European 4-Gbps VLBI and eVLBI

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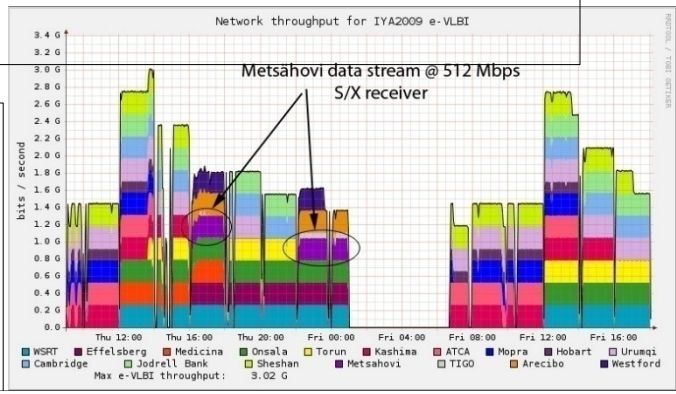
Outline

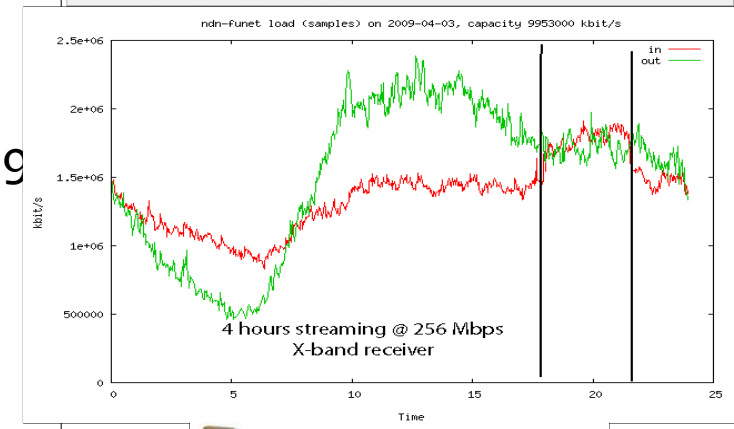
- Introduction
- Goals for 4 Gbps
- Testing
- Results
- Product
- Conclusions and future

Introduction

· During this year 2009 Metsähovi has been special active in e-VLBI opportunities:

- We participated in IYA 2009 demo, 100 hrs of Astronomy demo and the e-VLBI ToO sessions (May/June/July).
- In addition last geo-VLBI session (EURO99 in May) was also done with real-time streaming to Bonn. PC-EVN + Tsunami UDP.
- With a new 10 Gigabit card installed in Mark5A we have to perform 1024 Mbps soon with the EVN community.

