Performance issues in Forskningsnettet

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Overview

- Background
- Ideas and setup
- Measurements
- Prelimenary results
- Related project
- Concluding remarks

Background

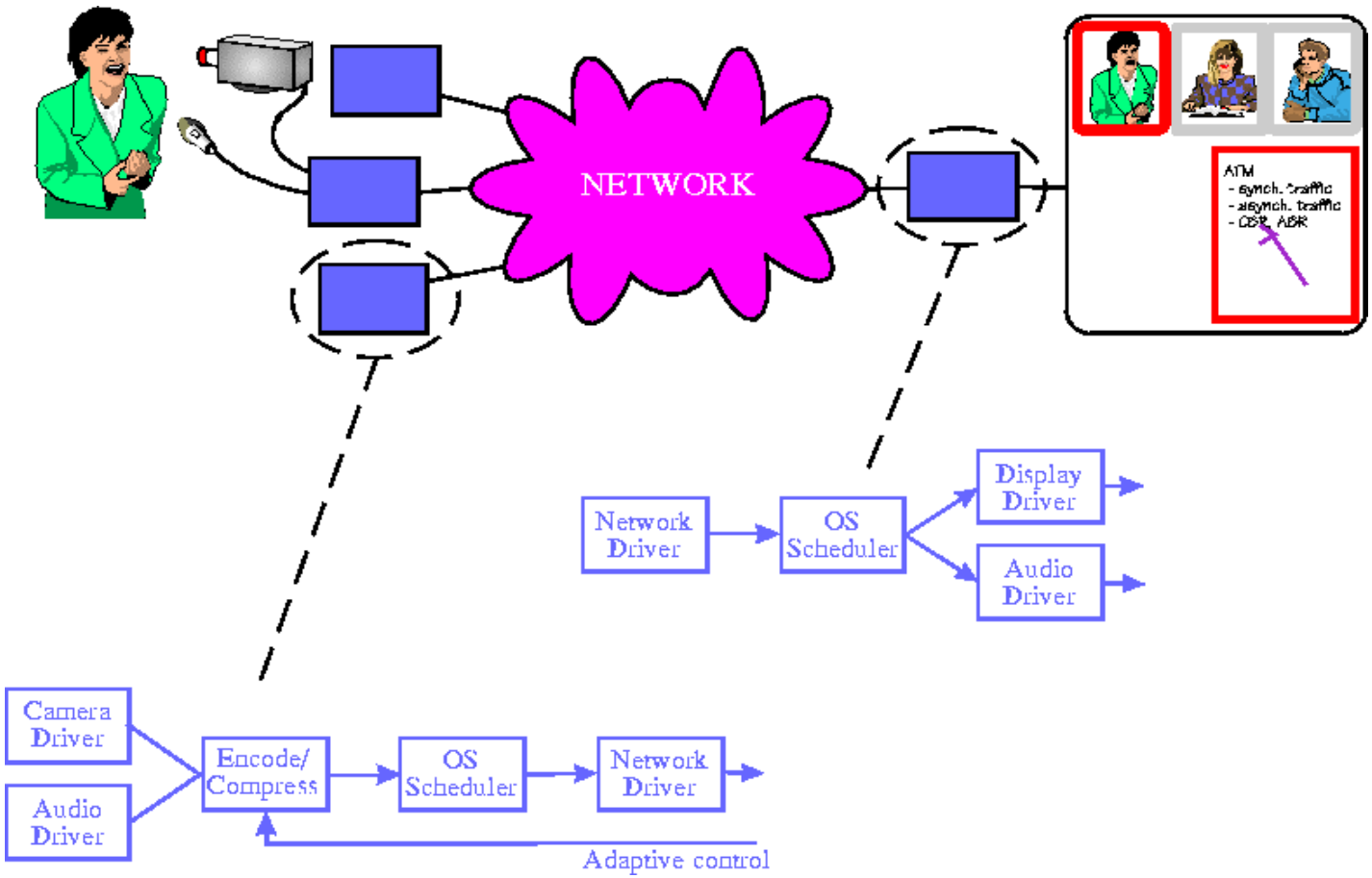
Distributed Multimedia Technologies and Applications (DMM)

The DMM project focuses on research issues central to the ***development and use of distributed multimedia***.

Real Time Multi-Modal Communication (RTMM)

Objective: Within a few years advanced broadband communications will support the transmission of images and sound in a ***quality much higher than today's***.

