

# Measuring Traffic on the Internet

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On Adaptable Networks and Teleservices**

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# **OVERVIEW**

**MEASURING TOOLS**

**MEASURING LIMITS**

**MEASUREMENT RESULTS**

**LESSONS TO BE LEARNED**

**CONCLUSIONS**



# **OVERVIEW**

**MEASURING TOOLS**

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# MEASURING TOOLS

**LOCAL SYSTEM**

**REMOTE (END) SYSTEM**

**ROUTERS**

**SNIFFERS**



# MEASURING TOOLS: LOCAL SYSTEM

**NETSTAT  
TCPDUMP  
ETHERREAL  
NTOP**

**PROMISCUOUS MODE**



# MEASURING TOOLS: LOCAL SYSTEM - NTOP

Welcome to ntop!

- What's ntop?
- Data Rcvd
  - All
  - Protoc.
  - IP
  - Thrt
- Data Sent
  - All
  - Protoc.
  - IP
  - Thrt
- Multicast Stats
- Traffic Stats
- Domain State
- Routers
- Plugins
- Thrt Stats
- Hosts Info
- R->L IP Traffic
- L->R IP Traffic
- L<->L IP Traffic
- Active TCP Sessions
- IP Protocol Distribution
- IP Protocol Usage
- IP Traffic Matrix
- Network Events
- NetFlows 1 list

### Info about zeus2

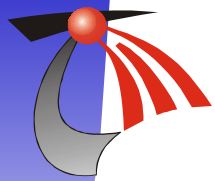
IP Address	130.89.12.12 [unicast]
Last Seen	06/22/00 12:29:53
Domain	cs.utwente.nl
MAC Address	00:00:00:00:00:00
Nw Board Vendor	XEROX CORPORATION
NetBios Name	ZEUS [domain INFORMATICA] (Workstation)
Host Location	Local (inside specified/local subnet)
Total Data Sent	355.1 Kb/1,470 Pkts/0 Retran. Pkts [0%]
Broadcast Pkts Sent	62 Pkts
Data Sent Stats	Local (99.4 %) Remote (0.6 %)
Total Data Rcvd	1.1 MB/2,240 Pkts/0 Retran. Pkts [0%]
Data Received Stats	Local (100.0 %) Remote (0.0 %)

### IP Protocol Distribution

Protocol	Data Sent		Data Received	
TCP	347.1 KB	97.7 %	1.1 MB	99.9 %
UDP	6.1 KB	1.7 %	1.4 KB	
(R)ARP	2.0 KB		0.1 KB	

### Last Contacted Peers

Receiver Name	Receiver Address	Sender Name	Sender Address
amazon	130.89.12.62	amazon	130.89.12.62
<broadcast>	255.255.255.255		




## MEASURING TOOLS: LOCAL SYSTEM - NTOP

Welcome to ntop! - Netscape

File Edit View Go Communicator Help

Back Forward Reload Home Search Netscape Print Security Stop

### Welcome to ntop!



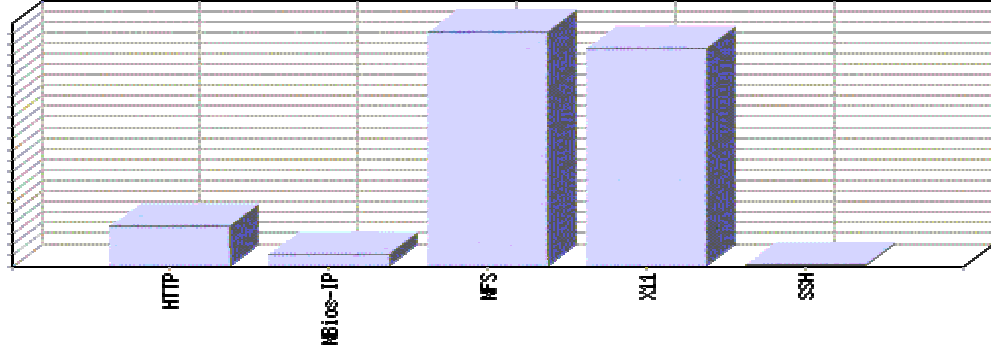
- ▶ About ntop
- ▶ Data Rcvd
- ▶ Data Sent
- ▼ Stats
  - [Multicast](#)
  - [Traffic](#)
  - [Hosts](#)
  - [Throughput](#)
  - [Domain](#)
  - [Plugins](#)
- ▶ IP Traffic
- ▶ IP Protocols
- ▶ Admin

[No JavaScript]

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by  
[Luca Deri](#)

### Global IP Protocol Distribution

IP Protocol	Data	Percentage
HTTP	3.5 MB	7.5 %
NBios-IP	976.7 KB	2.0 %
NFS	20.9 MB	44.0 %
X11	19.6 MB	41.1 %
SSH	10.1 KB	
Other TCP/UDP-based Prot.	2.6 MB	5.4 %



Report created on Wed Jun 21 17:24:36 2000  
Generated by ntop v.1.3.1 MT [sparc-sun-solaris2.6] listening on [!e0,!e0:0]  
© 1998-2000 by [L. Deri](#)

