Mark 5A/B/B+ Status

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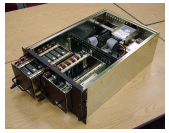
Overview

Systems

- Mark 5A: 1024 Mbps
- Mark 5B: 1024 Mbps
  VSI-H interface
  Built-in formatter for telescopes
  Bypass station units at correlators
  Direct interface to DBE
- Mark 5A+: Allows Mark 5B playback (firmware)
- Mark 5B+: 2048 Mbps (Amazon StreamStor board)



Mark 5

Status: ~150 Mark 5 units installed at telescopes and correlators
Mark 5A, Mark 5A+, Mark 5B and Mark 5B+ are operational
Mark 5B Correlator Interface Boards (CIBs) will ship Jan 07.

Mark 5B Data System Features

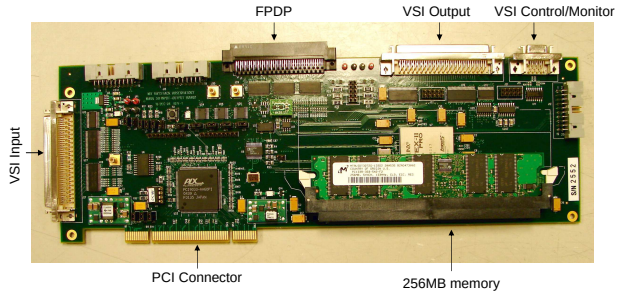
- Full VSI-H compatibility
- Same chassis as Mark 5A; uses same disk modules; requires Mark 5B I/O card
- 1024 Mbps record/playback
- Eliminates need for external formatters, but requires sampler adapter for Mark 4/VLBA DASs to provide VSI-compatible output
- Station Unit capabilities for connection to Mark 4 correlators is designed into Mark 5B
- Extensive built-in phase-cal extraction and state counting on both data record (DIM) and data playback (DOM)
- Front-panel status display – 8 tri-color LEDs
- DIM and DOM capabilities are separate FPGA downloads
- FPGA is programmable via software

Development supported by Mark 5 development consortium –
BKG, EVN, KVN, JPL, MPI, NASA, NRAO, USNO

Mark 5A/B/B+ System Comparisons

	Mark 5A	Mark 5B	Mark 5B+
Data Interface	Emulates Mark4/VLBA tape transport	VSI-H (64 MHz max clock rate)	VSI-H (64 MHz max clock rate)
Max data rate	1024 Mbps	1024 Mbps	2048 Mbps
Record modes	8, 16, 32, 64 "tracks"	1,2,4,8,16,32 bit streams	Same as Mark 5B
Disks	Mark5 "8-pack"	Same	Same
Chassis	Mark5	Same	Same
I/O card	Mark 5A	Mark 5B	Mark 5B
SS card	XF2	XF2	Amazon
I/O-SS interface	Modified FPDP	FPDP	FPDP2 (clocks on both edges)

Mark 5B I/O Board



Mark 5B Status

- Checkout of Mark 5B hardware is complete
- DIM support software has been released
  but phase-cal extraction not yet supported
- Successfully tested with 5-m VSI cables at 2048 Mbps
  expect 20-m cable to work, but not yet tested
- Mark 5B is in regular use at Westford antenna
  but still need some additional Field System support
- Mark 5B interfaced to Haystack Mark 4 correlator
  – in routine production use
  – highly reliable and repeatable
- Correlator Interface Boards (CIB) being built for MPI, JIVE, and USNO correlators for delivery in January 2007
- About 30 Mark 5B IO boards have been built and tested at Haystack and will be distributed to Mark 5 development consortia members in the near future
- Mark 5B can be ordered from Conduant Corp
- Haystack building VSI sampler upgrades for Mark 4 formatter capability with Mark4 DAS, but fery few orders (JB & Yebes)

Reasons to adopt Mark 5B

- Eliminate need for expensive external formatters
  particularly important for new stations or stations without existing Mark 4 or VLBA formatters
- With a 14-BBC Mark 4 or VLBA4 system, up to 1792 Mbps can be recorded with two parallel Mark 5B systems; current systems can only generate a maximum of 1024 Mbps of formatted data
- Extensive phase-cal extraction and state counting capabilities for better diagnostics and better system calibration
- Replace unreliable Station Units on Mark 4 correlators
  SU capability is built into Mark 5B
- At JIVE, double spectral resolution at correlator
- Mark 5B+ data recorded at 2 Gbps cannot be supported by Mark 5A+

