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1. Development of the Broadband Russian Acquisition System (BRAS)

The new data acquisition system BRAS is being developed for radio telescopes with 13-m diameter antennas [1]. Researches on the creation of such a system were spent in IAA RAS since 2010 [2]. BRAS is the digital backend terminal, which consists of eight Digital Signal Processing Units (DSP Units), one Clock Unit, and a Power supply (see Figure 1).

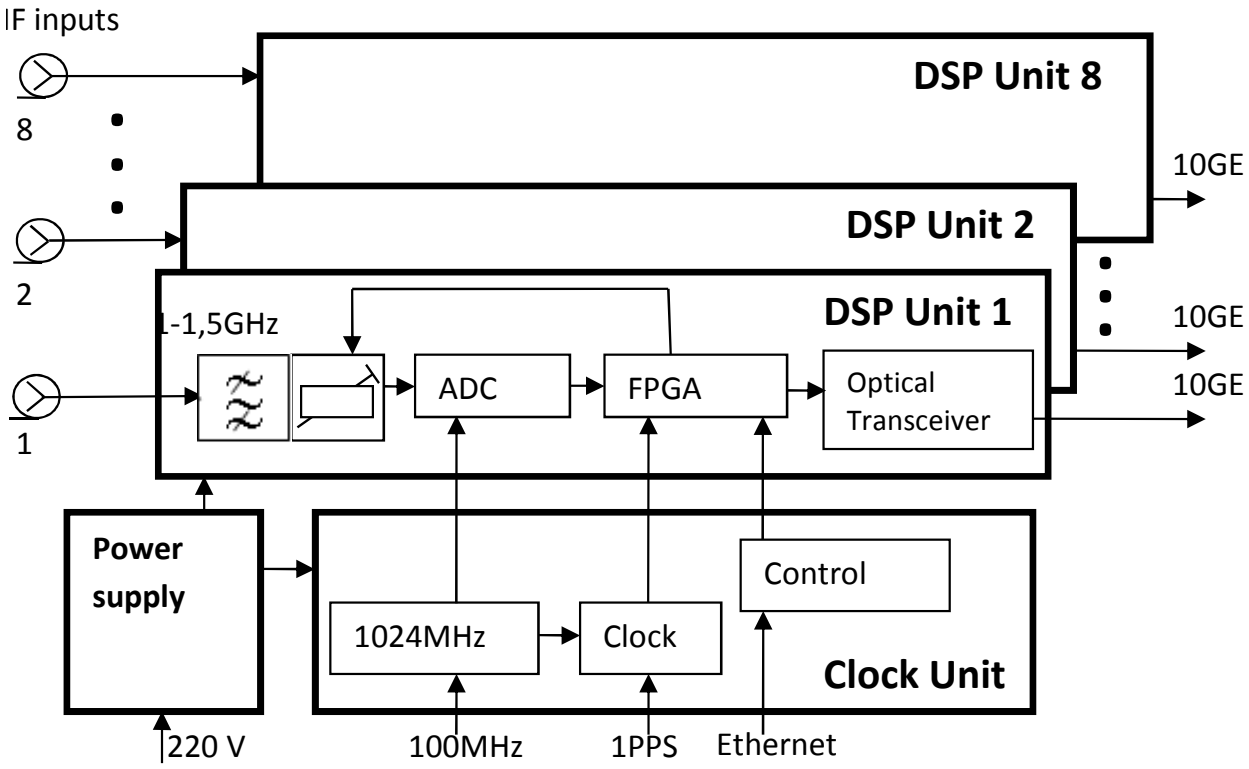

Figure 1. Simplified structure of BRAS.

BRAS inputs are connected to IF outputs of receivers. In every DSP unit the signal of 1-1.5 GHz frequency range is transformed to a VDIF data stream. After that it is translated to a special data buffering device by means of 10 G Ethernet for transmission to the correlator. The Clock unit is intended for formation and distribution of clock signals between all DSP units. Phases of these signals are synchronized with 100 MHz signal from H-maser and 1PPS from the time scale of a radio telescope. The distributed control system of BRAS is realized via controllers in the FPGA of the DSP units and the Clock Unit. The interface for communication with a computer is located in the Clock Unit. BRAS provides an expansion of channel bandwidth up to 512 MHz

and an increase of the total rate of a data stream up to 16 Gbps (Table 1).

Table 1. R1002M DAS specification.

Input frequency range	1 to 1.5 GHz
Number of IF-inputs	8
Number of channels (BBCs)	8
Bandwidth	512 MHz
Output data format	VDIF
Output data rate	16 Gbps
Output interface	10 G Ethernet
Control interface	Ethernet
Total dimension	376 x 233 x 200 mm

The modular design of BRAS provides convenience of operation. The special case with electromagnetic protection allows placement of this system directly on the antenna near to outputs of receivers. Two one-channel prototypes of BRAS have been made (see Figure 2). They have been placed in VLBI Network "Quasar" observatories and connected to IF outputs of usual receivers.

