

The history of Internet Exchanges in Sweden

Kurtis Lindqvist
<kurtis@netnod.se>



© 2007 - Netnod AB
www.netnod.se/

2007-04-04

Who am I anyway?

- Ålcom (EUnet Finland) -> 1997
- EUnet Sverige 1997-1998
- KPNQwest Sweden 1998-2000
- KPNQwest 2000-2002
- 2002- Consultant (Netnod)

- Other things...
 - Current chairman of the board for Euro-IX
 - IETF WG chair for shim6 and v6ops
 - Chair of RIPE NCC Services WG
 - Chair of the Swedish Operator Forum
 - Member of the Internet Architecture Board
 - Chair of IAOC
 - Member of the IETF ops-directorate
 - Various consultational groups to governments



Early history...

- D-GIX located at KTH in Stockholm
 - Started in 1992
 - From the beginning this was a 10/100 Mbps Ethernet Switch
- Was later complemented with an FDDI switch
- During 1996 there was a discussion inside SOF and the Swedish Internet community to discuss the future...
 - Netnod was created in 1997
 - Yet another FDDI switch was installed
 - The goal was a structure that could guarantee independence and continuity
 - The IX was considered critical national infrastructure

History

- 1999 the Swedish traffic had outgrown existing FDDI switches
 - This led to delay and packet loss
- At a SOF meeting future technologies were discussed
 - Gigabit Ethernet
 - Cisco DPT

History

- The operators jointly decided to go on with DPT
 - GigE jumboframes was not available then
 - Operators wanted to avoid the possibility of head-of-line blocking
- DPT was (is) a Cisco technology that was later called "Redundant Packet Rings" (RPR).
 - Sent in SONET/SDH format on something that looks like a buss
 - Today standardised as IEEE 802.17

History

- More IXPs where established in Gothenburg, Malmoe och Sundsvall
- 2001 the original 622Mbps DPT ring in Stockholm was full
- A 2.5Gbps ring was installed to off-load the old ring

History

- During 2000/2001 there was a discussion in SOF about using GigE as a complement to DPT622
 - Netnod investigated and concluded that 8 providers was needed to make a business case
 - As an alternative SOLIX was created out of Arrowhead and some other providers
 - Received government subsidies in form of support by KTH in Kista
 - Netnod shortly afterwards launched GigE as a service
-

2007-04-04

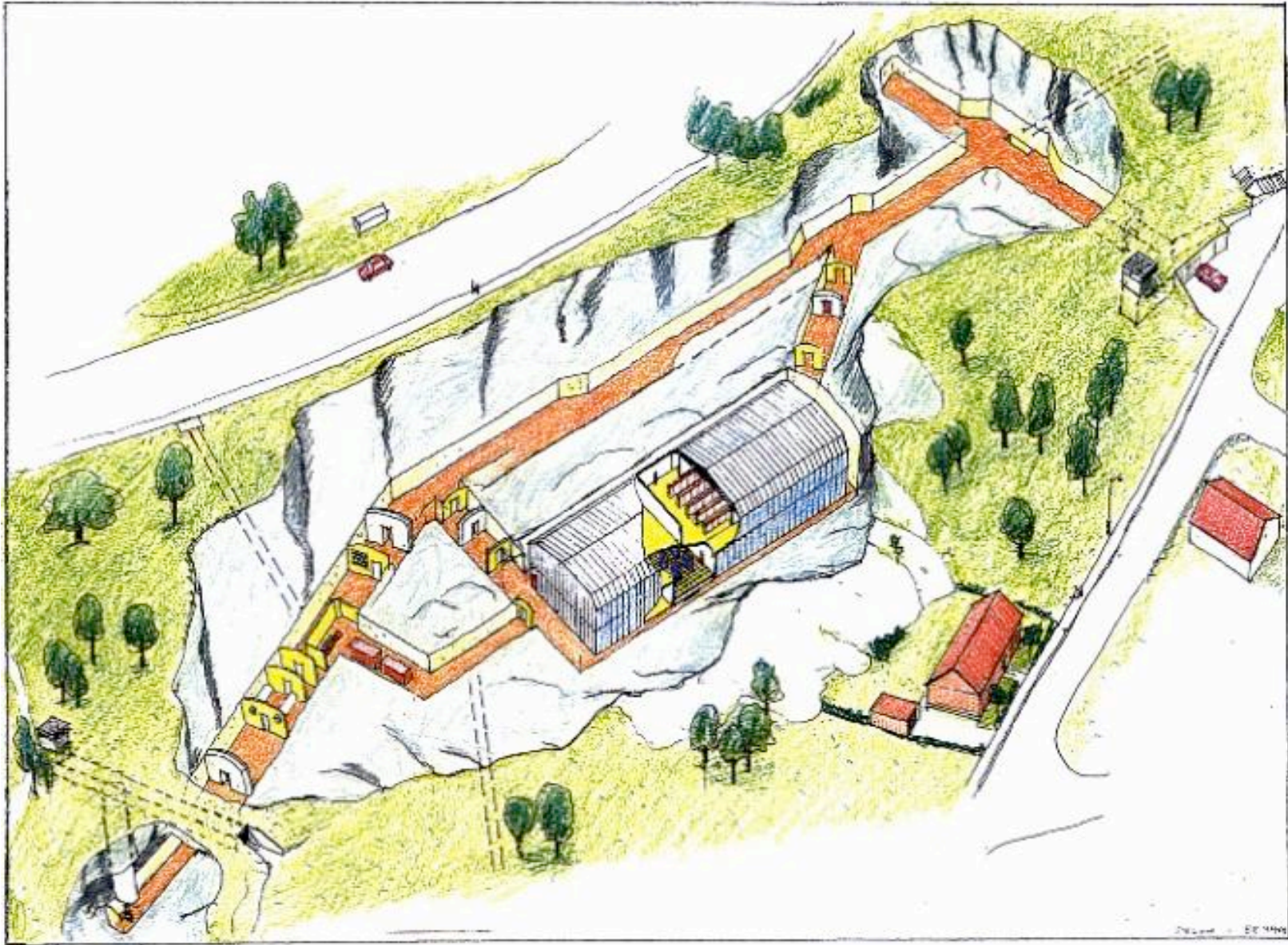


© 2007 - Netnod AB
www.netnod.se/

Netnod today

- Operates GigE based IXes in five cities
 - Stockholm, Gothenburg, Malmoe, Sundsvall och Luleå
- All IXes are located in government constructed bunkers that are controlled by the regulator
- In Stockholm Netnod provides fiber access
 - In the other cities the location is disclosed after order