DTU-RTMM project overview

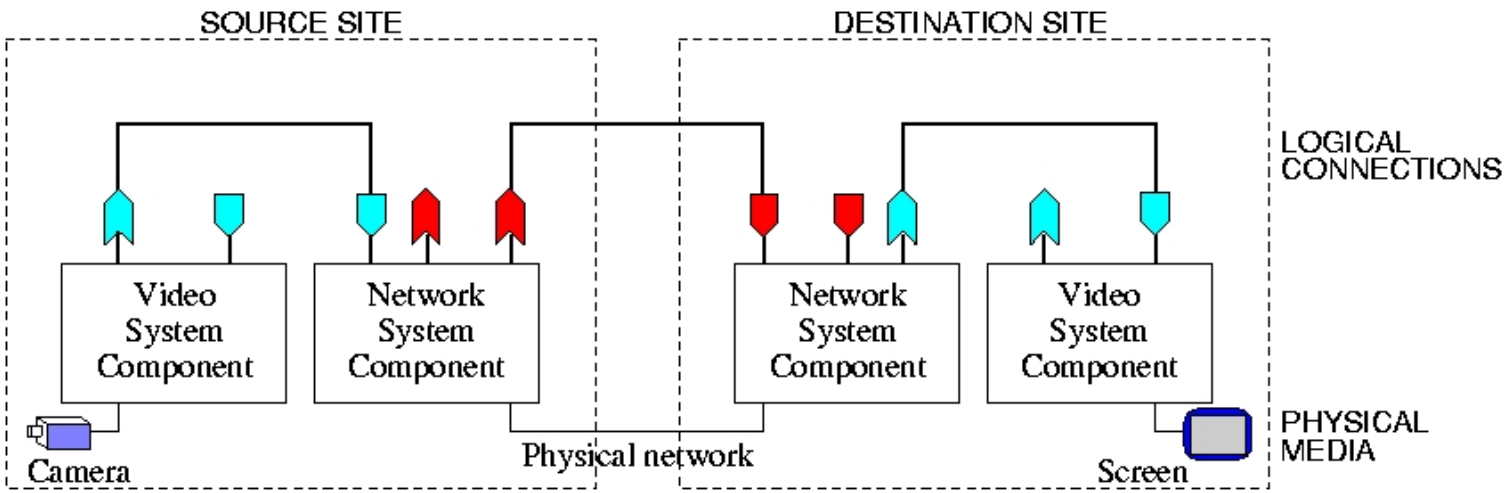


DTU-RTMM project test idea

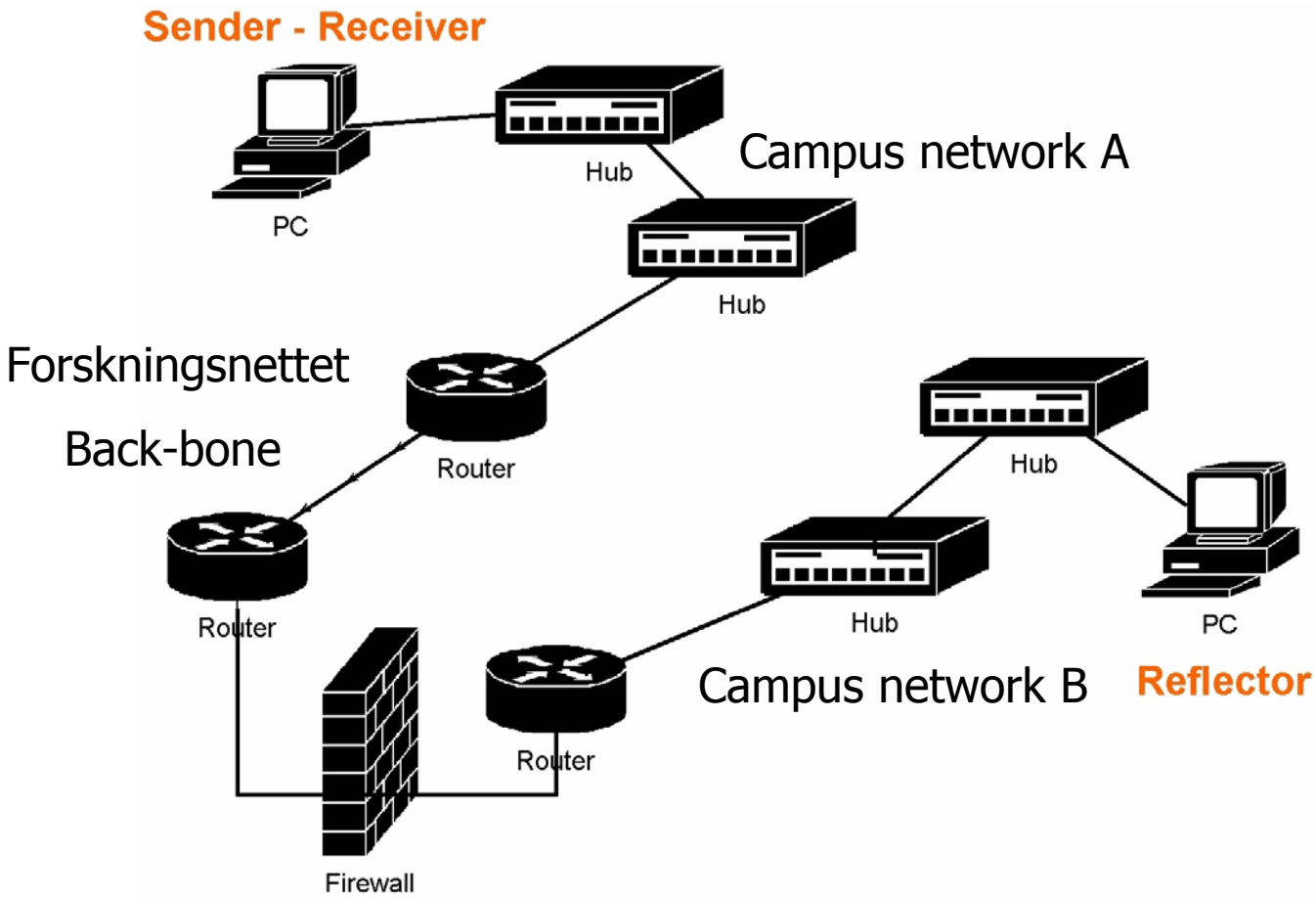
- The application must know the network delay from A to B before the buffer size and overall delay can be determined and optimized.
- A **sender – reflector – receiver** setup has been developed and included in the application.

System components

- Proto type based on ordinary PCs running Linux
- Of the shelf graphics board for M-JPEG encoding
- First ATM network tests, then IP based networks



End-to-end measurement setup

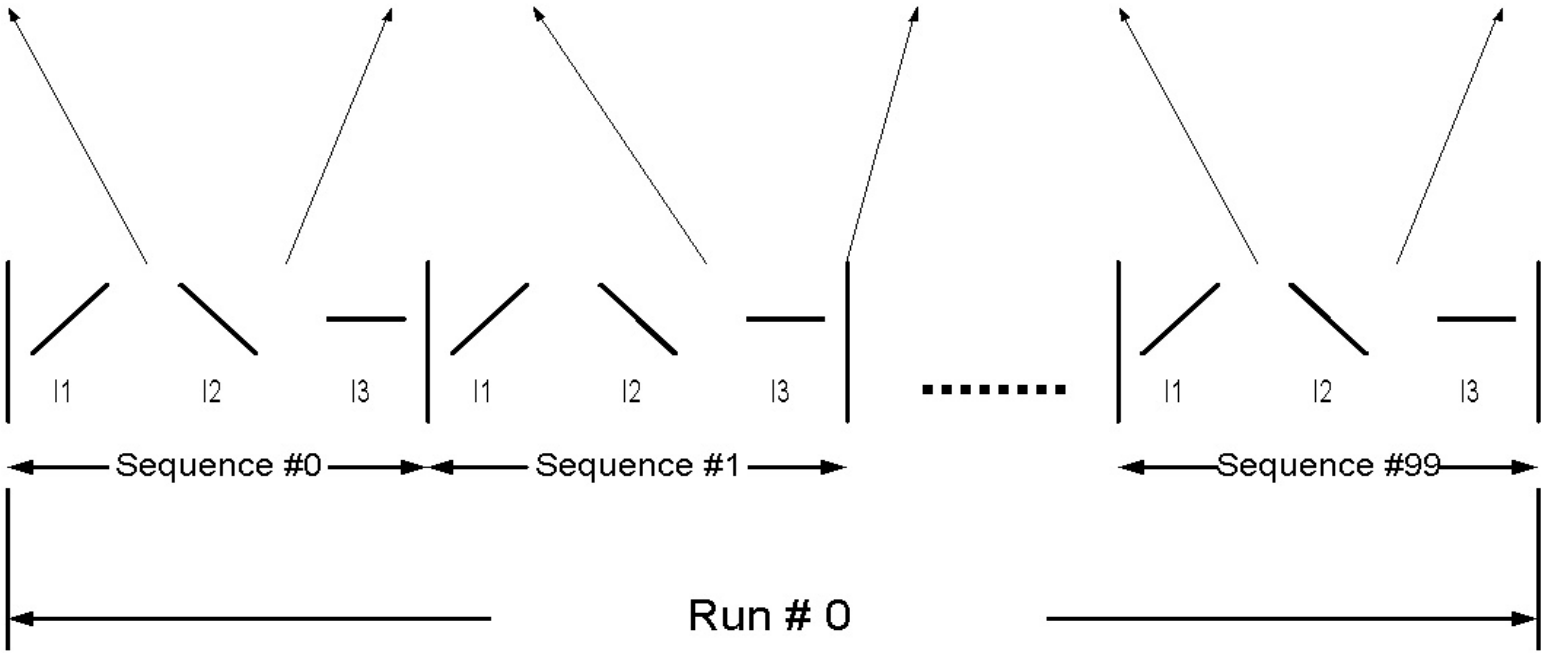


Data structure

Nr	Size	...	i	S
16	768		2	0
17	512		2	0
18	256		2	0
19	128		2	0
20	64		2	0

Nr	Size	...	i	S
80	64		3	1
81	16384		3	1
82	128		3	1
83	14336		3	1
84	256		3	1

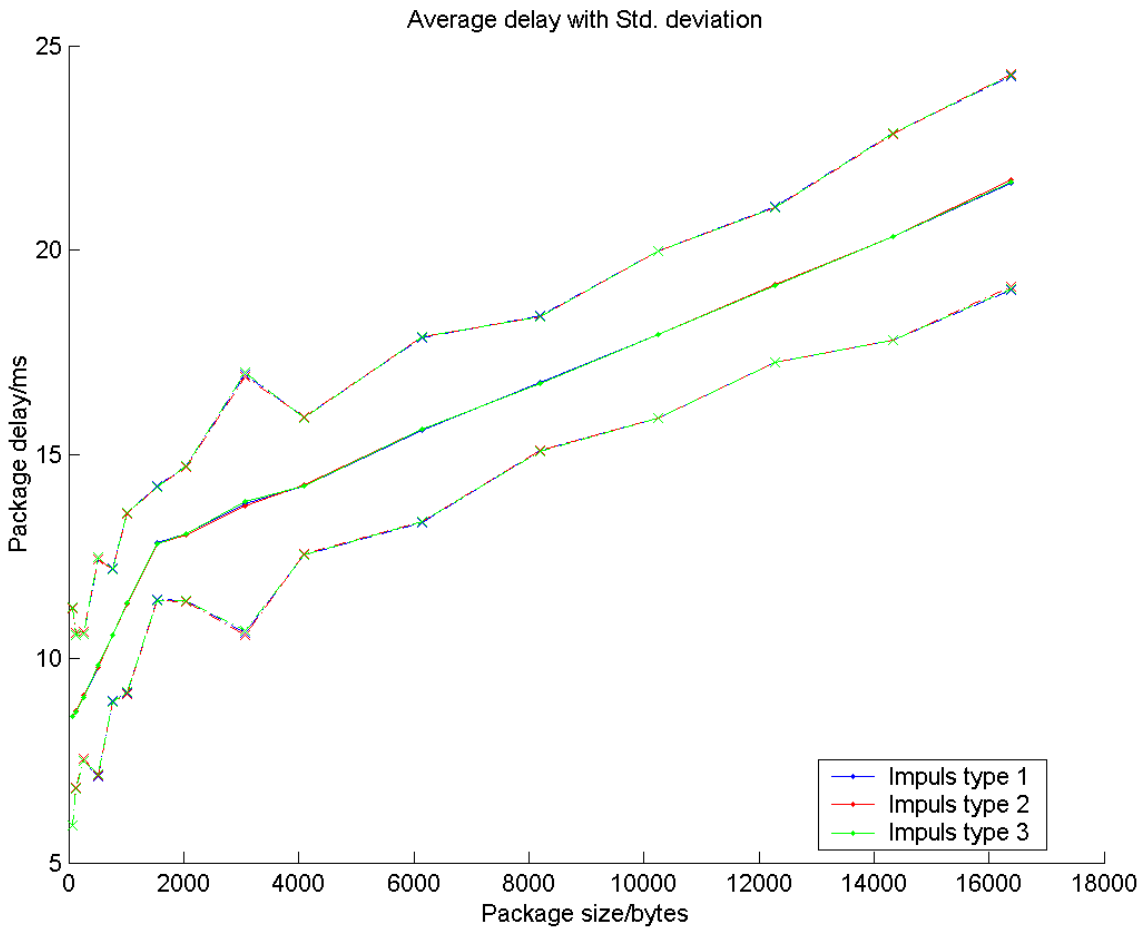
Nr	Size	...	i	S
4768	768		2	99
4769	512		2	99
4770	256		2	99
4771	128		2	99
4772	64		2	99



