Networking Infrastructure at Tbilisi State University

Development of telecommunications is becoming widely exploitable in every sphere of our live. It is especially significant in scientific-education fields. Consequently, it has been outlined in Ivane Javakhishvili Tbilisi State University (TSU) Development Strategy as a high priority.

Development of network technologies significantly increases the costs for investments and its maintenance. Optimal choice of the network costs is possible only through detailed planning of network infrastructure, technical decision-making during the projecting process and its realization, protecting the exploitation conditions and modernizing the network infrastructure. The increase of the network users is usually associated with the decrease in its performance, caused by the increased demand on limited resources. This in turn affects working efficiency of the organization.

Bearing in mind the demand on expanding the network infrastructure, increase in the number of computers that overloads the network and increases security risks, modernization of the TSU network seems vitally important. As a result, it is necessary to configure and upgrade the network by using modern technologies in order to preserve stability of the network and guarantee its security. Relevant technical facilities should be selected from among the network technologies that are highly demanded on the market and acknowledged by the users and professionals in the field.

Corporate local network consists of several hierarchical levels: a plug in switch which is connected with distribution switch through high speed channels. Usually this is a fiber optic cable.

Network security should be one of the major priorities for any organization or a company. To guarantee the security of a local network it is necessary to choose firewalls that predominantly determine the conditions according to which outer servers or users are linked with the central network and also to prevent unauthorized and unwanted links with the server.

The upgrade of the network will facilitate to promotion of full integration of IT technologies into the teaching and learning process. This will allow for installation and adaptation of e-learning and distance learning equipment on the premises of TSU and further application of these tools to the teaching and learning process. The main results of these processes will:

- Help faculty staff members realize their ideas for developing e-learning resources and courses.
- Encourage the students by providing the resources with accessibility elsewhere.
- Encourage the teaching and learning methodology upgrade to modern standards.
- Contribute to research and publication locally and internationally.
- Raise the general skill level in relation to IT tools and techniques amongst as many members of each department as possible and thus encourage a sustainable model for future support and embedding of IT into the teaching and learning process.
- Facilitate the local faculty and administration to make use of various distance learning and e-learning capacities.

Assessment of the existing networking facilities

Nowadays the computer network of TSU comprises 2 regions (Vake and Saburtalo). Each of these two regions is composed of several buildings (the first, second, third, fourth, fifth, sixth and eighth in Vake, and Uptown building (tenth), institute of applied mathematics, TSU library and Biology building (eleventh) in Saburtalo). Each of these buildings is separated from each other by 100 MB optical network. The telecommunication between the two regions is established through Internet provider the speed of which is 1 000 MB.
Please see fig. 1.