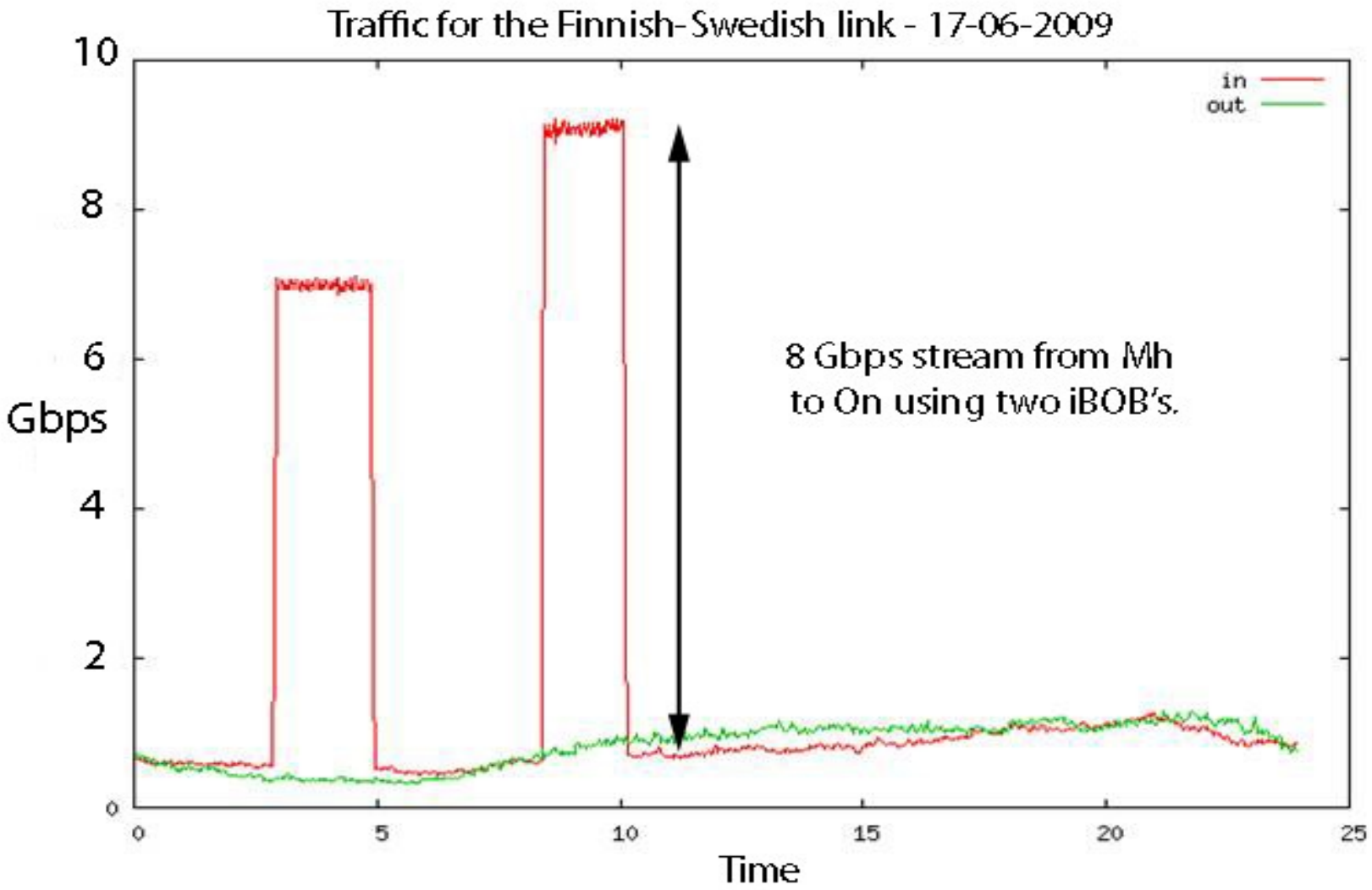




Introduction

- But we always look for further transfer rates
  - A real astronomical data at 4 Gbps streamed from Onsala and locally recorded at Metsähovi has succesfully been demonstrated. (Q3 2008)
  - A 8 Gbps live demonstration was performed during last 7th International eVLBI workshop at Shanghai. Data was streamed from Metsähovi to Onsala. No packets were lost. No crash on the network.

Introduction



Shanghai. Data was streamed from Metsähovi to Onsala. No packets were lost. No crash on the

Goals for 4 Gbps

- Test the limits of commercial off-the-shelf computers.
- Test the new 10 Gbps devices: switches, Ethernet boards or FPGA devices as iBOB.
- Test the performance of plain old Internet in high-speed transfers.
  - Use of simple UDP transfers protocols: Tsunami-UDP, VDIF UDP packetizer, VSIB Multicast.
- Test the performance of hard disks, RAID disk controllers and Port Multipliers (PMP).
  - Detailed analysis at http://www.metsahovi.fi/en/vsib-docs/yebes_presentation.pdf
- Build a Data Acquisition System capable of streaming and recording at 4 Gbps.
  - Compatible and interactive with current Mark5 A/B/C .

Testing – equipment

	System 1	System 2
Motherboard	Asus L1N-SLI WS	Rampage Extreme II
Processor	Two dual-core AMD	Pentium Quad-core
RAM memory	4 GB	4 GB
SATA controller	Native ports	HighPoint RR 2522
10 Gbps card	Chelsio 10 Gbps	Myrinet 10Gbps
Hard disks	Samsung F1 750GB	Samsung F1 1TB
Max capacity	24 TB (12 disks)	40 TB (20 disks)

Testing – equipment

Extra RAID controllers tested:

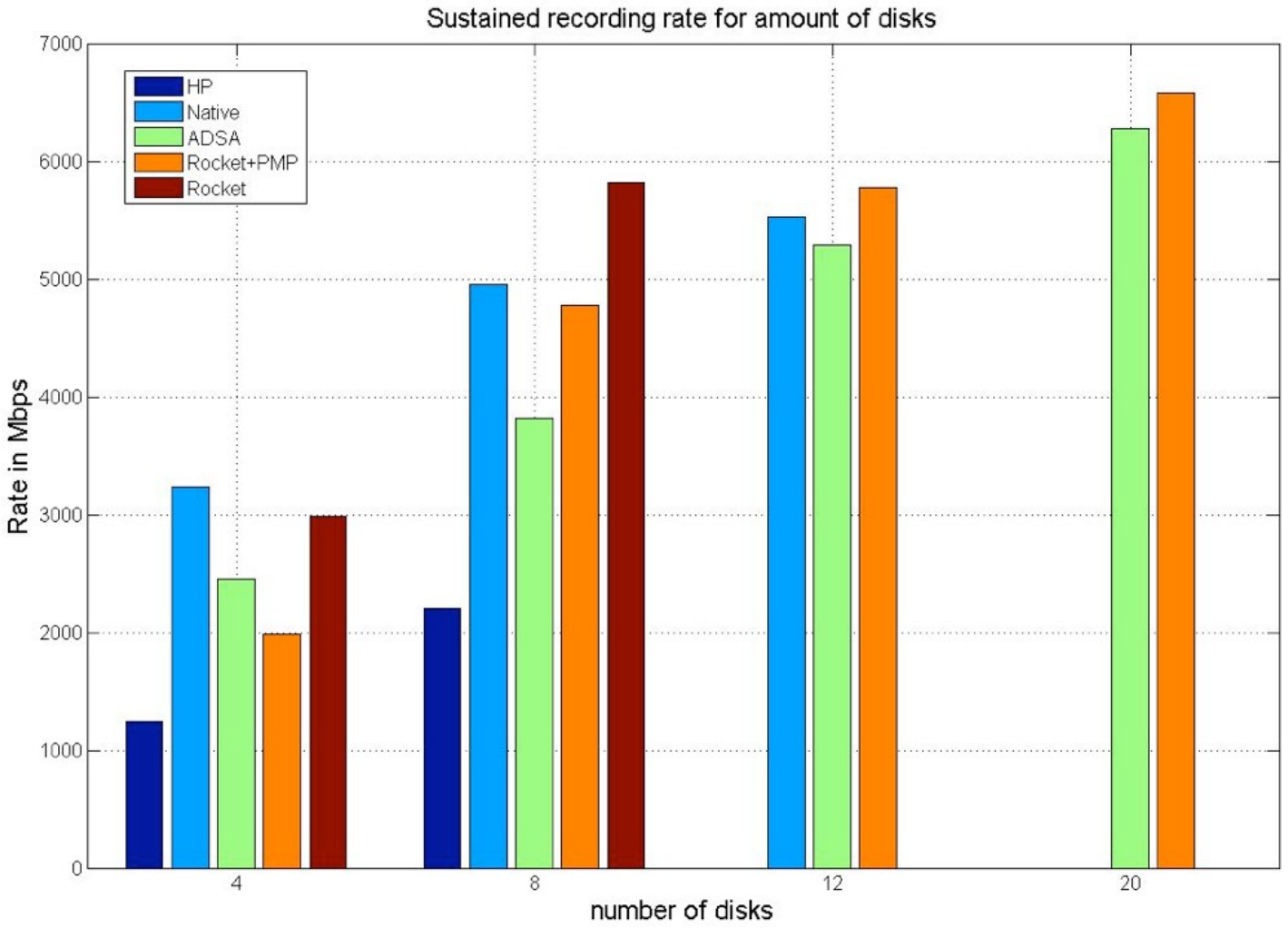
- Hewlett-Packard SC44Ge
- Addonics 4 x eSATA card ADSA3GPX8-4
- Addonics 5 internal SATA PMP

(24h x 4Gbps)

