

VLBI Standard Software Interface Specification – VSI-S

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1. Introduction

The VSI-S specification is the software counterpart of the VSI-H specification [Reference 1], which specifies the standardized hardware interfaces of a VLBI Data Transmission System (DTS). Systems adhering to both the VSI-H and VSI-S specifications should be interchangeable with minimal effort at both data-acquisition and data-processing sites.

2. Intent of the VSI-S Specification

The goal of VSI-S is to specify a robust, reliable communications protocol to control a VSI-H-compliant DTS. In this regard, VSI-S must address four issues:

1. Specify a communications structure and protocol.
2. Specify a generalized command and response syntax model to be used by the DTS.
3. Specify a base set of commands to configure and operate a generic DTS adhering to VSI-H specification.
4. Specify, as necessary, client/server relationships to be defined between the DTS and the controlling agent.

The base set of VSI-S commands is intended to address only those functions of a DTS which are common to all VSI-H DTS's. It is recognized that there may be some necessary modifications and/or additions to VSI-S commands and command sets to support specific DTS's of varying technologies.

3. Functional Description of Minimal VSI-S Command Set

Following is a simple list of the functional capabilities required to operate a VSI-H compliant system.

3.1 DIM Functions

Following is a descriptive list of the functions required to operate a DIM

- Select sync (1PPS or ALT1PPS)
- Specify CLOCK frequency and sample frequency
- Set DOT clock (or allow setting from PDATA)
- Set bit-stream mask
- Use/ignore PVALID
- Position media
- TVR configuration; report TVR statistics
- Start/stop receive (record)

3.2 DOM Functions

Following is a descriptive list of the functions required to operate a DOM

- Specify RCLOCK frequency
- Set ROT clock and speed-up factor
- Specify crossbar setup
- Set Delay
- TVG on/off
- Position media
- Start/stop transmit (playback)

3.3 P/QDATA Functions

The VSI-H specification includes P/QDATA signals as a generalized method of quasi-realtime transmission of information into the DIM and from the DOM. Some uses of P/QDATA are suggested, but not mandated, by VSI-H. However, it is perhaps useful to specify P/QDATA formats for some of the commonly expected uses. In particular, the following:

Time transfer

One of the most useful applications of P/QDATA is to transfer data-time during a data-copy operation between heterogeneous DTS's. In particular, the source DOM may utilize its QDATA output to transmit high-level data-time information to set the DOT clock in the receiving DIM. In this way, any data-time discontinuities within a data volume may be automatically recognized and properly processed.

General information transfer

For DTS's which can pass PDATA information through to the DOM, general information such as recording mode, station, source, etc may be useful for bookkeeping or perhaps to automate processing.

4. Communications Model

The VSI-S communications model specifies two communicating entities:

1. The DTS system itself, which supports 2-way communications through its Control interface. For purposes of this discussion, the DTS acts as *server*.
2. The Controller, which supports 2-way communication with the DTS Control interface. For purposes of this discussion, the Controller acts as a *client*.

The communications protocol can be specified, at the user's option, to be either half-duplex or full-duplex.

5. Packet Structure and Communications Protocol

VSI-S specifies a general communications syntax which is adhered to by VSI-S commands and which is mandated as a framework for DAS and DTS control and command outside of the VSI-S specification.

5.1 Packet Structure

Each communication to/from the DTS is an elementary packet of the form:

<SOH><command/response><S><C><EOT>

where

<SOH> is Start of Heading character, ASCII char 0x01

<command/response> is a command (or query) from the Controller or a response from the DTS

<S> is a 'sequence code' represented by a single ASCII character in the range 0x20 to 0x7D. The Controller maintains a command sequence number, which is incremented by one for each *new* command, then calculates <S> as $((\text{sequence number} \% 0x5E) + 0x20)$, where % is the modulo operator. Each DTS response contains the sequence code of the command to which it is responding.

<C> is an checksum code represented by a single ASCII character in the range 0x20 to 0x7D, computed as $((\text{sum} \% 0x5E) + 0x20)$, where 'sum' is the sum of all ASCII-character values in the packet following <SOH> and preceding <C>.

<EOT> is End of Transmission character, ASCII char 0x04

All characters in the packet except <SOH> and <EOT> are defined to be normal printable ASCII characters.