2007-04-04



© 2007 - Netnod AB
www.netnod.se/



2007-04-04



© 2007 - Netnod AB
www.netnod.se/



2007-04-04

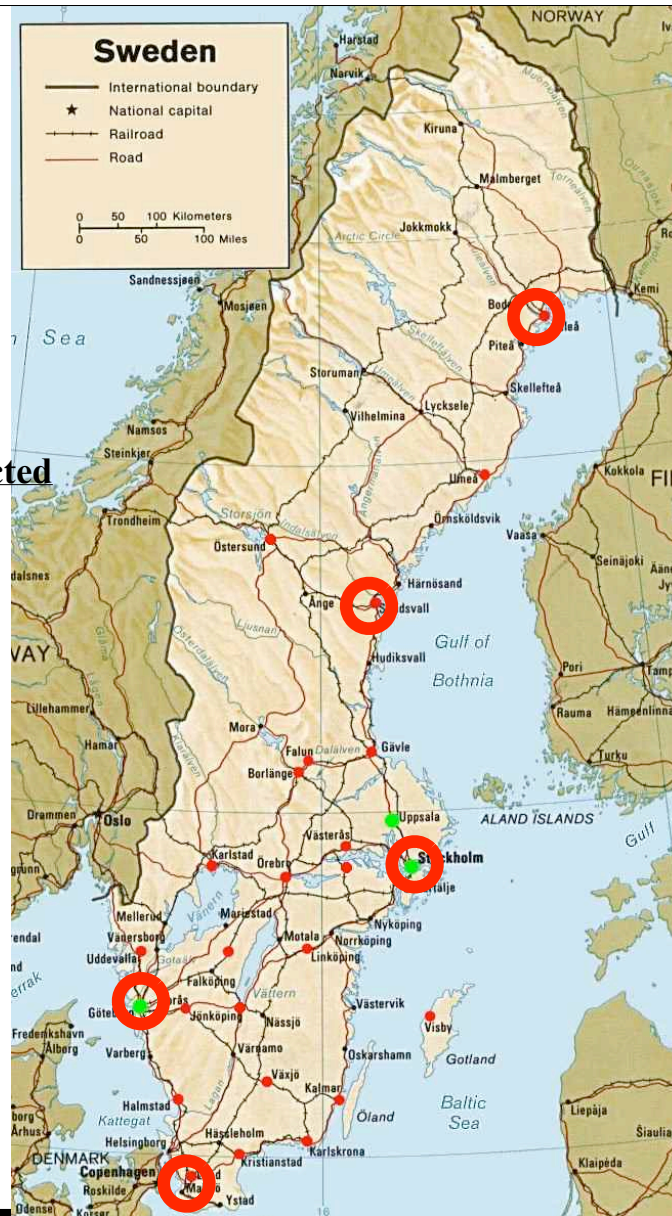


© 2007 - Netnod AB
www.netnod.se/



Examples of operator connected

- Tele2
- TeliaSonera
- B2
- Telenor
- SUNET
- Banhof
- Internet5
- Song
- Chello
- MCI WorldCom
- GlobalCrossing
- + 40 more



