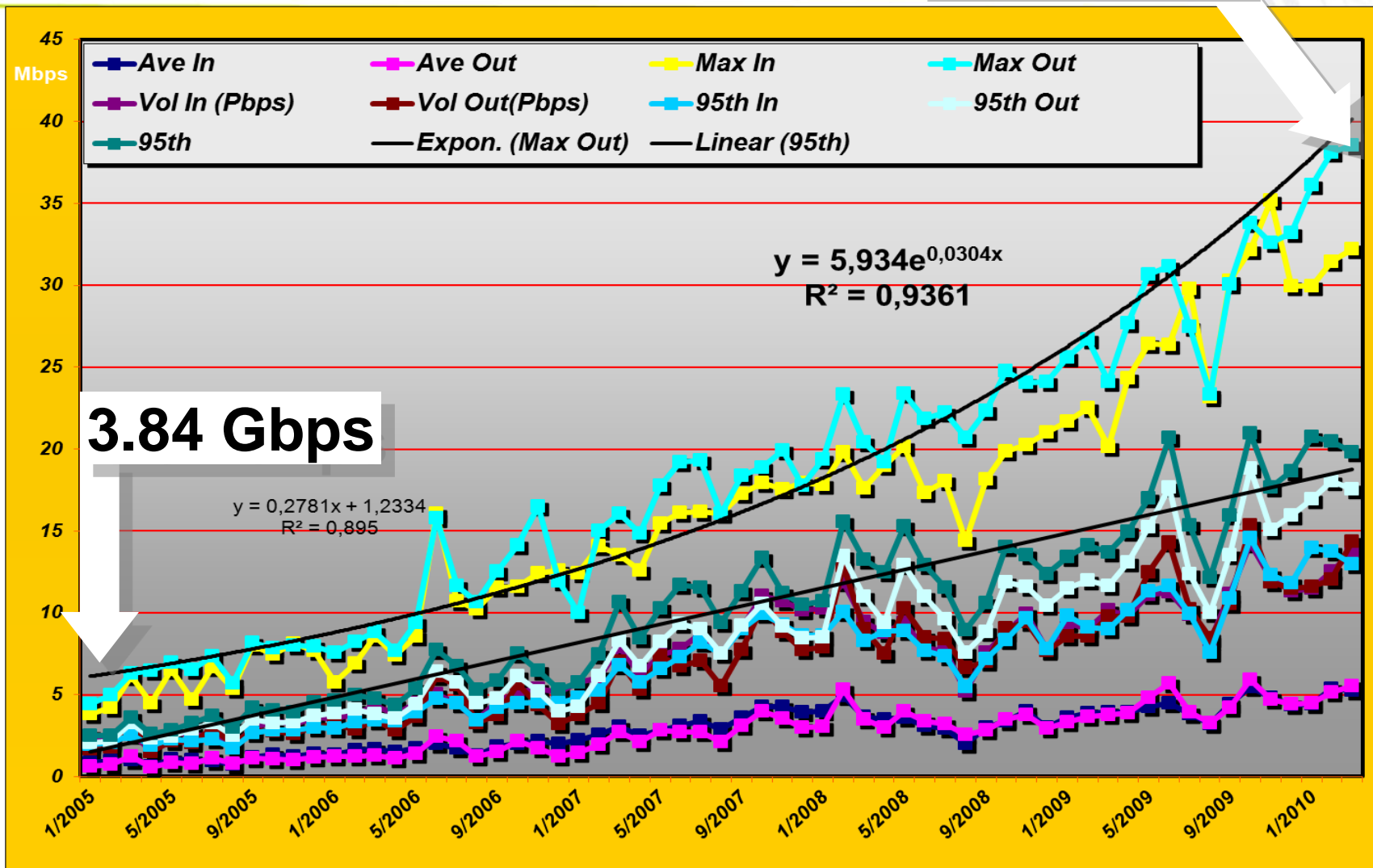
Aggregate Traffic [5 Years]