5.2 Half-Duplex Communications Protocol

The following rules apply for the case of a half-duplex communications link between the DTS and the Controller:

1. The Controller increments the command sequence number by one (and recomputes <S>) for each non-repeated command.
2. The DTS must respond to *every* recognized <EOT> character within 0.5 second. In particular:
 - a. If the recognized <EOT> terminates an 'intact' packet (a complete packet as defined above, including proper checksum), the DTS responds with an appropriate packet including <S> of the triggering packet.
 - b. If a recognized <EOT> does not terminate an 'intact' packet, the DTS responds with a 'checksum error' response (see below).
3. The DTS will *not* transmit any packet except in response to a recognized <EOT> (unless special exemptions apply – See Section 5.3).
4. The DTS will transmit one, and only one, packet in response to a recognized <EOT>
5. After a time-out period of 0.5 second, the Controller may repeat a command, which must use the same value of <S> as the original command. The DTS responds to a repeated command exactly the same as the original command.
6. A maximum of 2 re-tries is allowed for a failed command, after which the system is declared failed. Some time-sensitive commands, such as those that set clocks within the

DIM and DOM, cannot be re-issued, but must be sent with an updated time (which implies an updated <S> as well).

Comments:

1. Note that, in this model, all *commands* are from the Controller, while all *responses* are from the DTS.
2. Note that, for purposes of this document, each ‘message’, ‘command’ or ‘response’ is contained in a single packet.
3. If the Controller receives no response to a command within 0.5 second, it may assume the DTS has not properly received the packet and may initiate a resend with the same <S>.
4. The 0.5 second timeout rule is extended to one second for commands which set the DOT clock and the ROT clock since a normal response may be up to one second.
5. No DTS timeout is required – a corrupt or missing command <EOT> will hang the DTS, the Controller will timeout and repeat its message, and the new <SOH> will effectively delete the old packet.
6. A corrupt or missing response <EOT> will cause the controller to time-out and repeat its command, but the DTS will see the repeated <S> and simply repeat its previous response.
7. Errant <EOT>’s will cause a single checksum-error response:
 - a. An errant command <EOT> recognized by the DTS will trigger a checksum-error response from the DTS. The DTS will ignore all remaining text while it scans for a new <SOH>.
 - b. An errant response <EOT> recognized by the Controller will cause the Controller to ignore the response and commence searching for a new response <SOH>. Normally, in this situation, the DTS will time-out and repeat the command.
8. In the case of a Controller timeout, it cannot be clear whether the DTS improperly received the command or whether the Controller improperly received a DTS response. In either case, the proper response is for the Controller to repeat the command.
9. Special care must taken to avoid commands (especially status requests) which cause status conditions to cleared or quantities to be incremented/decremented within the DTS. Such a condition could cause the response to a repeated command to differ from the original response, resulting in possible confusion.

5.3 Option for Full-Duplex Communications Protocol

The communications protocol defined in Section 5.2 is specifically designed to be compatible with a half-duplex communications system, such that every message from the DTS is *solicited* by a recognized <EOT> character. If, however, the Controller supports full-duplex communications, the rule prohibiting the DTS from responding to any circumstance other than a recognized <EOT> may be optionally lifted to allow the DTS to transmit *unsolicited* messages at any time. All other aspects of the communications protocol are identical to the half-duplex case. A full discussion of the handling unsolicited messages is found in Section 6.3.

6. Command, Query and Response Syntax

6.1 Command and Command-Response Syntax

Commands are of the form

<keyword> = <field> : <field> : ;

where <keyword> is a VSI-S command keyword. The number of fields may either be fixed or indefinite; fields are separated by colons and terminated with a semi-colon. A field may be of type decimal integer, decimal real, integer hex, character, literal ASCII or a special 'time' code. White space between tokens in the command line is ignored.

