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Internet, network and computing services

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Abstract.
The Astronomical Institute of the Slovak Academy of Sciences began using the internet in 1994. A historical overview, together with the perspective for the future and a list of the most important services, is given to document the advancement of these activities.

Within the frame of the project "Centre of space research" a broadband interconnection of the partnership institutions mountain observatories at Skalnaté pleso and Lomnický štít has been realized. This fast and high-quality connection enables to deploy demanding network applications of the project.
Key words: internet – network services – broadband connection

1. History

Astronomy has always been rich in sudden events such as discoveries of new comets, novae, supernovae. That is why the ability of a swift communication played such an important role here. A couple of years ago telegram or telex were widely used. Nowadays the internet dominates.

The history of the internet at the Astronomical Institute of the Slovak Academy of Sciences (AI) is illustrated by the following list of the most important moments.

- 1991: the UUCP connection (just e-mail) to the Slovak Academy of Sciences network node in Bratislava,
- 1994: internet connection,
- July 23, 1994: NSF (USA) connectivity,
- 1994: domain ta3.sk registration,
- 1994: beginning of SANET node in Tatranská Lomnica,
- 1996 – 1998: first attempts to interconnect the mountain observatories at Skalnaté pleso (SP) and Lomnický štít (LŠ) with the AI main building in Stará Lesná (SL) using radio bridges,
- March 26, 2003: interconnection via a radio bridge to the network SANET II in Poprad, speed 10 Mbps,
- July 26, 2004: interconnection of the Skalnaté pleso observatory to the AI building at Stará Lesná via a radio bridge (CISCO Aironet 340 Series),

speed 11 Mbps. The previous triangle topology (LŠ-SL-SP) was replaced by two connections: LŠ-SL (2 Mbps) a SL-SP (11 Mbps),

- May 02, 2005: interconnection via a radio bridge to the network SANET II in Poprad, speed 34 Mbps; frequency 18 GHz,
- October 25, 2005: interconnection of the Lomnický štít observatory to the AI building at Stará Lesná via a radio bridge (CISCO Aironet 340 Series), speed 11 Mbps,
- January 12, 2006: VoIP: ISDN line to PSTN, new telephone numbers for AI +421/52/78791xx,
- January 14, 2006: VoIP: DNS ENUM records for the telephone numbers of AI, the authority delegated to the local DNS server,
- January 19, 2006: VoIP: CISCO 2801 was installed as a gateway to the Slovak Telecom PSTN,
- June 18, 2007: interconnection of the Catholic university in Poprad via a radio bridge to the Družba building in Poprad and the SANET CISCO router,
- August 2007: reconstruction of the servers room (data center), new racks, air-condition,
- February 29, 2008: interconnection of the G2 building to the LAN at the G1 building via a radio bridge ARLAN/CISCO,
- October 2008: optical fiber cable from G1 to the horizontal solar spectrograph building,
- November 25–27, 2009: redundant air-conditioner Toshiba installation in the data center,
- April 2010: backup radio connection tothe Lomnický štít observatory for the Institute of Experimental Physics installed, public band 5 GHz,
- April 29, 2010: the installation of a DELL optical switch in the data center as the main LAN switch, optical network cards, optical modules for the router and 3com switch,
- **May 26–27, 2010: the installation of the radio interconnection Stará Lesná – Lomnický štít and Stará Lesná – Skalnaté pleso**, company SWAN, private radio band, speed 35 Mbps,
- July 19, 2010: an upgrade of the radio interconnection to the SANET II network backbone in Poprad, speed 54 Mbps; frequency 18 GHz.

The establishment of the SANET - Slovak Academic Network (SANET; Kohút, 2007)- node had a great significance. Since that moment the Astronomical institute has been fully integrated into the academic network world in Slovakia. All internet services are available and, moreover, our network node can provide these services to other local academic, or non-profit subjects.

From this list one gets an idea about the need of a permanent improvement of the existing hardware (HW), means of network connections, etc. to be able to provide modern and reliable services.