National Peering

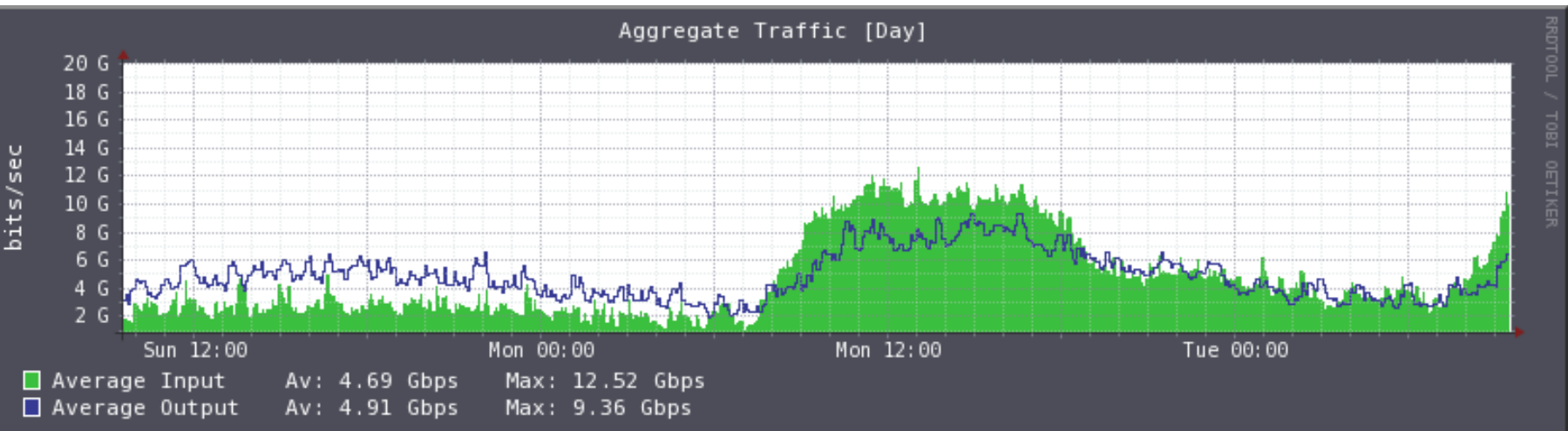
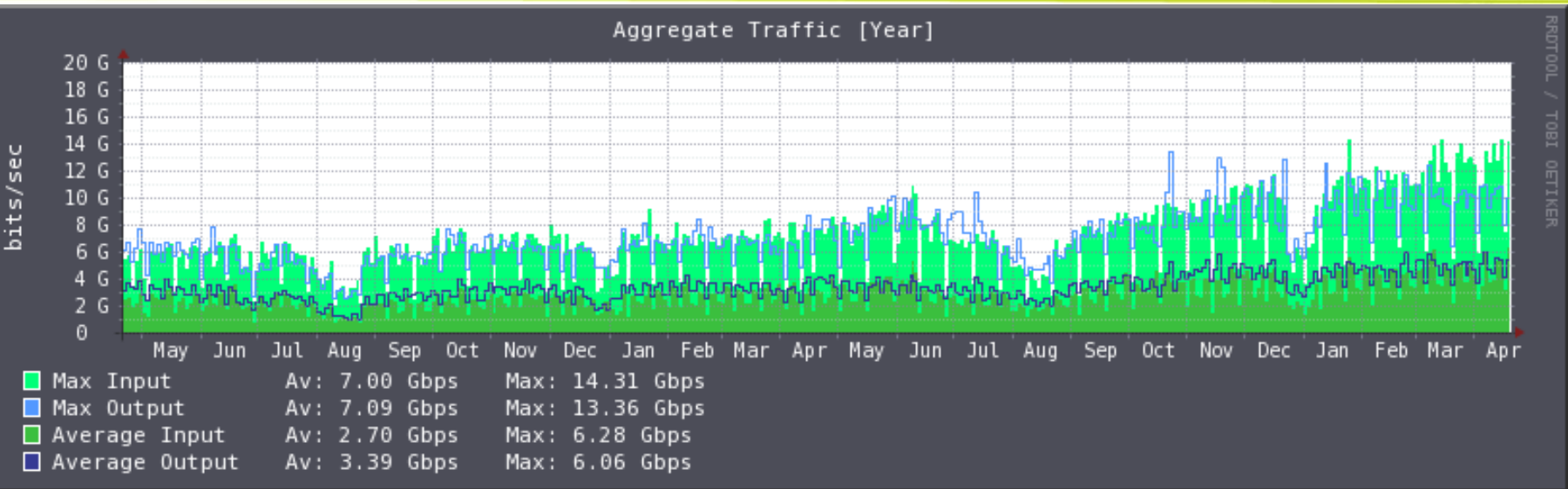