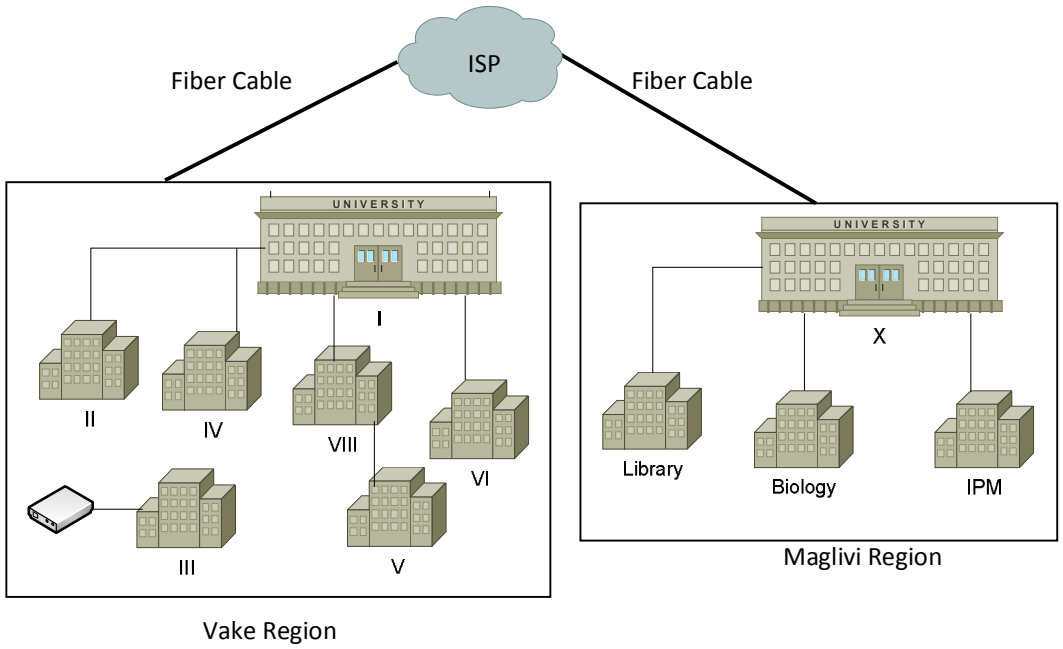

Figure 1

Servers and controllable network facilities are predominantly located in Vake region network. Electronic mail, domain systems, webhosting, database, distance learning and other services are presented at TSU. Students, administrative staff members and academic staff members, research and scientific units at TSU are the users of these servers. There are 5 Internet resource centers and several learning computer laboratories at TSU. The scientific research is also supported by network programs. Total number of users is 2500 PCs. The diversity of users is determined by the diversity of network protocols, and asks for maximum speed, security and manageability of the network.

Initially, the TSU network consisted only from dozens of computers that were scattered throughout different faculties and administrative units. Besides, there was no unified administrative system, mechanisms for further development, design and implementation. This has resulted in flat deployment of the TSU network. This type of network:

- Does not allow setting up of sub-networks and Broadcast Domains are hard to control.
- Formation of Access Lists of various user groups is complicated.
- It is hard to identify and eliminate damages to each separate network.
- It is almost impossible to prioritize the traffic and the quality of service (QOS).

Because there is no direct connection between the two above-mentioned regions it is impossible to set up an IntraNet at TSU. In the existing conditions it would have been possible to set up an IntraNet by using VPN technologies. However, its realization required relevant tools equipped with special accelerators in order to establish the 200 MB speed connection. This is the equipment that TSU does not possess.

The reforms in learning and scientific processes demands for the mobility and scalability of the computer network. It is possible to accomplish by using VLAN technologies, however in this case too absence of relevant switches hinders the process of implementation.

In order to eradicate the above-mentioned problems and improve the communication network we worked out a network typology that needs special network equipment: Switches, Routers, Firewalls, Converters, Patch Cords, GBIC.

The products of the company Cisco - a leading supplier of networking equipment and network management tools for the Internet were identified as optimal for TSU networking infrastructure.

The Cisco plug-in switches provide ports for a large number of users to connect with 2 uplinks. These switches support various functions like VLANs, 802.1q trunks, 802.1 p Cos, 802. 1 spanning tree etc. However, the major role is given to the central and distribution Switches- because of the third level routing, termination of VLANs and control of network and transportation levels.

Cisco Catalyst 3560 series Switches are next-generation energy-efficient Layer 3 Fast Ethernet switches. These new switches support Cisco EnergyWise technology, which helps companies manage power consumption of the network infrastructure and network-attached devices, thereby reducing their energy costs and their carbon footprint. 3560 series is an ideal solution for corporate network management, because it increases and maximizes the productivity and provides investment protection.

Cisco 3845 routers support for over 90 existing and new modules, have integrated GE ports with copper and fiber support, support up to 2500 VPN tunnels, have Cisco IOS Firewall support and many more essential security features. In addition, they can support Survivable Remote Site Telephony support for local call processing.

For Firewall security reasons Cisco ASA 5520 was selected. It prevents unauthorized network intervention and controls network activity and applications, provides secured and protected interconnection among the network components. As a result we receive multifunctional and strong equipment that implements in-depth protection to all size business networks. It also reduces the projecting and operational expenses accompanied by a large-scale configuration for security reasons.

Characteristics, nature and type of data to be exchanged and rate of transfer

Implementation of this topology will enable us to expand and improve the services that are widely used by universities and research oranization throughout the world.

- Internet services: Web, FTP, SMTP, IMAP, POP3
- Monitoring attendance of the TSU staff members at work, accomplished through UDP protocol.
- Providing security service through IP cameras.
- Distance connection and videoconference service tools, implemented by H323 protocol.
- The bank client service implemented through VPN connections.
- Network management and monitoring service SNMP and NetFlow protocols.