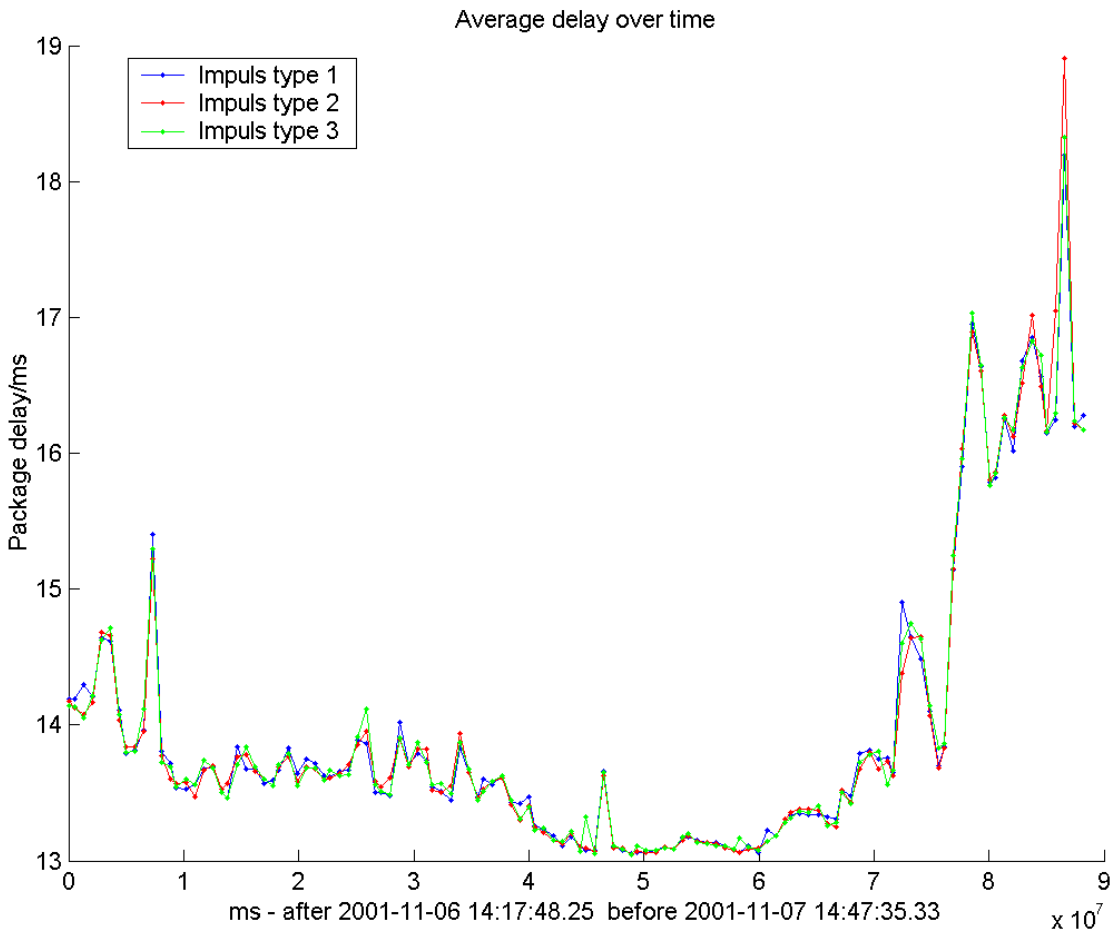
Network load during measurement

- Stream of UDP packets
- Interval between packet send is 40 ms
- Packet sizes between 64 and 16,384 bytes
- Worst case load 3.7 Mbit/s in 40 ms
- Average load 730 kbit/s during active test
- Average load 300 kbit/s in 24 hours

Measurement A: Ly – KU (FE, 11-2001)



Measurement A: Ly – KU (FE, 11-2001)



