ST.PETERSBURG NATIONAL RESEARCH UNIVERSITY
OF INFORMATION TECHNOLOGIES, MECHANICS AND OPTICS
Laboratory of the
Network Technologies in Distributed Computing Systems

Big Data transfer over computer networks
Initial

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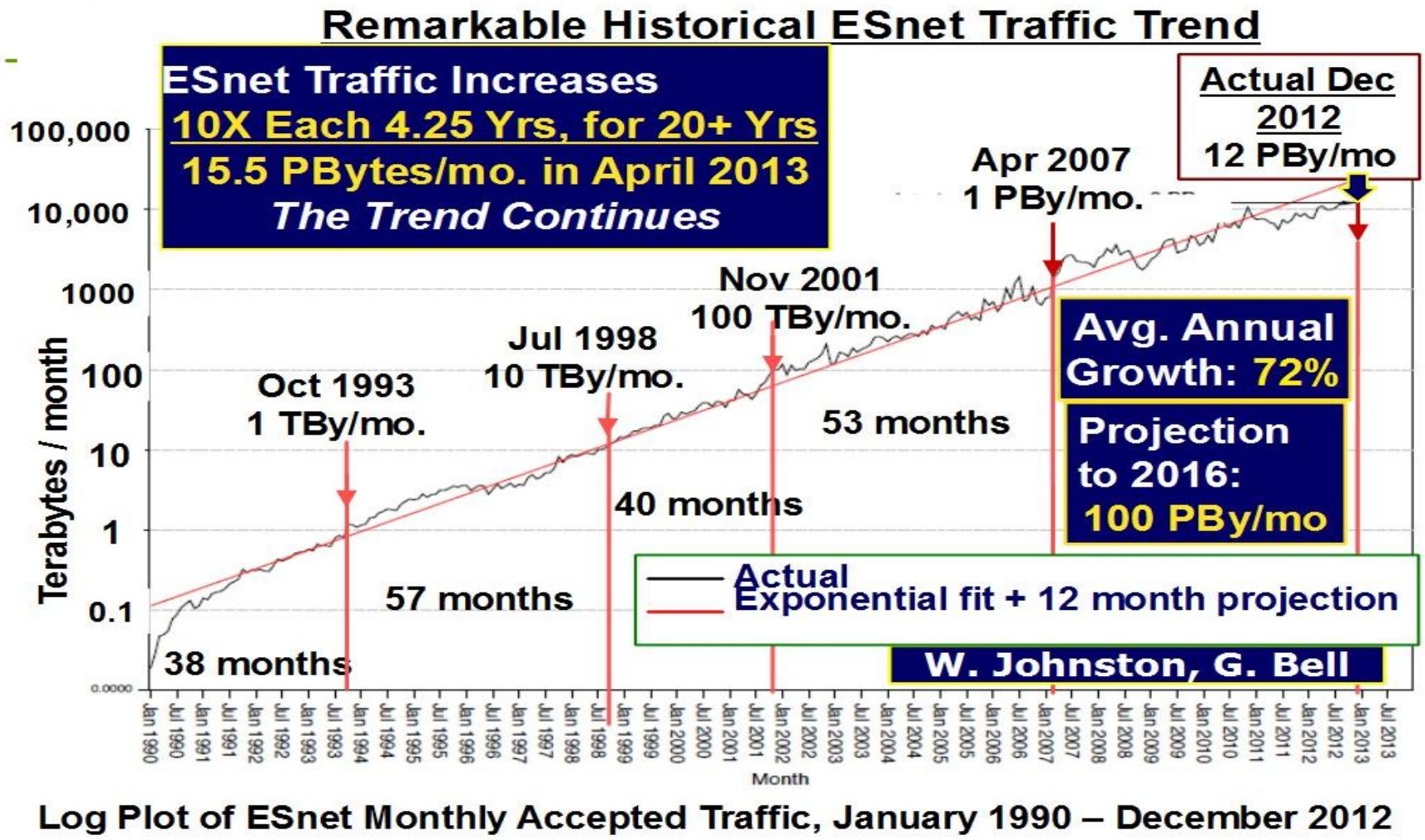
Outlook

- Sources of the Big Data.
- Ecosystem of the Big Data.
- Technology of the Big Data transfer.
- Our recently started research.