GARR Traffic Trends

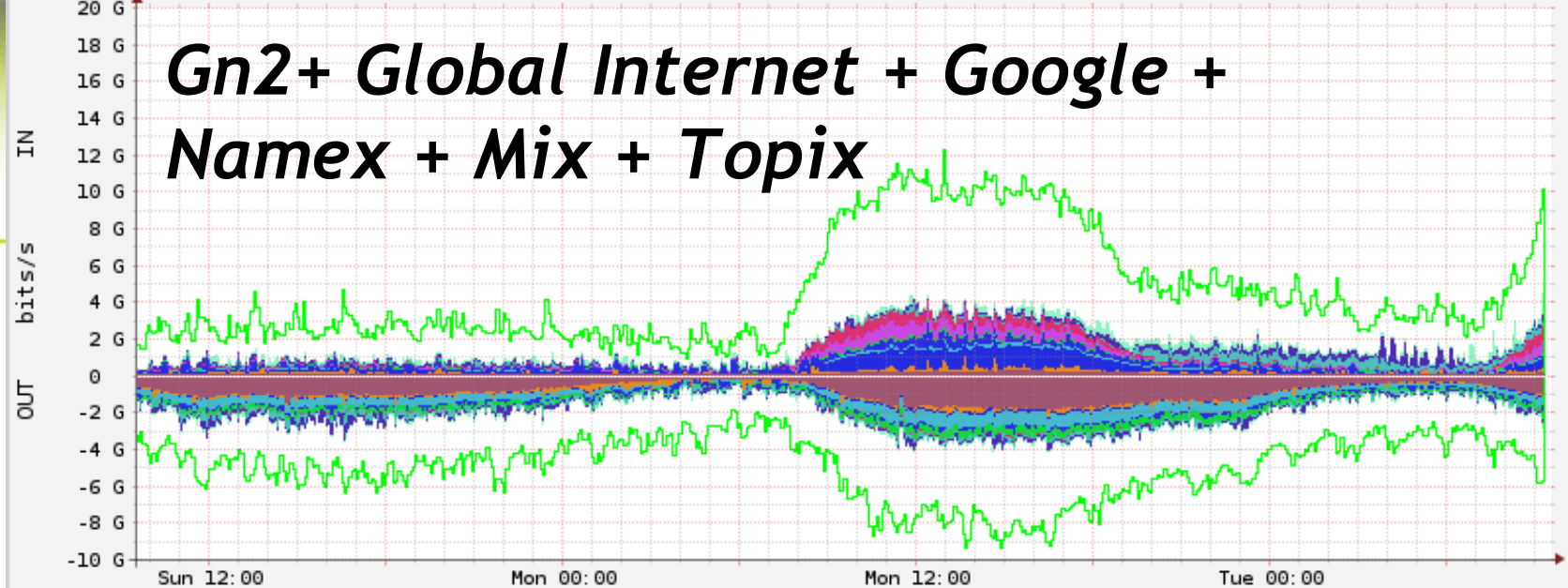
38.54 Gbps



Aggregato di traffico IP sui principali upstream



Gn2+ Global Internet + Google + Namex + Mix + Topix

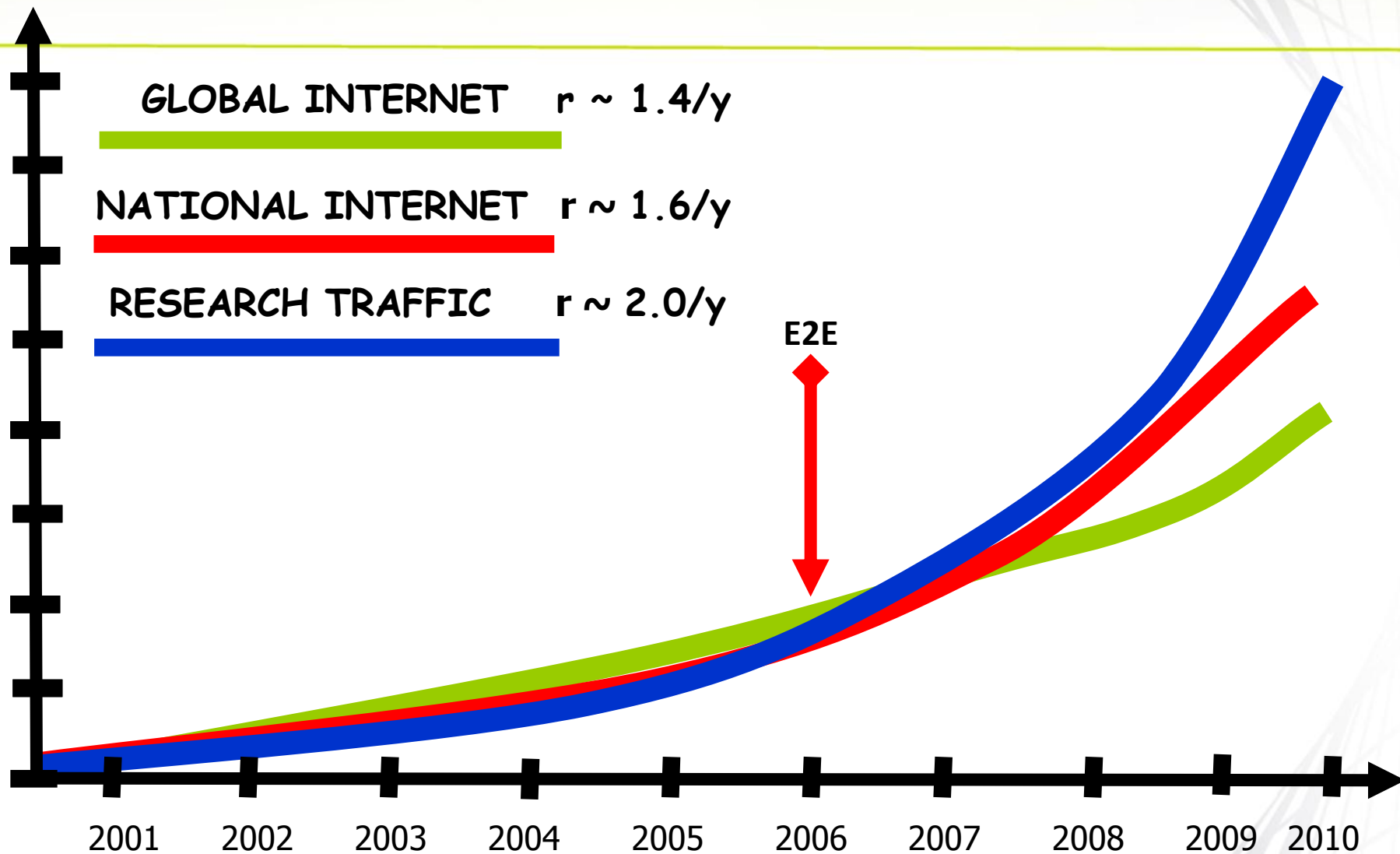


- 1) - ASN-IBSNAZ In
- 2) - CERN CERN In
- 3) - GOOGLE In
- 4) - ASN-INFOSTRADA In
- 5) - FZK-AS In
- 6) - FASTWEB In
- 7) - LEASEWEB In
- 8) - ITGATE In
