LBA DAS to S2 Interface

Revised 22/11/99

Introduction

Data is transmitted from the DAS to an S2 Record Terminal over the S2's C1 cable which plugs into a matching socket on the DAS backplane. The C1 cable carries clock and time reference signals and up to 16 data streams at rates from 4 to 32Msps. The S2 is programmed to match the rate and total volume of data produced by a particular DAS configuration by choosing one of more than 40 *recording modes* (see Table B-5 in the S2 User's Manual). Each mode prescribes which wires or "channels" on the C1 cable are active to carry data.

Either or both IF Processors may be in use and each may be programmed independently to produce up to five passbands (each) of possibly differing bandwidths. One or two of the resulting data streams from each IFP may be selected for output at the S2 port. All data streams are available for independent selection at the other output ports, for monitoring or further processing. In the following notes and tables only *recorded* data streams are relevant. No distinction is made between data from the Band Splitter or the Fine Tuner since only the bandwidth, and hence sample rate, is of significance to the interface.

While the S2 itself is quite insensitive to the content of any data stream it is necessary for signals of the appropriate polarisation, frequency, bandwidth and format to be mapped to active channels in a consistent way so they can be recovered efficiently on playback. This mapping is described in the following text and summarised in the following table. The table shows the associations between DAS configuration, S2 mode, and signal channel allocation on the S2 port. These are listed in order of decreasing effective signal bandwidth.

Clock Channels

The C1 cable obtains the Input Reference Clock, SCLK_REC, and the Input 1Hz Reference, S1HZ_REC, from IFP 1 in bin slots 0 and 2, specifically from the module in slot 2, i.e. Digital Filter 1, even if data is being recorded from IFP 2 (slots 4 and 6) only. If the N3 module in slot 2 should fail it must be replaced by the good module from slot 6 and all recording done from IFP 1.

The Input Reference Clock, SCLK_REC, is always 32MHz regardless of the data rate.

To configure the S2 RT: >scpll mode refclk System clock PLL lock mode set to refclk >userio clkin c1 UI reference clock and 1Hz sync inputs from C1 cable Expected ref clock rate is 32MHz (fixed) >

Data Channels

The mapping of data streams onto S2 channels is constrained by the limited number of recording modes, and the practical requirement that each IFP's outputs are hardwired to a specific group of user data channels (UDCs). Within an IFP the UDCs in its group may be allocated in pairs, (0,1), (2,3) etc., to any available data stream, thus providing some measure of flexibility in connecting signals to data channels. The actual mapping further depends on whether the S2's C1 cable is plugged into the S2 RECORDER OUT connector or the S2 AUX connector (see later). On S2 RECORDER OUT, IFP1 is wired to S2 UDCs 0..3 (also known as IN_0..IN_3, see Table B-1 in the S2 User's Manual), and IFP 2 to UDCs 4..7, whereas on S2 AUX, IFP 1 connects to UDCs 0 & 1, and IFP 2 connects to UDCs 2 & 3.

At all times 2-bit sign-and-magnitude data streams have the sign bit on an even numbered UD channel and the magnitude bit on the next channel. Data streams of ≤ 16 MHz bandwidth have exclusive occupancy of a single channel pair. If only one data stream is recorded for an IFP it is allocated the lowest numbered UDC pair in its group. 32MHz data is transmitted two samples at a time on two adjacent channel pairs, while 64MHz data limited to 1-bit format is transmitted four samples at a time on adjacent channels. In these cases the oldest sample is on the lowest numbered channel(s). Single bit (sign only) data uses exclusively even numbered UD channels, except for 64MHz BW which uses all channels in the group.

Non-AT data codes such as VLBA (offset binary) have the MSB on an even numbered UD channel and the LSB on the next channel. Note that "Multi beam" format data is stored in sign-and-magnitude format, the same as regular AT data (but with different amplitude statistics). It is later converted to the required ternary code in the correlator input section.

Effective Data Rate

Each IFP may be programmed to have a different filter configuration and bandwidth(s). However for the purpose of setting up the S2 recorder *all* recorded data streams are considered to have the same bandwidth as the widest *recorded* data stream. The S2 input data rate is twice this bandwidth or 4Mbps, which ever is larger, except for two channel recordings which have a minimum rate of 8Mbps.

Data at rates less than 4Mbps use 4Mbps modes and will be multiply recorded by the S2; the excess bits are ignored on playback. Similarly eight channel recording always requires at least two transports. These factors may sometimes mean that one more transport/tape is used than is theoretically necessary, but the finite set of options in both the S2 and the correlator make it unavoidable. Likewise if two data streams are recorded for one IFP then available S2 modes will provide either zero or two data streams for the other. In the latter case if only one data stream is actually wanted the presence of data on the remaining UD channel is immaterial.