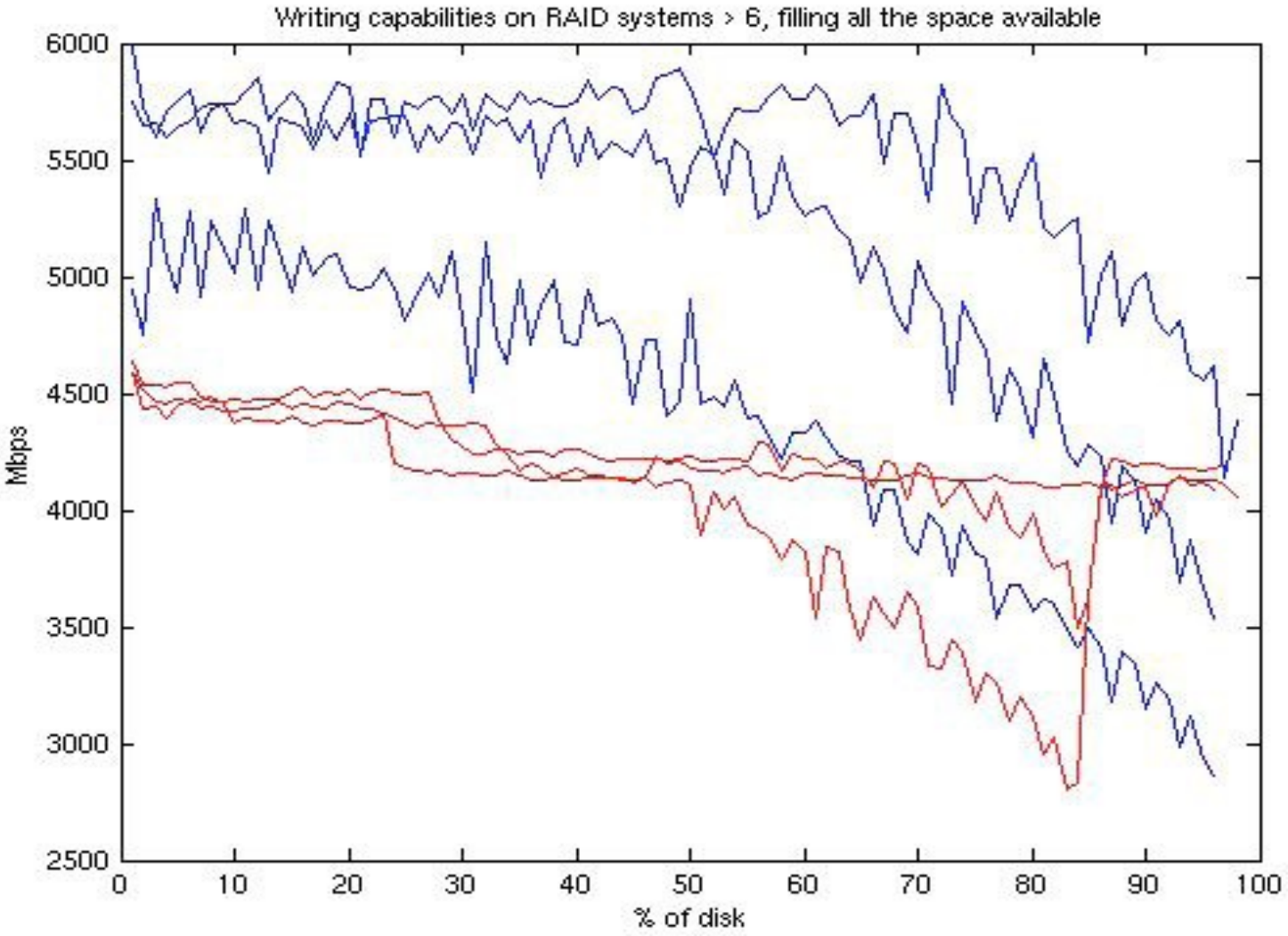
Results

- 4 Gbps recording is achievable with carefully selected equipment
  - 10 Gbps streams + disks recording are CPU-limited
  - Multi-core processors and threads to divide the load are needed .
- Only the newest and fastest Samsung hard disks were fast enough, expect the new 2TB disks to be even faster
- Native ports are faster than RAID controllers.
- None of the on-board chipset controllers supports FIS-based switching in PMP
- RAID disk controller ->more disks and good performance
  - Port Multipliers (PMP) allow multiple disks connections.
  - Higher amount of disks might require to divide the disk pack in 2 RAID's set and two UDP streams. TBD
- Sustained 4 Gbps transfer from 10GBE to disks

Results


Sustained recording rate for amount of disks
HP
Native
ADSA
Rocket+PMP
Rocket
Rate in Mbps
7000
6000
5000
4000
3000
2000
1000
0
4
8
12
20
number of disks