2. Broadband interconnection of the mountain observatories

2.1. Reasons and implementation

Facing the growth of data obtained at the mountain observatories - switch to the CCD photometry, providing on-line services (the Lomnický štít neutron monitor http://neutronmonitor.ta3.sk/) and intended further development of these observational stations, it was necessary to provide a failure-free fast connection to the AI local area network (LAN) and the internet as well. This kind of connection enables to supply the observatories with the precise and reliable time which is required by every astronomical observation.

Moreover, the radio interconnection working till 2010 was realized by devices using the public radio band. This band, given a dramatic growth of its users, failed to be a reliable way of connection.

At the same moment the radio interconnection is the only possible way of connection. There is no optical fiber cable in the Skalnatá valley nowadays, the old metallic cables are not used any more by the telephone provider, and their reliability has always been problematic. Due to a large direct distance (~ 7 km) the laser deployment is unsuitable as well. The situation with the Lomnický štít observatory is even worse. These were the reasons leading to the decision to realize a new radio interconnection working in a private radio band, providing not just a much higher speed, but reliability as well.

2.2. Technical specifications

In the period of May 26–27, 2010, the company SWAN realized an installation of radio devices. After configuration, they were put into operation. The Lomnický štít and Skalnaté pleso observatories are connected to the AI main building via two independent interconnections.

NEC Pasolink Neo CPV16 (NEC Pasolink Neo) devices are used for the interconnection. Wattage 25 W, frequency 23 GHz, speed 34 Mbps. It is monitored by means of SNMP and is transparent to all network protocols.

The outer antennas of the installed radio interconnection on the AI main building in Stará Lesná and the observatory at Skalnaté pleso are depicted in Fig. 1.

2.3. The Result

The real parameters of the new radio interconnection have been tested by means of the code nttcp. This code measures the actual connection speed (memory to memory) between two distant computers connected via the tested interconnection. The results can bee seen in Fig. 2, which illustrates the situation before (the old radio interconnection working in the public band) and after the installation.

Figure 1. The antennas of the new radio interconnection at the main building in Stará Lesná and the observatory at Skalnaté Pleso.

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================================ B E F O R E ===============================
Mon Dec 28 14:03:54 UTC 2009
     Bytes  Real s   CPU s Real-MBit/s  CPU-MBit/s   Calls  Real-C/s   CPU-C/s
1  8388608   35.26    0.01      1.9030   5593.3376    2048     58.08  170695.1
1  8388608   36.03    0.14      1.8624    482.8705    5376    149.19   38682.1

Mon Dec 28 14:04:45 UTC 2009
     Bytes  Real s   CPU s Real-MBit/s  CPU-MBit/s   Calls  Real-C/s   CPU-C/s
1  8388608   21.17    0.02      3.1700   3355.9466    2048     96.74  102415.4
1  8388608   21.86    0.11      3.0702    588.7672    5590    255.74   49042.8

Wed May 26 14:30:54 UTC 2010
     Bytes  Real s   CPU s Real-MBit/s  CPU-MBit/s   Calls  Real-C/s   CPU-C/s
1  8388608   46.63    0.03      1.4391   2033.9101    2048     43.92   62070.0
1  8388608   46.89    0.14      1.4312    476.0203    5446    116.14   38629.9

Thu May 27 08:53:39 UTC 2010
     Bytes  Real s   CPU s Real-MBit/s  CPU-MBit/s   Calls  Real-C/s   CPU-C/s
1  8388608   20.37    0.03      3.2946   2397.1732    2048    100.54   73155.9
1  8388608   20.70    0.07      3.2425    919.4381    5597    270.43   76682.8

================================ A F T E R =================================
Thu May 27 11:55:22 UTC 2010
     Bytes  Real s   CPU s Real-MBit/s  CPU-MBit/s   Calls  Real-C/s   CPU-C/s
1  8388608    1.70    0.03     39.3813   2485.8818    2048   1201.82   75863.1
1  8388608    1.72    0.06     39.0047   1137.6119    5655   3286.78   95862.1