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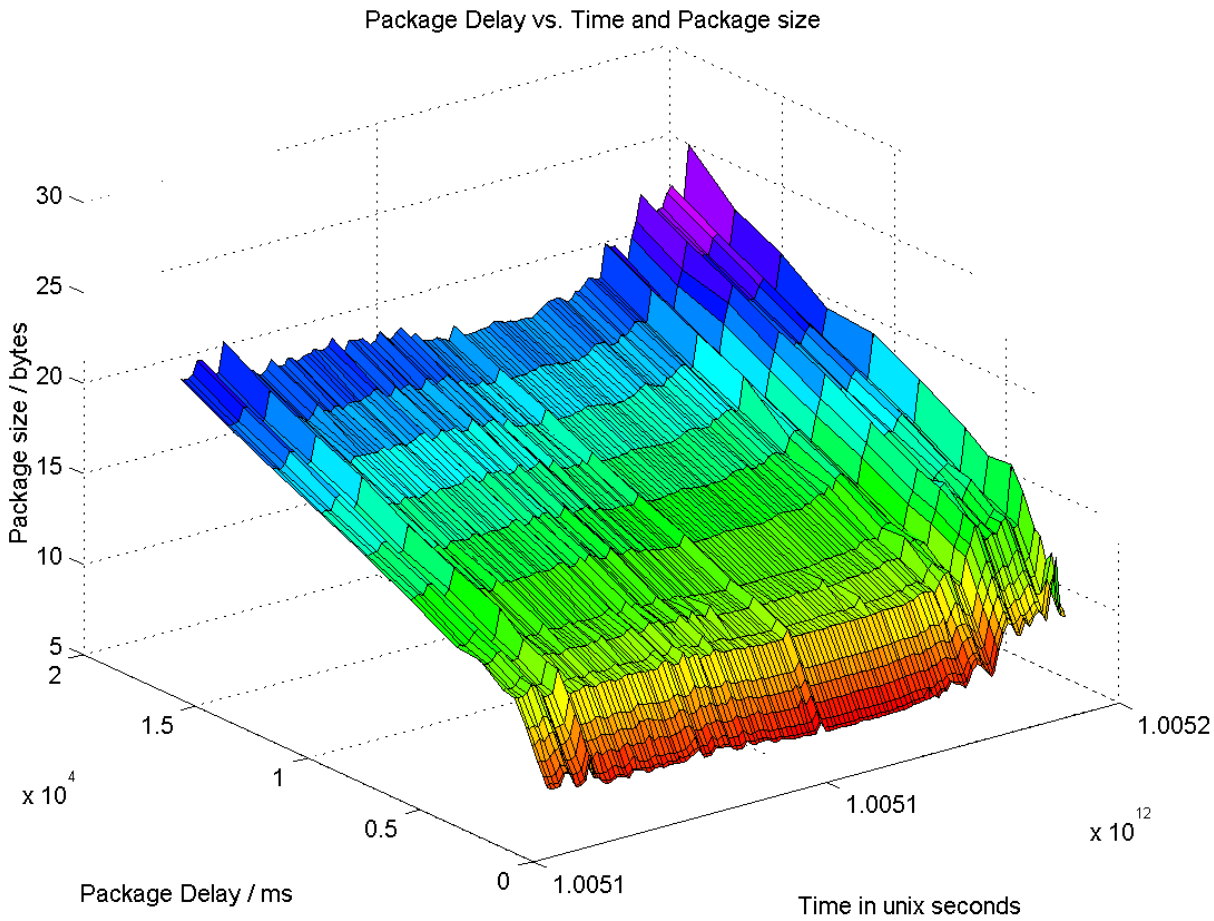
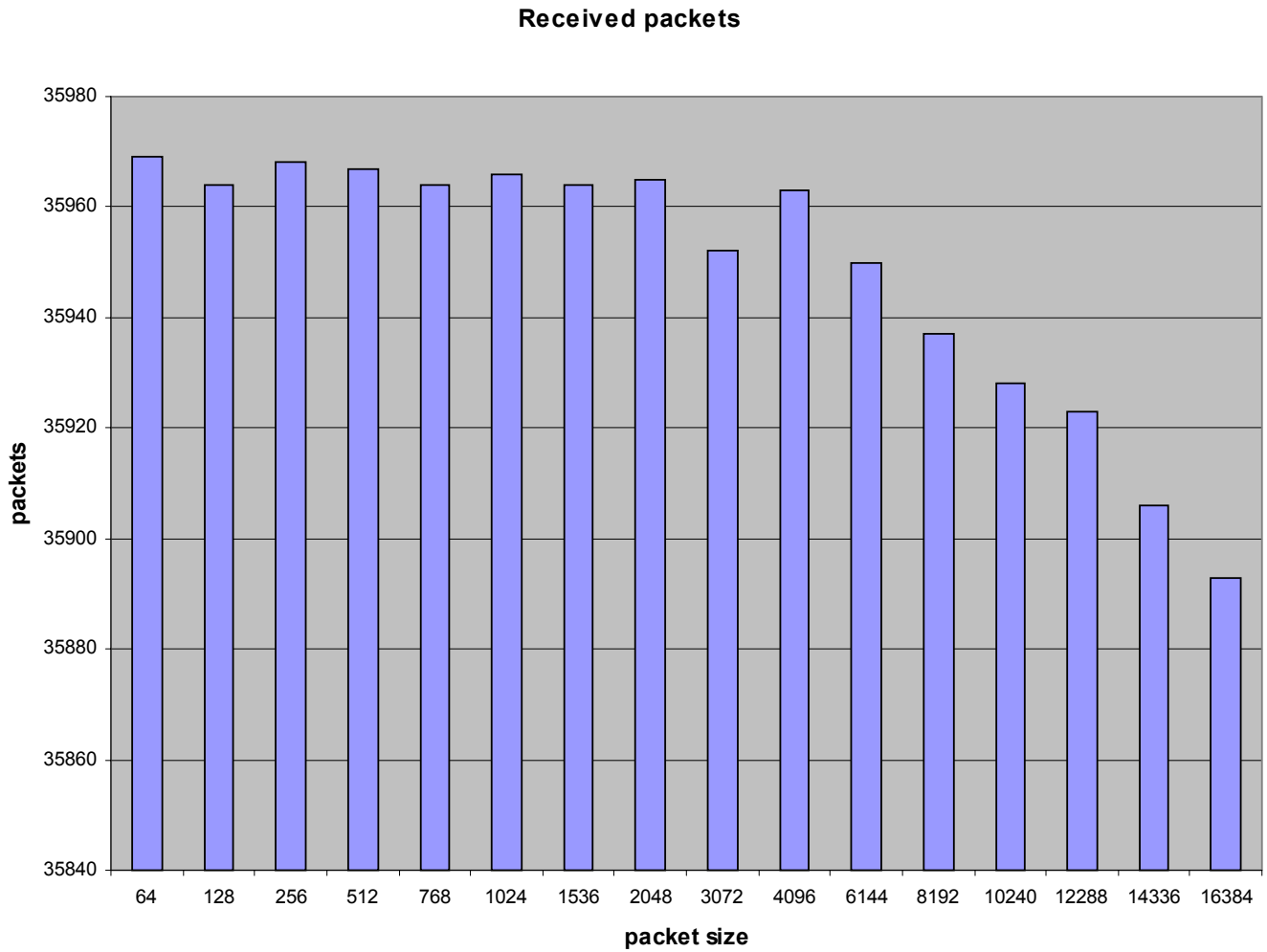
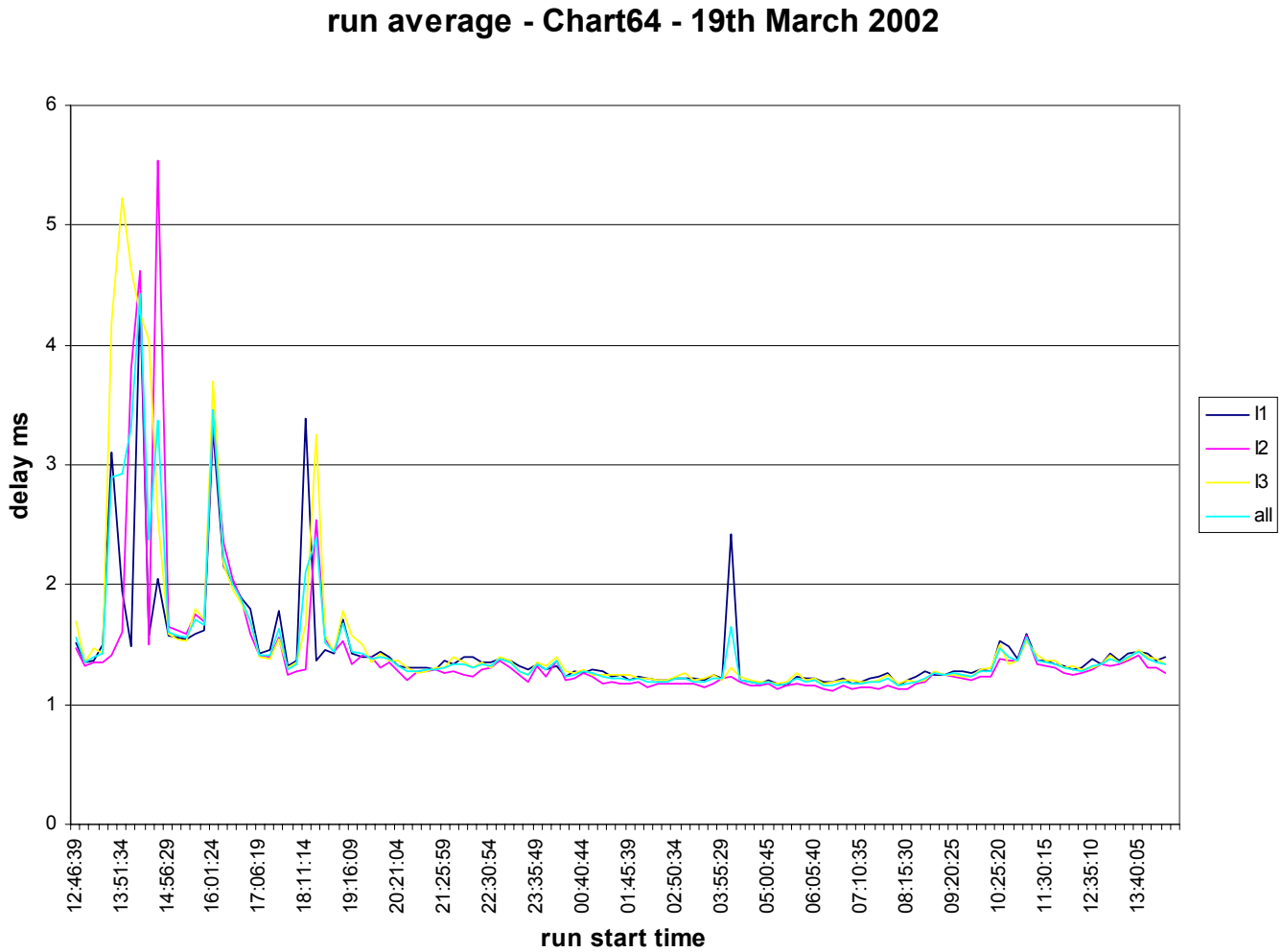


