

Institute of Applied Astronomy Technology Development Center

*Leonid Fedotov, Alexander Ipatov, Anton Berdnikov, Dmitry Marshalov, Alexey Melnikov,
Mikhail Kharinov, Andrey Mikhailov*

Abstract

The domain of IAA TDC includes the development of software and hardware for Russian VLBI network QUASAR. This report describes IAA activities in this direction.

1. General

Technology Development Center is responsible for all parts of the Russian VLBI network and consists of separate laboratories developing hardware and software for this project. Now the 32 m radio telescope in Svetloe is participating in international VLBI network observations and in domestic radioastronomical and VLBI observations. Radio telescope in Zelenchukskaya is participating in domestic radioastronomical and VLBI observations and since December 2005 in international VLBI observations as well. The Badary station was equipped with VLBI registration terminal produced in IAA and first testing VLBI observations on the three base QUASAR network were carried out.

2. Technical/Scientific

2.1. VLBI Data Acquisition and Recorder Equipment

A new VLBI Data Acquisition System was installed at Zelenchukskaya observatory (Figure 1). The system consists of VLBA4 Terminal with 14 BBC, Mark IV Formatter and Decoder (Figure 2) and Mark 5A recorder. The station was already equipped with an S2-RT recorder. By now all equipment installation work is completed for this observatory.

The usage of the VLBA4 Terminal in geodetic VLBI observations requires an additional frequency converter because the frequency range of the VLBA BBCs is limited to 480–1020 MHz. The converter was developed and assembled in the laboratory of Signals Conversion and Registration Systems IAA RAS together with RELTA company.

The converter transfers signal of intermediate frequency range from 100–500 MHz to working frequency range of VLBA4 system. It consists of two identical channels working in terms of frequencies addition and LO with fixed frequency 479.9 MHz. Every channel has two outputs. Non-converted IF signal passes to first output which is used in the IF range 480–1000 MHz. Converted signal appears on second output which is used in the IF range 100–479 MHz.

Investigations showed that the frequency converter allows the usage of the VLBA4 terminal in the frequency range 100–1000 MHz except for the range 460–480 MHz where the operation is complicated by the existence of moire components.

The frequency converter consists of two identical conversion channels, a local oscillator plate (Figure 3) and an LO power divider.

The main parameters of the frequency converter are shown in Table 1.



Figure 1. VLBI Data Acquisition and Recorder Equipment at Zelenchukskaya observatory

Table 1. The main parameters of frequency converter

Number of channels		2
Working frequency range		100–1000 MHz
Frequency range with converting		100–479 MHz
Frequency range without converting		479–1000 MHz
Dynamic range		more than 35 dB
Minimum level of signal		–50 dBm
Level of moire components		no more 20 dB
Gain		–4 dB
AFC unevenness in range:	100–479 MHz	no more 2 dB
	479–1000 MHz	no more 3 dB
AFC unevenness in 16 MHz bandwidth in range:	100–479 MHz	no more 0.4 dB
	479–1000 MHz	no more 0.3 dB
LO frequency		479.9 MHz
Signal level of LO		+5 dBm
Phase noise's level of LO (relative)	1 MHz	–85 dBc/Hz
	100 kHz	–75 dBc/Hz
under tune-out for:	10 kHz	–55 dBc/Hz

2.2. SKED Software

Operation Centers use SKED as the main tool in geodetic scheduling to make the .skd file that contains observing schedule. These centers had to maintain a Hewlett-Packard workstation because SKED was restricted to using this platform with HP-UX operating system.

Since the price of personal computers has dropped, while their power increased, there has been much interest in porting applications that once ran only on workstations to run on personal

