From rtreacy@polaris.cv.nrao.edu Fri Dec 15 12:44 EST 2000

Date:	Fri, 15 Dec 2000 12:44:45 -0500 (EST)
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The attachment to this mail is a block diagram which is related to the following discussion.

VLBA TAPE TO DISK STATUS SUMMARY

This is a summary of the progress I have made since the November meeting.

COMMERCIAL 32 BIT DIGITAL I/O CARD (PCI Bus Interface)

In our meeting on 13 November 2000, we decided that the desired performance for this card would be to have additional capacity beyond what was needed for a single track. Since then, I have looked at about five or six cards and spoke to the support engineers concerning our transfer rate requirements. Two cards were able to easily meet the single track rate of 1.125 MBytes/s and a third was marginal but would probably work. The transfer rate of the first two cards is more than adequate to handle several tracks, possibly even the total rate of 11.25 MBytes/s from ten playback drives (PBDs). Since the PBD clocks are not synchronous with respect to one another, it is not yet clear whether several tracks could be multiplexed together on a common bus to drive this card. The cards are:

(Adequate) National Instruments PCI-DIO32HS, base price $995
(Adequate) Circuit Specialists PCI7300A-B, base price $995
(Marginal) Circuit Specialists PCI7200, base price $250

The two cards from Circuit Specialists are very similar. If the PCI7300A-B is selected and a scheme to multiplex several channels cannot be worked out due to the asynchronous clocks, an alternative could be to scale back to the slower, cheaper card (PCI7200) and use one of these for each track, hopefully salvaging most of the software and interface design from the PCI7300A-B. The cards from Circuit Specialists have on board FIFOs to improve the PCI transfer rates and overall look to be more capable than the National Instrument card. However, they are a smaller company and do not have the support resources that are likely available from National Instruments. National Instruments has seen the need to add FIFO to their card also but it is not available until the first quarter of 2001 and is $600 higher.

CUSTOM SERIAL TO PARALLEL CARD

This card will be designed to accept the 9.072 Mbit/s data, clock, and a Data Valid or Init line from one (or more) PBDs. The serial input will be converted to a 32 bit word and then clocked into a FIFO. The FIFO will provide for block transfers into the Digital I/O card and will also provide flexibility for an expanded scheme that could include several of these SPC/FIFO blocks to receive inputs from multiple tracks and multiplex their outputs onto a common bus that would drive the input to the Digital I/O card. Since the PBD clocks can be fixed, but are not synchronous, one playback mode involving several tracks might use the FIFOs to package the

data into a block that would be transferred to the Digital I/O card. As the data rates drift from track to track, some of the FIFOs will fill sooner than others. The output cycle for the FIFOs would be managed in such a way as to monitor the FIFO states and dump the ones that are filling faster at a higher rate. In order to achieve this, the FIFOs must hold several blocks of data. The more tracks that are multiplexed will either result in larger FIFOs or faster dumps. Another consideration, is if during playback, the correlator is exercising servo control on the PBD playback speed. In this case, the same scheme may work also provided the FIFO is at least the same size as the VLBA Track Recovery Card Playback buffer (32KB, I think). In any case, the bottleneck is clearly in the sustained transfer rate to disk. The best transfer rates are achieved with the use of sequential writes into a single file. The data blocks in the file would not be in any recognizable order, but would be tagged with identifiers.

Components to handle a single track (CPLD & FIFO) should not be more than $100. A few of these could fit on a wire wrapped card and mount inside the PC. At some point, the number of tracks on the custom card may lead to an external device instead of having the card mounted inside the PC

APPLICATION SOFTWARE

Most of the vendors of the Digital I/O cards provide driver libraries that can be used with Visual Basic. This seems to be a popular programming environment that has wide support in the data acquisition field. I have purchased and installed a copy of Visual Studio V6.0 that includes the Visual Basic compiler. The cost of this package was $236.

COMPUTER SYSTEM

The sustained transfer rate writing to disk is clearly the bottleneck. A high end desk top or a low to mid range workstation in the 800Mhz range with 256M of RAM, SCSI Bus (Ultra160), and a 10,000 RPM drive will be adequate to handle several if not all of the 11.25 Mbyte/s throughput. We will not need all of this capacity unless multiple tracks are handled in a single PC. Card and computer vendors are very reluctant to guarantee any sustained transfer rates but are willing to admit that the 11.25 MByte/s is probably achievable. A system that fits this task, with modest video performance, can be obtained for about $3400. Specifically, the Dell Precision Workstation 220 with a 73GB 10,000 rpm drive was priced in this range. For a single track, at 1.125 MBytes/s, the disk needs to have about 10GB to hold 150 min. of data.