Mark 5B+ (2048 Mbps)

- Conduant has introduced an upgraded StreamStor (dubbed “Amazon”) that supports up to ~3 Gbps on FPDP2 interface
- Mark 5B I/O card has been designed to support input VSI-H clock rate of 64MHz, as well as FPDP2 DDR compatibility, to support max recording rate of 2048 Mbps with Amazon board
- May be desirable to record across 2 disk modules (16 disks) simultaneously
- Playback is limited to 1024 Mbps
- Recordings made on Amazon are playable on a standard Mark 5B or Mark 5A+ system
- Mark 5B+ can now be ordered from Conduant

Mark 5 Upgrade Costs

Existing \ Target	**Mark 5A**	**Mark 5B**	**Mark 5B+**
0	$18K	~$20K	~$23K
Mark 5A	-	~$3K (Mark 5B I/O)	~$12.5K (Mark 5B I/O plus Amazon)
Mark 5B	-	-	~$9.5K (Amazon)

Note: Does not include external cabling costs, typically a few hundred dollars

Disk-Media Reliability

- We have seen only 8 disk drive failures during the past year at Haystack
  4 Hitachi, 4 Maxtor
  4 replaced under warranty
- Failure rate of Hitachi had been higher than average,
  but may now have been fixed.
- Disk reliability at high altitude was investigated in Mark 5A tests on Mauna Kea in early 2006:
  Tested disk drive types were:
  Maxtor 300-GB Model 7L300R0
  Seagate 300-GB Model ST3300831A
  Western Digital 320-GB Model WD3200SB-01KMA0
  Hitachi 250-GB Model HDS722525VLAT80
  →Only the Hitachi's functioned reliably at 14000 ft.
  (However, all disk drives recovered when returned to low altitude.)

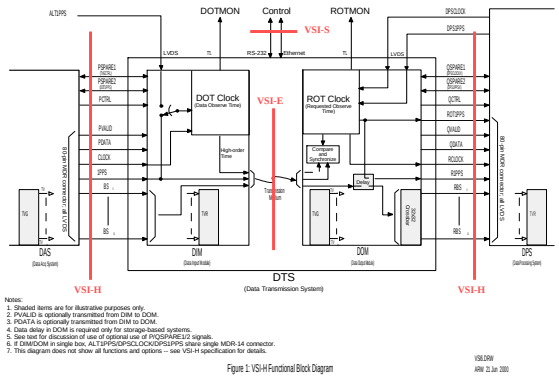
Plans for Serial-ATA Support

- A new module is being designed to support SATA disks.
- Existing 200-pin connector on module will be maintained using PATA signals.
- Conversion to SATA will be on module backplane.
- Prototype SATA modules should be ready in a few months, but we don't feel any urgency at the present time.

Mark 5B Command Set

- Very similar to Mark 5A; many commands are the same
- New commands
  1pps_source = <1pps source>
  clock_set = <clk freq> : <clk source>
  DOT_set = <time>
  DOT_inc = <+/-n seconds>
  mode = <data source>:<bit-stream mask>:<decimation ratio>
  TVR = <tvr mask>

VSI-H Functional Block Diagram



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 PIQSPARE1/2 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.

Figure 1: VSI-H Functional Block Diagram

Mark 5A/B Compatibility

- Mark 5B can play only Mark 5B recordings (VSI format in/out)
- Upgraded Mark 5A ("Mark 5A+") can play:
  - All Mark 5A recordings
  - Mark 5B recordings made in almost all modes; playback is in VLBA-track-format
- Mark 5A+ design is complete and tested, but is needed only on correlators that do not yet support Mark 5B
- Existing Mark 5A systems can be upgraded to Mark 5A+ with new Xilinx download and upgraded software

Bottom line: Existing Mark 4 correlators with only Mark 5A/5A+ units will be able to process data from both Mark 5A and Mark 5B units during the transition period to Mark 5B.

Mark 5B Functional Block Diagram