Each command recognized by the DTS will elicit a response, within 0.5 second, of the form

!<keyword> = < return code > [:<DTS-specific return> :....] ;

where

<return code> is a 2-character ASCII code 'ab' as follows:

b='0' - command not implemented or not relevant to this DTS

b='1' - action successfully initiated, but not completed ('delayed completion')

b='2' - action successfully completed

b='3' - checksum error

b='4' - syntax or parameter error

b='5' - 'soft' (non-catastrophic) error encountered

b='6' - 'hard' (catastrophic) error encountered

a='0' - DTS has no unsolicited messages waiting

a='1' - DTS has one or more unsolicited messages waiting (relevant only in a half-duplex communications system)

<DTS-specific return> consists of one or more fields specific to the particular DTS, which may be of any type, and should be more informative about the details of the action or error.

'Delayed completion' commands are defined as those commands requiring more than 0.5 second to complete. For these commands, an immediate response is triggered with a VSI-S return code 1. The Controller may follow up with subsequent identical commands carrying the same value of <S> as the original command; the DTS will continue to issue responses of return code 1 until the action is completed, when the return code will change to 2 to indicate successful completion of the requested action. Additionally, the completion of a delayed-completion command will be signaled by a='1' in the return code of *any* response; the delayed-completion response may then be elicited with a special status request (see Section 6.3); in this case, the response will be identical in either case.

The repetition of the keyword in the response is an acknowledged redundancy (since the value of <S> establishes cause and effect), but is included for readability of log files which may be kept of Controller/DTS communications.

For user convenience, some commands are ‘informational’ and are intended for purposes of internal DTS logging only. Some of these ‘informational’ commands may also optionally cause the relevant information to be passed through to the QDATA output of the DOM.

6.2 Query and Query-Response Syntax

Queries are of the form

<keyword>;

with a response of the form

!<keyword> ? <field> : <field> :

Notes:

1. Queries are normally used to establish to the current status of some parameter(s) and have no effect on DTS actions.
2. Special care must be taken to avoid queries which cause status conditions to be cleared or quantities to be incremented/decremented within the DTS. Such a condition could cause the response to a repeated query to differ from the original response, resulting in possible confusion.

6.3 Special Status Query and Unsolicited Messages

‘Unsolicited’ messages, as defined in Section 5.3, are of two general types:

Type 1. Multiple responses to a single command – of two varieties:

- a. Response from the DTS indicating the completion of execution of a ‘delayed-completion’ command.
- b. Requested periodic response, such as a periodic tvr status report.

Type 2. Messages not in response to a command – of two varieties:

- a. Self-generated error or status messages from the DTS.
- b. Echo of commands received through PDATA or issued through QDATA lines.

In order to receive these ‘unsolicited’ messages (see Section 5.3) from the DTS in a half-duplex system, a special status query is defined. The existence of such a pending message(s) will be made known to the Controller by setting the return code character a=’1’ in a normal response. The Controller may, at that time or any time, issue a *special status query* of the form:

status?;

The response to the special status request is according to the following rules:

1. If there are no ‘unsolicited’ messages pending, the DTS response is, by default

!status?;

2. Type 1 message pending: The normal command response is transmitted.

Type 1 messages are, in fact, actually normal responses to normal commands, but are unsolicited by our definition. These responses will have the same format as the normal command response, including the same <S> as the originating command.

3. Type 2 message pending: Type 2 messages are truly unsolicited and are not in response to any command. They are, however, required to conform to the normal VSI-S packet specification, except that all are assigned the same special sequence character <S>=0x7E (~) in order to distinguish them.

Type 2a messages are in the format

!status? <status code> : <DTS-specific field>

Type 2b messages are normal command messages that have been received via PDATA or transmitted via QDATA and are being echoed to the Controller. They must all have the special value of <S>=0x7E.

Notes:

1. The 'delayed-completion' response can also be elicited by repeating the original 'delayed-completion' command.
2. The special status query may, of course, be issued at any time.
3. The special status query is not useful in full-duplex systems.

6.4 'Operational' vs 'Informational' Commands

Most commands cause the DTS to take some kind of action; these commands are called 'operational' commands.

A second class of commands, which only convey information to the DTS and which have been specified only for user convenience, are classed as 'informational' commands. These commands are used to specify useful VLBI observing parameters such as station name, source, recording mode names, media ID, user comments, etc. This information may be of particular utility when used in conjunction with the PDATA/QDATA facilities of the DTS or with internal logging within the DTS.

By convention, keywords corresponding to informational commands begin with an asterisk (*) character.