Document: Done



# MEASURING TOOLS: REMOTE (END) SYSTEM

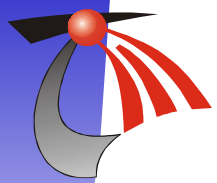
**MIBS**

**IF-MIB**

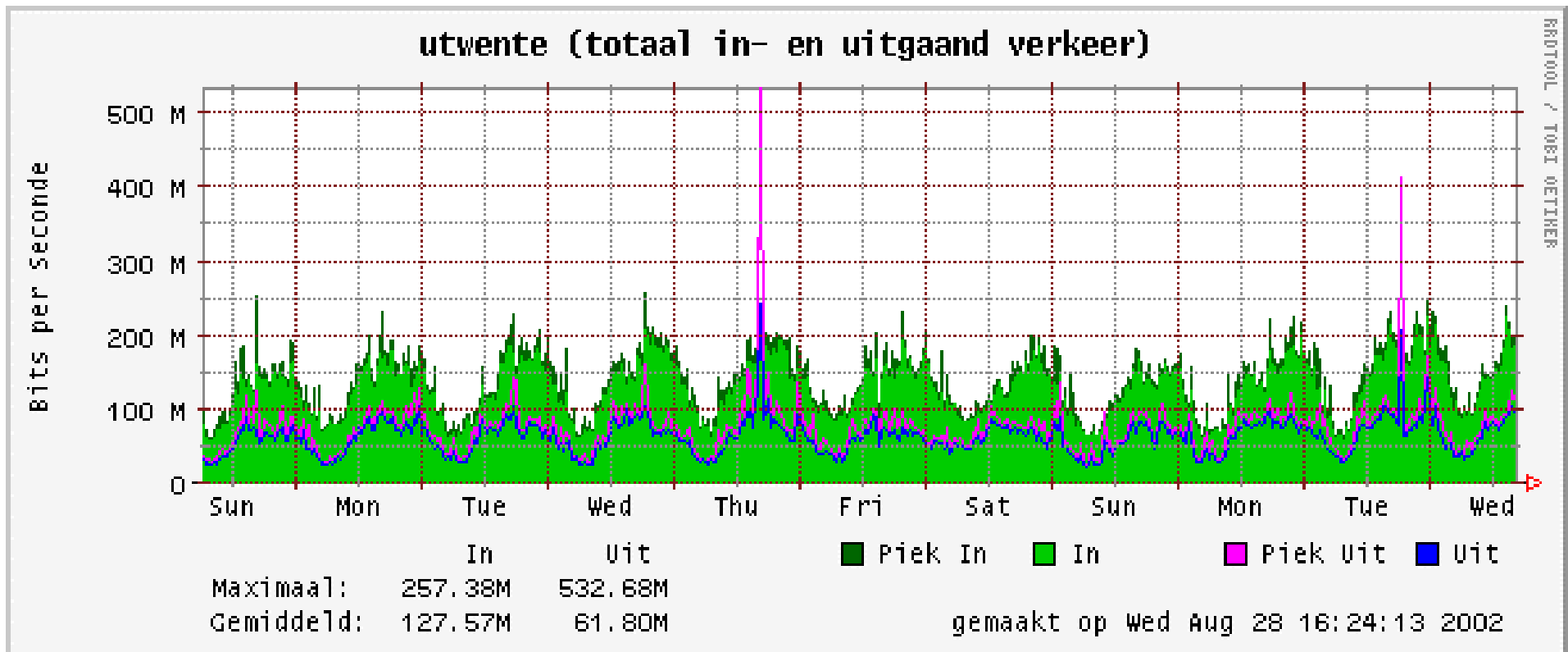
**SNMP**

**MRTG**





# MIBS - MRTG





# MEASURING TOOLS: ROUTERS

## NETFLOW

- CISCO

## LFAP

- ENTERASYS (CABLETRON)



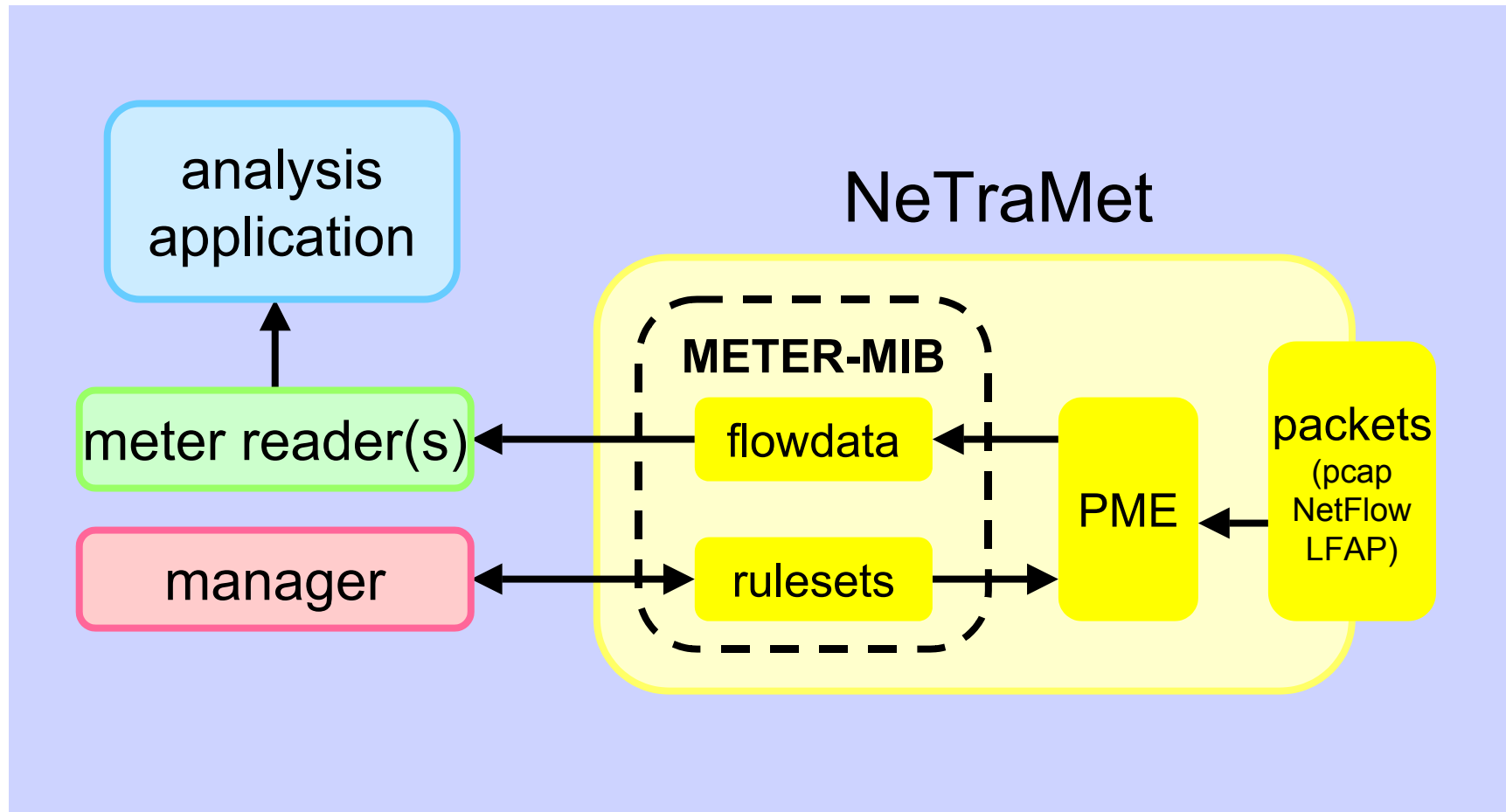
# MEASURING TOOLS: SNIFFERS

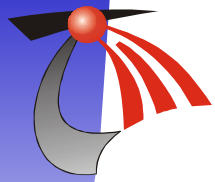
**RMON**  
**RMON2**

**NETRAMET**



## MEASURING TOOLS: SNIFFERS - NETRAMET





## MEASURING TOOLS: SNIFFERS - NETRAMET

### EXAMPLE OF A RULESET

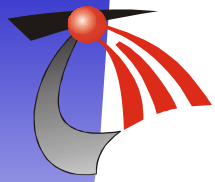
```
if SourcePeerType == IPv4
{
  if DestPeerAddress == ( 130.89/16 )
  {
    count;
  }
}
```



# MEASURING TOOLS - CONCLUSIONS

**MANY TOOLS EXIST**

**SOME ARE COMMERCIAL  
MANY ARE OPEN SOURCE**



**ISN'T THIS GREAT?**

**MANAGERS CAN FIND ADEQUATE TOOLS TO  
MONITOR THEIR NETWORKS**

**STUDENTS CAN FIND GREAT TOOLS TO  
MONITOR WHAT TEACHERS DO**

**I CAN MONITOR WHAT YOU ARE DOING**

...