Recorder Mode Selection

The following table is provided to facilitate selection of the appropriate S2 Mode. It shows a variety of *regular* passband configurations but is in no ways represents a complete list of DAS configurations. For example it is truncated after 1MHz bandwidths as all narrower bands (extending down to 62.5kHz) are perforce treated as 1MHz bands when configuring the S2. Similarly, multiply over sampled bandwidth options and mixed bandwidth options are omitted as they simply re-use S2 configurations already mentioned in lines above. eg. [(16+1),(32)] is equivalent to [(16+16),(16+16)] and therefore requires mode 32s4-1.

Most data recording will be in 2-bit mode, but 1-bit modes are used in three circumstances. These are: 1) where 2-bit mode for the filter configuration would exceed the 128Mbps capacity of the S2, 2) to provide compatibility with MkIII systems, and 3) where reducing to 1-bit halves the number of tapes required. Below 64MHz BW, DAS data streams are always produced in 2-bit format and '1-bit' mode is effected by choosing an S2 mode which records only the sign bits (ie only even numbered UD channels). These configurations are shown for each effective bandwidth, following the 2-bit entries.

In order to provide full flexibility in matching IFP outputs to the available S2 recording modes a multiplexer is required between the S2 RECORDER OUT connector and the S2 C1 cable. Since an integrated solution is not yet available temporary measures have been adopted to cover the two circumstances requiring UDC manipulation. These are indicated in the columns headed 'Cable Swap" to the right of the main table.

In the case where a single 2-bit data stream of 8MHz bandwidth or less (or 16MHz or less for 1-bit data) is recorded from *each* IFP, a "mode converter" is provided to remap the lower pair of channels from IFP 2 onto the S2 UDCs normally occupied by the upper pair from IFP 1. To implement this the S2 C1 cable is removed from the usual S2 RECORDER OUT connector and plugged instead into the S2 AUX socket. The free end of the converter cable is then plugged into S2 RECORDER OUT. Note that single 2-bit *16MHz* bandwidth signals from each IFP may be recorded directly from the normal socket by using S2 non-standard mode 32a4-2. This is the preferred option and is indicated in the table following. If the C1 cable *is* in S2 AUX the correct mode would be 32x4-2.

The second case arises when only signals normally produced by IFP 2 are being recorded. To accommodate this the IF input signals must be swapped so that the recording can be done from IFP 1.

Table Entries

Column 1,2 : DAS configuration represented by effective bandwidths q.v. (not sample rates).

Column 3 : Matching S2 recording mode.

Column 4 : Total data and recorder Mbps,

or <total data Mbps>/<total recorder Mbps> where minimum recorder rate exceeds data rate

Column 5..12: Active channels on the normal DAS S2 Port

Column 13 : Indicates need to swap IF inputs

Column 14 : Indicates C1 cable plugged into S2 AUX instead of S2 RECORDER OUT socket

DAS Configurations and S2 Modes

| IFP 1 | IFP 2 | S2 Mode | Total | Active Channels on S2 REC OUT | | | | | | | | Cable Swap | |
|-----------|-----------|---------|-------|-------------------------------|---|---|---|---|---|---|---|------------|--------|
| B / B0+B1 | B / B0+B1 | btu-q | Mbps | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | IF Swap | C1>AUX |
| 64 | | 32x4-1 | 128 | x | x | х | X | | | | | | |
| | 64 | 32x4-1 | 128 | | | | | х | x | х | х | << | |
| | | | | | | | | | | | | | |
| 32 | | 32x4-2 | 128 | x | x | x | x | | | | | | |
| | 32 | 32x4-2 | 128 | | | | | x | x | x | X | << | |
| 32 | 32 | 32s4-1 | 128 | x | | x | | х | | x | | | |
| 32 | | 32s2-1 | 64 | x | | x | | | | | | | |
| | 32 | 32s2-1 | 64 | | | | | x | | x | | << | |
| | | | | | | | | | | | | | |
| 16+16 | | 32x4-2 | 128 | x | x | x | x | | | | | | |
| | 16+16 | 32x4-2 | 128 | | | | | x | x | x | х | << | |
| 16 | 16 | 32a4-2 | 128 | x | x | | | x | x | | | | |
| 16+16 | 16+16 | 32s4-1 | 128 | x | | x | | x | | x | | | |
| 16 | | 32x2-2 | 64 | x | x | | | | | | | | |
| | 16 | 32x2-2 | 64 | | | | | x | x | | | << | |
| 16+16 | | 32s2-1 | 64 | x | | x | | | | | | | |
| | 16+16 | 32s2-1 | 64 | | | | | х | | х | | << | |
| 16 | 16 | 32s2-1 | 64 | x | | | | х | | | | | * |
| 16 | | 32x1-1 | 32 | x | | | | | | | | | |
| | 16 | 32x1-1 | 32 | | | | | х | | | | << | |
| | | | | | | | | | | | | | |
| 8+8 | 8+8 | 16x8-2 | 128 | x | x | x | X | x | x | x | X | | |
| 8+8 | | 16x4-2 | 64 | x | x | x | х | | | | | | |
| | 8+8 | 16x4-2 | 64 | | | | | х | x | х | х | << | |
| 8 | 8 | 16x4-2 | 64 | x | x | | | х | x | | | | * |
| 8+8 | 8+8 | 16s4-1 | 64 | x | | x | | х | | x | | | |
| 8 | | 16x2-2 | 32 | x | x | | | | | | | | |
| | 8 | 16x2-2 | 32 | | | | | х | x | | | << | |
| 8+8 | | 16s2-1 | 32 | x | | x | | | | | | | |
| | 8+8 | 16s2-1 | 32 | | | | | x | | х | | << | |
| 8 | 8 | 16s2-1 | 32 | x | | | | x | | | | | * |
| 8 | | 16x1-1 | 16 | х | | | | | | | | | |
| | 8 | 16x1-1 | 16 | 1 | | | | x | | | | << | |

