The VLBI Standard Interface Hardware (VSI-H) Interface Specification

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Introduction

The incompatibility of various VLBI data systems has long been recognized as posing a serious obstacle to the realization of the full potential of VLBI observations. A major initiative over the past two years has led to the development of an internationally agreed VLBI standard interface specificaton called VSI-H. Implementation of VSI-H will allow easy interchangeability of various VLBI data systems both at stations and correlators, and should greatly improve the efficiency and lower the cost of VLBI observations.

Goals of VSI-H

The goals of VSI-H can be summarized as follows:

- to define a standard interface to and from a VLBI Data Transmission System (DTS) that allows heterogeneous DTS's to be interfaced to both data-acquisition and correlator systems with a minimum of effort.
- to be compatible with tradition recording/playback systems, network data transmission and even direct-connect systems.
- to completely hide the detailed characteristics of the DTS and allow the data to be transferred from acquisition to correlator in a transparent manner.
- VSI is *not* intended to be completely 'plug and play' at the first level of implementation, but instead should help to relieve many of the existing incompatibilities that new exist between various VLBI data systems.
- to be developed as a joint effort between the geodesy and astronomy communities,

The VSI-H Development Process

The incompatibility of various VLBI data systems has long been recognized as posing a serious obstacle to the realization of the full potential of VLBI observations. Sporadic efforts have developed over the years to define a common interface standard which would allow observations recorded on different VLBI data systems to be processed at a common correlator, but these efforts have foundered for various reasons.

The establishment of the Global VLBI Working Group (GVWG) in the early 1990's, growing primarily from the space-VLBI community but serving the broader interests of astronomy, and the International VLBI Service (IVS) in 1998, serving primarily the geodetic VLBI community, provided an organizational framework for which efforts at standardization could proceed in a more organized and sanctioned fashion. It was from these roots that the present effort was initiated.

The fledgling VSI concept leading to the current specification was first proposed at the time of the GEMSTONE meeting in Tokyo in January 1999 and was discussed by a small interested group at that meeting. Support was then sought and received from IVS and GVWG to create a VSI Technology Coordination Group (VSI-TCG) comprised of experts representing all of the major world institutions involved in the development of VLBI equipment. The members of this

committee are Wayne Cannon (York University/Crestech, Canada), Brent Carlson (DRAO, Canada), Dick Ferris (ATNF, Australia), Dave Graham (MPI, Germany), Tetsuro Kondo (CRL, Japan), Nori Kawaguchi (NAO, Japan), Misha Popov (ASC, Russia), Sergei Pogrebenko (JIVE, Netherlands), Jon Romney (NRAO, U.S.), Ralph Spencer (Jodrell, England), Alan Whitney (Haystack, U.S., Chairman) and Rick Wietfeldt (JPL, U.S.).

The VSI-H Assumptions

The VSI-H specification is based on the following assumptions ground rules:

1. The VSI Data Transmission System (DTS) is fundamentally a receiver and transmitter of parallel *bit streams* between a Data-Acquisition System (DAS) and a Data Processing System (DPS).
2. The *meaning* of individual bit streams is not specified; normally, a bit-stream will be a stream of sign or magnitude bits associated with particular samples, but the actual meaning is to be mutually agreed upon between the DAS and DPS.
3. The received and transmitted bit-stream clock rates may be different (e.g. the playback rate into the DPS may be speeded-up or slowed-down), however all bit-stream clock rates on acquisition must be the same, and all bit-stream clock rates on transmit must be the same.
4. A single time-tag applies to all parallel bit streams. The DAS time-tag of every bit in every bit-stream must be fully recoverable at the output of the DTS.

Features of the VSI-H Specification

The VSI-H specification contains the following 'features':

- 1 Gbit/sec 'Quantum Channel' defined
- 32 parallel bits streams
- 32 MHz (extension to 64, 128 MHz for 2, 4 Gbit/sec 'quantum channel')
- One standard 80-pin connector per 'quantum channel'
- Standardized electrical and timing specifications
- Signal interface is entirely LVDS
- Method of time-tagging data is totally internal to DTS and not specified by VSI-H.
- Built-in Test-Vector Generator/Receiver capability
- Model-delay capability to simplify direct connection to correlator
- Two levels of compliance defined to ease transition to new systems
- Easy media translation (i.e. media copying)

A simplified block diagram of the VSI-H model is shown in Figure 1. The Data Transmission System (DTS) is divided into a Data Input Module (DIM) and a Data Output Module (DOM). The VSI-H specification defines:

1. the interface for accepting sample data into the DIM
2. the interface for reproducing sample data at the output of the DOM
3. control and monitor interfaces
4. functional characteristics the DTS, based on the model in Figure 1

VSI-H specifies nothing about *how* the functional characteristics of the DTS are to be implemented, so that the designer is free to use any technology or technique of his choice.

