JINR Networking Activities in 2012 - 2013

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Introduction

The years of 2012 and 2013 were the period of multiple networking activities fulfilled by LIT network team with the purpose to incorporate the advanced features into the networking engines, to further improve the JINR network features. All goals of the JINR network infrastructure remain the same over the long period of time and are listed in [1]. The main changes refer to hardware and software components of the network infrastructure, which become more and more sophisticated, demonstrating more and more advanced features, and providing more services for the JINR users. The following will illustrate the introduction.

The JINR LAN

The following works were made to strengthen the features and performance of the JINR network.

1. The JINR LAN backbone. In the "Scientific report 2010-2011" was pointed out that only three Laboratories LIT, DLNP, and LHEP had 10 Gigabit per second (Gbps) data rate. The second (and the final) phase to build the 10 Gbps JINR LAN backbone was completed in March of 2012. The rest of the JINR main divisions were equipped with 10 Gbps backbone switches: FLNP, FLNR, BLTP, JINR Administration. The Laboratory of the Radiobiology (LRB) became the ninth member of the JINR optical backbone with data rate of 1000 Mbps. The main goal of the both phases was the readiness test of the optical transceivers of the backbone switches installed in the JINR Laboratories to work with the backbone speed of 10 Gigabits per second. Thus the transfer rate of the data packets in the backbone was increased by 10 times due to installation of the new backbone Layer 3 switches Cisco Catalyst 3560 which were equipped with 10 Gbps interfaces. The previous value of the data rate in the backbone was 1000 Mbps or 1 Gbps, so it was hard to expect that all the optical components of the backbone would work correct. The undertaken connectivity tests have shown that not all segments of the optical lines were producing proper optical level of the signals or even were not at all transparent. In these cases the network engineers were making thoroughly cleaning or even have made replacement of the optical connectors and these activities were repeating multiple times until the tests of the fibers showed good results. But sometimes it was sufficient only to increase the radius of the fiber in an attempt to reduce energy losses in the optical cables.

Thus the all optical links were examined and adjusted to produce proper level of connectivity. And again we have to say that all the works were done in close cooperation with the network people in all JINR divisions to achieve the reliable work of the entire JINR LAN optical backbone.

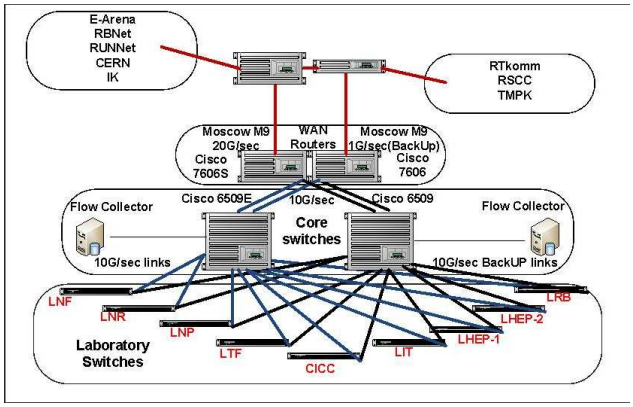

Figure 1: The diagram of the current JINR LAN structure

One can see in the Fig.1 the diagram of the current JINR LAN structure without detailing of the WAN structure in Moscow MSK-IX.

2. The JINR Administration network. A side effect of the implementation of ps.1 of this report became the possibility of the expansion of the Institute Administration access network. Thus some JINR minor divisions and home computers of the JINR scientific managers were connected to the administration network due to availability of the free 1000 Mbps optical ports on the Administration backbone switch.

The JINR-affiliated organizations the House of culture "Mir" and the hotel and restaurant complex management office received the access to the JINR Administration information data bases and Internet.

The new optical cabling. To be able to make the new connections in the JINR Administration network, the new optical communication lines have been laid. Laying of the fiber-optical cables in the ground or suspending them in the air does the department of technical communications in JINR. This department has also made the fiber-optical

cabling to the JINR-affiliated "Medical center 9"), the JINR-affiliated hotel "Dubna" (Veksler street), the hotel and restaurant complex management office and some other organizations: branch of the Moscow State University in Dubna, Dormitory for its students, JINR Library. Last three places are along Leningradskaya street.

The specialists of the department have worked out the conditions of the future laying of the optical cables to some of the objects in the Institute and near it: the JINR stadium, RSU – "RemStroyUchastok", the "Archimedes" swimming pool. The optical cabling for these JINR objects will be hopefully done in 2014.