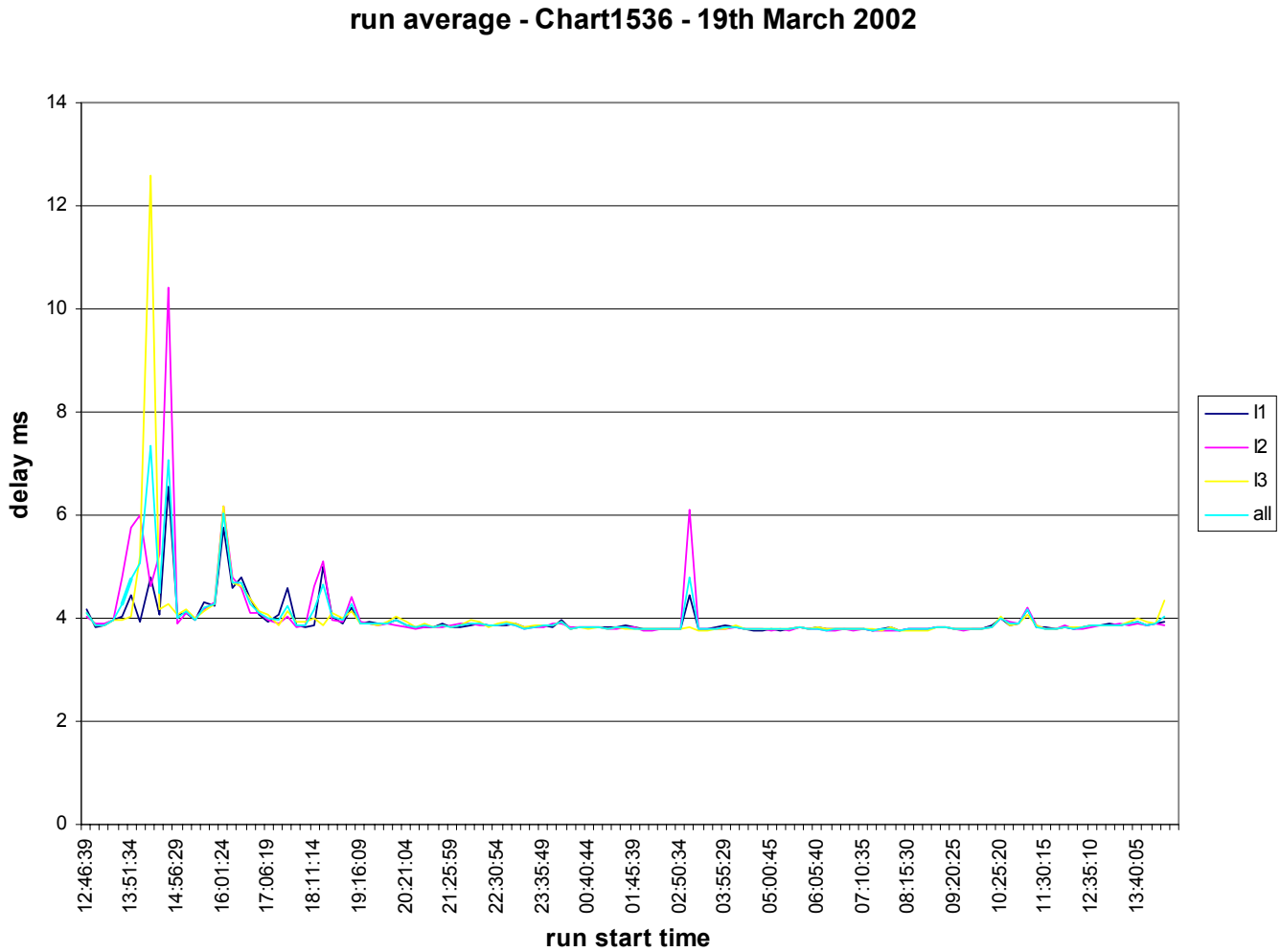
Measurement A: Ly – KU (FE, 11-2001)



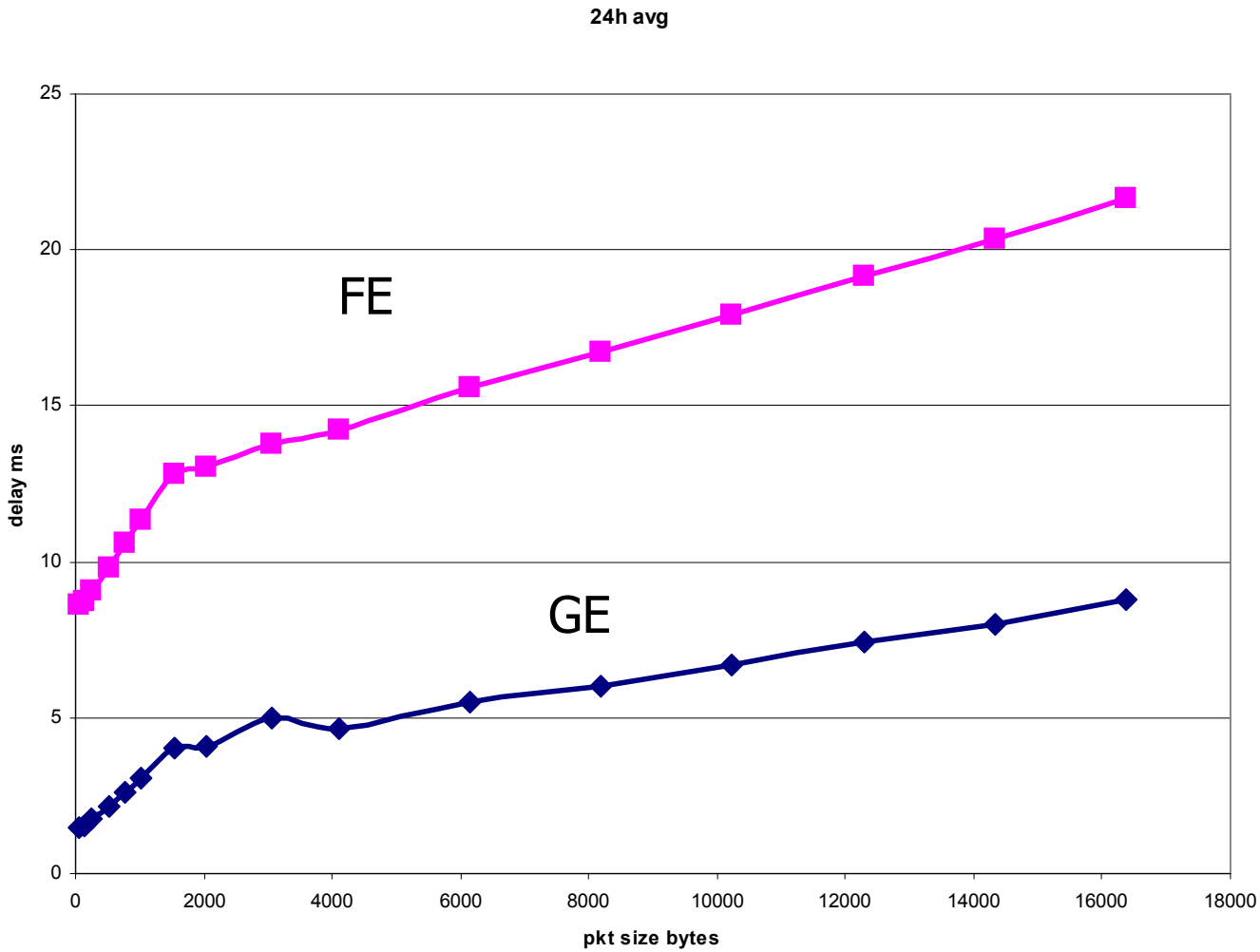
Measurement B: Ly – KU (GE)



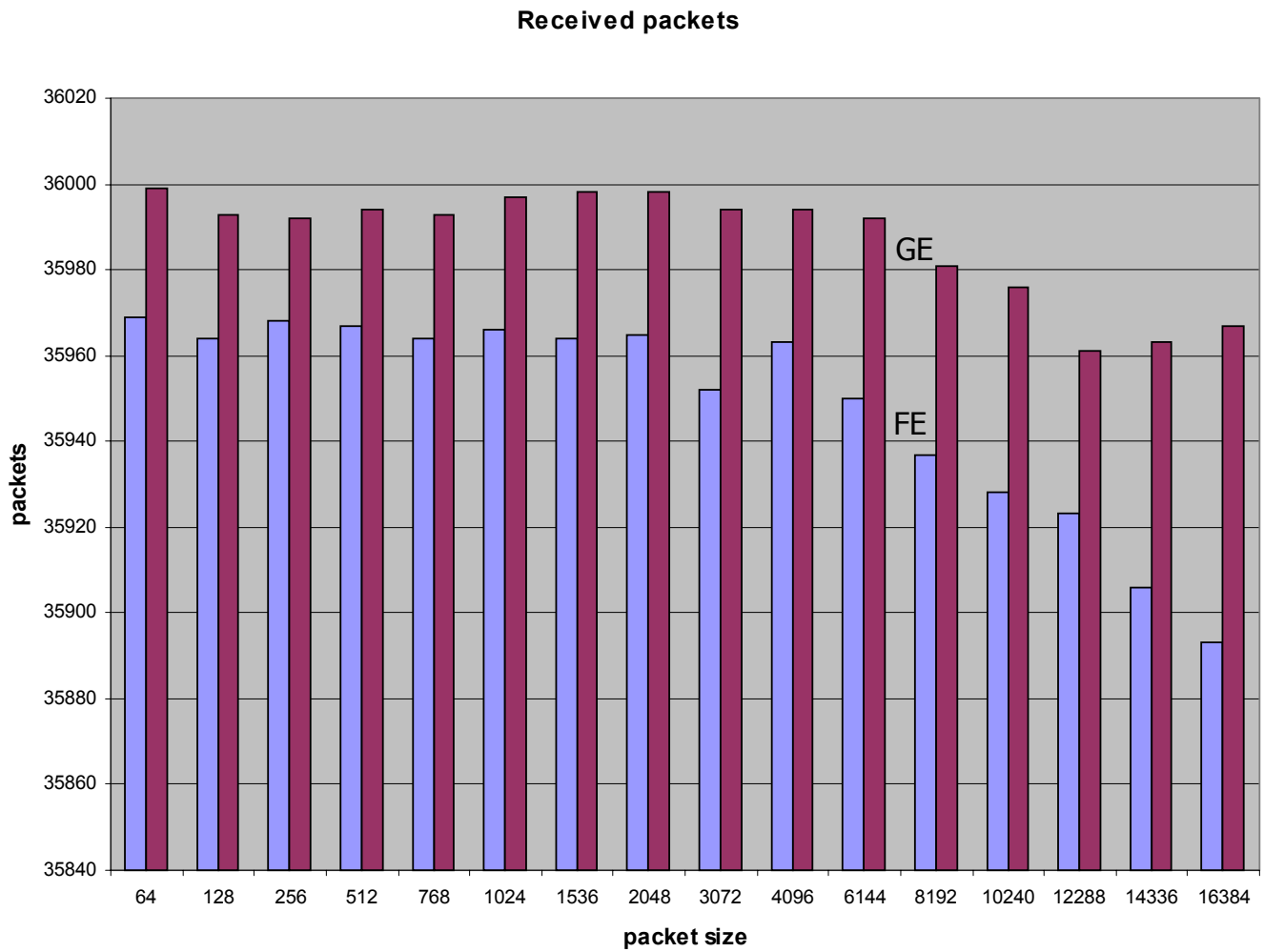
Measurement B: Ly – KU (GE)