# **OVERVIEW**

**MEASURING TOOLS**

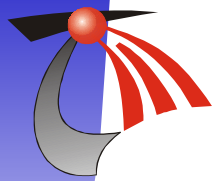
**MEASURING LIMITS**

**MEASUREMENT RESULTS**

**LESSONS TO BE LEARNED**

**CONCLUSIONS**





# MEASURING LIMITS

WHAT ARE THE LIMITS OF THESE MEASUREMENT TOOLS?  
CAN, FOR EXAMPLE, SNIFFERS HANDLE MEGABITS OF TRAFFIC?

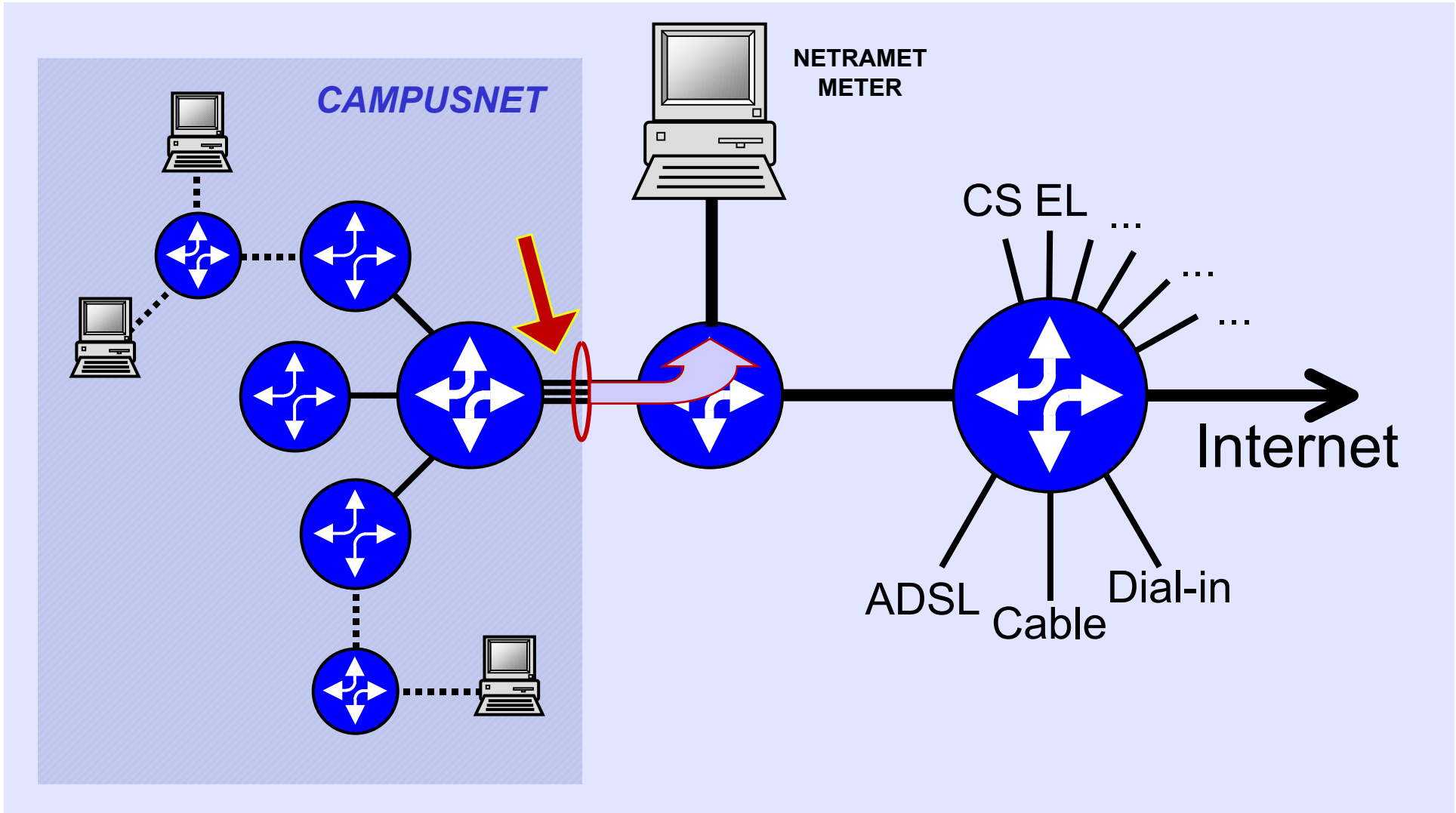
TO DETERMINE THIS, WE HAVE EXPERIMENTED WITH  
NETRAMET ON OUR CAMPUS-NET

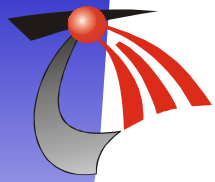
- 2000 USERS
- 100 Mbps ACCESS
- 400 Mbps PEAK