Network traffic growth

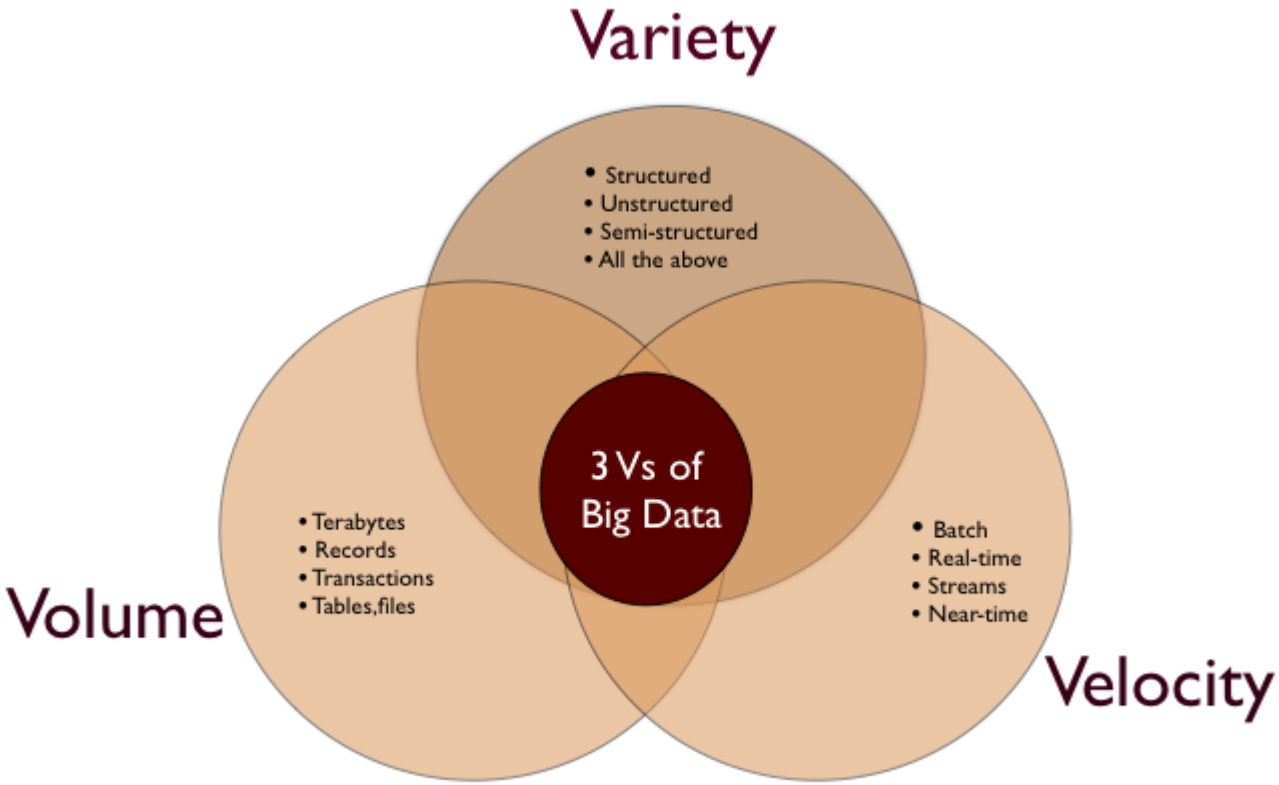


Log Plot of ESnet Monthly Accepted Traffic, January 1990 – December 2012

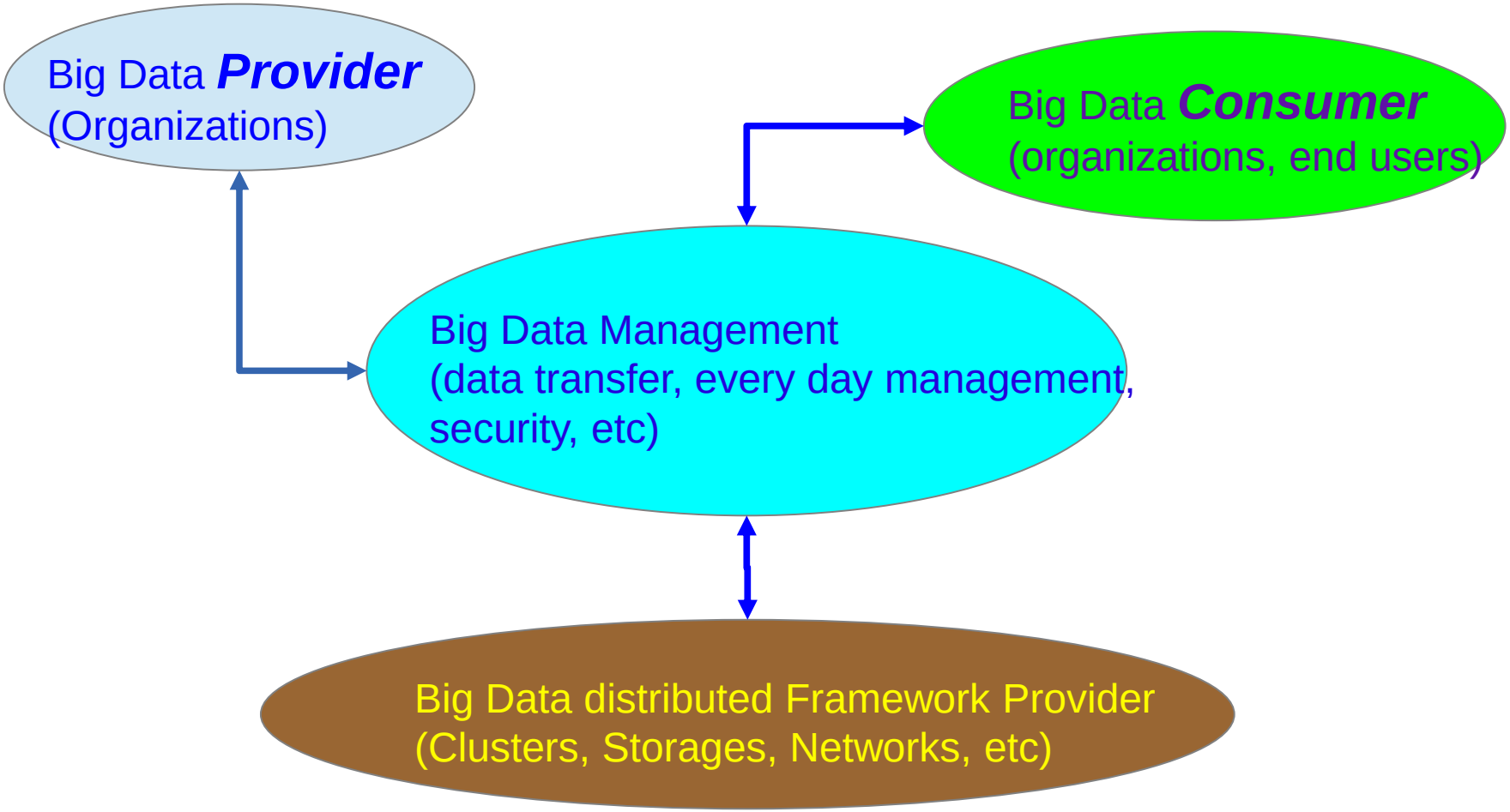
Scientific sources of Big Data

- **Scientific experimental installations**
  - http://www.lsst.org - **Large Synoptic Survey Telescope**
    - **15 TB per night (may be 10 PB/year)**
  - https://www.skatelescope.org/ - **Square Kilometre Array**
    - **300-1500 PB/year**
  - http://www.cern.ch — **CERN**
    - **~ 20PB/year (FAIR ~ same)**
  - http://www.iter.org - **International Thermonuclear Experimental Reactor**
    - **~ 1 PB/year**
  - http://www.cta-observatory.org/ - **CTA - The Cherenkov Telescope Array**
    - **~ 20 PB/year**