7. Keyword and Field Rules

7.1 Keyword Rules

Keywords are constructed according to the following rules:

1. Length is limited to 16 characters.
2. Any standard printable ASCII character in the range 0x?? to 0x?? except white space and any of the 7 characters "=:;!?" (including the single-quotes) may be used. Case is significant.

7.2 Field Rules

Each field in a command or return statement may be one of the following six types:

Integer – a simple positive, negative or zero decimal integer (examples: '12', '-25'; of course, no quotes in actual usage).

Real – number with a decimal point and/or possible exponent (examples: '1.12', '-2.23e-6')

Hex – in standard ‘C’ format (example: ‘0x4a32dc09’)

Character – prescribed character string (examples: ‘on’, ‘off’)

Literal ASCII – arbitrary ASCII string enclosed with single quotes (example: ‘This is a string’; in this case, the quotes would be included). Quote characters themselves are not allowed within a literal ASCII string. Similarly, non-printing characters are not allowed within a literal ASCII string.

Time – following the vex format, time will be specified as ‘.y..d..h..m..s’, where the ‘.’ fields represent year, day-of-year, hour, minute and second, respectively. Leading zeroes may be dropped. Examples: ‘2000y212d19h03m’, ‘2003y91d9h23m13s’. *VSI-S time information never has a time resolution smaller than one second, so fractional seconds should never be specified in any VSI-S time field.*

The following rules apply to character fields (same as keywords):

1. Length is limited to 16 characters.
2. Any standard printable ASCII character except white space and any of the 7 characters ‘=:;!?’ (including the single-quotes) may be used. Case is significant

8. P/QDATA Usage

8.1 PDATA

The PDATA serial-data line into the DIM may be used to transmit commands to the DIM, either of the ‘operational’ or ‘informational’ variety (see Section 6.4). The following rules apply to PDATA:

1. The format of PDATA data must conform to the VSI-S packet specification, with an exclusive fixed value of <S>=0x7E.
2. Only standard VSI-S commands are recognized.
3. Since PDATA is a one-way communication channel, there will never be a response to the PDATA source.

At the user’s option, commands transmitted over PDATA may either be accepted or ignored by the DIM; operational and informational commands may be specified separately in this regard. The ‘DOT_set’ command has a special option that allows the DOT clock in the DIM to be set by a ‘DOT_set’ command received via PDATA; this option is particularly useful for media copying. The user may also request that accepted PDATA commands be echoed (as unsolicited messages) to the Controller, along with the DTS responses to these commands which the DTS would have sent back to the PDATA source had that been possible.

8.2 QDATA

The QDATA serial-data line from the DOM may be used to transmit commands to a data-processing system, or to a DIM of another DTS for media-copying purposes or data-transmission purposes. The following rules apply to QDATA:

1. The format of QDATA data must conform to the VSI-S packet specification, with an exclusive fixed value of <S>=0x7E.
2. Only standard VSI-S commands may be sent via QDATA.

Since QDATA is a one-way communication channel, there will never be a response from the QDATA target.

At the user's option, media-embedded PDATA informational commands may be passed through to QDATA; no operational commands are allowed to be passed to QDATA in this manner. Additionally, informational commands from the Controller may be passed through to QDATA (with <S> suitably modified). A special option causes QDATA to issue a 'DOT_set' command immediately following each ROT1PPS tick, where the time in the 'DOT_set' command has been properly adjusted (one second added) in order to properly set a DOT clock in a receiving DIM or other device; this option is particularly useful for media copying. And, finally, the user may request an echo to the Controller of all commands sent via QDATA.

9. Client/Server Relationships

9.1 RS-232 Control

As stated in the VSI-H specification, the DTS is configured as a DCE device. The DTS controlling device will therefore act as a DTE device.

9.2 Ethernet Control

Under Ethernet control, the DTS will act as a server in the server/client relationship with the controlling device. The protocol used in the connection will be TCP/IP (preferred) or UDP. A registered standard port number xxxxx has been assigned to VSI-S.

10. VSI-S Command/Response Format Tables

The following tables detail the VSI-S command set. Field numbers in square parenthesis ('[]') are optional. Field numbers in curly brackets ('{}') may be DTS specific; the recommended implementation is stated.

10.1 System Commands

These commands are 'system level' commands not specific to either the DIM or DOM.