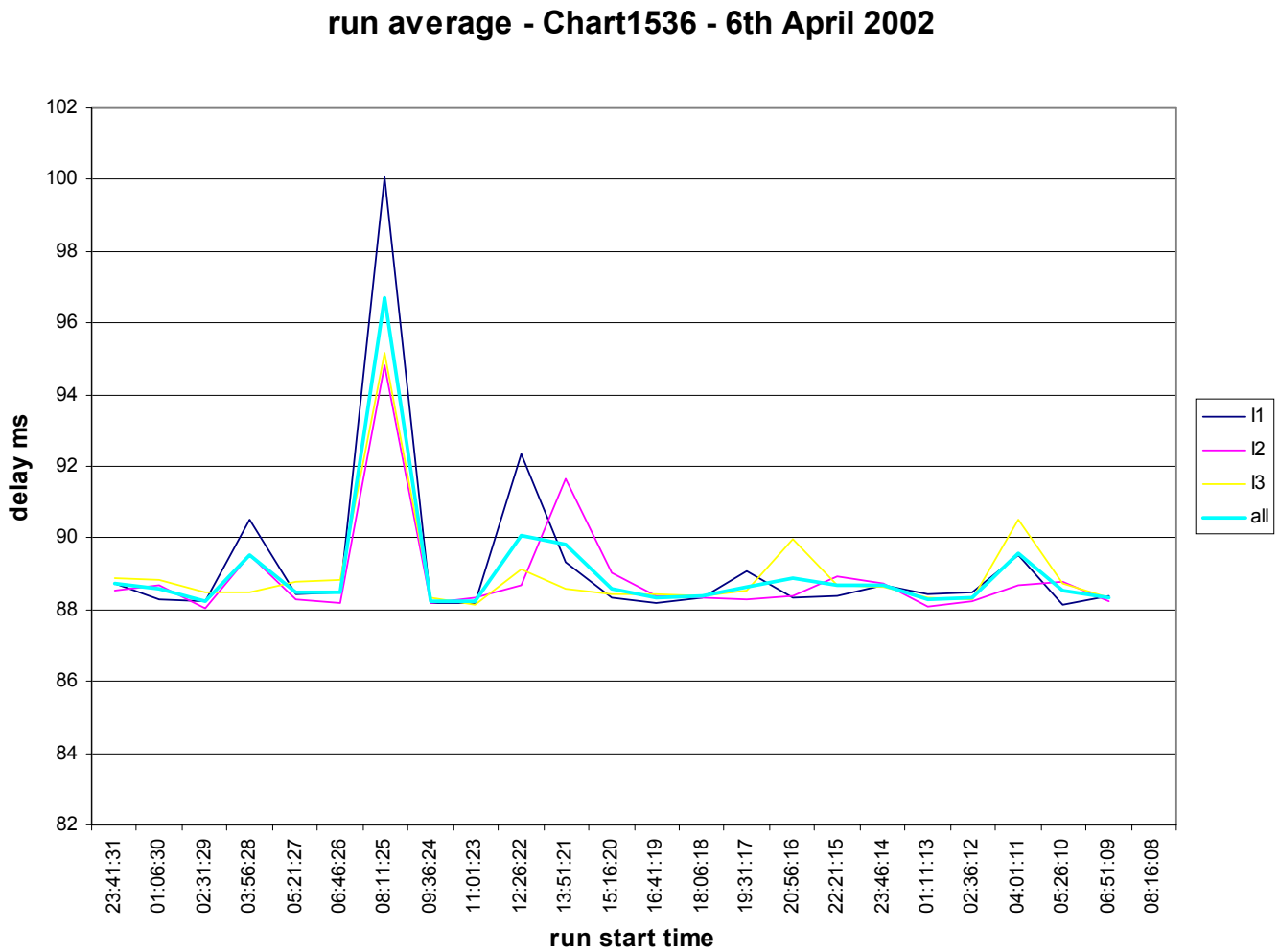
Measurement A: Ly – KU (FE - GE)



Measurement B: Ly – KU (GE)



Measurement C: LY- KU (512 kBit/s ADSL)