3 Vs of Big Data



Big Data ecosystem



Peculiarity of the Big Data transfer

- Big Data transfer might consume many hours or days.
- The situation in channel might be changed: RTT, % of lost network packages, data link bandwidth).
- Finally, it might occured the interruption (hours?, days?) in operation of data link .
- Obviously it is useful to have access to two or more independent data links.

Technology peculiarities with Big Data transfer

- Still main protocols — stack of TCP/IP.
  - Number of network parameters in Linux (around ½ thousand). /proc
  - -bash-4.1$ /sbin/sysctl -a | grep "^net\." | wc -l
    - Important parameters: e.g. size of block, size of TCP Window, etc. Main method to decrease the transfer time (even over one data link) is using the multi-stream data transfer.

Testing on the first stage (program tools)

- BBCP - http://www.slac.stanford.edu/~abh/bbcp/
- GridFTP - http://www.globus.org/toolkit/data/gridftp/
- BBFTP - http://doc.in2p3.fr/bbftp/
- FDT - http://monalisa.cern.ch/FDT/
- FTS3 - http://fts3-service.web.cern.ch/
- Also technology components to watch the data links status, e.g. perfSONAR.

Ideas to compare the data transfer tools

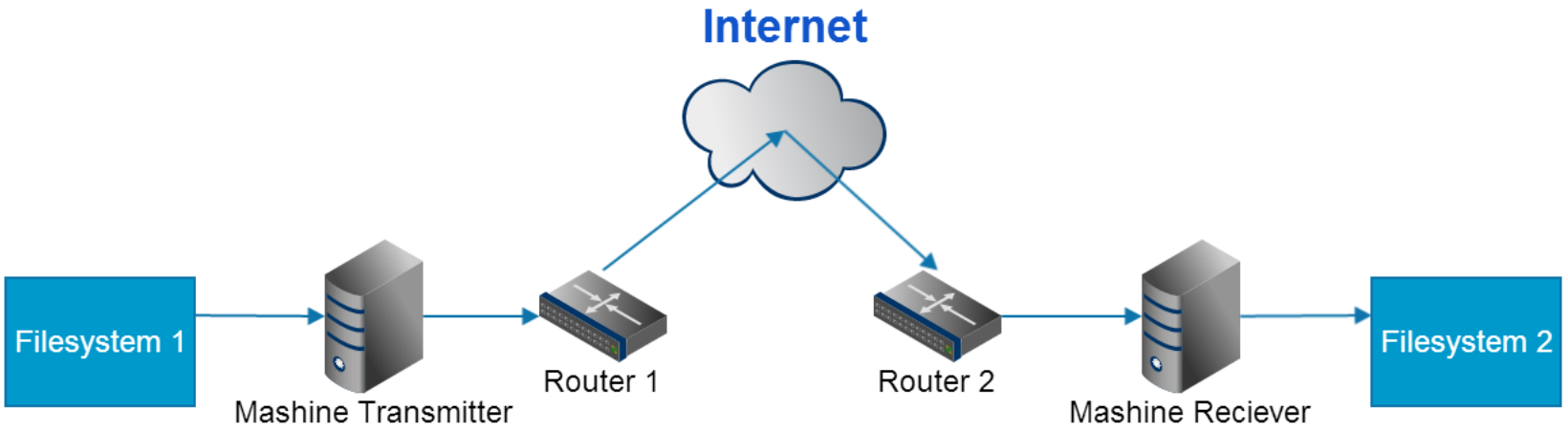
- Availability.
- API.
- Performance.
- Reliability.
- Operation tracking.
- Ability to predict the time to transfer the data on the base of existing tracking records.
- Required resources: memory, CPU time, etc.
- Others.