3. "1C" project. The IT structure of the JINR divisions should conform to the requirements of the "1C" project. This project requires that from the network point of view the communication line speed should not be less than 100 Mbps. In fact all research divisions, that are located on the two JINR research sites, meet the demands, but it was not so in case of small divisions, widely spread across the two JINR sites and out of JINR. So the local network segments of already mentioned "UGRK", the JINR "ATX", and "RSU" were modified. The intelligent Ethernet switches were installed in every division; this type of switches can be monitored remotely by use of the specialized software, which will notify divisions' network administrators on the switches status and thereby will help to increase up time of the network segment of a particular division. This way "1C" software become capable to communicate with its' peripheral clients in the Laboratories and Divisions of the JINR.

4. Wi-Fi service. In many JINR buildings (HS, ICH, JINR Administration), in the Laboratories (LIT, DLNP) were deployed Wi-Fi wireless services. Soon all of the available in JINR wireless access points will be configured to operate in one domain named "jinr". Besides JINR sites Wi-Fi service is also available in the hotels and in Ratmino facility.

5. The JINR WAN. The JINR WAN (Wide Area Network) equipment installed in the Moscow Internet Exchange MSK-IX facility, were relocated to the better place to have more efficient cooling and more reliable electric power supply. This more comfortable environment will allow us to organize the center of the communications with the JINR infrastructure as for scientific, as well for business organizations in Moscow taking into account the future JINR interests.

One of the most important results of this period of time is the increase of the backup channel bandwidth from 450 Mbps to 1 Gbps in the initial phase and in the near future up to 10 Gbps.

The Dubna Exchange. Also it is necessary to mention the growth of the number of participants of the Dubna-city traffic exchange. Were added some organizations: Lanoptic (Kimri), Svjaz-stroy (Dubna), University of Dubna (Dubna).

Networking for the Central Information & Computing Complex

Tier-1 backbone + CERN OPN (Fig. 2 & 3)

The nearest challenging goal for the JINR IT specialists is the creation of the Tier-1 backbone which will be connected to CERN OPN (Optical Private Network). LIT IT specialists are carefully worked this task. First, the 2 Gbps test channel was raised to simulate the data streams in and out with the purpose to estimate the problems of the existing equipment for the Tier-1 design. Second, the different vendors' solutions were investigated. Among these vendors are Brocade, Cisco Systems, Extreme Networks, Juniper Networks, and Huawei Technologies. Networking approaches of these different in very many aspects companies were closely examined [2]. Also were considered the different backbone types of a data center (the star-like, the tree-like, and the Ethernet fabric), as well as different Layer 2 communication protocols M_LAG, Trill, vPC (virtual Port Channel). The solutions for Tier-1 projects in some research centers were thoroughly studied.

The final decision was made in favor of Brocade as a platform for internode switch with Ethernet fabric and Trill protocol. Blocking capability or oversubscribtion should be not less than 1:3 by the year of 2015.

TRansparent Interconnection of Lots of Links (TRILL) is an *Internet Engineering Task Force* (IETF) protocol standard that uses Layer 3 routing techniques to create a large cloud of links that appear to IP nodes to be a single IP subnet. It allows a fairly large Layer 2 cloud to be created, with a flat address space, so that nodes can move within the cloud without changing their IP addresses, while using all the Layer 3 routing techniques that have evolved over the years, including shortest paths and multipathing [7].

Thus the selected equipment will allow JINR Tier-1 infrastructure fit into LHCOPN through two independent optical 10 Gbps links one of which goes to the Tier-0 CERN directly and the other goes through the Kurchatov Institute (KI).

In the Fig.2 one can see the diagram of the LHCOPN communications between JINR, KI, and CERN, including e-arena facility in Moscow.

Should be noted about the agreement with RETN – International telecommunications network provider — to raise two 10 Gbps fiber optic channels in 2013 for the Tier-1 project in Russia. The 1-st

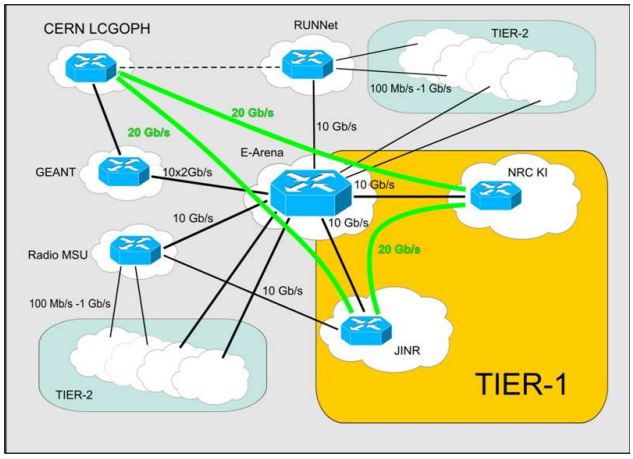

Figure 2: The diagram of the LHCOPN communications between JINR, KI, and CERN, including e-arena facility in Moscow