2005-05-05

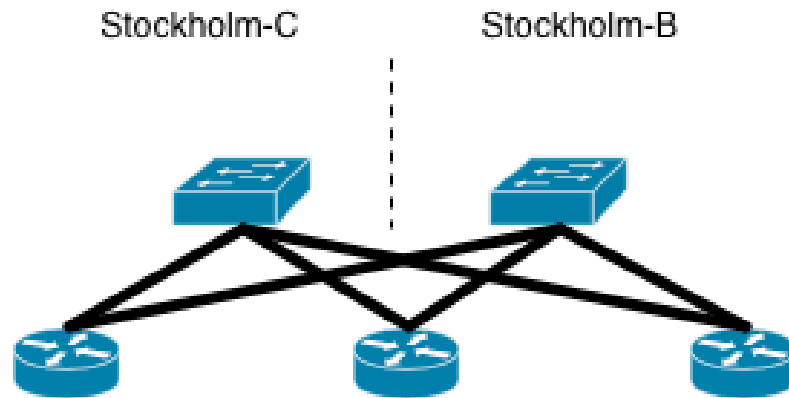


© 2005 - Netnod AB <http://www.netnod.se/>

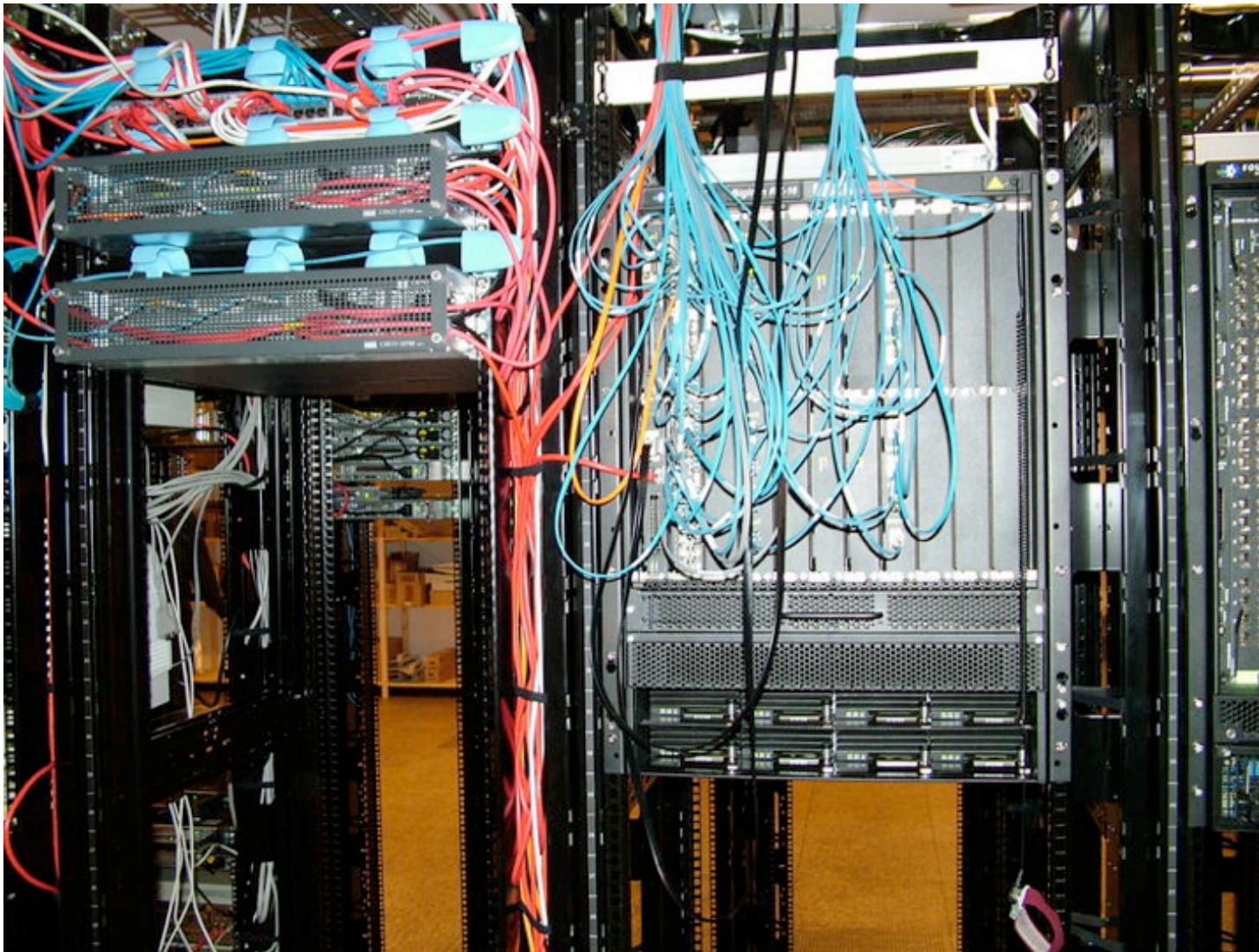
Design

- The IXPs consists of independent chassis
 - None of the problems that (can) occure with trunking
 - STP
 - Capacity planning
 - Limiting growth factor is the number of ports
- Makes troubleshooting easier

Layer 2 design



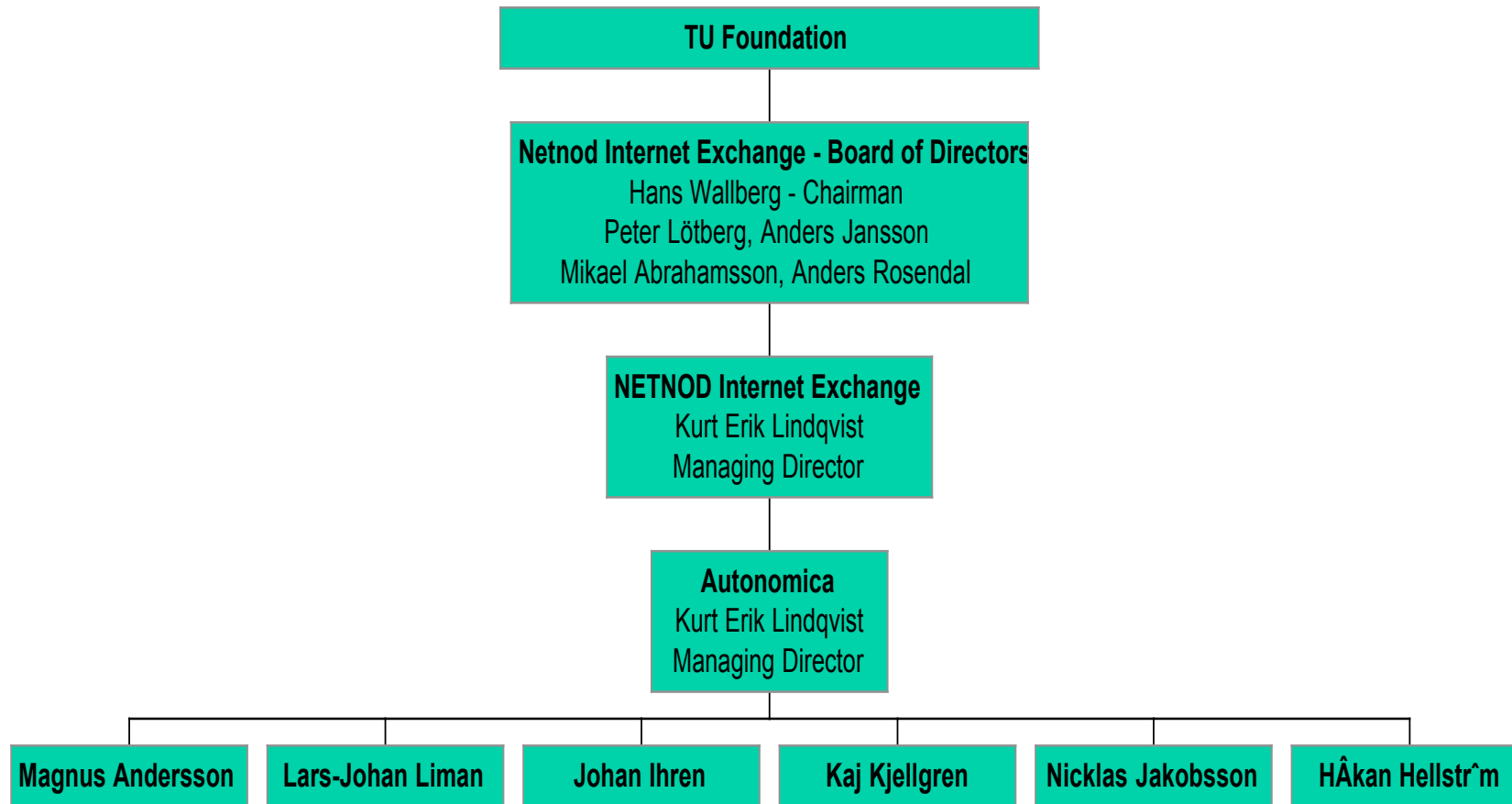
- All IXes are based on Gigabit Ethernet
 - Foundry RX platform
 - Only Gigabit Ethernet / 10GE connections
 - No 10/100
- In Stockholm there is two switches
 - On in each bunker