## MEASUREMENT SET-UP





## **WHAT DID WE MEASURE?**

### **THE TOTAL TRAFFIC ON THE LINK**

#### **TRAFFIC FOR DESTINATIONS:**

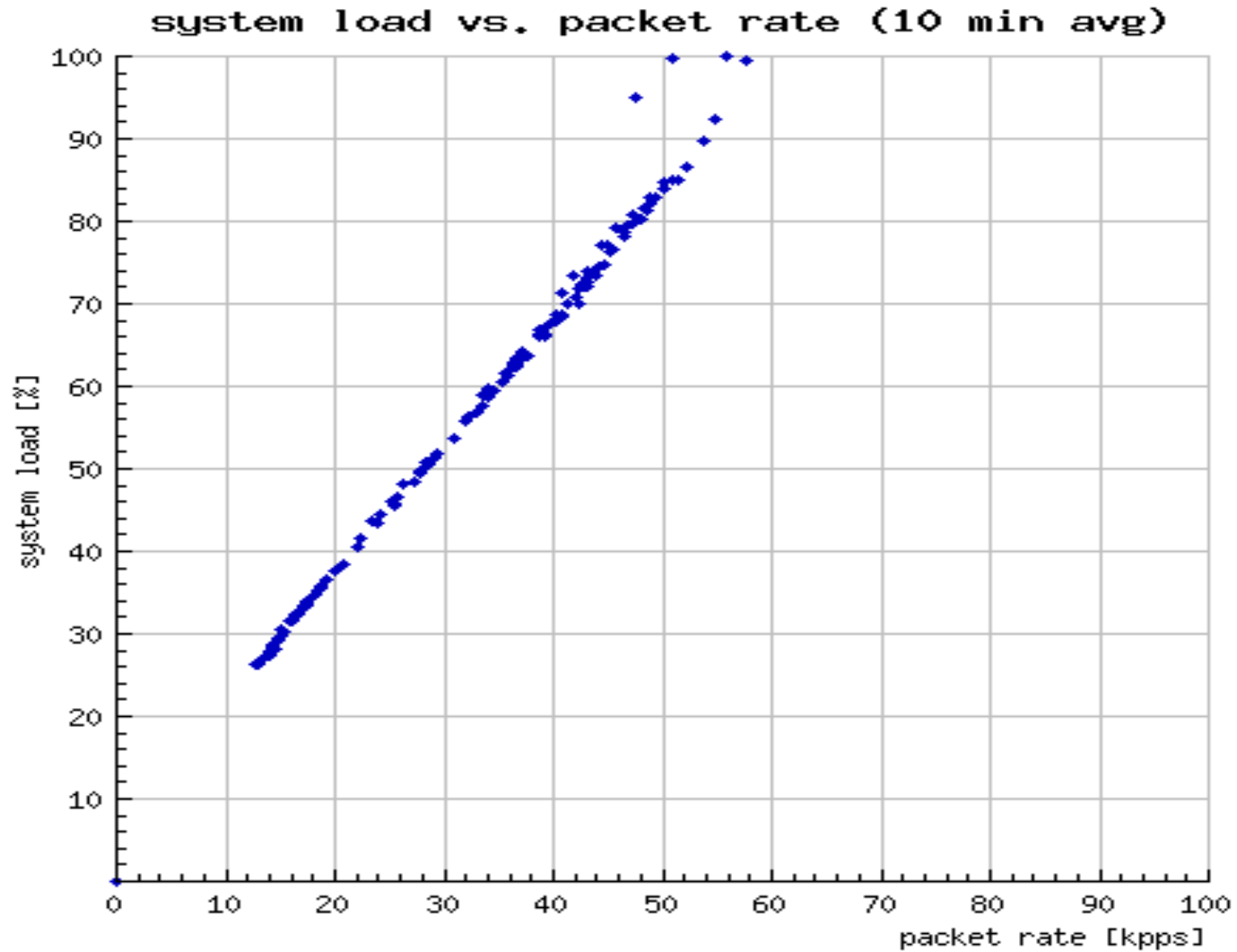
- **INSIDE THE UNIVERSITY (CABLE / ADSL / DEPARTMENTS)**
  - **OUTSIDE THE UNIVERSITY**

#### **TOP-TALKERS**

- **INSIDE THE UNIVERSITY**
- **OUTSIDE THE UNIVERSITY**



# SYSTEM LOAD OF METER

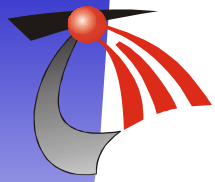




## **MEASURING LIMITS - CONCLUSIONS**

**CURRENT PCs CAN EASILY HANDLE 0.5  
GIGABITS**

**WITH SOPHISTICATED NETWORK CARDS  
SPEEDS OF SEVERAL GIGABITS SEEM  
POSSIBLE**



## **ISN'T THIS GREAT?**

**MEASUREMENT RESULTS CAN BE USED FOR DIMENSIONING**

**MEASUREMENT RESULTS CAN BE USED FOR ACCOUNTING**

**COMPANIES CAN TRACE TRAFFIC FROM EMPLOYEES**

**GOVERNMENTS CAN TRACE ALL TRAFFIC**

**AOL-WARNER CAN DETECT ILLEGAL MP3s**

**NEW LAWS (DMCA, HOWARD BERMAN , ...)**



# **OVERVIEW**

**MEASURING TOOLS**

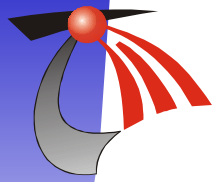
**MEASURING LIMITS**

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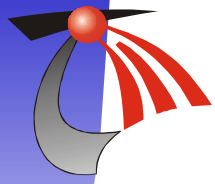
# MEASUREMENT RESULTS

## UNIVERSITY OF TWENTE

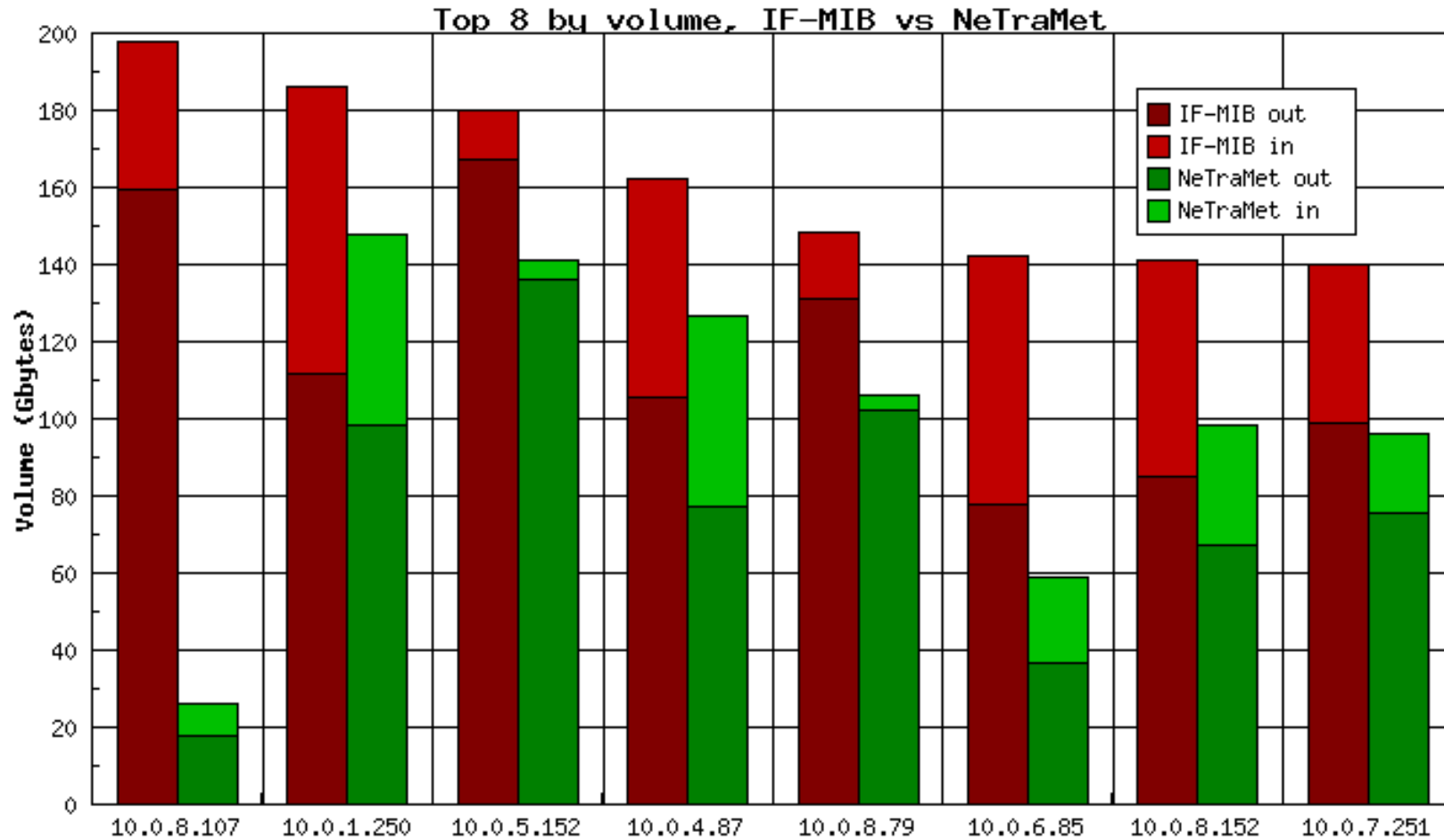
- BANDWIDTH CONSUMPTION FOR TOP USERS
- BANDWIDTH CONSUMPTION FOR AVERAGE USERS
  - POPULAR PROTOCOLS / APPLICATIONS
- EXCHANGE BETWEEN STUDENTS & TEACHERS