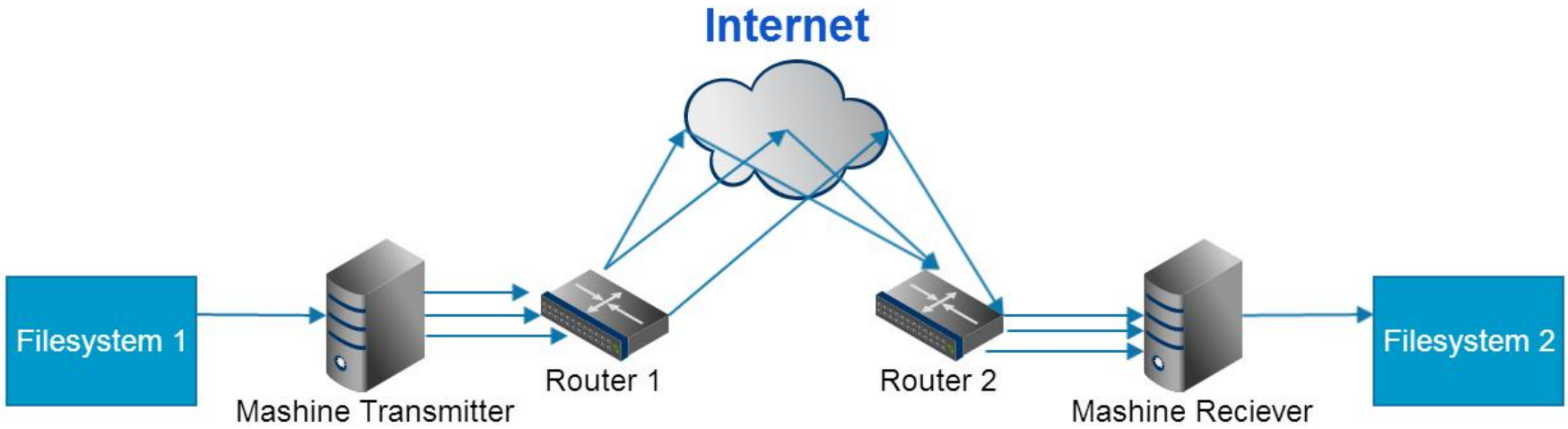
Research topic at ITMO University: the transfer of Big Data

In laboratory of network technologies http://sdn.ifmo.ru/ at ITMO University http://www.ifmo.ru/ the new research «Big Data transfer over Internet» has been formed .

- It is planned to implement the special testbed (100 TB of disk storage + server 96 GB of main memory under OS RedHat/ScientificLinux on each side).
  - Comparative study of the existing tools of the data transfer (testing and measurements).
  - To use the testbed as instrument to compare various tools (tracking for the measurements + results).
  - Extended automatic tracking information about measurements is under development.