Keyword	Field #	Description	Type	Allowed values	Default	DTS-specific?	Comments
comm_set	1	Set duplex	char	half full	half	No	
	[2]	Set next sequence number	char	Char 0x20-0x7D	<Space> (0x20)	No	Causes DTS to expect <S> in next command/query to be as specified
diagnostic	1	Perform diagnostic self-test	int		0	Yes	Field 1 specifies test to be performed

10.2 System Queries

These queries are 'system level' queries not specific to either the DIM or DOM.

Keyword	Returned Field #	Description	Type	DTS-specific?	Comments
DTS_id	1	System ID	literal ASCII	Yes	Example response: 'S2-REC'
	2	System revision level	Real		Example response: '2.1'
	3	Media type	Int	No	0 – magnetic tape 1 – magnetic disc 2 – real-time (non-recording) 3 – other (to be defined?)
status	1	Special status query (to gather unsolicited messages)			If no message waiting, returns all fields null; if message pending, triggers transmission of message to DTS (see Section 6.3)

10.3 DIM Setup and Operating Commands

Keyword	Field #	Description	Type	Allowed values	Default	DTS-specific?	Comments
dim_sync	1	Select second-tick sync source	char	1pps alt 1pps	1pps	No	

CLOCK_freq	1	CLOCK frequency	int	2 4 8 16 32 64 128	-	No	Units are MHz. 64 and 128 MHz may be supported by some units.
	[2]	Ratio of CLOCK freq to Bit-stream information rate (BSIR)	int	1,2,4,8,16	1	No	Minimum BSIR is 2 MHz
DOT_set	1	Set DOT clock to specified time	time	Valid time	-	No	Sets specified time into DOT clock on <i>next</i> DOT second tick; time must always be integral second
	[2]	Time source	int				0 – set DOT clock according to field 1 1 – 1-time set DOT clock according DOT_set command(s) in PDATA 2 – auto-set DOT clock according to DOT_set command(s) in PDATA (i.e. reset DOT clock at clock discontinuities); for media copying 3 – turn off auto-set DOT clock
DIM_mask	1	Bit-stream receive mask	hex	32-bit hex	0xffffffff	No	Specifies bit-streams to be received (recorded) by DIM; VSI-H allows selection of any 1, 2, 4, 8, 16 or 32 bit streams
PVALID	1	PVALID line active/inactive	char	on off	off	No	If 'on', PVALID signal indicates data validity. PVALID may be ignored by some systems.
PDATA	1	Set PDATA control mask	hex	0x00 to 0x07	0x0	No	Bit mask: 0x01 – Accept informational commands via PDATA 0x02 – Accept operating commands via PDATA, except DOT_set 0x04 – Echo accepted PDATA commands and DTS 'responses' to Controller
tvr	1	Test-vector receiver reporting period	integer secs	>=0	0	No	Sets tvr analysis period to specified number of DOT seconds. Value of 0 stops tvr reporting immediately.
	[2]	Number of periodic tvr reports to be transmitted	int	>=1	1	No	Default = 1 report
	{[3]}	Bit-stream mask	hex	0x00000001 to 0xffffffff	0x00000001	Yes	Default is DTS dependent (some systems may only be able to analyze a single bit-stream at a time).
	{[4]}	Analysis mask	hex	0x1 to 0x7	0x3	Yes	LSB – error rate analysis MSB – DC-level analysis Default = 0x3 (full analysis)
	{[5]}	Bit-stream rotation	int	0-31	0	Yes	Rotate full set of 32 bit-streams to the left by specified number of positions before entering tvr. For example, '2' places BS0 in place of BS2 before entering tvr, BS1 in place of BS3, BS30 in place of BS1, etc. This capability is useful for unscrambling misdirected bit-streams, but may not exist in some systems or be implemented in a different fashion.
position	1	Position media	int		-	Maybe	Units are DTS-specific. >=0 to position media, -1 to dismount media; -2 to abort (stop at current position) – relevant for tape;

									May not be relevant for real-time or quasi-real-time DTS' s.
receive	1	Start/stop data receive (recording)	char	on off	off	No			
	[2]	Media speed	int	>0 forward <0 reverse	-	Yes			Probably relevant only for tape systems. Absolute value is speed in units appropriate for specific DTS.