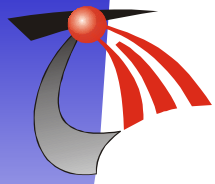
## ABILENE BACKBONE OF INTERNET2

- POPULAR PROTOCOLS / APPLICATIONS

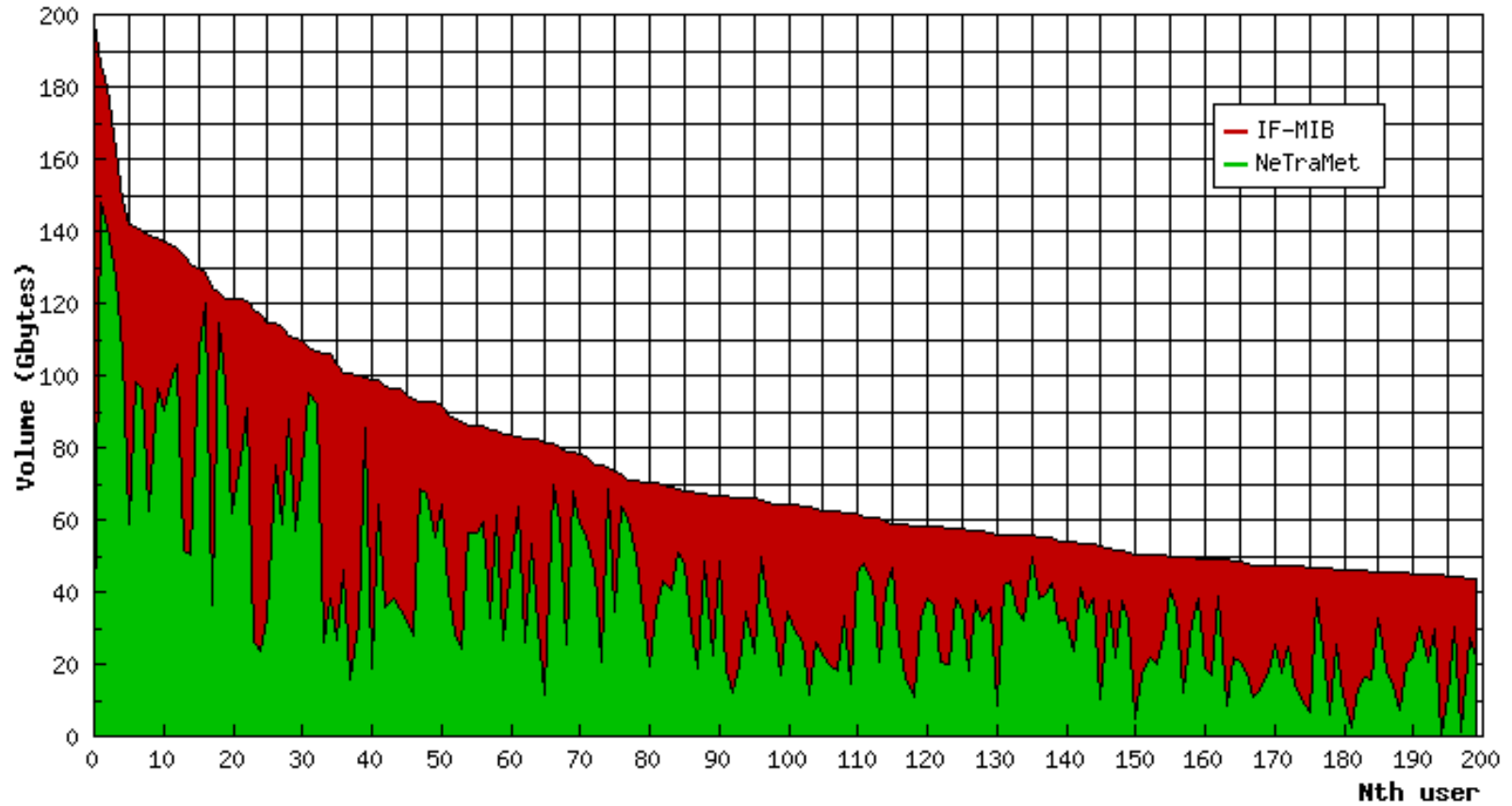


# UNIVERSITY OF TWENTE: TOP USERS



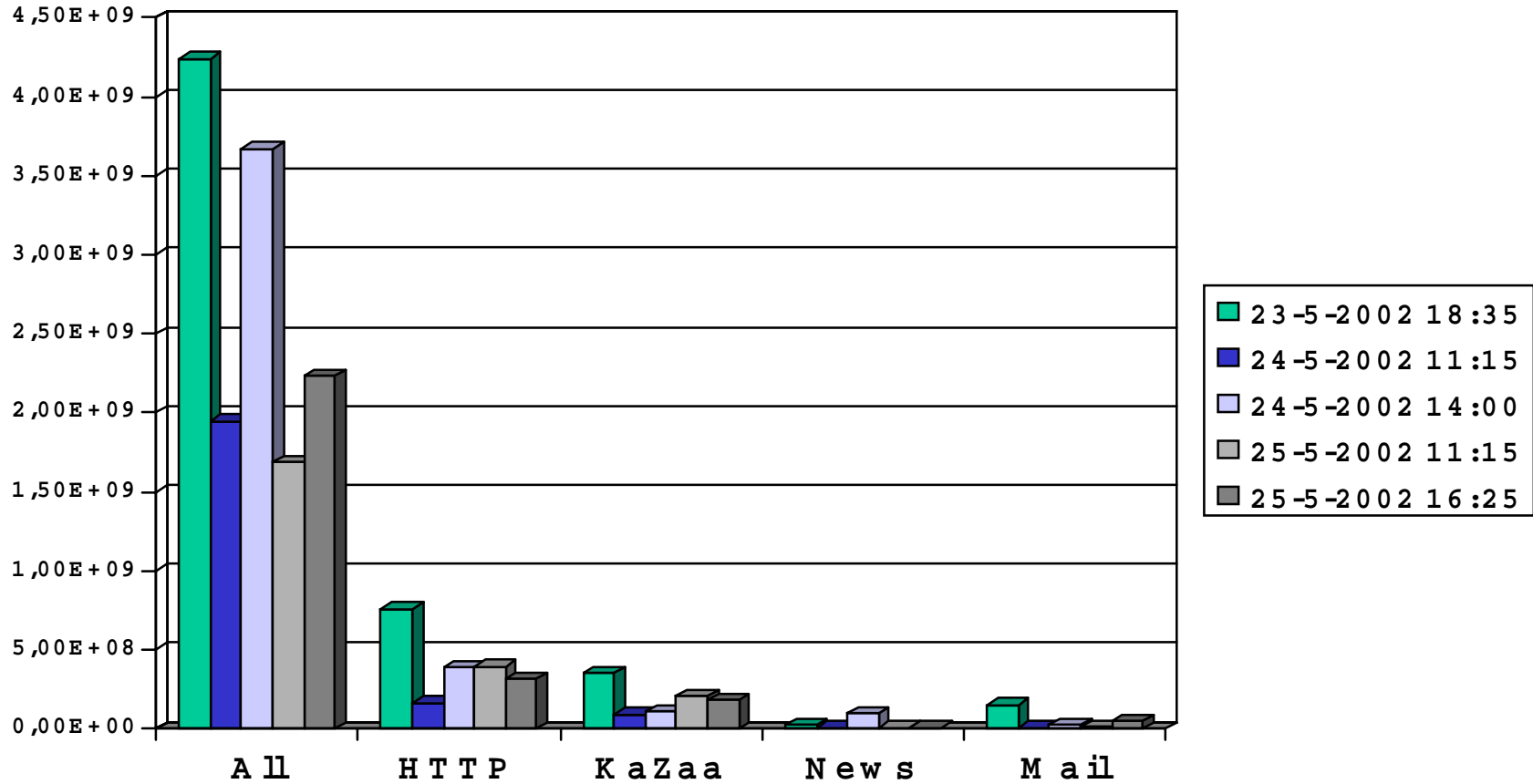


# UNIVERSITY OF TWENTE: AVERAGE USERS



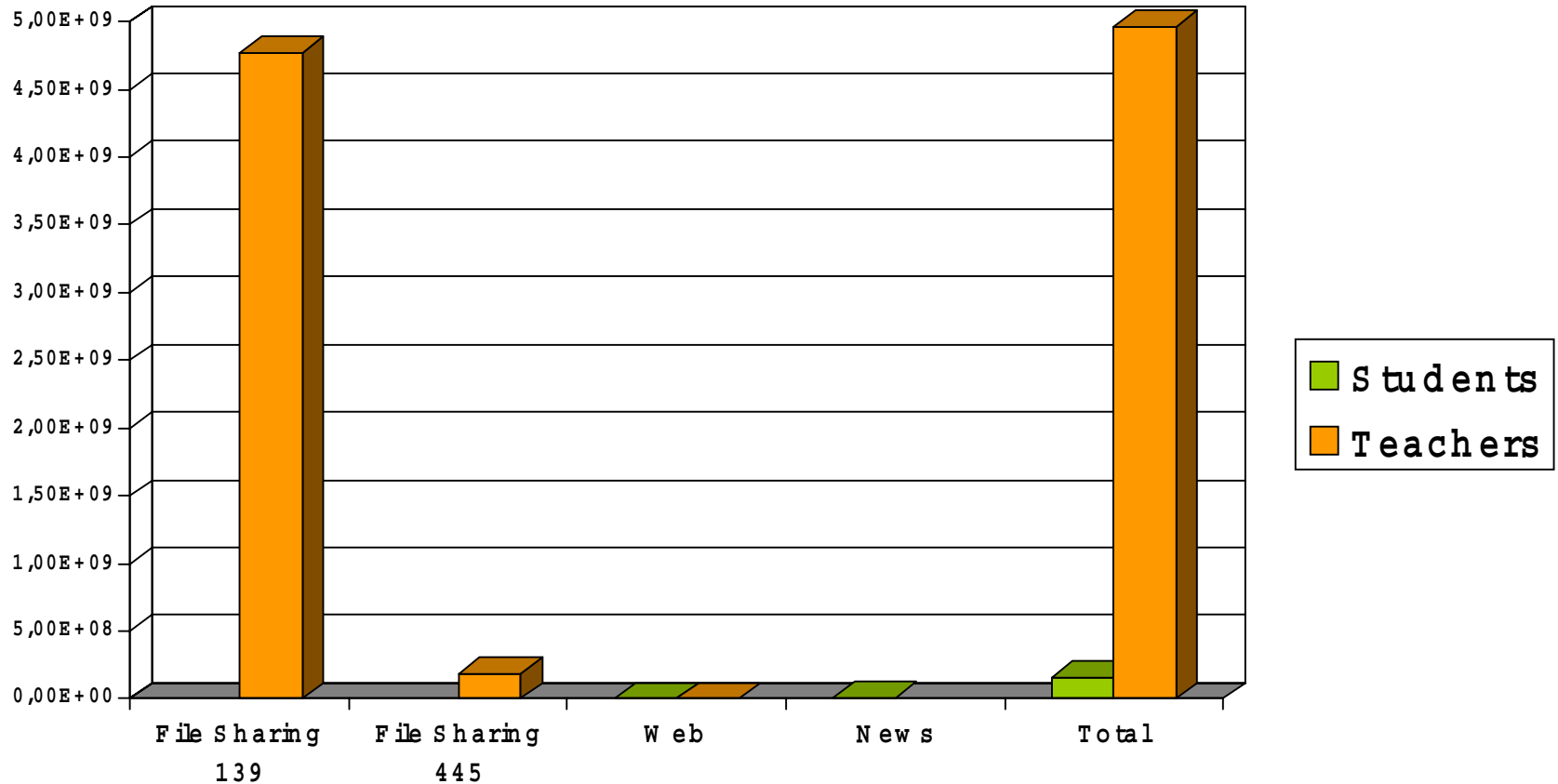


# UNIVERSITY OF TWENTE: WHAT STUDENTS DO



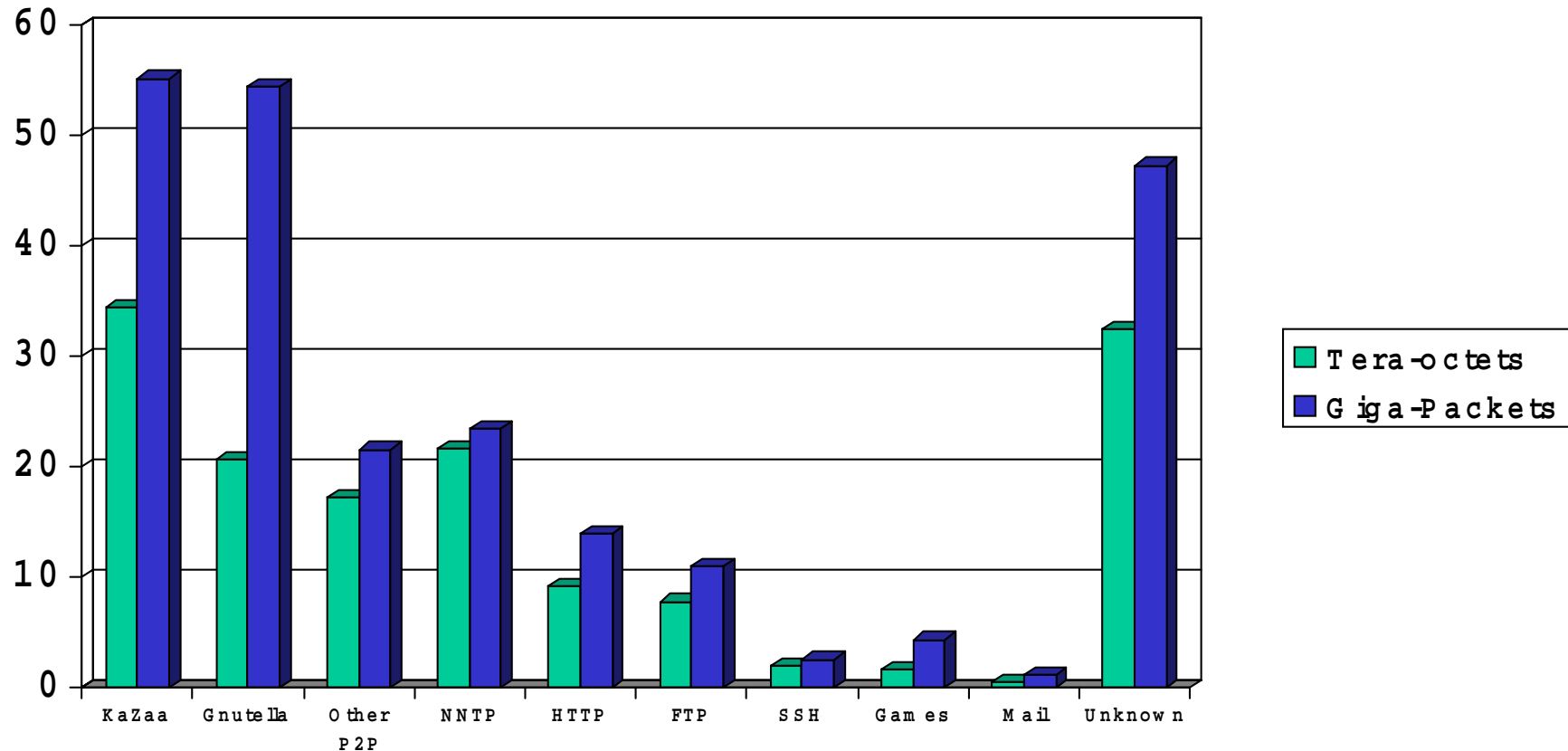


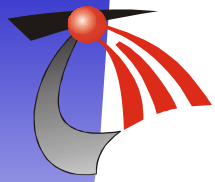