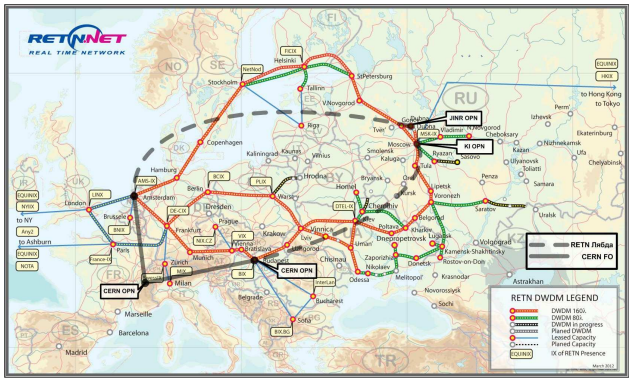

Figure 3: Topology of the route, as one of the possible ways, what was determine in collaboration with RETN

channel will go from JINR to Budapest, and the 2-d one — from Kurchatov Institute (KI) in Moscow to Amsterdam, then from these two cities communication channels have to be arranged over CERN optical fibers. The presented scheme provides reliable solution for both parties as for JINR as well for KI.

Topology of the route, as one of the possible ways, what was determine in collaboration with RETN, is shown in the Fig.3.

Tier-2 backbone

The year of 2012 was a very important milestone in the development of the CICC network backbone after some years of work because the decision was made to use optic communications instead of copper lines. Four 1 Gbps copper lines were replaced with two optic links of 10 Gbps each. And in general the architecture of the node was worked out to be presented by the new pieces of equipment, new cabinets, and finally new modules. The change of the data transfer media has demanded to reconfigure network software, relating to available VLANs, data trunks, etc. All changes done are consistent with the development of the overall data processing system.

Central Telecommunication Node in LIT: changing of the location

In 2012 the JINR Central Telecommunication Node in LIT has changed its location: the equipment racks, the optical and UTP communication panels, routers, switches, and network servers were moved to the room 219, which is informally called "Second Floor Computer Hall". The reasons for this event are tree "NO": there is *NO* available free space to accommodate the old but still working equipment and the new networking equipment (14 servers), the devices of uninterrupted power supply (two 16 kw Symmetra cabinets) in the room 215, then 2-d "*NO*": there is no enough power of the cooling system (in the room 219 there is much more space to install powerful cooling system), and 3-d "*NO*": There is no proper electric power supply system and again no required free space to install the necessary power system.

The relocation was done in two steps very quickly with no loss of time because it was planned very carefully, and all preliminary works were done in advance. The above mentioned new servers were acquired in the end of the year and have not yet configured for the network services. Currently they are studied and are being tested.

The Network Services

The LIT network team supports all of the services described in the former yearly reports [3-6]. List of the services for the users can be changed with time along with changing of users' personal tasks and demands. But there are system services, such as routing, switching, security, accounting, authorization, authentication, DNS, DHCP should be always available for all users, should be part of the system, running in non-stop mode.

Last few years more and more popular become videoconferencing and voice over IP. These two types of services are used by the increasing groups of users.

Here we'll talk of the video and videoconferencing. Videoconferencing is the conduct of a video conference by a set of telecommunication technologies which allow two or more locations to communicate by simultaneous two-way video and audio transmissions. It has