Results

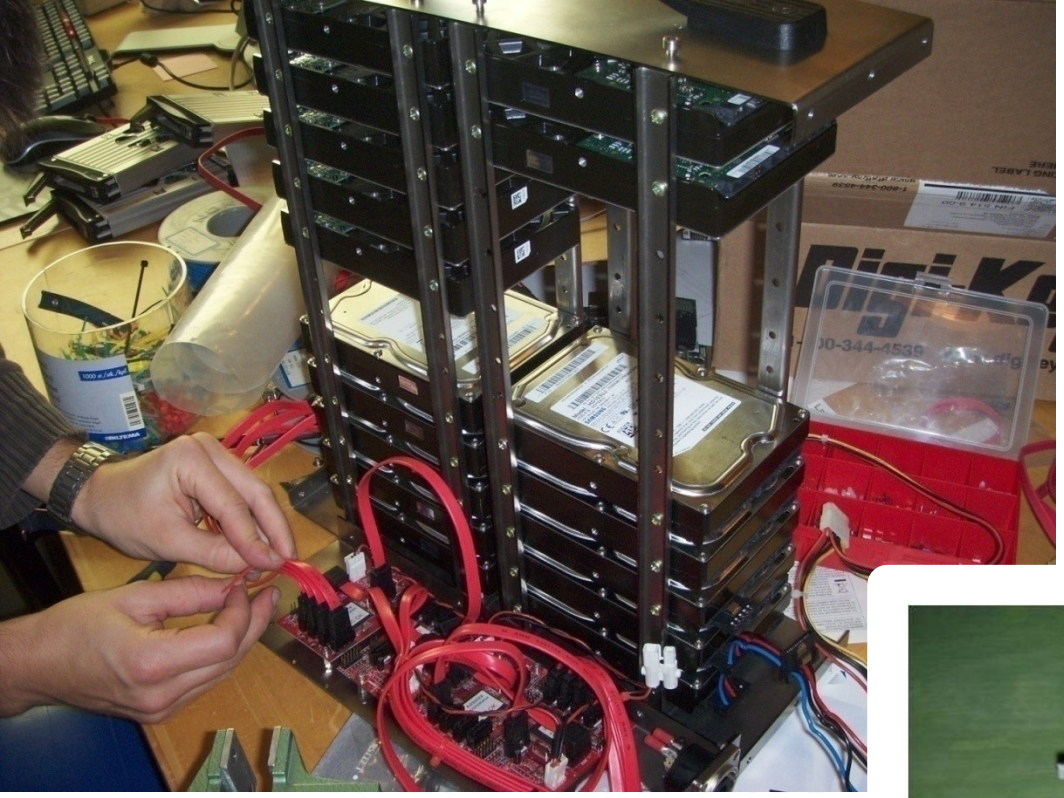

Writing capabilities on RAID systems > 6, filling all the space available
Mbps
% of disk
6000
5500
5000
4500
4000
3500
3000
2500
0
10
20
30
40
50
60
70
80
90
100

Results II

- Eight Gbps continuous streaming over production network, no errors, no packet loss
  - Don't forget to notify the network people before ;).
- Plain old Internet seems to work better than light paths
- FPGA-generated traffic is even safer than PC-traffic
  - e-VLBI at high rates matches with new FPGA based devices: dBBC, iBOB, iBOB2, ROACH…
- 100 Gbps Ethernet announced, demos Q3 2009, deployment 2010

Product

- A dedicated equip based on system 2 spec's has been built to clone Mark5 capabilities.
  - A Mark5C emulator software is being written @ Mh to emulate all possible calls from the Field System. www.metsahovi.fi/en/vlbi/4gexpres
- An alternative diskpack with 20 disks capacity and 4 PMP has been designed and built.
  - An external 500 W PSU and CX4 cable to connect RAID controller and the module is needed.
- A "fan rack shelf" cools down the diskpack by blowing the air through the disks.