Process of the Data transfer

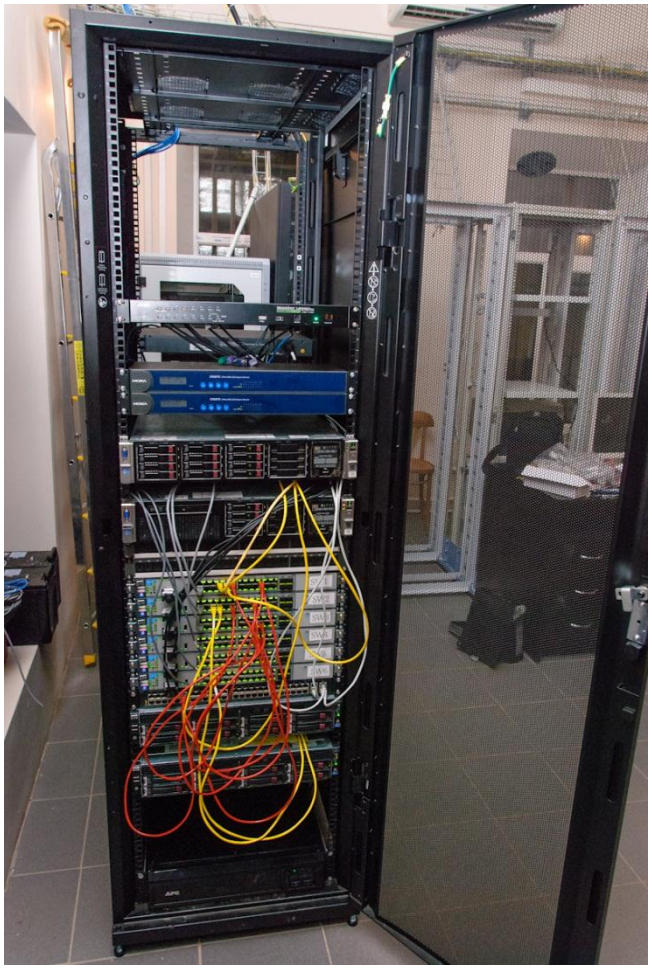




Planned measurements

- Local and long distant sites with existing data links (not only most advanced links).
- The idea is to use more than one data link in parallel.
- Recently we obtained some experience with Software Defined Networks (SDN) approach (*protocol Openflow*) and now we plan to use it in the Big Data transfer.

What was done until now



- **There were deployed**
  - Two servers HP DL380p Gen8 E5-2609, Intel(R) Xeon(R) CPU E5-2640 @2.50GHz, 64 GB under Scientific Linux 6.5.
  - Six HP-3500-24G-PoE yl (OpenFlow 1.0)
  - Pica8 P-3920 (OpenFlow 1.2)
  - Openstack Havana with appropriate set of Virtual Machines to test a number of mentioned utilities.
  - PerfSonar
  - Scripts for testing https://github.com/itmo-infocom/BigData

Main goals

- Combining the developed contemporary components and methods with ideas, developments, experience to achieve maximum speed for Big Data transfer on existing links.
- To create the testbed which would be used as place where researchers might compare theirs (new) tools for data transfer with earlier recorded measurement results.
- To sugggest the collaboration with … (suggestions?)
- To invite students from … (suggestions?)