# UNIVERSITY OF TWENTE EXCHANGES BETWEEN STUDENTS AND TEACHERS





# ABILENE BACKBONE: POPULAR APPLICATIONS





## ISN'T THIS GREAT?

**IT IS SAFE TO ASSUME THAT BETWEEN 25 AND 75% OF ALL INTERNET TRAFFIC IS MP3, DIVX, ETC.**

**ACCORDING TO THE FCC IN THE U.S. THE NUMBER OF:**

- BROADBAND USERS = 12.8 MILLION / **GROWTH = 80.3%**
- DSL USERS = 3.9 MILLION / **GROWTH = 95%**

**INTERNATIONAL FEDERATION OF THE PHONOGRAPHIC INDUSTRY:**

- IN 2001 BACK FROM 35.7 TO 33.7 BILLION DOLLAR
  - SINGLES 16% DOWN, ALBUMS 5%

**YANKEE GROUP:**

- 2001: 5.16 / 2005: 7.44 / 2007: 3.9 BILLION ILLEGAL MUSIC DOWNLOADS

**FORRESTER RESEARCH:**

- 2007: ONLINE MUSIC MARKET MORE THAN 2 BILLION DOLLAR



# OVERVIEW

MEASURING TOOLS

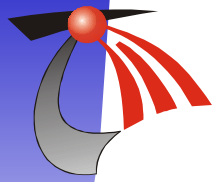
MEASURING LIMITS

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# LESSONS TO BE LEARNED

**INTERNET IS HEAVILY USED FOR ILLEGAL  
CONTENT**

**MANY INDIVIDUALS EXCHANGE *LARGE*  
AMOUNTS OF TRAFFIC**

**NEXT GENERATION WIRELESS NETWORKS  
ARE NOT SUITED FOR THESE AMOUNTS  
EXAMPLE: GPRS**