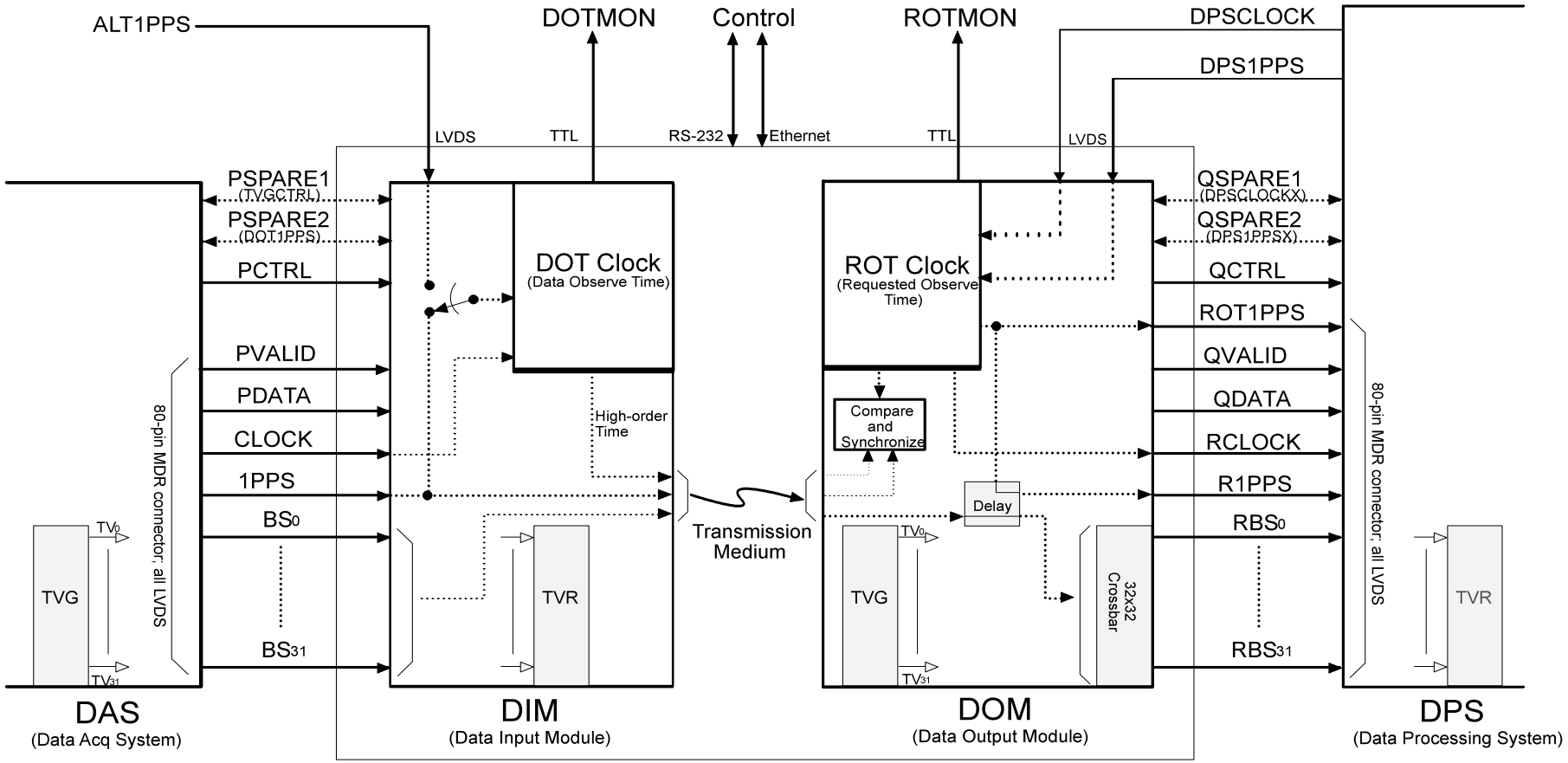
The full VSI-H specification is available, as well as an interesting chronology of its development, is available at http://dopey.haystack.edu/vsi/index.html.

The VLBI Standard Software Specification (VSI-S)

A complementary specification for the software control interface for VSI-H, called VSI-S, is now under development by the VSI technical committee and should be available in the next few months.

Summary

The current VSI-H specification is intended as a starting point from which to progress, and will be extended and amended as requirements and technology demand. It is heartening that already at this writing at least three groups are known to be developing or adapting VLBI data systems to meet the VSI-H standard. The adoption of VSI by the worldwide VLBI community will lead to developing a much richer international VLBI capability at a cost substantially less than would be the case if non-compatible systems were allowed to continue to flourish.



Notes:
1. Shaded items are for illustrative purposes only.
2. PVALID is optionally transmitted from DIM to DOM.
3. PDATA is optionally transmitted from DIM to DOM.
4. Data delay in DOM is required only for storage-based systems.
5. See text for discussion of use of optional use of P/QSPARE1/2 signals.
6. If DIM/DOM in single box, ALT1PPS/DPSCLOCK/DPS1PPS share single MDR-14 connector.
7. This diagram does not show all functions and options -- see VSI-H specification for details.

FIG1.DRW
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Figure 1: VSI-H Functional Block Diagram