This project envisages accomplishing the following - to increase the connection speed between the TSU building I and other buildings (the first, second, third, fourth, fifth, sixth and eighth) in Vake region up to 1 GP. Currently only TSU buildings I and II are supported with this type of service, however it is recommended to upgrade it by double GBIC modules.

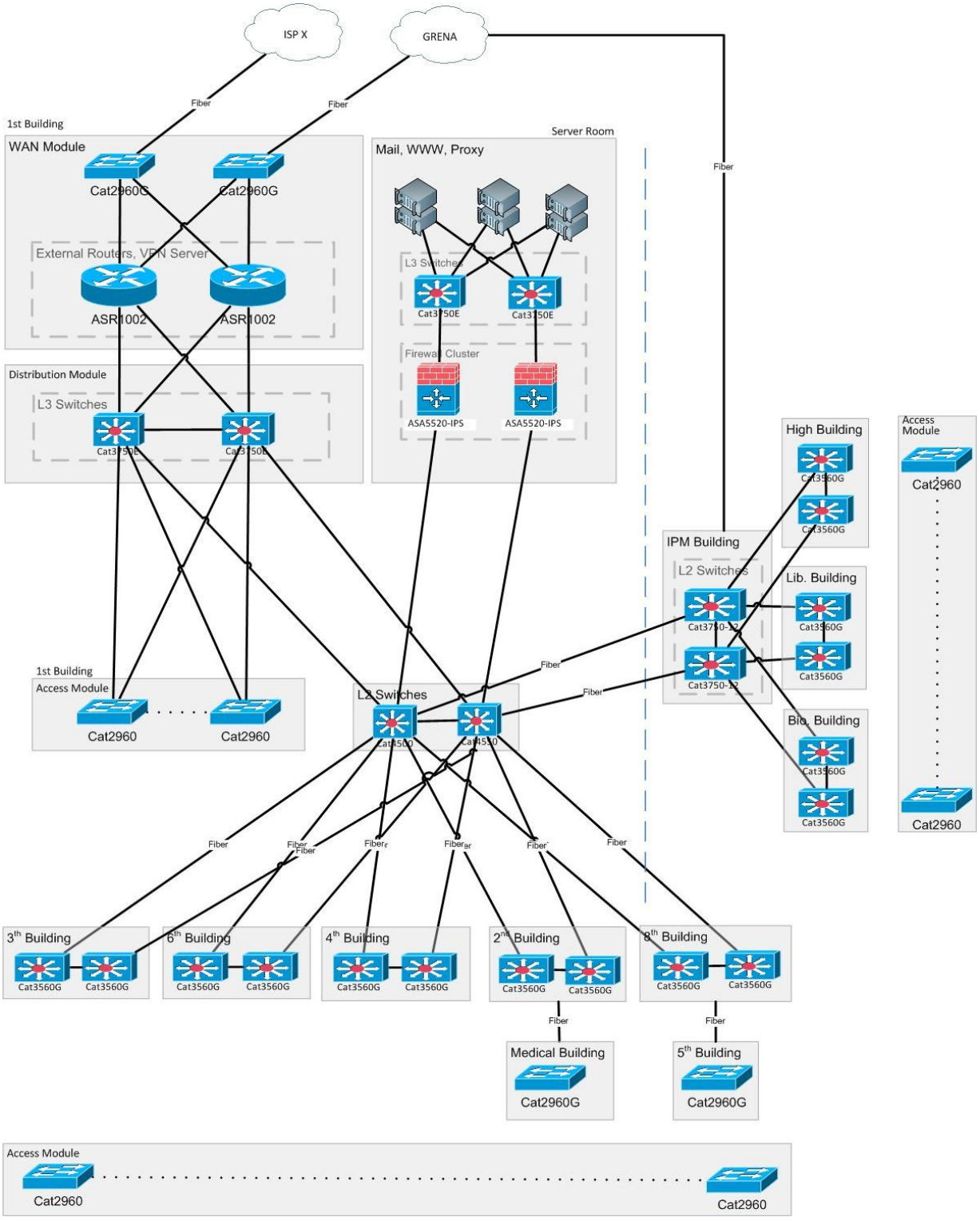

Figure 2. Schematic view of Tbilisi State University Network

1a. to accomplish this, Cisco Catalyst 3750 Multilayer Switch will be installed with Gigabit Interface Card (GBIC) and this Switch will distribute local network and Internet among the Cisco Catalyst 3560 Switches in stalled in the TSU buildings II, IV, VI, VIII.