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DAS Configurations and S2 Modes ctd.

| IFP 1 | IFP 2 | S2 Mode | Total | Active Channels on S2 REC OUT | | | | | | | | Cable Swap | |
|-----------|-----------|---------|-------|-------------------------------|---|---|---|---|---|---|---|------------|--------|
| B / B0+B1 | B / B0+B1 | btu-q | Mbps | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | IF Swap | C1>AUX |
| 4+4 | 4+4 | 8x8-2 | 64 | x | x | x | х | x | x | x | x | | |
| 4+4 | | 8x4-2 | 32 | x | x | x | x | | | | | | |
| | 4+4 | 8x4-2 | 32 | | | | | x | x | x | x | << | |
| 4 | 4 | 8x4-2 | 32 | x | x | | | x | x | | | | * |
| 4+4 | 4+4 | 8s4-1 | 32 | x | | x | | x | | x | | | |
| 4 | | 8x2-2 | 16 | x | x | | | | | | | | |
| | 4 | 8x2-2 | 16 | | | | | x | x | | | << | |
| 4+4 | | 8s2-1 | 16 | x | | x | | | | | | | |
| | 4+4 | 8s2-1 | 16 | | | | | х | | x | | << | |
| 4 | 4 | 8s2-1 | 16 | x | | | | х | | | | | * |
| 4 | | 16x1-1 | 8/16 | x | | | | | | | | | |
| | 4 | 16x1-1 | 8/16 | | | | | х | | | | << | |
| | | | | | | | | | | | | | |
| 2+2 | 2+2 | 4x8-2 | 32 | x | x | x | х | x | x | x | x | | |
| 2+2 | | 4x4-2 | 16 | x | x | x | х | | | | | | |
| | 2+2 | 4x4-2 | 16 | | | | | x | x | x | х | << | |
| 2 | 2 | 4x4-2 | 16 | x | x | | | х | x | | | | * |
| 2+2 | 2+2 | 4s4-1 | 16 | x | | x | | х | | x | | | |
| 2 | | 8x2-2 | 8/16 | x | x | | | | | | | | |
| | 2 | 8x2-2 | 8/16 | | | | | x | x | | | << | |
| 2+2 | | 8s2-1 | 8/16 | x | | x | | | | | | | |
| | 2+2 | 8s2-1 | 8/16 | | | | | х | | x | | << | |
| 2 | 2 | 8s2-1 | 8/16 | x | | | | x | | | | | * |
| | | | | | | | | | | | | | |
| 1+1 | 1+1 | 4x8-2 | 16/32 | x | x | x | X | x | x | x | x | | |
| 1+1 | | 4x4-2 | 8/16 | x | x | x | x | | | | | | |
| | 1+1 | 4x4-2 | 8/16 | | | | | х | х | x | х | << | |
| 1 | 1 | 4x4-2 | 8/16 | x | х | | | х | х | | | | * |
| 1+1 | 1+1 | 4s4-1 | 8/16 | x | | x | | x | | x | | | |
| 1 | | 8x2-2 | 4/16 | x | x | | | | | | | | |
| | 1 | 8x2-2 | 4/16 | | | | | x | x | | | << | |

1. $B / B0+B1 \iff$ Nominal passband bandwidth/s in MHz

2. 8/16 etc.: data/recorder Mbps

3. "Active Channels" shows the normal mapping without application of "Special Configurations".