## **COSTS GPRS**

### **NETHERLANDS:**

**KPN: 2,25 EURO PER MB**

**VODAFONE: 1,50 PER MB**

### **GERMANY:**

**E-PLUS: 25 EURO PER MB**

**VODAFONE: 1,90 EURO PER MB**



## **COSTS GPRS**

**COSTS OF COPYING 1 CD  
(600 MB)**

**900 EURO**

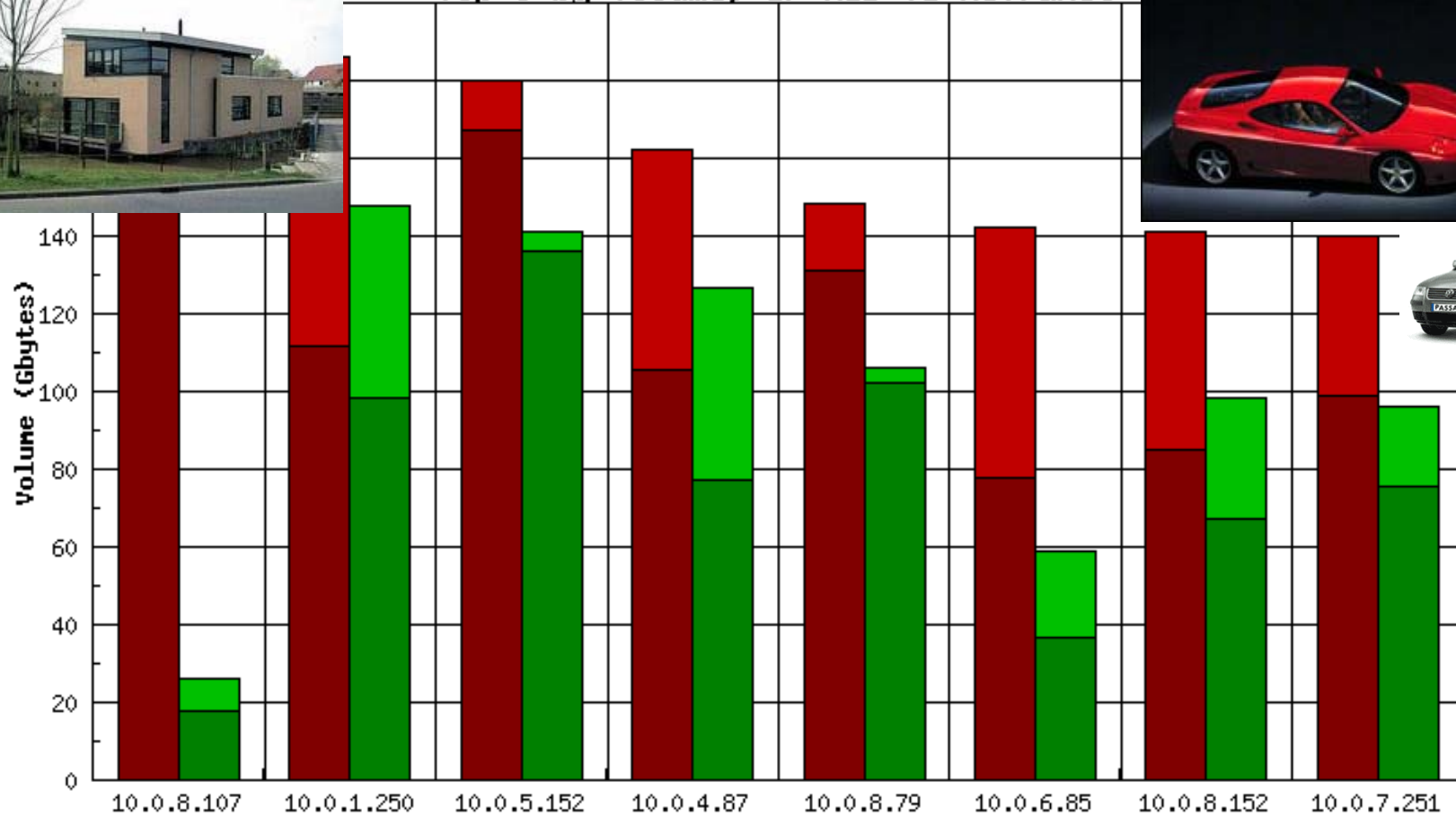
**DOWNLOAD TIME: 13 HOURS**



# TOP USERS - UNIVERSITY OF TWENTE

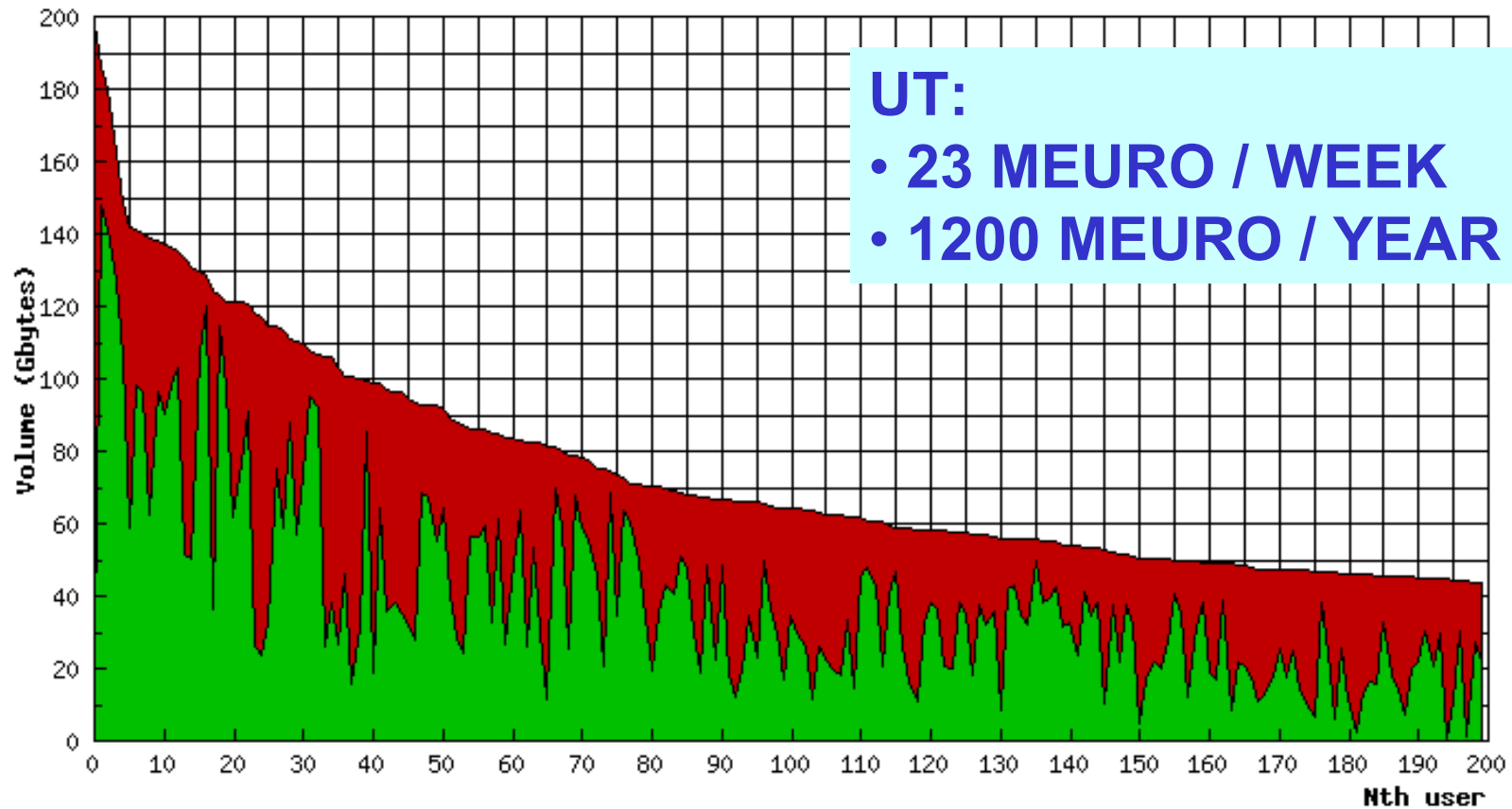


Top 8 by volume, IF-MIB vs NeTraMet





# UNIVERSITY OF TWENTE





# CONCLUSION

**MEASURING INTERNET TRAFFIC  
IS FUN!**