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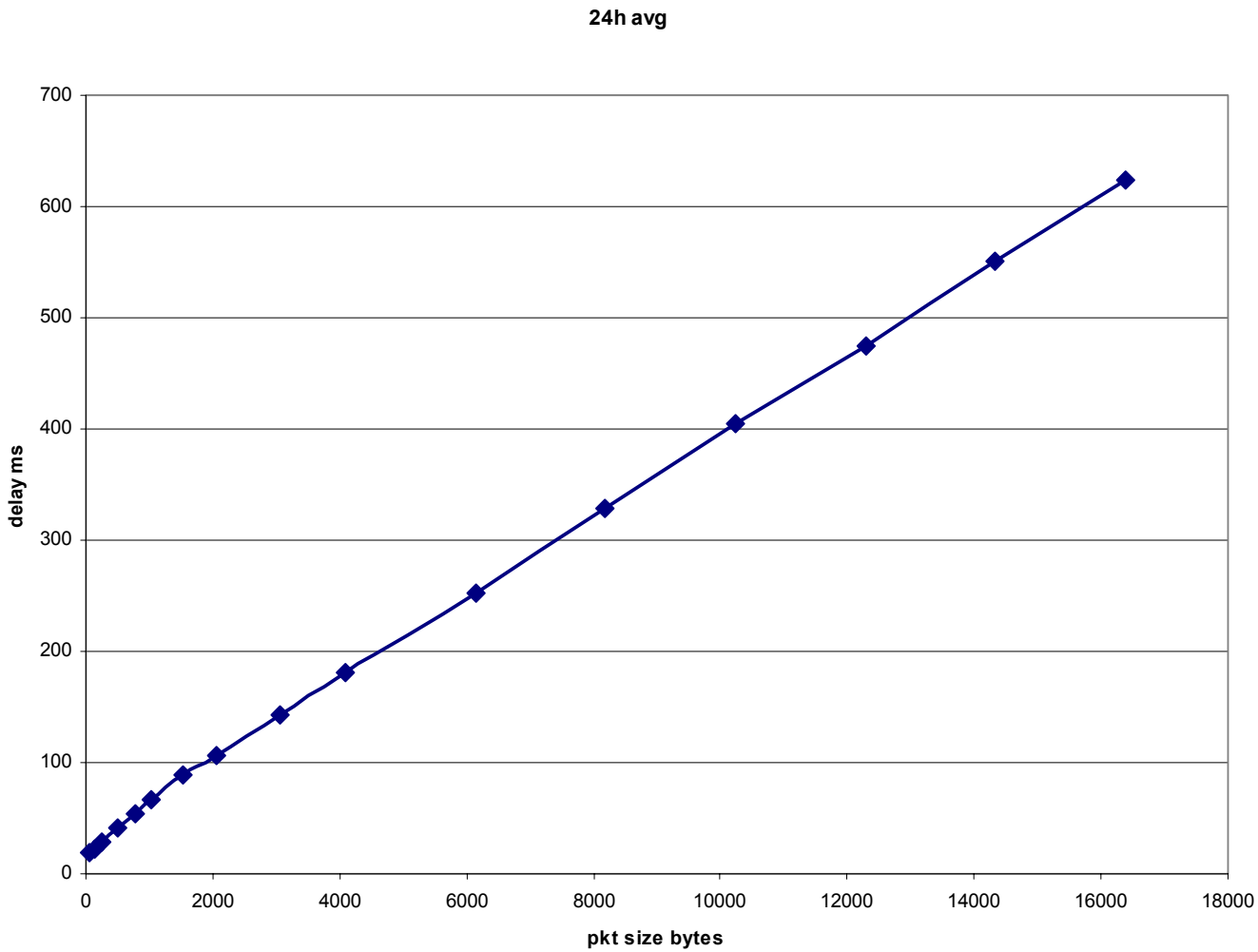
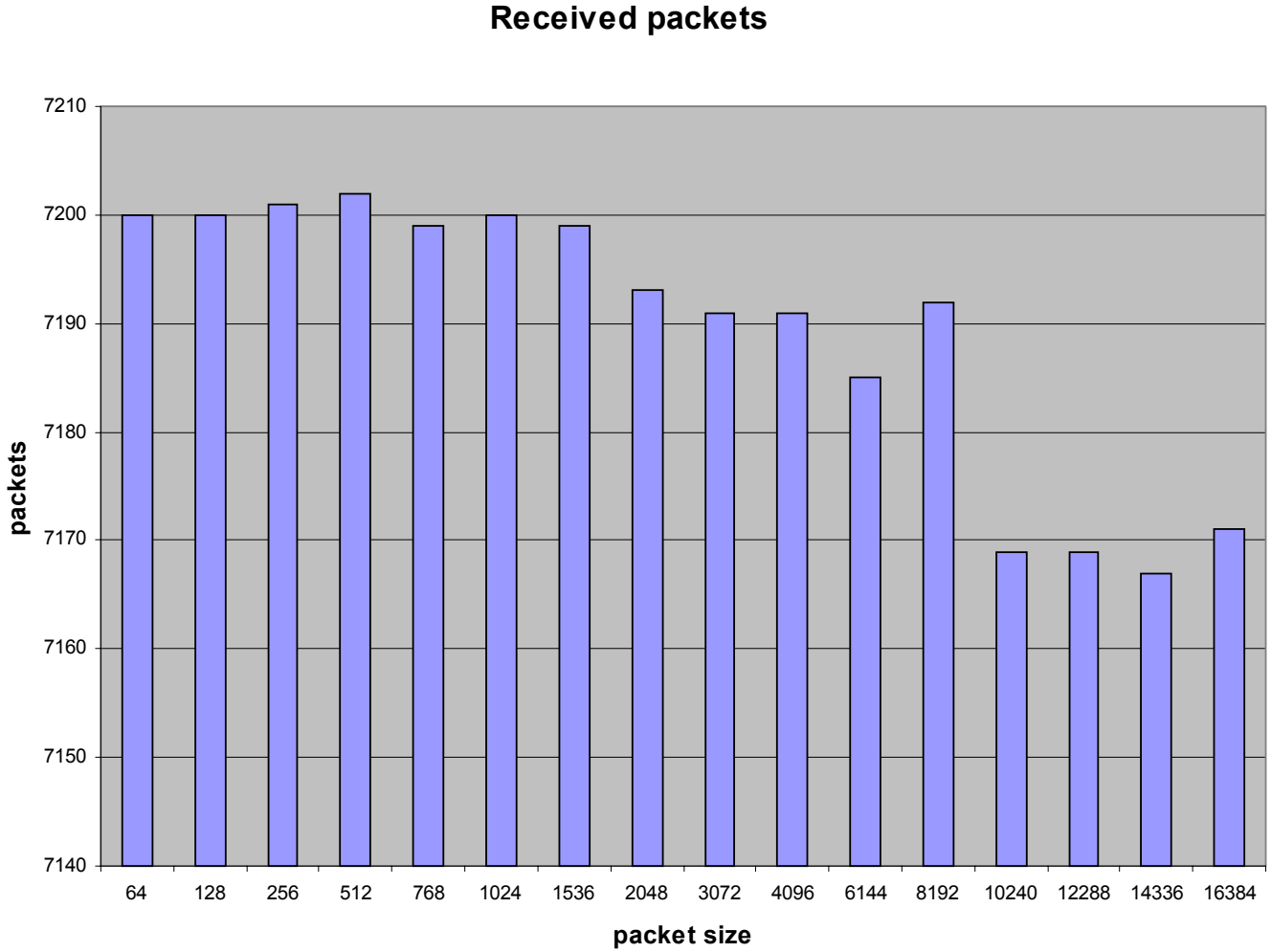


Measurement C: LY- KU (512 kBit/s ADSL)



The **N**ational **L**aboratory for **A**pplied **N**etwork **R**esearch (NLANR) has as its primary goal to provide technical, engineering, and traffic analysis support of NSF High Performance Connections sites and HPNSP (high-performance network service providers) such as the NSF/MCI very high performance Backbone Network Service (vBNS).

Packet Loss (%)		S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
R0	beacon@ag-audio (206.75.91.25)	0	0	99	0	NA	2	2	NA	10	NA
R1	beacon@ag-video1 (156.56.104.3)	0	0	99	0	0	0	0	NA	0	NA
R2	beacon@audio (130.20.208.21)	2	0	0	0	19	23	0	NA	NA	NA
R3	beacon@backup2 (144.174.129.22)	NA	NA	NA	0	NA	NA	NA	NA	NA	NA
R4	beacon@dingdong (198.48.78.89)	0	0	99	0	0	0	0	NA	0	NA
R5	vu-amsterdam@display (130.37.42.36)	0	0	99	0	2	0	0	NA	0	NA
R6	beacon.noc.kreonet2.net@kreonet2 (134.75.20.90)	0	0	99	0	0	0	0	NA	0	NA
R7	beacon@mocha (128.208.20.215)	0	0	99	0	0	0	0	0	0	NA
R8	otter-ns3@ns3 (145.41.1.167)	0	0	0	0	0	0	0	NA	0	NA
R9	beacon@ntania (128.111.55.97)	0	0	99	0	0	0	0	NA	2	0
Packet Loss (%)		S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
R10	beacon@video (128.83.143.75)	2	0	0	0	2	0	0	NA	NA	NA
R11	beacon@beacon.sheridanc.on.ca (142.55.1.52)	0	7	99	0	0	12	7	NA	10	NA
R12	jnj@lab-disp.atr.jnj.com (192.168.3.96)	27	7	22	NA	7	20	22	NA	NA	NA
R13	beacon@hendrix.multicasttech.com (63.105.122.14)	0	0	99	0	0	0	0	NA	0	NA
R14	beacon@techie.multicasttech.com (216.177.62.40)	0	0	99	0	0	0	0	NA	0	NA
R15	beacon@nettest.arsc.edu (199.165.80.245)	0	0	99	0	NA	0	0	NA	0	NA
R16	beacon@agaudio.bu.edu (192.12.188.20)	0	0	0	0	0	0	0	NA	0	NA

Multicast Beacon *Server*

v0.8.X (Perl) January 2002

Kai Chen
Mitch Kutzko
Tony Rimovsky

Multicast Beacon

Multicast is a way of distributing IP packets to a set of machines which have expressed an interest in receiving them. It is a one-to-many distribution model suitable for video conferencing and data sharing over the network.

- **Beacon Client** -- an active probing program running at each machine. A set of Beacons sends packets continuously to each other through a multicast session, and measures the performance of the transmission. It then reports to the Beacon Server periodically. Java program.

- **Beacon Server** -- a central server collecting the performance information from the Beacon Clients.