SUMMARY

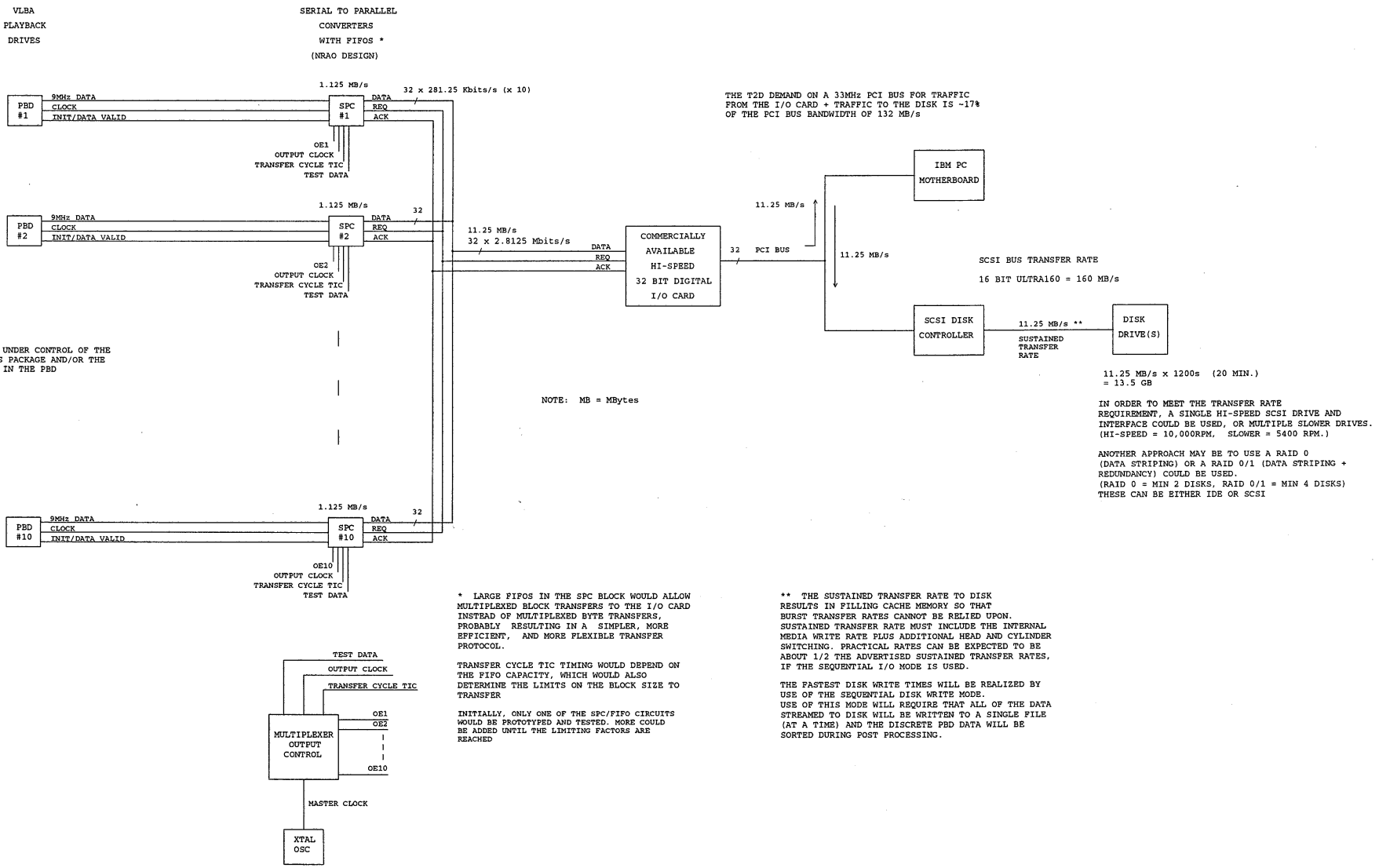
The Circuit Specialists PCI7300A-B card is the most capable for the price. The transfer rates are really going to be unknown until something is working and can be characterized. If we design the custom card (Wire Wrapped at this stage) with a potential capacity for four or five tracks, we can populate one and move toward getting that much to work. Once the system can be shown to work for a single track, we can populate a second one and attempt to multiplex the two together.