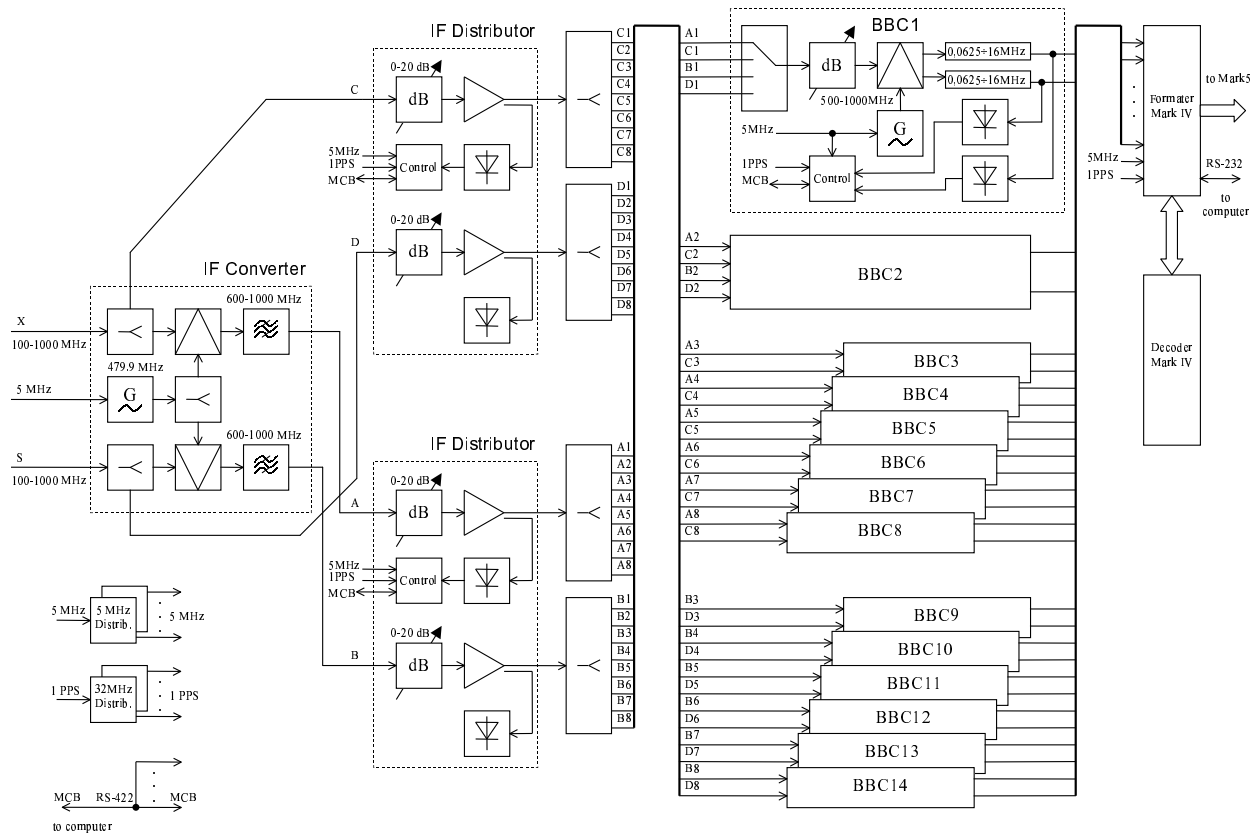


Figure 2. VLBI Data Acquisition System VLBA4

computers, often under the Linux environment.

In late 2004, IAA RAS volunteered to help modify the SKED software to run on personal computers under Linux.

In early 2005 Alexey Melnikov with the assistance of John Gipson (GSFC) completed porting SKED to Linux and then some testing has been done. Several bugs were fixed.

Now SKED has the unified source code that can be compiled under both Linux and HP-UX and it is 2–3 times faster under Linux than under HP-UX.

The Linux version of SKED was used at IAA to make several schedules using the three stations Svetloe, Zelenchukskaya, and Badary. Altogether 13 sessions were observed since July, 2005.

2.3. Monitoring of Geodetical Sources

Observation methodics were developed for radiometric monitoring of the flux density of the sources from the four lists, which are used in the following IVS programs: 1) Intensives INT1 and INT2, 2) CRF, 3) ICRF and 4) Geodesy (R1, R4, T2).

The program of monitoring was started in July 2005. The complete list of sources consist of 128 sources. The observations are carried out every month on X-band. Currently 22 daily observations have been carried out. Each time from 30 up to 50 sources are being observed. The results of the processing come to GSFC. The software developed at IAA is used for processing.

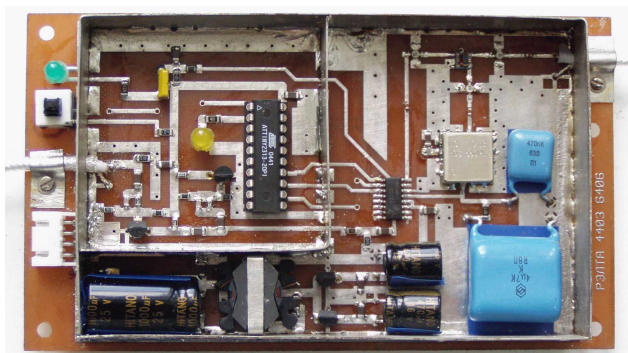


Figure 3. The LO plate of the frequency converter

3. Technical Staff

For all staff the IAA address (8, Zhdanovskaya st., St. Petersburg, 197110, Institute of Applied Astronomy (IAA) RAS, Russia, Director Andrey Finkelstein, FAX +7-812-230-7413) is valid.

Table 2. Technical Staff

Prof. Nikolay Koltsov	Main Scientific Researcher	VLBI and radiometric registration system	+7-812-235-3316	nec@ipa.rssi.ru
Dr. Sergey Smolentsev	Vice Director	Time keeping Frequency standard	+7-812-275-4415	smolen@ipa.rssi.ru
Dr. Alexander Salnikov	Chief of Laboratory Communication and Computer Systems	Network Communication Computers	+7-812-230-8361	ais@ipa.rssi.ru
Dr. Edward Korkin	Main Scientific Researcher	Dish metal constructions	+7-812-230-7415	korkin@ipa.rssi.ru
Dr. Irina Ipatova	Senior Scientific Researcher	Receivers Antenna performance	+7-812-230-6496	ipatova@ipa.rssi.ru
Dr. Vyacheslav Mardyshkin	Chief the Receivers Laboratory	Receivers Refrigerators Antenna performance	+7-812-230-6496	vvm@iaa.nw.ru
Dr. Andrey Mikhailov	Scientific Researcher	FS software Radio telescope control system	+7-812-230-6496	agm@ipa.nw.ru
Dr. Dmitry Ivanov	Chief of Laboratory Time and Frequency	Time keeping Frequency standard	+7-812-230-7416	labtf@ipa.rssi.ru
Dr. Leonid Fedotov	Chief of Laboratory Signals Conversion and Registration	VLBI DAS and registration system	+7-812-235-3316	flv@ipa.rssi.ru