2007-04-04



© 2007 - Netnod AB
www.netnod.se/



2006-09-11

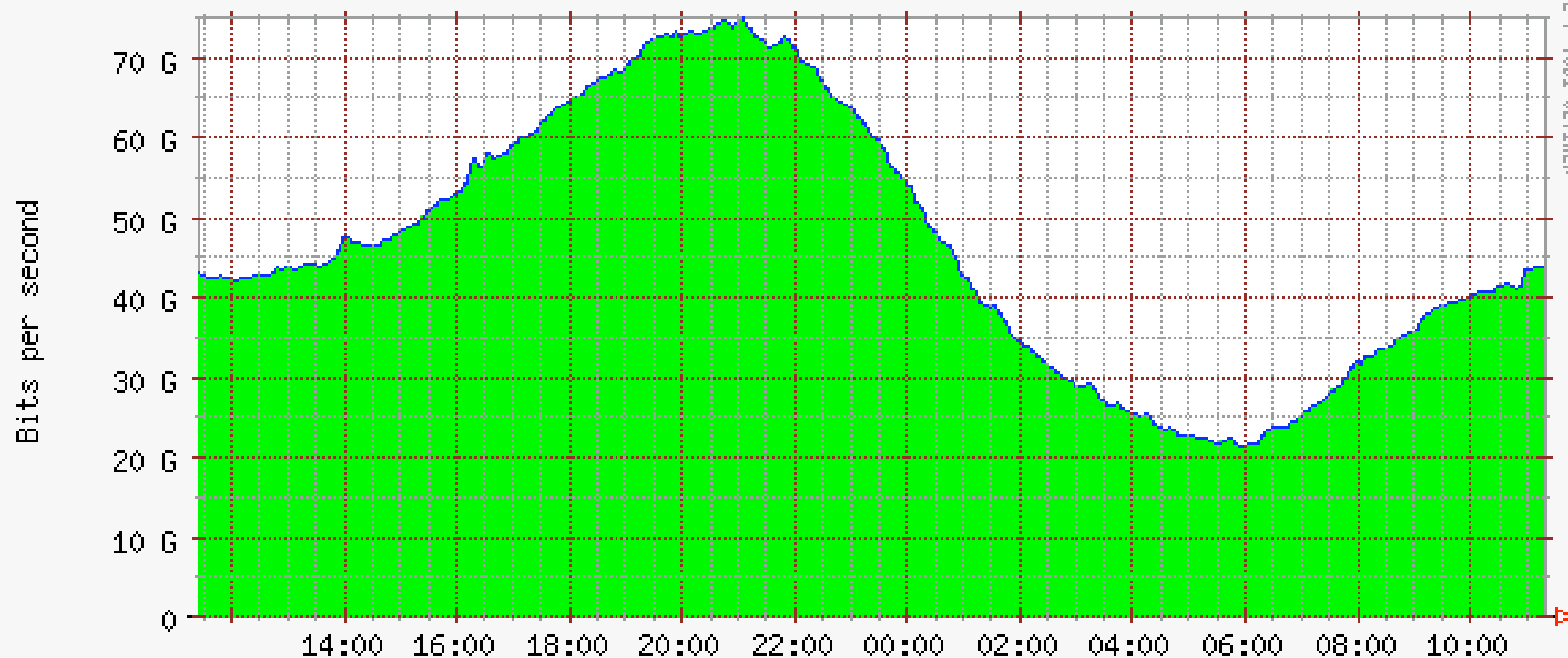


© 2006 - Netnod AB <http://www.netnod.se/>

Netnod today

- Currently no plans to establish more IXes due to lack of interest among the providers
- Two other main activities
 - Infrastructure services and consulting work
 - Research

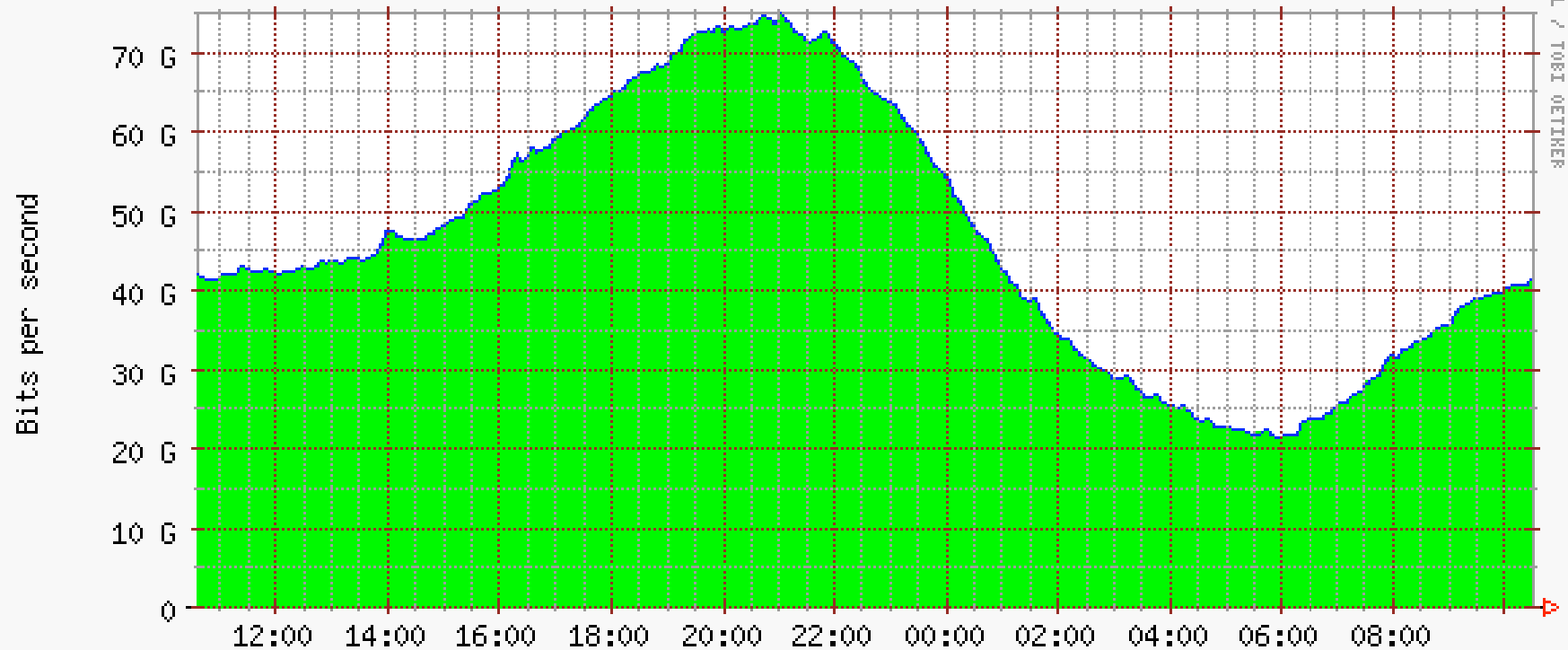
Aggregate traffic All (Thu Mar 29 11:24:01 2007)



■ Incoming Traffic in Bits per second
■ Outgoing Traffic in Bits per second

Maximal In:	74.883 G	Maximal Out:	74.883 G
Average In:	46.423 G	Average Out:	46.423 G
Current In:	43.898 G	Current Out:	43.894 G

Maximum traffic load All (Thu Mar 29 10:34:01 2007)