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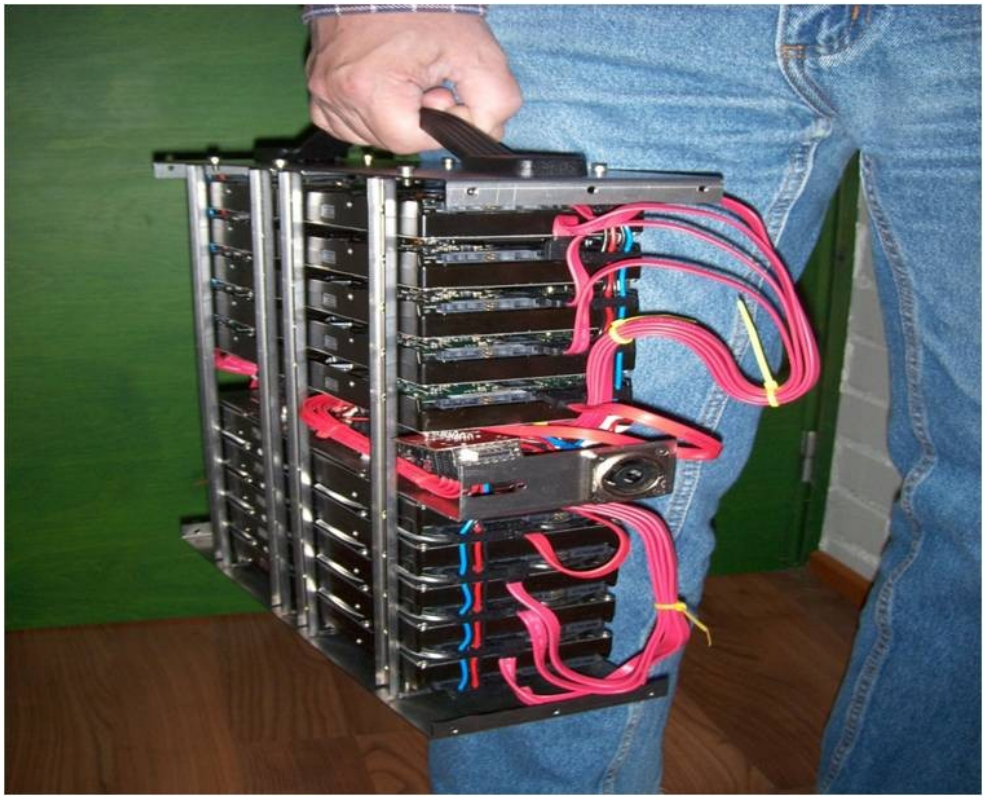
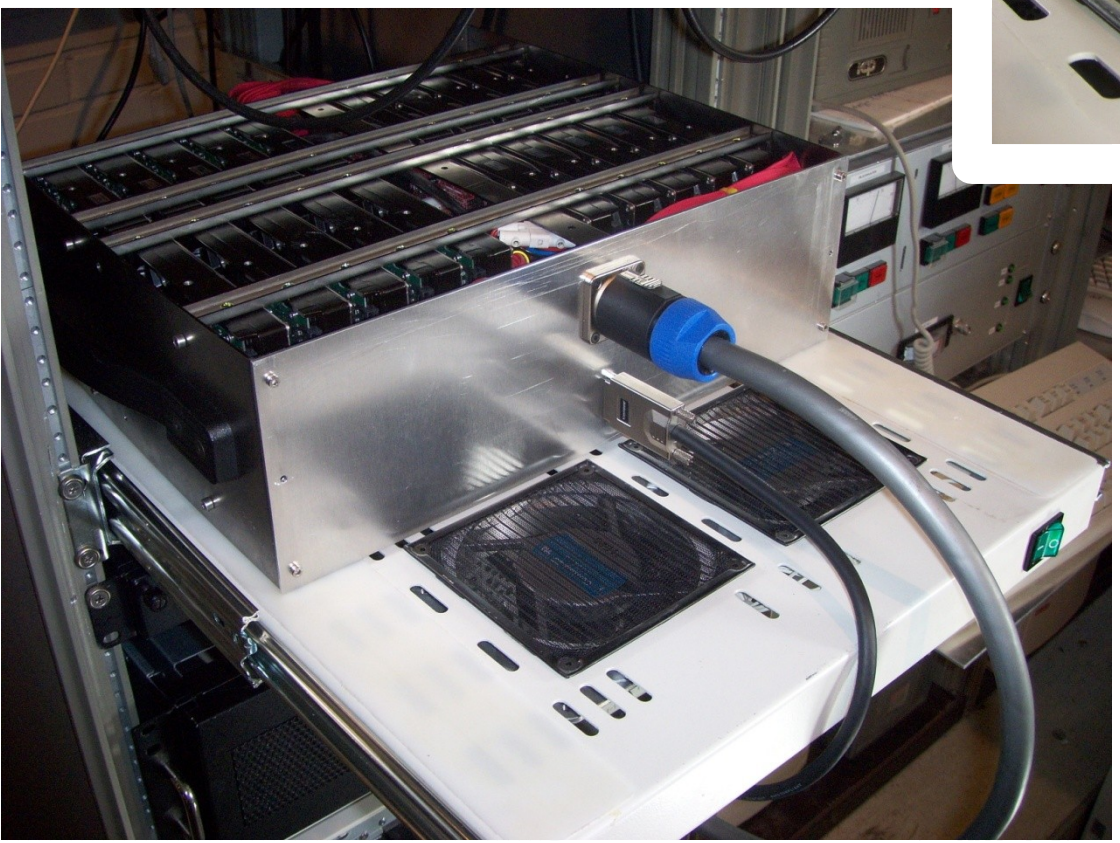
is being written @ Mh