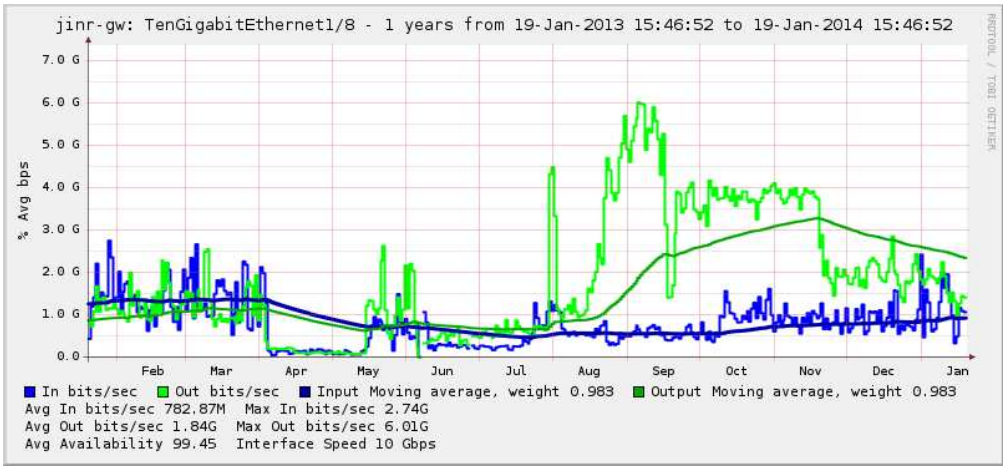

Figure 4: The diagram of the external data traffic distribution

also been called 'visual collaboration' and is a type of groupware. Our choice for this service is Cisco/Tandberg MCU (*MCU – Multipoint Conference Unit*) Codian 4505. The Codian 4505 server is capable to provide videoconferencing service based on the *users' categories*: some users will work with personal videoconferencing systems, some users will be united in groups, and the third part will use own notebooks with client program installed. And also we have an opportunity for viewing of the stream video and recording of the video conferences with the possibility to view recordings of the video conferences by using of the "JINR Content Server" service built on new hardware of the "Cisco TelePresence Content Server". In ICH, SH, in LIT videoroom 310 were installed Tandberg Edge 95 MXP and Tandberg C20 video-conferencing system parts be used as the end-stations.

Electronic Libraries Access as a Service

There are 1210 user accounts in total registered in JINR. In average there are 360 users' queries per month. In 2013 approximately 48 gigabytes of the electronic library articles were downloaded by all registered users (4 gigabytes per month for all or 8 Mbytes per user).

Statistics based on IPDB and NMIS

The most interesting statistical data related to the networking can be seen below. These data are withdrawn from IPDB and NMIS packages. Fig. 4 shows the complete picture of incoming and outgoing traffic, relating to the clients of the JINR network by the end of 2013.

Traffic values derived from the IPDB. The traffic for the most populated categories is shown in Table 1. Incoming and outgoing traffic, and percentages for each registered category are shown in this table. And finally the total traffic distribution by years beginning from 2005 is shown in Fig.5.

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Table 1: The external channel traffic statistics by categories for 2013

N	Category	Name	Incoming (IN)	Outgoing (OUT)	% IN	% OUT
1	Scientific & educational organizations	SCIENCE	1244.22 Tb	2151.33 Tb	91 %	93.72 %
2	File Exchange (p2p)	P2P	95.46 Tb	139.58 Tb	6.98 %	6.08 %
3	Web resources	WEB	17.01 Tb	3.78 Tb	1.24 %	0.16 %
4	Social networks	SOCIAL_NET	9.46 Tb	185.17 Gb	0.69 %	0.01 %
5	Multimedia Broadcasts	MM_STREAM	797.72 Gb	46.89 Gb	0.06 %	0 %
6	Software	SOFTWARE	388.76 Gb	437.42 Gb	0.03 %	0.02 %
7	Dubna Exchange	DUBNA	23.13 Gb	99.12 Gb	0 %	0 %
Total:			**1367.33 Tb**	**2295.44 Tb**	**100 %**	**100 %**

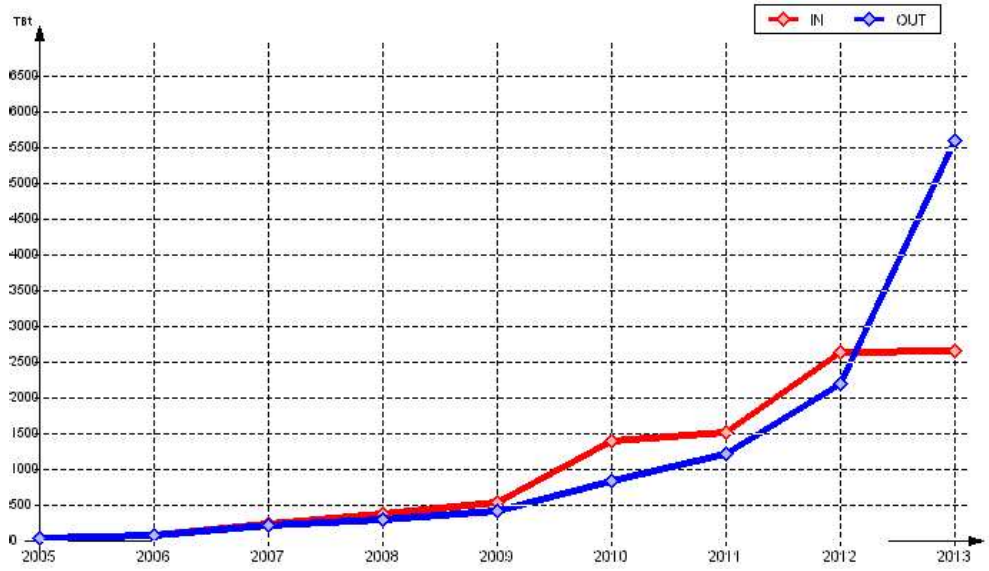

Figure 5: The 2005-2013 total traffic in terabytes

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