- 9) - FR-RENATER In
- 10) - JANET In
- 11) - DFN-IP In
- Total In
- 1) - ASN-IBSNAZ Out
- 2) - CERN CERN Out
- 3) - GOOGLE Out
- 4) - ASN-INFOSTRADA Out
- 5) - FZK-AS Out
- 6) - FASTWEB Out
- 7) - LEASEWEB Out
- 8) - ITGATE Out
- 9) - FR-RENATER Out
- 10) - JANET Out
- 11) - DFN-IP Out
- Total Out

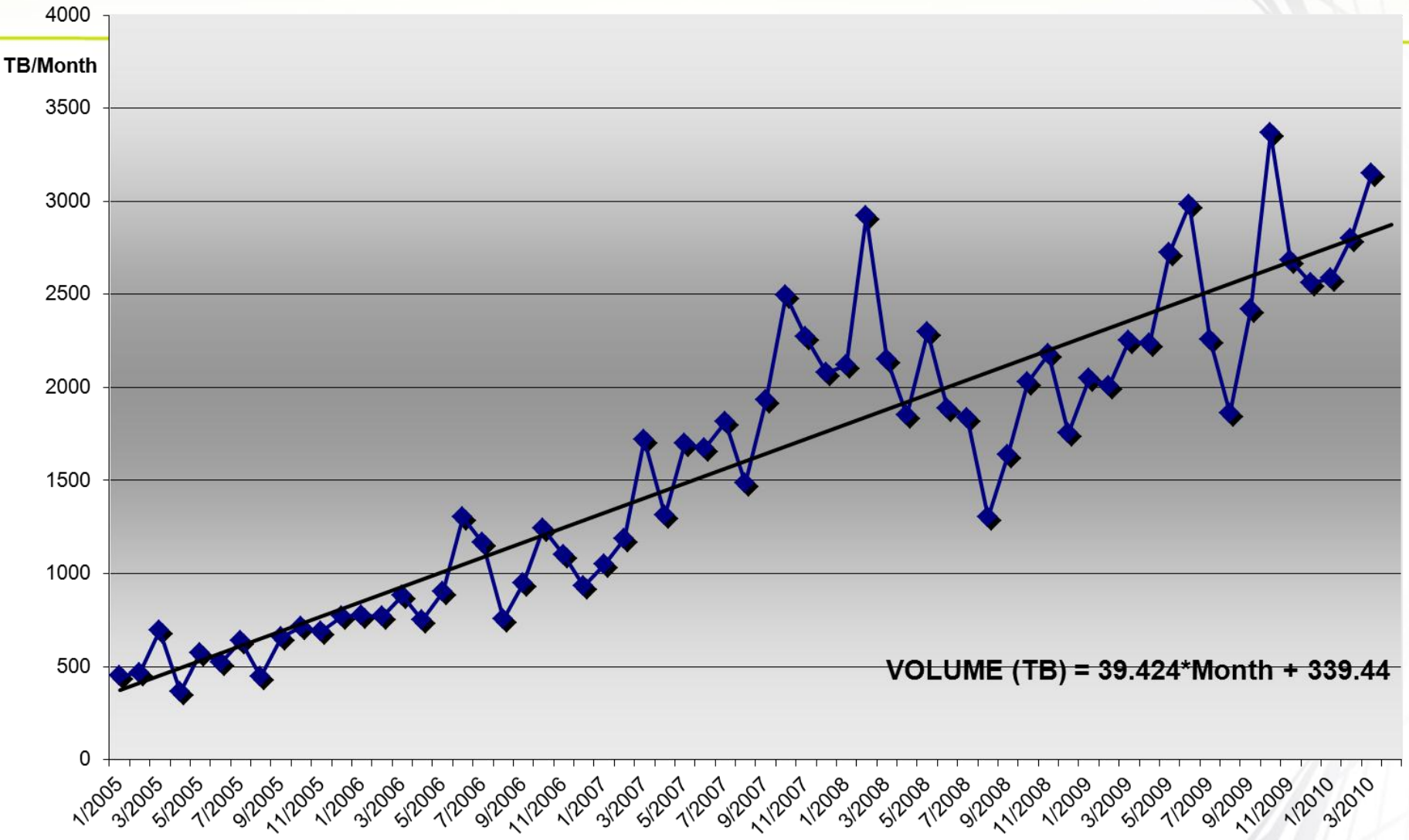
As Top5 7 days			
IN		OUT	
CERN CERN AS513	678.35 Mb/s	ASN-IBSNAZ AS3269	1.09 Gb/s
GOOGLE AS15169	402.84 Mb/s	ASN-INFOSTRADA AS1267	452.87 Mb/s
FZK-AS AS34878	227.81 Mb/s	FASTWEB AS12874	258.6 Mb/s
LEASEWEB AS16265	227.57 Mb/s	CERN CERN AS513	221.54 Mb/s
ITGATE AS12779	205.58 Mb/s	FR-RENATER AS2200	179.66 Mb/s
JANET AS786	197.75 Mb/s	JANET AS786	175.98 Mb/s
DFN-IP AS680	156.12 Mb/s	FZK-AS AS34878	132.4 Mb/s