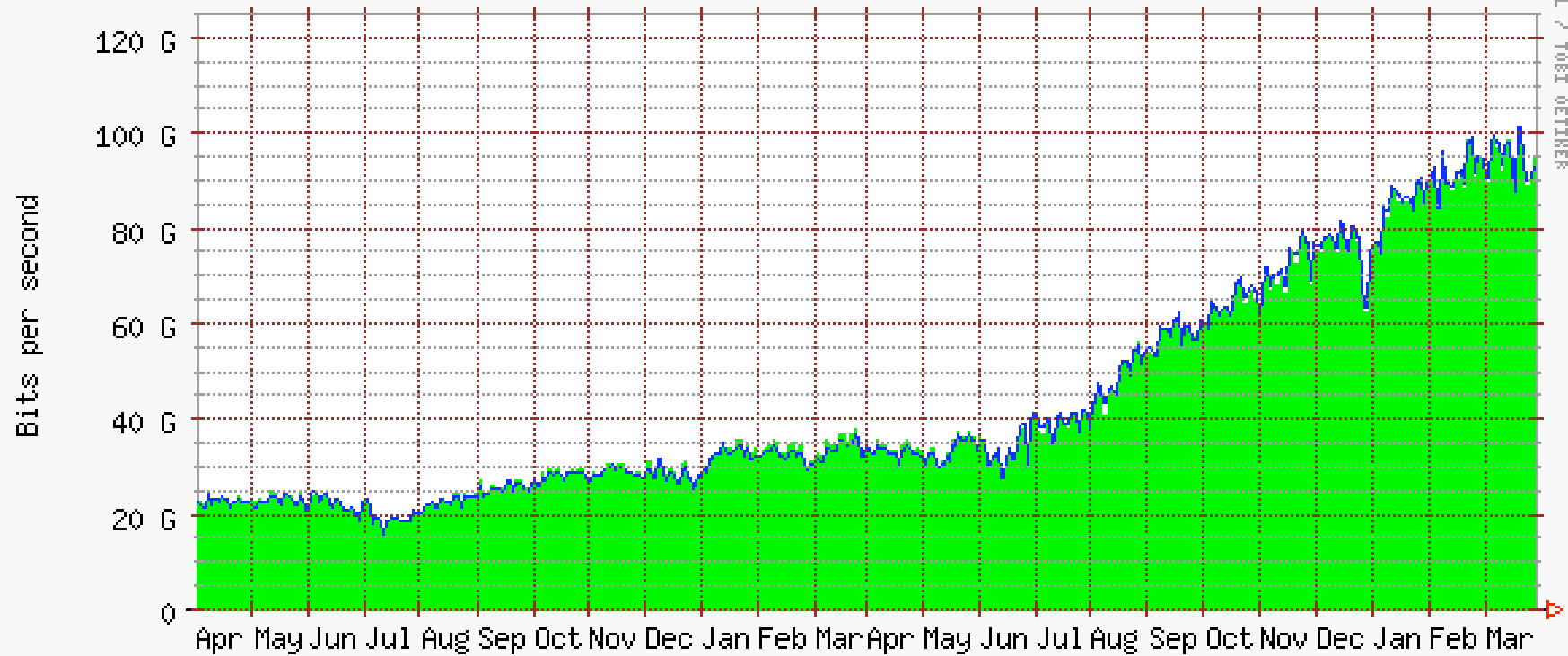


■ Incoming Traffic in Bits per second
■ Outgoing Traffic in Bits per second

Maximal In: 74.883 G Maximal Out: 74.883 G



Maximum traffic load All (Thu Mar 29 10:34:09 2007)