and 4 PMP has beer

- An external 500 W PS
  RAID controller and t

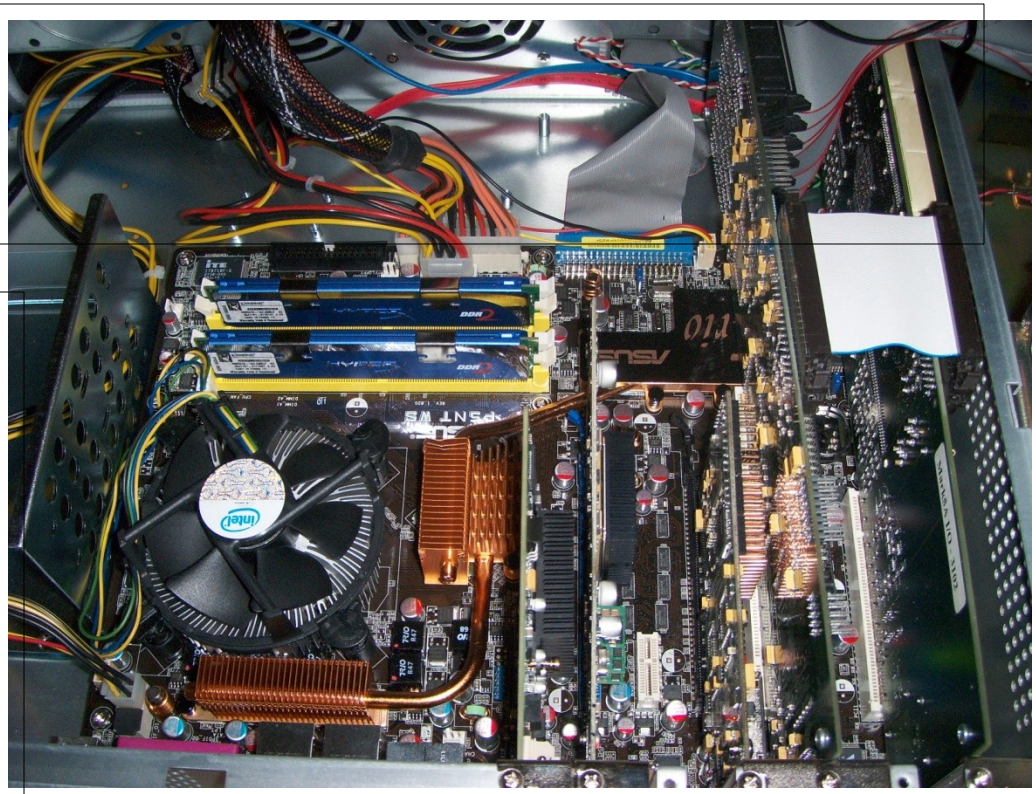
- A "fan rack shelf" cc
  blowing the air thrc






POWER
HDD

Product II



- A full new equipment won't be necessary.
  - The new diskpack system could be compatible with the current Mark5 units that each station.
  - Minor upgrade is needed to have extra PCI-E ports.

www.metsahovi.fi/en/vlbi/10gbps/mark5_upgrade.html

- Mark5 could switch easily between both modes.

Conclusions

- 4 Gbps real-time observations already possible with the current networks.
- 4 Gbps recording possible with COTS.
  - Non-real-time VLBI transfer also possible.
- An eVLBI demonstration at 4 Gbps with several stations will be perform soon.
- eVLBI becomes easy with 100 Gbps trunk network.
  - 2010 100 Gbps link Finland-Estonia

Future work

- New applications: Kurtosis spectrometer for RFI mitigation
  - Estimates which parts of signal are RFI and removes them
  - First results extremely promising
- Bit compression for high data rates streams.
- VLBI spectroscopy and VLBI space satellite tracking.