Av:	99.40 Mbps	Max:	289.74 Mbps
Av:	90.51 Mbps	Max:	789.76 Mbps
Av:	301.07 Mbps	Max:	1.21 Gbps
Av:	55.03 Mbps	Max:	178.92 Mbps
Av:	180.28 Mbps	Max:	868.71 Mbps
Av:	44.87 Mbps	Max:	162.19 Mbps
Av:	171.06 Mbps	Max:	812.14 Mbps
Av:	152.28 Mbps	Max:	822.33 Mbps
Av:	141.12 Mbps	Max:	675.28 Mbps
Av:	168.97 Mbps	Max:	1.22 Gbps
Av:	148.41 Mbps	Max:	1.33 Gbps
Av:	4.50 Gbps	Max:	12.32 Gbps
Av:	996.98 Mbps	Max:	1.97 Gbps
Av:	99.13 Mbps	Max:	608.18 Mbps
Av:	52.16 Mbps	Max:	128.22 Mbps
Av:	385.29 Mbps	Max:	815.72 Mbps
Av:	108.45 Mbps	Max:	556.64 Mbps
Av:	224.51 Mbps	Max:	482.95 Mbps
Av:	7.31 Mbps	Max:	66.35 Mbps
Av:	5.92 Mbps	Max:	29.33 Mbps
Av:	143.37 Mbps	Max:	631.63 Mbps
Av:	160.99 Mbps	Max:	857.07 Mbps
Av:	57.72 Mbps	Max:	340.35 Mbps
Av:	4.94 Gbps	Max:	9.33 Gbps