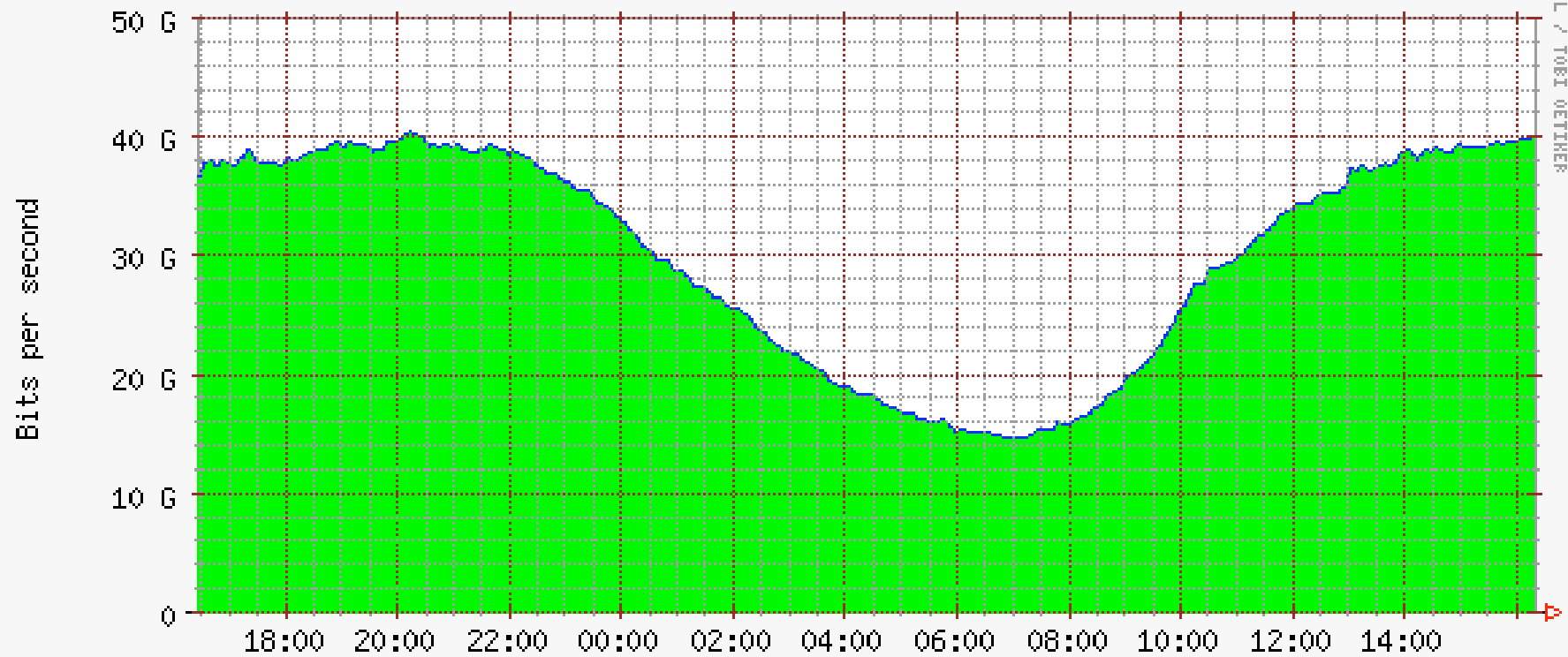
■ Incoming Traffic in Bits per second

■ Outgoing Traffic in Bits per second

Maximal In: 100.644 G Maximal Out: 101.356 G



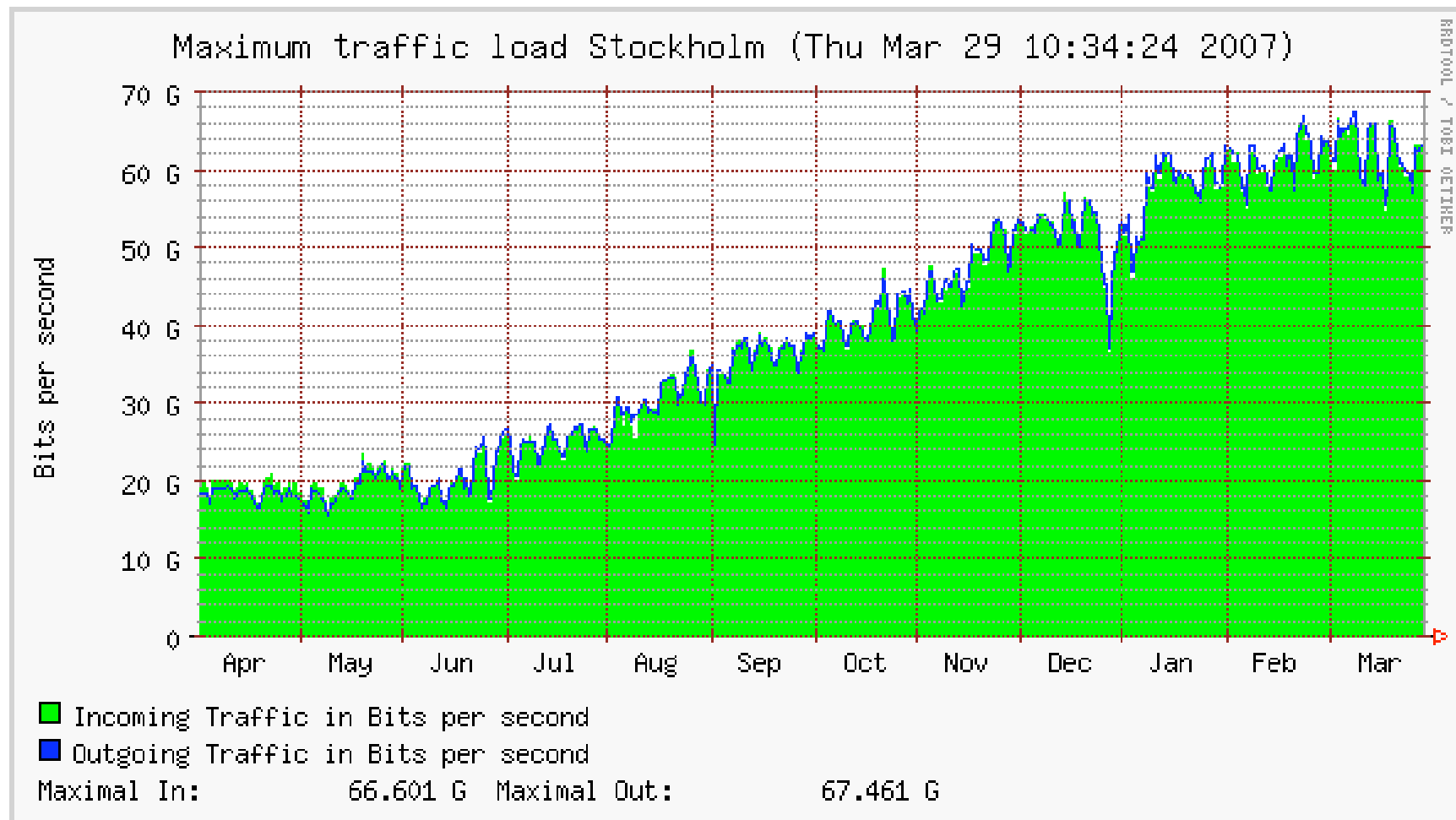
Aggregate traffic Stockholm (Sun Sep 10 16:24:28 2006)