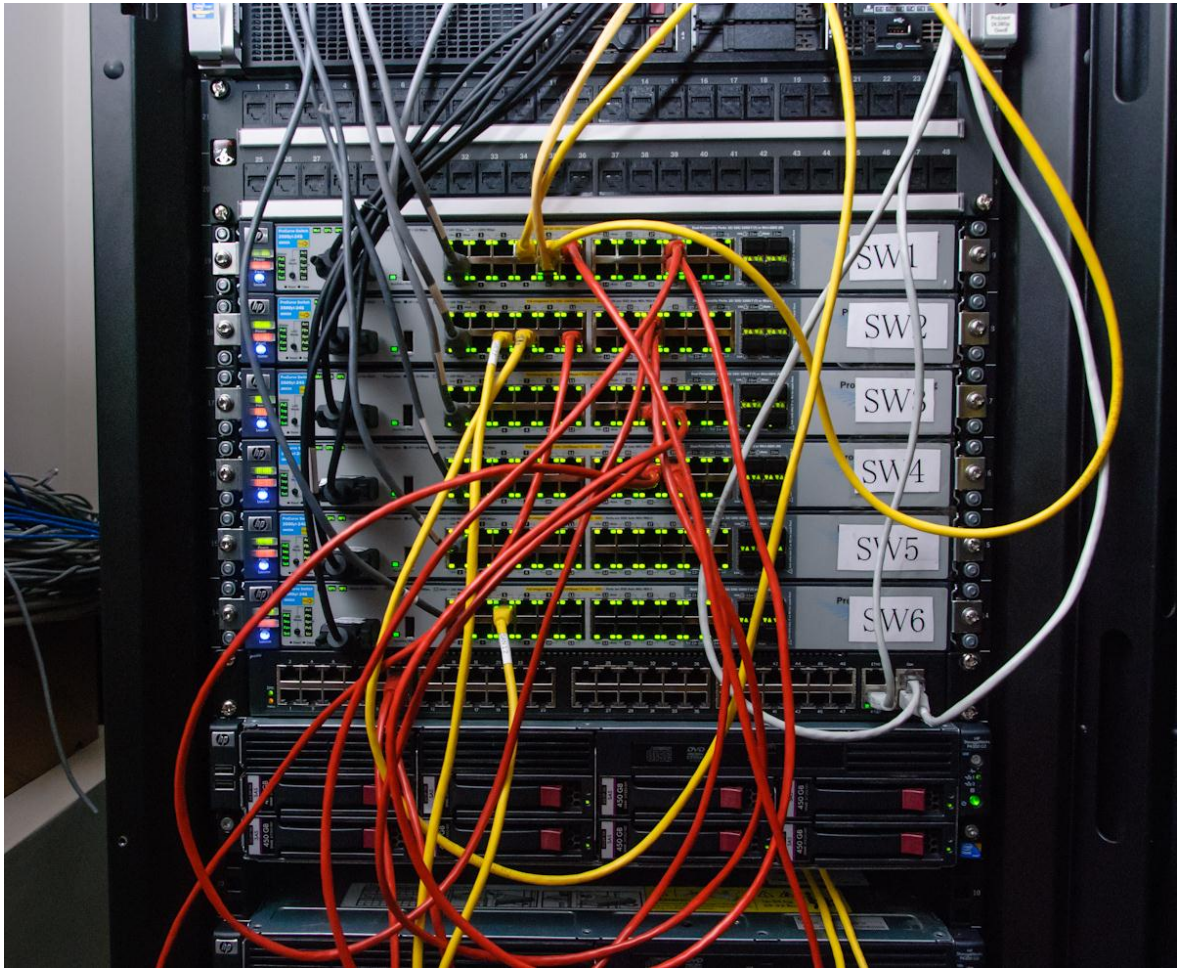
Partners (ideas exchange)

- Laboratory of Information Technology (LIT)
  http://lit.jinr.ru/index.php?lang=lat
  @ Joint Institute for Nuclear Research (JINR.ru)
- The Application Research Center for Computer Networks at Moscow University http://arccn.ru/
- We are starting to collaborate with GENI http://www.geni.net/

The work is supported by the Saint-Petersburg University of Information Technology, Mechanics & Optics (ITMO University www.ifmo.ru)

Questions?

OF Switches



bbcp

- TCP Window size;
- number of TCP streams;
- I/O buffer size;
- compression on the fly;
- multi-directory copy;
- resuming failed copy;
- authentication with ssh;
- using pipes, where source or/and destination might be pipe;
- special option to transfer small files;
- and many other options dealing with many practical details.

bbftp

- encoded user name and password at connection;
- SSH and Grid Certificate authentication modules;
- multi-stream transfer;
- big windows as defined in RFC1323;
- on-the-fly data compression;
- automatic retry
- customizable time-outs;
- transfer simulation;
- AFS authentication integration.

gridFTP

- two security flavors: Globus GSI and SSH;
- the file with host aliases: each next data transfer stream will use next host aliases (useful for computer cluster);
- pipes;
- special debugging mode to find bottleneck in data transfer;
- backend module name for source and destination sites;
- number of parallel data transfer streams;
- buffer size;
- restart failed operations and number of restarts.

Other utilities

- Xdd – utility developed to optimize data transfer and I/O processes for storage systems.
- fdp – Java utility for multi-stream data transfer;
- FTS3
- UDT
- RDMA
- MP TCP