Notes:

- Additional fields may be added beyond those specified to meet need of specific DTS' s.

10.4 DIM Query Responses

Keyword	Returned Field #	Description	Type	DTS-specific?	Comments
DIM_sync	1	Select second-tick sync source	char	No	Returns current value
CLOCK_freq	1	CLOCK frequency	int	No	Returns current value
	2	Sample rate	int	No	Returns current value
DOT_set	1	Read current DOT clock time	time	No	Responds with DOT clock reading <i>immediately</i> after <i>next</i> DOT clock second tick. Response can be used as synchronizing agent for 'DOT_set' command.
mask	1	Bit-stream receive mask	hex	No	Returns current value
PVALID	1	PVALID line active/inactive	char	No	Returns current value
PDATA	1	PDATA control mask	hex	No	Returns current value of PDATA control mask
tvr	1	Test-vector receiver reporting period	integer secs	No	Returns current value
	2	Number of periodic tvr reports to be transmitted	int	No	Returns <i>remaining number</i> of tvr reports to be transmitted
	3	Bit-stream mask	hex	Yes	Returns current value
	4	Analysis mask	hex	Yes	Returns current value
	5	Bit-stream rotation	int	Yes	Returns current value
position	1	Position media	int	Maybe	Returns current media position in DTS-specific units; -1 indicates media not loaded
	[2]	Media speed	int	=0 stopped >0 forward <0 reverse	Returns current media speed; units are appropriate to specific DTS
receive	1	Start/stop data receive (recording)	char	No	Returns current value

	[2]	Media speed	int	Returns current value
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Notes:

- Note that the response to 'DOT_set?' status request is delayed until the occurrence of the *next* DOT second tick.

10.5 DIM Periodic Responses

Currently only the 'tvr' command can elicit a periodic DIM response.

Keyword	Returned Field #	Description	Type	DTS-specific?	Comments
tvr	1	Bit-stream number	int	No	
	2	Analysis period in DOT seconds	int	No	
	2	Error rate	int	Yes	Interpretation is DTS-specific
	3	DC offset	int	Yes	Interpretation is DTS-specific

Notes:

- A separate '!tvr=.....;' string will be transmitted for each bit-stream under TVR scrutiny.

10.6 DOM Setup and Operating Commands

Keyword	Field #	Description	Type	Allowed values	Default	DTS-specific?	Comments
DOM_clock	1	Select DOM clock source	char	dpsclock dpsclockx qctrl	dpsclock	No	'qctrl' puts clock source under control of QCTRL, as specified by VSI-H.
DOM_sync	1	Select DOM second-tick sync source	char	dpslpps dpsclockx qctrl	dpslpps	No	'qctrl' puts sync source under control of QCTRL, as specified by VSI-H.
RCLOCK_freq	1	DOM RCLOCK frequency	int	2 4 8 16 32 64 128	-	No	Units are MHz. 64 and 128 MHz may be supported by some units.
	[2]	log ₂ (DOM speedup factor)	int	-4 to +4	0	Yes	Default=0 (no speedup); capabilities are very DTS-specific. Speedup factor is necessary for ROT clock to increment properly.
ROT_set	1	Set ROT clock to specified time	time	Valid time	-	No	Sets specified time into ROT clock on <i>next</i> DPSCLOCK/DPSCLOCKX tick.
delay	1	Specified data delay wrt ROT clock	int	See comments to right	0	Perhaps	Units are sample bits; >0 indicates data delayed relative to ROT clock.

		clock		to right				
crossbar	1	Select bit-stream RBS0	int	0-31	0	No	Causes specified DIM input bit-stream to be directed to RBS0	Specified delay is set on <i>next</i> ROTIPPS tick. Implemented range should be sufficient to cover $\pm 0.5 * ROTIPPS$.
	2	Select bit-stream RBS1	int	0-31	1	No	Causes specified DIM input bit-stream to be directed to RBS1	
							
