VLBI Observation Systems "OCTAVE-Families" to support VDIF specifications with 10 GbE for VERA, JVN and Japanese e-VLBI (OCTAVE)

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Abstract

NAOJ has developed VLBI observation Systems (OCTAVE-Families) to support the VDIF specifications. The Octave systems consist of a high speed 8-Gsps 3-bit ADC (OCTAD) enable us to acquire not only wide intermediate frequency but also radio frequency up to 50 GHz, a converter (OCTAVIA) between one 10 GbE port and four 2 Gbps input/output ports conformable to VSI-H and new disk recorders (OCTADISK) at up to 4.5 Gbps with 10 GbE. The OCTAVE systems are connected via 10 GbE network with VDIF (Vlbi Data Interchange Format) specifications. These components will be used for VERA, JVN, Japanese e-VLBI (OCTAVE) and KJJVC (Korea-Japan Joint VLBI Correlator). We will report the detailed performances and results of test VLBI observations.

1. Introduction

NAOJ (National Astronomical Observatory of Japan) is conducting the VERA and the Optically connected Array for VLBI Exploration project (OCTAVE), (Kobayashi et al. 2003; Doi et al. 2009). The VERA-terminal system consists of a gigabit digital filter and a DIR2000 tape recorder system at 1 Gbps. These systems are currently over 10 years old and are nearing the end of its expected lifetime. It is difficult to maintain these systems over the next decade. Moreover, the VERA project is aiming to observe with higher sensitivity to get more target and calibrator sources. On the other hand, the OCTAVE project which is operated as a subarray of the Japanese VLBI Network have been conducted for 8 years with ATM-IP and 10GbE-IP protocol via Science Information NETwork 3 (SINET3) operated by National Institute of Informatics (NII) and Japan Gigabit Network plus (JGN2plus) operated by National Institute of Information and Communications Technology (NICT). From 2011, NII and NICT have upgraded these network systems to each SINET4 and JGN2X. These networks enable us to transmit the data from several Japanese radio telescope stations (Yamaguchi 32m, Gifu 11m, Tukuba 32m, Kashima 34m and Tomakomai 11m) to Mitaka Correlation center at up to 10 Gbps. Therefore, we have developed the OCTAVE systems for VERA, OCTAVE, JVN and EAVN. Also, we will upgrade the Raw VLBI Data Buffers (RVDBs) named VDB-2000 for Korea-Japan Joint VLBI Correlator (KJJVC), (e.g., Yeom et al. 2009; Oh et al. 2010) to OCTAVIA and OCTADISK.

2. Specifications

The OCTAve A\D Converter (OCTAD) is a high speed 8-Gsps 3-bit Analog-to-Digital Converter which directly acquire not only intermediate frequency but also radio frequency up to 50 GHz. This ADC supports the VDIF specifications and output data with three 10 GbE ports. The OCTAve VsI Adapter (OCTAVIA) is a converter between VSI-H and 10 GbE. This converter can transfer data in real-time, at up to 8 Gbps, from Station to Correlator, support the VDIF specifications. This converter has four input/output ports with VSI-H compliance at up to 8 Gbps totally. The OCTAve DISK drive (OCTADISK) is a high speed disk recorder at up to 4. Gbps. This recorder has one 10 GbE port and supports the VDIF specifications. The detailed specifications of the OCTAVE-Families are summarized in Table 1.

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Table 1: Specifications of the VDB-2000

OCTAVIA		OCTADISK	
Number of Input ports	4+1 (VSI-H and 10 GbE-LR)	Number of I/O ports	1+1 (I/O 10 GbE-LR)
Number of Output ports	4+1 (VSI-H and 10 GbE-LR)	Recording rate	4608 Mbps (max)
Data rate (VSI-H)	1024 or 2048 Mbps/port	Playback rate	4608 Mbps (max)
Maximum Data Rate	Total of 8192 Mbps	Playback, recording (simul)	2048+2560 Mbps (max)
TIME CODE	PDATA, QDATA	Number of Disk Units	24 (2 Tbye HD*24)
VBR Function	128 steps (variable)	Total Recording Time	100 hours@1 Gbps
Control Command	VSI-S compatible	Control Command	VSI-S compatible
Data protocol	VDIF	Data protocol	VDIF
OCTAD			
Input Bandwidth	2048 or 4096 MHz		
Input Frequency	Up to 50 GHz		
Number of Output ports	3 (10GbE-LR)		
Sampling rate	4096 or 8192 Msps		
Number of output bits	3 bits		
TIME CODE	PDATA		
Data protocol	VDIF		

Figure 1: Photograph of OCTAD

Figure 2: Photograph of OCTAVIA

Figure 3: Photograph of OCTADISK

3. References

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