Multicast Beacon Info

Multicast Beacon v0.8.09
Feedback to beacon@dast.nlanr.net

Loss Delay Jitter Out of Order Packets Duplicate Packets Beacon Info [Original Table File | [Modified Table File]
Select a Subset of these Beacons
Time: **Sun Apr 7 16:38:28 2002** | Page Refresh: **120 seconds** | Beacons: **7**
Target Multicast Group: **233.10.43.1** | Server listening on port: **26031**

Beacon		IP	Resolved As	OS	OS Version	Arch	JVM Version
R0	japs@japs.adm.**ku.dk**	192.38.97.130	japs.adm.ku.dk	Linux	2.4.18-6mdk	i586	1.0.6
R1	japs@mandrake2.adm.**ku.dk**	130.225.127.204	mandrake2.adm.ku.dk	Linux	2.4.18-6mdk	i686	1.0.6
R2	cwjapstest@reflector.net.**ku.dk**	192.38.116.236	reflector.net.ku.dk	Linux	2.4.18-6mdk	i586	1.0.6
R3	unimogul@otto.net.**uni-c.dk**	130.226.1.32	otto.net.uni-c.dk	Linux	2.2.14-5.0smp	i686	1.0.6
R4	marius@eldborg.rhi.**hi.is**	130.208.165.53	eldborg.rhi.hi.is	Solaris	2.x	sparc	1.1.6
R5	oli@durinn.**rhnet.is**	130.208.16.20	durinn.rhnet.is	SunOS	5.8	sparc	1.2.2
R6	he@vever.urc.**uninett.no**	158.38.152.34	vever.urc.uninett.no	NetBSD	1.4.3A	x86	1.1.8

Multicast Beacon: Delay

Multicast Beacon v0.8.09
Feedback to beacon@dast.nlanr.net

Color key: Green <= 200 ms Delay | Yellow <= 1000 ms Delay | Red <= 10000 ms Delay (*** = impossible data) | Gray = No Data

Loss Delay Jitter Out of Order Packets Duplicate Packets Beacon Info

[Original Table File | [Modified Table File]
Select a Subset of these Beacons
Time: **Sun Apr 7 13:02:28 2002** | Page Refresh: **120 seconds** | Beacons: **7**
Target Multicast Group: **233.10.43.1** | Server listening on port: **26031**

Delay (ms)			S0	S1	S2	S3	S4	S5	S6
R0	japs.adm.**ku.dk**	192.38.97.130	4.0	5.0	6.0	NA	NA	NA	NA
R1	mandrake2.adm.**ku.dk**	130.225.127.204	21.0	1.0	3.0	NA	NA	NA	NA
R2	reflector.net.**ku.dk**	192.38.116.236	28.0	9.0	2.0	NA	NA	NA	NA
R3	otto.net.**uni-c.dk**	130.226.1.32	NA	NA	NA	0.0	-73.0	20.0	11.0
R4	eldborg.rhi.**hi.is**	130.208.165.53	NA	NA	NA	NA	0.0	95.0	119.0
R5	durinn.**rhnet.is**	130.208.16.20	NA	NA	NA	NA	-93.0	0.0	24.0
R6	vever.urc.**uninett.no**	158.38.152.34	NA	NA	NA	NA	-68.0	26.0	1.0

Multicast Beacon: Jitter

Multicast Beacon v0.8.09
Feedback to beacon@dast.nlanr.net

Color key:

Green <= 50 ms Jitter	Yellow <= 100 ms Jitter	Red <= 10000 ms Jitter (*** = impossible data)	Gray = No Data

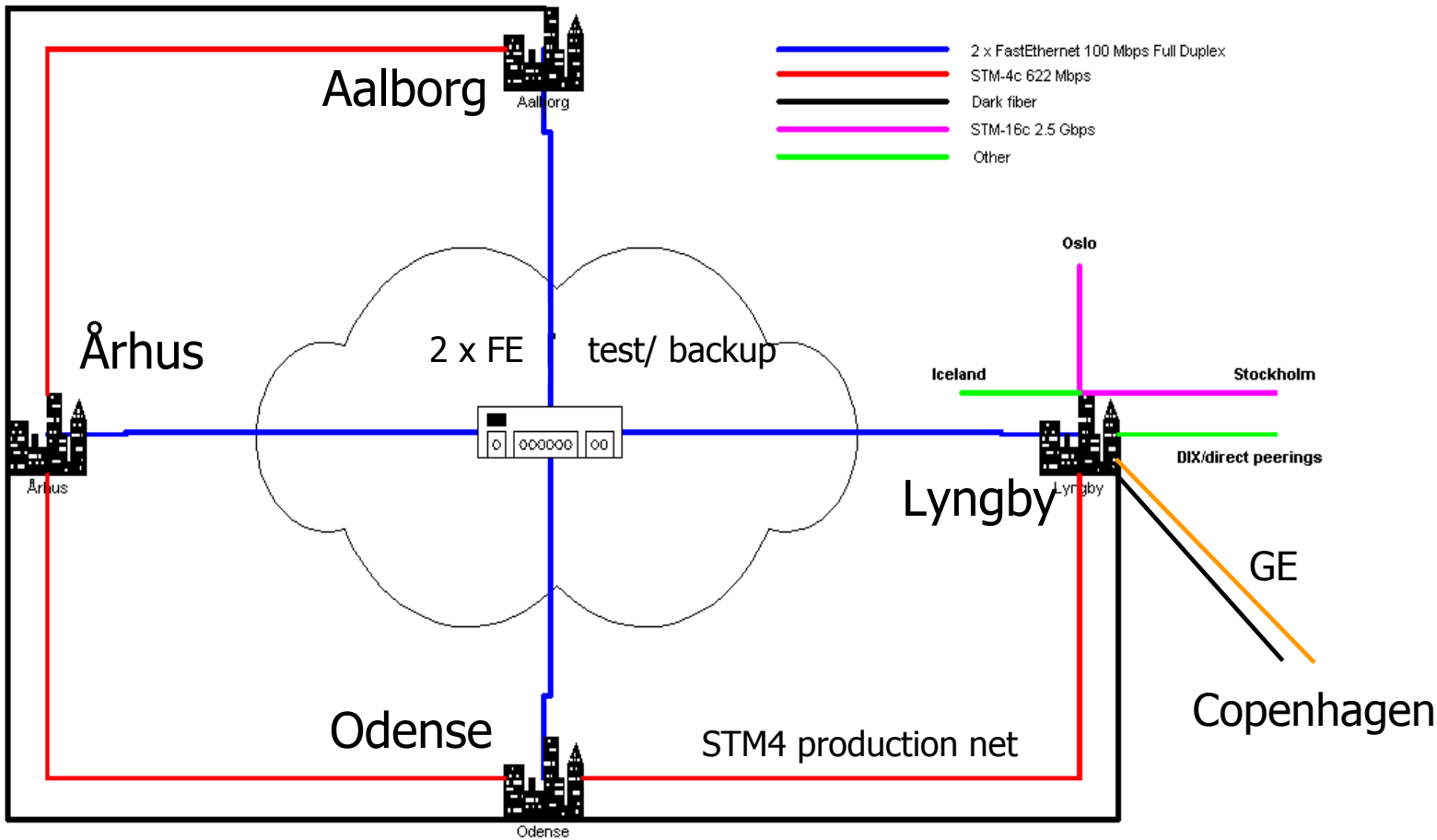
Loss Delay Jitter Out of Order Packets Duplicate Packets Beacon Info

[Original Table File | [Modified Table File]
Select a Subset of these Beacons
Time: **Sun Apr 7 10:30:28 2002** | Page Refresh: **120 seconds** | Beacons: **7**
Target Multicast Group: **233.10.43.1** | Server listening on port: **26031**

Jitter (ms)			S0	S1	S2	S3	S4	S5	S6
R0	japs.adm.**ku.dk**	192.38.97.130	2.2	3.3	3.0	NA	NA	NA	NA
R1	mandrake2.adm.**ku.dk**	130.225.127.204	5.2	0.3	5.3	NA	NA	NA	NA
R2	reflector.net.**ku.dk**	192.38.116.236	2.6	0.9	0.8	NA	NA	NA	NA
R3	otto.net.**uni-c.dk**	130.226.1.32	NA	NA	NA	0.2	1.0	0.9	0.2
R4	eldborg.rhi.**hi.is**	130.208.165.53	NA	NA	NA	NA	0.2	0.0	0.8
R5	durinn.**rhnet.is**	130.208.16.20	NA	NA	NA	NA	0.0	0.0	0.4
R6	vever.urc.**uninett.no**	158.38.152.34	NA	NA	NA	NA	0.4	0.4	0.3

Forskningsnettet backbone

Connects more than 100 universities and research institutions



Future plans in Forskningsnettet

- Set up reflectors at more sites
- Set up more sender – receivers
- Analyze the data in more detail
- Select ways to give users and applications access to use the data or carry out specific measurements of their own choice

Thanks to

- Jan P. Sørensen, University of Copenhagen/NetSek
- Ole Kjærgaard, UNI-C
- Robin Sharp, Edward Todirica, and Bo Friis Nielsen

  Collegues at IMM - Technical University of Denmark
- Radu Dudici, Christian Kaaber, and Lars Kanstrup Sørensen

  Students at IMM - Technical University of Denmark