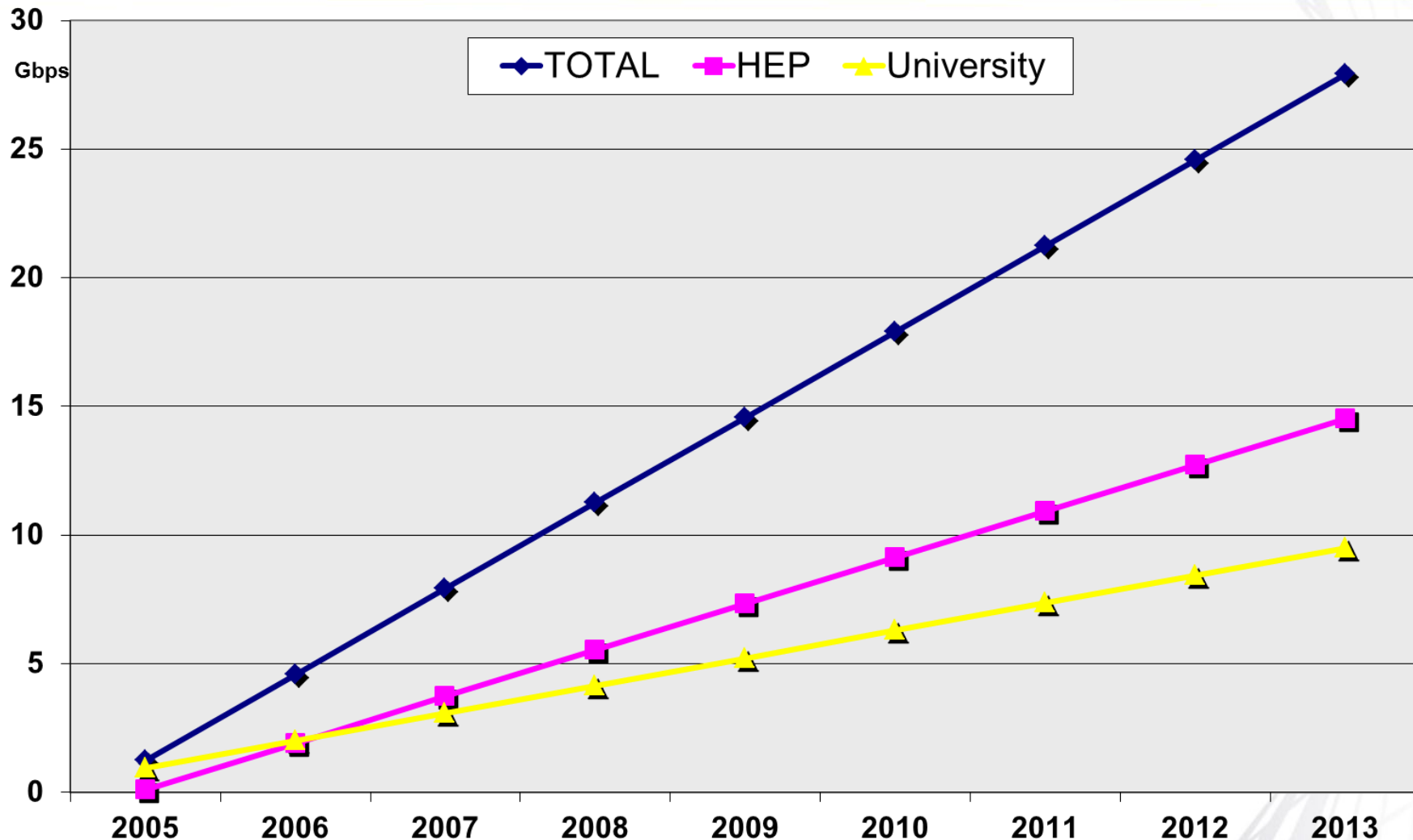
Traffic Evolution



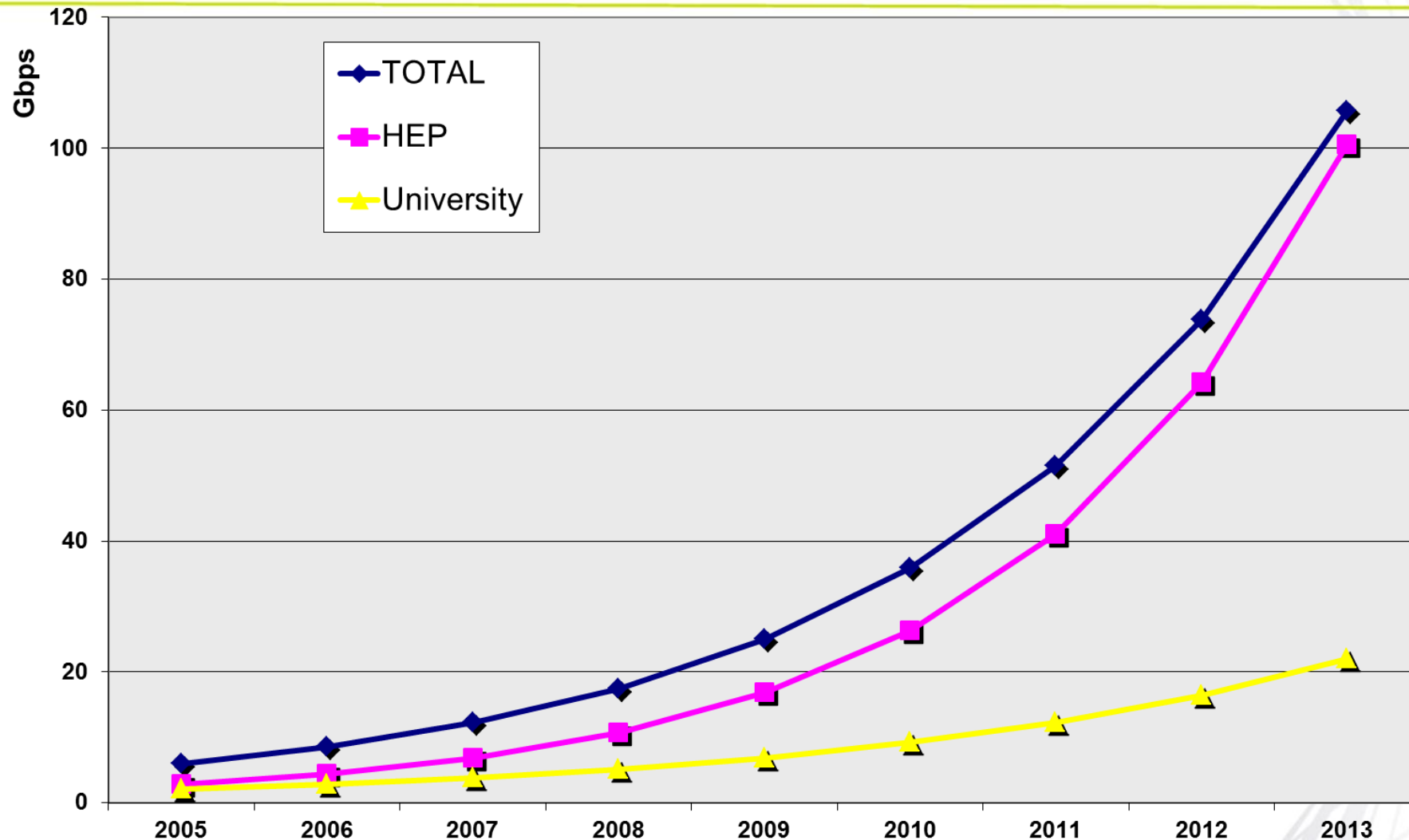
Global Traffic Trend (→ 1/1/2005)



Proiezioni del 95th percentile



Proiezione d'uso della banda di picco



Cosa abbiamo visto

- Il traffico di Ricerca
 - IP based
 - E2E: (eVLBI, DEISA, LHC, Research Infrastructure)
 - CBF: Complementary infrastructure
- In traffico Internet
 - Nazionale
 - Internazionale
 - Content-provider
 - Nuove direttrici di traffico
- Qual'è la banda passante per singolo utente finale?
- Come ha funzionato?
- Come e' stata percepita?
- Come è stata gestita questa evoluzione
 - CBF per LHC
 - Peering diretti verso i Content provider Ipv4 e Ipv6 (GOOGLE)
- Quali sono stati i colli di bottiglia?
 - Reti di accesso?
 - Reti utente?
 - Sicurezza?

... *some url:*

- <https://www.noc.garr.it/GINS/>
 - Statistics/mrtg_index_aggregates.php
 - Statistics/mrtg_routers.php
 - svg/weathermap.php
- Network Map:
 - <http://www.garr.it/reteGARR/mappa.php?idmenu=rete>
- GARR Users List:
 - <http://www.garr.it/reteGARR/utenti.php?idmenu=rete>

FINE