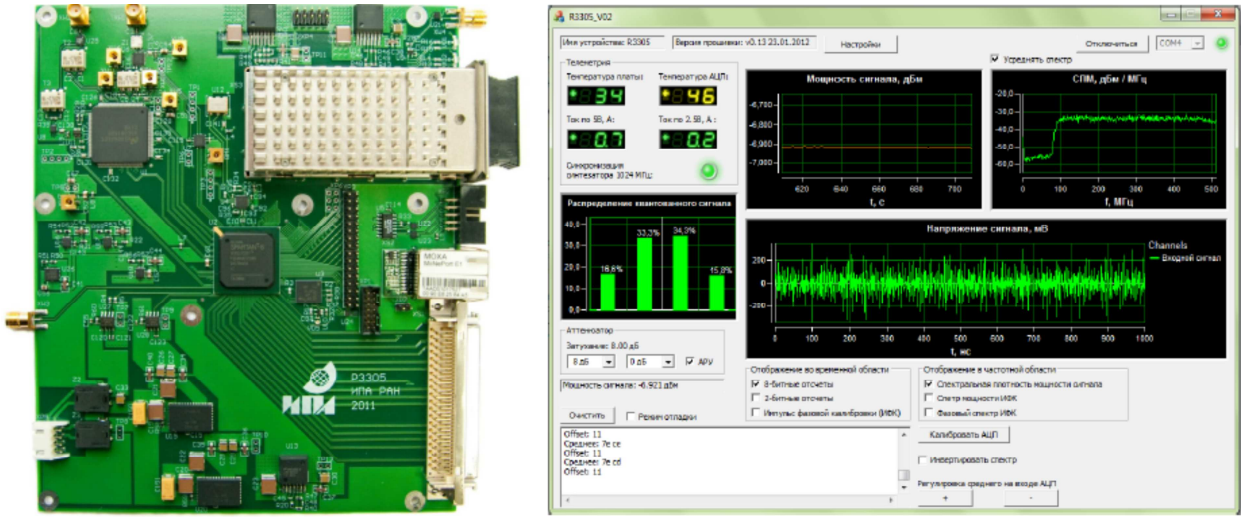

Figure 2. The single channel prototype of BRAS (left) and the interface of control software (right).

It has allowed observation of an experimental VLBI observing session on the Svetloe-Zelenchukskaya baseline with the recording of signals in 512 MHz frequency bandwidth by means of a Mark 5C recording system. On eight observed sources with flux densities from 0.1 Jy up to 2 Jy good fringe responses have been obtained with SNRs from 42 up to 1737 (see Figure 3). Experimental research has validated the technical and program decisions, which are incorporated into BRAS. The end of development and the commissioning of BRAS samples is planned for 2015.

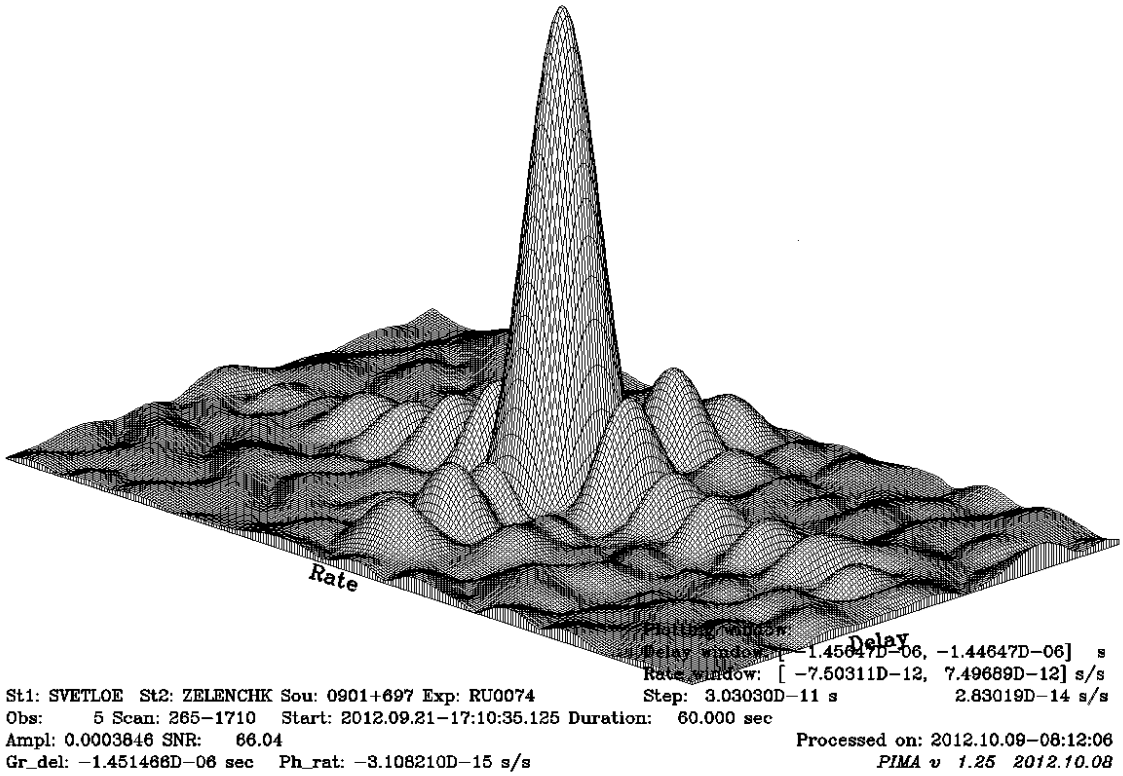

Figure 3. Amplitude of the search function on the group-delay and fringe-frequency plane, obtained from the VLBI observation of 0901+697 source at frequency range 8.6-9.1 GHz with 512 MHz bandwidth.

References

[1] A. Finkelstein, A. Ipatov, S. Smolentsev, V. Mardyshkin, L. Fedotov, I. Surkis, D. Ivanov, I. Gayazov. The New Generation Russian VLBI Network. IVS 2010 General Meeting Proceedings. December 2010. Pp. 106 – 110.

[2] L. Fedotov, E. Nosov, S. Grenkov, D. Marshalov. The Digital Data Acquisition System for the Russian VLBI Network of New Generation. IVS 2010 General Meeting Proceedings. December 2010. Pp. 400 – 404.