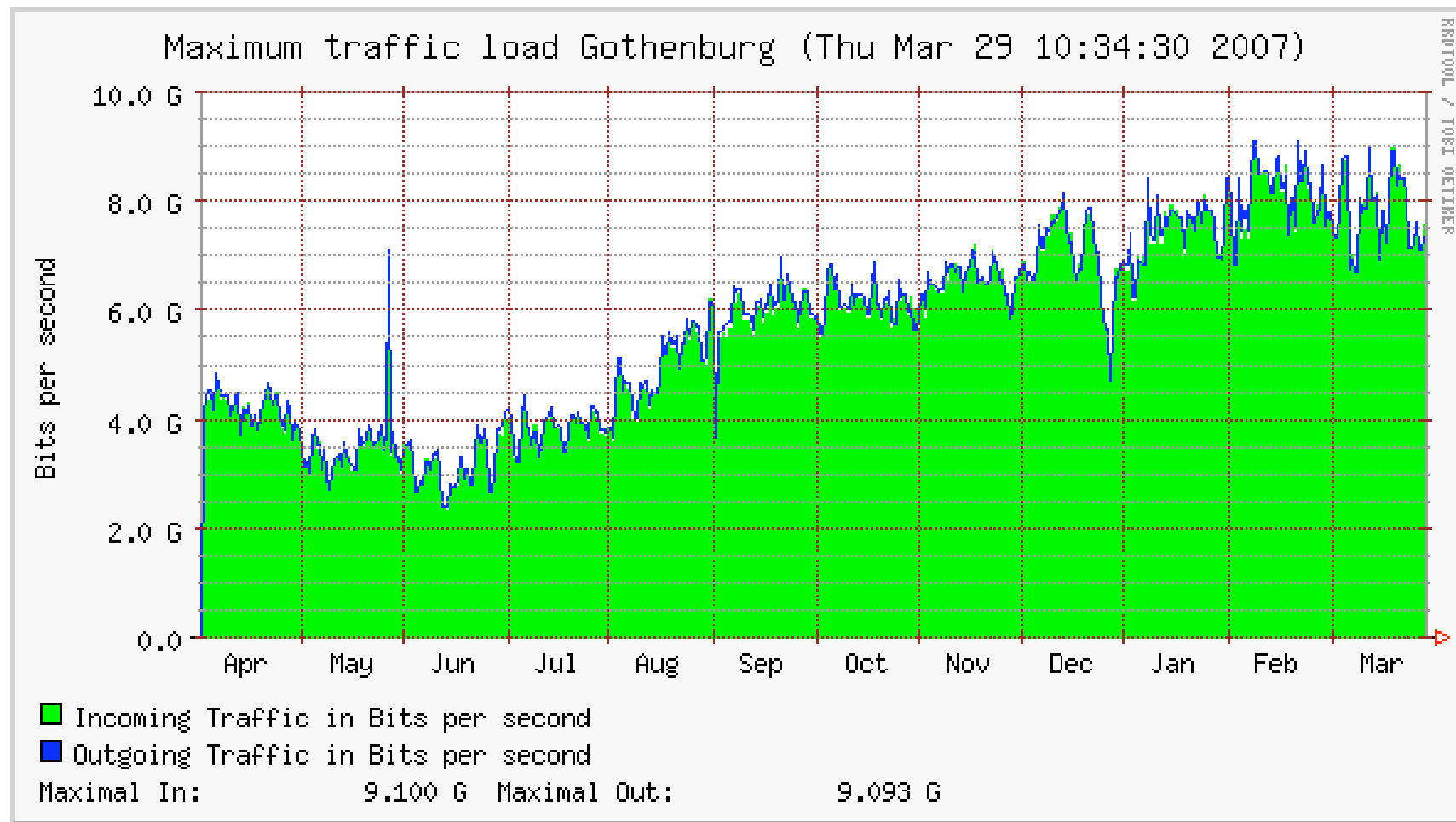


- Incoming Traffic in Bits per second
- Outgoing Traffic in Bits per second

Maximal In:	40.436 G	Maximal Out:	40.449 G
Average In:	30.067 G	Average Out:	30.073 G
Current In:	40.096 G	Current Out:	40.100 G