	32	Select bit-stream RBS31	int	0-31	31	No	Causes specified DIM input bit-stream to be directed to RBS31	
QVALID	1	QVALID line active/inactive	char	on off	off	No	If 'on', QVALID signal indicates data validity. QVALID may be ignored by some systems.	
QDATA	1	Set QDATA control mask	hex	0x00 to 0x07	0x0	No	Bit mask: 0x01 – Pass media-embedded PDATA informational commands through to QDATA 0x02 – Pass Controller informational commands to QDATA 0x04 – Echo QDATA output to Controller. 0x08 – Enable transmission of DOT_set command at each ROTIPPS tick (with time adjusted forward by one second for proper setting of DOT clock); useful for media copying	
tvgr	1	Test-vector generator on/off	char	on off	off	No	If 'on', replaces DOM output data with TVG data	
position	1	Position media	int		-	Yes	Same as DIM 'position' command	
transmit	1	Start/stop data transmit (play/back)	char	on off	off	No		

Notes:

1. Note that 'position' command is common for DIM and DOM.

10.7 DOM Query Responses

Keyword	Returned Field #	Description	Type	DTS-specific?	Comments
DOM_clock	1	Select DOM clock source	char	No	Returns current value
DOM_sync	1	Select DOM second-tick sync source	char		Returns current value
RCLOCK_freq	1	DOM clock frequency	int		Returns current value
	2	log ₂ (DOM speedup factor)	int		Returns current value
ROT_set	1	Set ROT clock to specified time	time		Responds with ROT clock reading <i>immediately</i> after <i>next</i> ROT clock second tick. Response can be used as synchronizing agent for 'ROT_set' command.
	2	Delay data wrt ROT clock	int		Responds with delay value in place at <i>next</i> ROT clock second tick.
crossbar	1	Select bit-stream RBS0	int		Returns current value
	2	Select bit-stream RBS1	int		Returns current value
				
	31	Select bit-stream RBS31	int		Returns current value
QUALID	1	QUALID line active/inactive	char		Returns current value
tvg	1	Test-vector generator on/off	char		Returns current value
position	1	Position media			Returns current media position in DTS-specific units; -1 indicates media not loaded
	[2]	Media speed	int	=0 stopped >0 forward <0 reverse	Returns current media speed; units are appropriate to specific DTS
transmit	1	Start/stop data transmit (playback)	char		Returns current value
status	1	General status	hex	Yes	DTS-specific status word; meaning not defined here

Notes:

1. Note that the response to 'ROT_set?' status request is delayed until the occurrence of the *next* ROT second tick.

10.8 Informational Commands

Informational commands are no-op commands that specify certain types of potentially useful information to the DTS.

Keyword	Field #	Description	Type	Allowed values	DTS-specific?	Comments
*media_id	1-n	Media label or serial #'s	literal ASCII			This command useful only if media is not self identified by the DTS; if n media units (such a multiple discs), need to specify n fields
*mode	1	Data/recording mode	literal ASCII		Yes	DTS-specific
*source	1	Celestial source name	literal ASCII		No	Source currently being observed
	2	On/off source	char	on off	No	Specifies whether time in field 3 is on-source or off-source time
	3	Time	time		No	On/off source time
*cal	1	On/off	char	on off	No	Specifies whether time in field 2 is cal-on or cal-off time
	2	Time				On/off cal time
*station	1	Station ID	literal ASCII		No	Standard 2-char VLBI station ID
*comment	1	User comment	literal ASCII		No	Arbitrary user comment

10.9 Informational Queries

These queries simply respond with the current values associated with the informational keyword, irregardless of the source of the information (Controller or PDATA).

Keyword	Returned Field #	Description	Type	DTS-specific?	Comments
*media_id	1-n	Media label or serial #'s	literal ASCII		If n media units (such a multiple discs), will return n fields
*mode	1	Data/recording mode	literal ASCII	Yes	Returns mode
*source	1	Celestial source name	literal ASCII	No	Returns source name
	2	On/off source	char	No	Current on/off source status
*cal	1	On/off	char	No	Current cal status

*station	1	Station ID	literal ASCII	No	Current station ID
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10.10 Special Status Query

The special status query is useful for receiving unsolicited message in half-duplex systems (See Section 6.3)

Keyword	Returned Field #	Description	Type	DTS-specific?	Comments
status		Special status query			If pending unsolicited message, causes it to be returned

References:

1. 'VLBI Standard Hardware Interface Specification – VSI-H', Rev 1.0, 7 August 2000