

DATA PROCESSING CENTER FOR RADIOASTRON PROJECT HARDWARE OPTIMIZATION

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ABSTRACT. The RadioAstron is an international space VLBI project led by the Astro Space Center of Lebedev Physical Institute in Moscow, Russia. The payload - Space Radio Telescope, is based on spacecraft Spektr-R, that have been designed by the Lavochkin Association. The Spektr-R space craft was successfully launched 18 th July 2011.

In this article we want to summarize Radioastron data processing center work during 2 last years. Tasks facing of the scientific data processing center are organization of service information exchange, collection of scientific observations, storage of scientific observations, processing of scientific observation data Radioastron project.

Key words: Radioastron, data processing center, VLBI.

Data Processing Center (DPC) actively participated in service data exchange between tracking station, ballistic center, ground telescopes, tracking headquarters, center of experiment planning.

For this aim we organized ftp-server and received different kind of information:

from Institute of applied mathematics predicted and reconstructed orbit; scientific and telemetric data from ground telescopes; from tracking station scientific and telemetric and other data. We also receive telemetric information from tracking headquarter.

There is intensive exchange between center of experiment planning and ground headquarter and ground telescope about plans of observation also over our ftp-server.

We can say that this structure corresponds to our requirements. All this information is various, but it has small size. We collect about 0.5 TB during 2 years.

Our next task is collection of scientific data from space and ground telescopes. Especially for transferring data of space telescope observations we organized a direct channel of 1 Gbit /s between the monitoring station and Astro Space Center. 1:00 hour observation takes about 50 GB of memory. The data comes to DPC in Moscow and stored there.

For transferring data from ground telescopes in the most cases we use Internet. The hour of observations at ground radio telescope takes about 100 GB of memory.

Today we have two channels Internet with 200 Mbit/s and 70 Mbit/s for this data transferring.

More than 20 ground-based telescopes participate in the observations with Radioastron. This telescopes from Europe, Asia, Australia, Africa, America. Many different countries take part in Radioastron project. They are Spain, Japan, Germany, Italy and others. The Torun telescope is actively involved in the work only in January 2013.

We connected with these telescopes and tested communication between us. Transfer rates with almost all quite good, allowing us to collect the data. For transmission, we use multi-threading. This increases the speed of transmission of information and makes life easier for us. The biggest speed of transferring with Medicina and Noto is up to 70 Mbit/s.

In general, the rate of transmission over the Internet depends on many factors: time of day, day of the week, the number of threads, the state of the Internet in general, and we do not know what else.

The human factor plays an important role in this process. The number of sessions is increases. It results to delay in the transmission of data. People sometimes forget, sometimes make a mistakes. For this reason, delay growth, especially in the winter because of the large number of sessions, New Year's Eve.

Sometimes, in the case of large amounts of data, we use the data transferring on hard disks. From the places where there are no high-speed communication channels, the information is also delivered on disks.

All information is delivered to a processing center of scientific information Radioastron project. This is a special room equipped with air conditioning and fire suppression, video surveillance, uninterruptible power supplies for electricity stabilization.

The initial scheme of DPC was simple. We bought a cluster of 11 servers, storage of 200 TB. We connected their by 10Gbit/c network and SAS interface. And we thought that everything will work as we want. We thought that would be enough.

But a lot of reasons have led us to optimization and reorganization of the storage structure and the work com-

puter system as a whole. We have organized the work center in a new way.

This reasons are:

Increasing the number of observations,

Increasing the number of ground-based telescopes,

As a result of overflow storage.

Hardware failures, after which we were forced to save observations.

Processing features (large amount of output).

Store all the data.

Bottlenecks.

– disks (reference to the same disks in the collection, processing and archiving of data)

– Problems of network interaction between storage and computing cluster in processing.

For optimization DPC work we divided the collection, archiving and processing of information, to divided the flow of information in the correlation and postcorrelation processing.

Any rewriting of information is accompanied by verifying checksums md5.

We also have a 400 TB tape. We rewrite the data on magnetic tape. This will be the second copy of the data. Today we have collected about 400 TB information.

Everything I said above is about the work of the early scientific program. The structure and functions of ASC Data Processing Center correspond the necessary requirements.

In July 2013 began a key scientific program. We have received proposals for observation for the next year.

Over the next year observations, we have to accept about 2,000 TB.

For this volume we are expanding our storage and channels, and we organizing new server room.