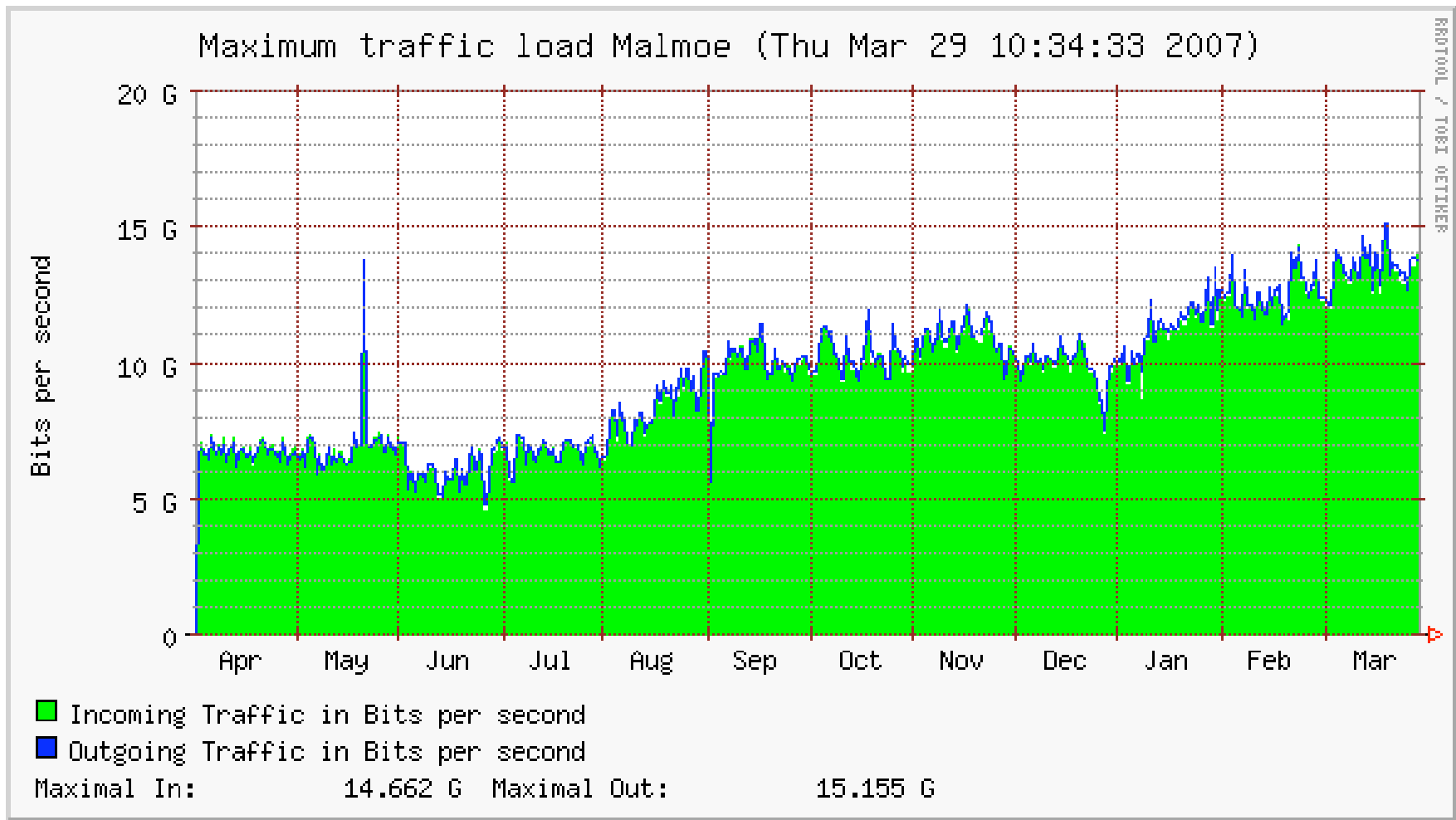




2007-04-04



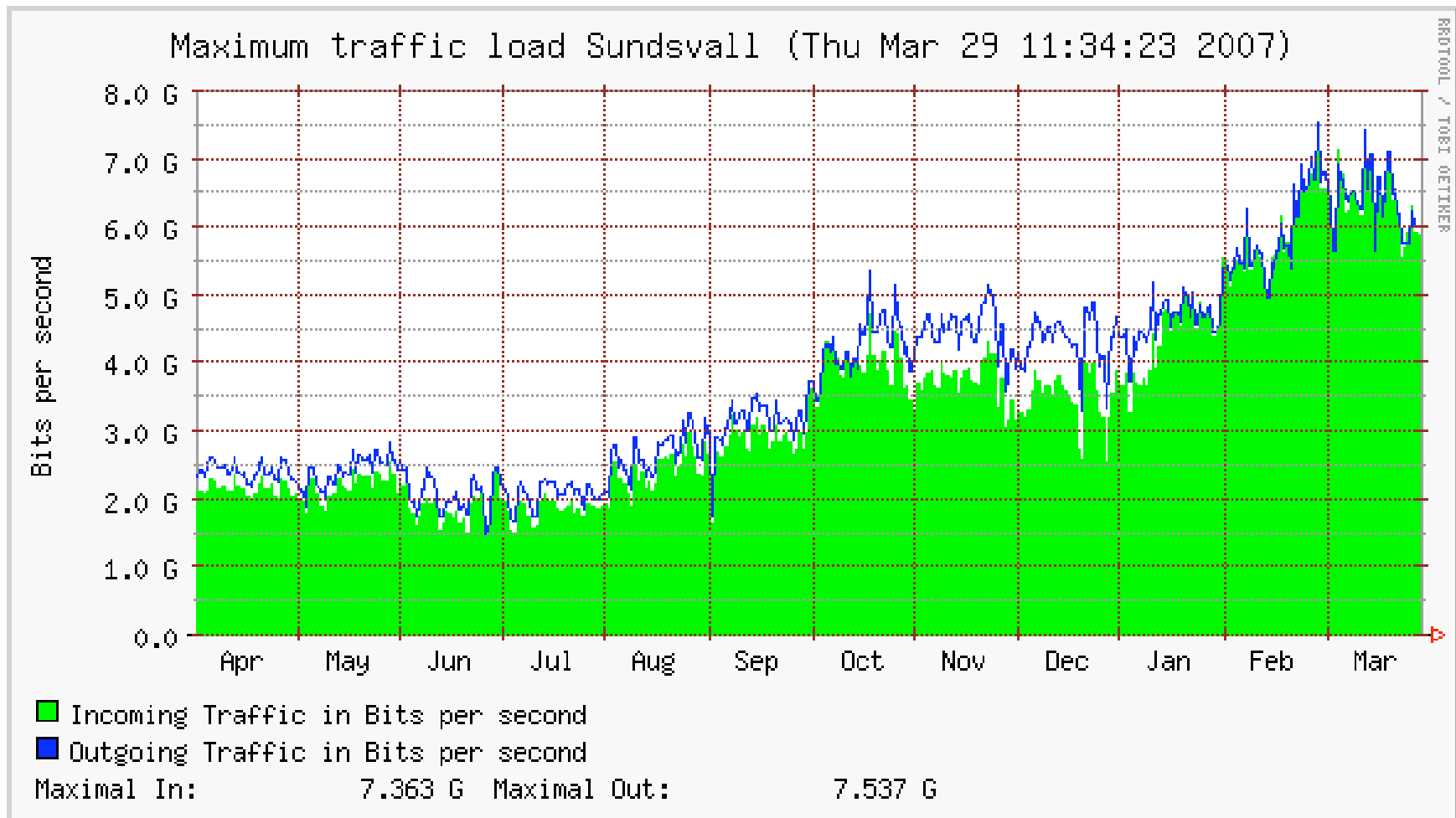
© 2007 - Netnod AB
www.netnod.se/



2007-04-04



© 2007 - Netnod AB
www.netnod.se/



2007-04-04



© 2007 - Netnod AB
www.netnod.se/

Services

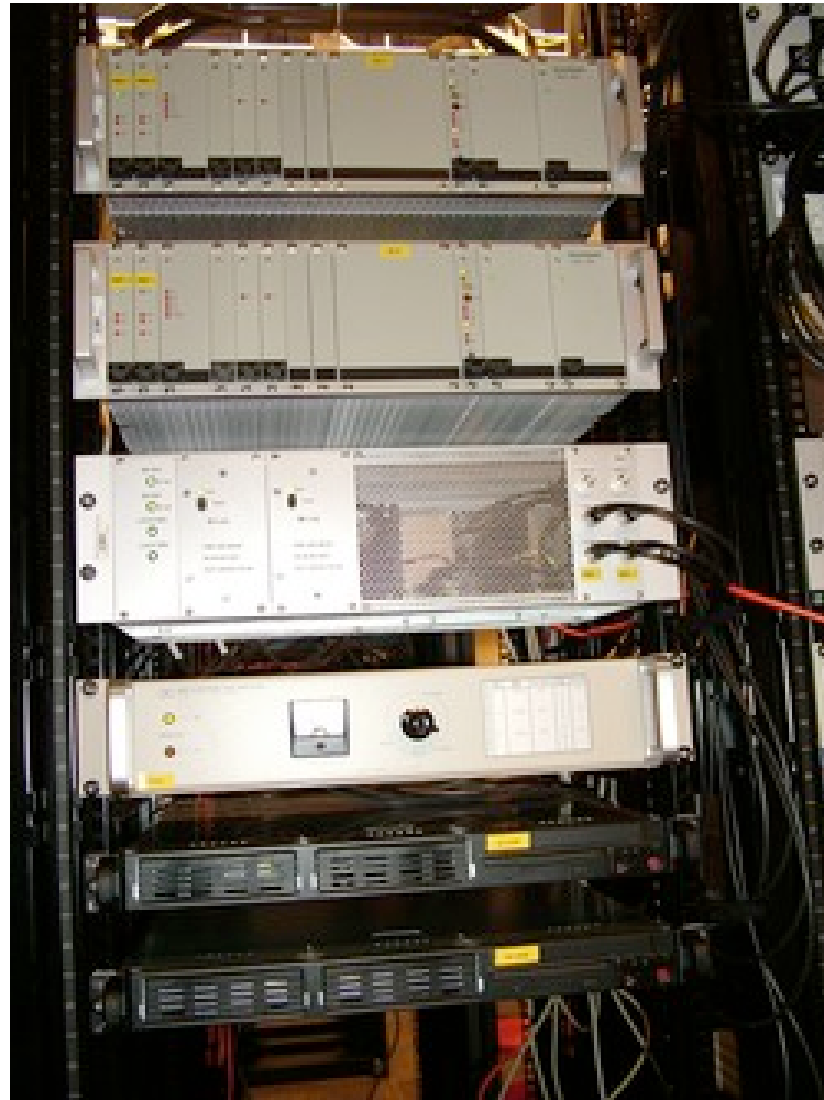
- Netnod was also tasked with providing a number of common infrastructure services at the IXes
 - i.root-servers.net
 - Anycasted from approx 30 locations in the world
 - .SE slave servers
 - Stockholm, Göteborg och Sundsvall, and anycast
 - Slave services for a number of TLDs (as well as anycast)
 - Verisign (j.root-servers.net, .com, .net), .DE, .NL, .NO, .DK, .CH, .LI, CL, .POST, .FI, .IT (and approx 40 more)
 - Official Swedish time
 - Distributed with NTP from Stockholm, Gothenburg, Malmoe, and Sundsvall
 - TPTEST
 - RIPE whois copy



Time

- Official Swedish time UTC(sp) is generated by SP in Borås
- Netnod distributes this through NTP from 3 of the bunkers
- Netnod will also start providing SDH/SONET sync services from the bunkers





?

Contact

Netnod Internet Exchange i Sverige AB

Bellmansgatan 30^I
SE-118 47 Stockholm
Sweden

Office address: Bellmansgatan 30^I

Telephone: +46-8-615 85 70

Telefax: +46-8-442 09 67

E-mail: kurtis@netnod.se

URI : <http://www.netnod.se/>



© 2007 - Netnod AB
www.netnod.se/

2007-04-04