NOTE:

Since this summary was written, a purchase requisition has been submitted

for the PCI7300A Digital I/O card

- Bob


VLBA
PLAYBACK
DRIVES
SERIAL TO PARALLEL
CONVERTERS
WITH FIFOS *
(NRAO DESIGN)
PBD #1
PBD #2
PBD #10
9MHz DATA
CLOCK
INIT/DATA VALID
1.125 MB/s
32 x 281.25 Kbits/s (x 10)
SPC #1
SPC #2
SPC #10
DATA
REQ
ACK
32
OE1
OE2
OE10
OUTPUT CLOCK
TRANSFER CYCLE TIC
TEST DATA
11.25 MB/s
32 x 2.8125 Mbits/s
COMMERCIALLY AVAILABLE HI-SPEED 32 BIT DIGITAL I/O CARD
32 PCI BUS
IBM PC MOTHERBOARD
SCSI DISK CONTROLLER
DISK DRIVE(S)
11.25 MB/s **
SUSTAINED TRANSFER RATE
THE T2D DEMAND ON A 33MHz PCI BUS FOR TRAFFIC FROM THE I/O CARD + TRAFFIC TO THE DISK IS ~17% OF THE PCI BUS BANDWIDTH OF 132 MB/s
SCSI BUS TRANSFER RATE
16 BIT ULTRA160 = 160 MB/s
PBDs WILL BE UNDER CONTROL OF THE VLBA RSCREENS PACKAGE AND/OR THE MINI-DECODER IN THE PBD
NOTE: MB = MBytes
11.25 MB/s x 1200s (20 MIN.)
= 13.5 GB
IN ORDER TO MEET THE TRANSFER RATE REQUIREMENT, A SINGLE HI-SPEED SCSI DRIVE AND INTERFACE COULD BE USED, OR MULTIPLE SLOWER DRIVES. (HI-SPEED = 10,000RPM, SLOWER = 5400 RPM.)
ANOTHER APPROACH MAY BE TO USE A RAID 0 (DATA STRIPING) OR A RAID 0/1 (DATA STRIPING + REDUNDANCY) COULD BE USED. (RAID 0 = MIN 2 DISKS, RAID 0/1 = MIN 4 DISKS) THESE CAN BE EITHER IDE OR SCSI
TEST DATA
OUTPUT CLOCK
TRANSFER CYCLE TIC
MULTIPLEXER OUTPUT CONTROL
OE1
OE2
OE10
MASTER CLOCK
XTAL OSC
* LARGE FIFOS IN THE SPC BLOCK WOULD ALLOW MULTIPLEXED BLOCK TRANSFERS TO THE I/O CARD INSTEAD OF MULTIPLEXED BYTE TRANSFERS, PROBABLY RESULTING IN A SIMPLER, MORE EFFICIENT, AND MORE FLEXIBLE TRANSFER PROTOCOL.
TRANSFER CYCLE TIC TIMING WOULD DEPEND ON THE FIFO CAPACITY, WHICH WOULD ALSO DETERMINE THE LIMITS ON THE BLOCK SIZE TO TRANSFER
INITIALLY, ONLY ONE OF THE SPC/FIFO CIRCUITS WOULD BE PROTOTYPED AND TESTED. MORE COULD BE ADDED UNTIL THE LIMITING FACTORS ARE REACHED
** THE SUSTAINED TRANSFER RATE TO DISK RESULTS IN FILLING CACHE MEMORY SO THAT BURST TRANSFER RATES CANNOT BE RELIED UPON. SUSTAINED TRANSFER RATE MUST INCLUDE THE INTERNAL MEDIA WRITE RATE PLUS ADDITIONAL HEAD AND CYLINDER SWITCHING. PRACTICAL RATES CAN BE EXPECTED TO BE ABOUT 1/2 THE ADVERTISED SUSTAINED TRANSFER RATES, IF THE SEQUENTIAL I/O MODE IS USED.
THE FASTEST DISK WRITE TIMES WILL BE REALIZED BY USE OF THE SEQUENTIAL DISK WRITE MODE. USE OF THIS MODE WILL REQUIRE THAT ALL OF THE DATA STREAMED TO DISK WILL BE WRITTEN TO A SINGLE FILE (AT A TIME) AND THE DISCRETE PBD DATA WILL BE SORTED DURING POST PROCESSING.
Title
VLBA Tape to Disk
Size
D
Document Number
<Doc>
Rev
<RevCode>
Date:
Friday, December 13, 2002
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