1b. Cisco Catalyst 3750 will be installed in server rooms at TSU Uptown building and the institute of applied mathematics and local network and Internet will be distributed among Cisco Catalyst 3560 GBICs in TSU Uptown building, TSU Library and Biology building.

1c. to establish GB connection between the TSU building 8 and 5, a 24 port Cisco Catalyst 3560 Switch will be installed in room 45 of TSU building 8 that will be connected with 48 port Cisco Catalyst 3560 Switch GBIC in room 145 at TSU building 5. In all TSU buildings where central Switches are installed Intranet and sub networks will be implemented.

2a. The 24 port Cisco Catalyst 3560 Switch installed in room 66 will connect network cables with 4X24 and 5X48 port Switches on 1, 2, 3, and 4th floors of TSU building 2. AIR-AP1252G-E-K9 Wireless Router will be installed at the Resource Center.

2b. The 12 port Cisco Catalyst 3560 Switch installed in room 20 of the TSU building 4 will connect network cables with 12 ports Switch on the 4th floor of TSU building 4. Free ports from both Switches will be used to link the computers in all four floors of the TSU building 4.

2c. The 12 port Cisco Catalyst 3560 Switch installed in room 8 of TSU building 6 will connect network cables with 12 ports Switch on the 4th floor of TSU building 6.

2d. The 24 port Cisco Catalyst 3560 Switch installed in room 45 of TSU building 8 will connect network cables with 24 port Switches installed on the 1st and 3rd floors of TSU building 8. Free ports of the three Switches will be used to link the computers in the building.

2e. The 48 port Cisco Catalyst 3560 Switch installed in room 145 of TSU building 5 will connect network cables with 48 port Switches on the 1st and 3rd floors of TSU building 5. Free ports of the three Switches will be used to link the computers in the building.

2f. The 48 port Cisco Catalyst 3560 Switch installed in room 15 of TSU building 3 and its free ports will be used to link the computers in the building.

2g. The 24 port Cisco Catalyst 3750 Switch installed in Server room of the Institute of Applied Mathematics will connect network cables with the 24 port Switches on the 1st floor, and 2nd,4th,7th,8th,9th, and 11th floors of TSU Uptown building. Free ports of all these Switches will be used to connect the computers and network equipments installed in the buildings. AIR-AP1252G-E-K9 Wireless Router will be installed at three Resource Centers of TSU Uptown building.

2h. The 48 port Cisco Catalyst 3560 Switch installed in room 305 of TSU building 11 will connect network cables with 24 Cisco Catalyst 3560 Switches on the 2^{nd,} 3rd and 4th floors of TSU building 11. Free ports of these Switches will be used to link computers in the building. AIR-AP1252G-E-K9 Wireless Router will be installed at the Resource Center.

2i. The 24 port Cisco Catalyst 3560 Switch installed in room 505 of TSU library will connect the computers in the building.

3a. CISCO3845-SEC/K9 router will be installed in the server room of TSU 1st building to connect with the Server and to filter the traffic in ASA5520-CSC10-K9 firewall server network.

3b. CISCO3845-SEC/K9 router will be installed in Server room of TSU Institute of Applied Mathematics to connect with the Server and to filter the traffic in ASA5520-CSC10-K9 firewall server network.

Overview of expected results

With all above-said, through implementing all of the devices we will have a centralized, high speed, secured and optimized network system.

- **Improving TSU informatics networks security** - traffic between the local and global networks will be controlled through network firewalls. The communications between sub-networks will be established through Access Lists.
- **Improving communication among TSU buildings** - main connections among the ten TSU buildings are established through Fiber Optic Cables and Gigabit Interface Converters (GBIC). This facilities increase the speed of the bandwidth up to 1 GB.
- **Improving internal communication at every TSU building** - internal communications will be established through third-level multiport switches that will allow to maximally reducing the so- called Broadcasts by configuring local networks (VLAN). The Bandwidth will increase up to 1 GB.
- **Providing the network mobility and management** - In administrative terms, it will be possible to monitor the general network performance as well as provide the prioritization analysis for each sub-network, post or server.