Tue Aug 31 22:40:13 UTC 2010
     Bytes  Real s   CPU s Real-MBit/s  CPU-MBit/s   Calls  Real-C/s   CPU-C/s
1  8388608    1.71    0.03     39.2521   2397.0876    2048   1197.88   73153.3
1  8388608    1.72    0.07     38.9870    919.4255    5551   3224.86   76051.5

Wed Oct  6 17:13:45 UTC 2010
     Bytes  Real s   CPU s Real-MBit/s  CPU-MBit/s   Calls  Real-C/s   CPU-C/s
1  8388608    1.71    0.03     39.2275   2485.8818    2048   1197.13   75863.1
1  8388608    1.72    0.06     38.9557   1032.6029    5523   3206.02   84982.3
```

Figure 2. The results of the radio connection speed tests carried out by the code *nttcp*. The first part (BEFORE) represents the old radio connection working in the public band, the second one (AFTER) is after the new interconnection installation.

We can conclude that the interconnection achieves (actually exceeds) the designed speed parameter: 34 Mbps. No relevant fluctuations of this speed, like those exhibited bythe oldsystem are observed neither.

During the whole period since its installation no drop-out has been recorded, except those caused by electricity outages.

3. Services provided

The facilities of the center are built to provide the users with reliable networking and computing services. We can put them into several groups and those of the the greatest importance are listed bellow.

- basic
  - IP address space

  - routing
  - DNS
  - FireWall
  - DHCP
- HW
  - data center, monitoring
  - air-conditioning
  - stabilized and backed-up power supply: UPS
- applications
  - precise timing: NTP, stratus 0, GPS: M12+ Timing Oncore Receiver http://www.ta3.sk/ntp/
  - centralized authentication – kerberos
  - centralized authorization – LDAP
  - e-mail, antivirus, antispam
  - WWW, PHP
  - databases: PostgreSQL, MySQL
  - FTP
  - SSH, SCP
  - VoIP – ENUM (transparent), SER
  - library services: CDS/ISIS, WEBgateway
  - automatic backups of user data – BackUp
  - OS: unix/linux, MS Win
  - compilers: gcc, g77, gfortran
  - environments: MIDAS, IRAF, IDL
- disk space
  - servers – RAID 1 – mirroring
  - OFS – 4 disk arrays each containing 12 disks – 18 TB – iSCSI
  - /home directories management

4. Plans for the future

Bearing in mind the users' troublefree work it is necessary that the networking and computing services are being kept up to date, following modern trends and new technologies (hardware and software), protocols services are implemented. A permanent improvement of the administrated systems reliability is important as well, including reasonable redundancy (disk space, spare HW), keeping wide accessibility of provided services.

To meet the aims mentioned above we will focus in the near future on:

- Optical fiber cables SL – SP. Cooperating with other subjects at Skalnaté pleso and with the SANET an optical cable connecting observatory at Skalnaté pleso and the AI main building at Stará Lesná could be built.
- Radio connection (in the private band) SP – LŠ. In the case of successful realization of the preceding item, the observatory at Lomnický štít could be directly connected to the observatory at Skalnaté pleso using a radio connection in the private band.
- Optical fiber cables SP (Encián) – LŠ. It could be possible to put optical fiber cables into the lightning conductor or the cable of the existing cableway. The cooperation with other subjects at Lomnický štít could enable the realization of this project.
- IPv6 (a new version of the Internet Protocol (IP) that is designed to succeed current IPv4)
- Multicasting (videoconferencing)
- Power generator (Diesel)
- Library services – KOHA, Z39.50, MARC21
- VPN (virtual private network)
- EDUroam (Eduroam, EduroamSK). This project offers a new and very effective way of providing internet connection within academic institutions:
  - secure and reliable network access,
  - simplification of the network access within academic institution, WiFi,
  - technology: hierarchical AAA servers, free-radius; kerberos (authentication).

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