

Mark 5C VLBI Data System

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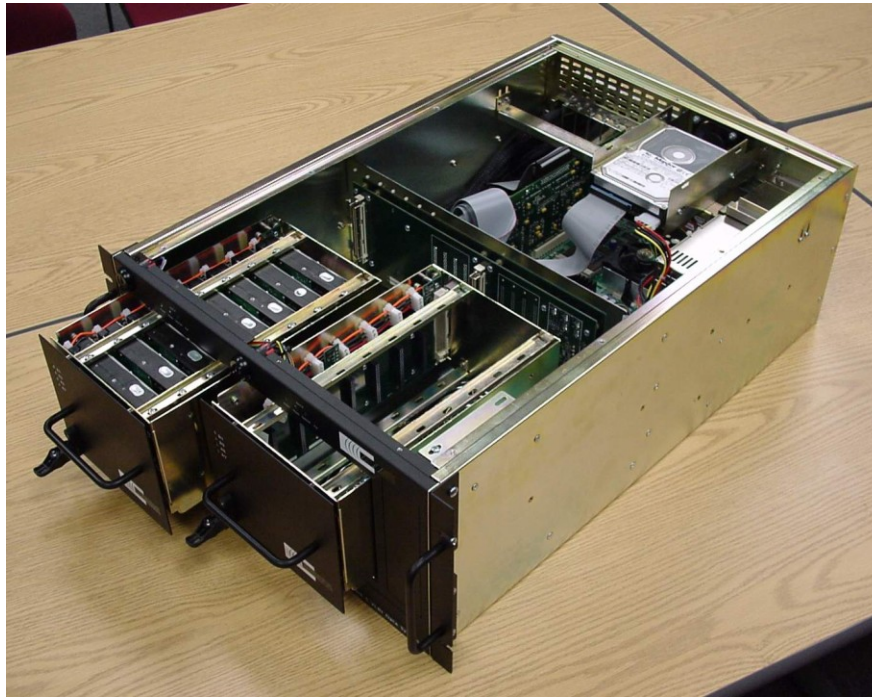
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EVGA

Bordeaux, France

Mark 5 Data Acquisition System

(Mark 5A/B/B+/C all look the same)

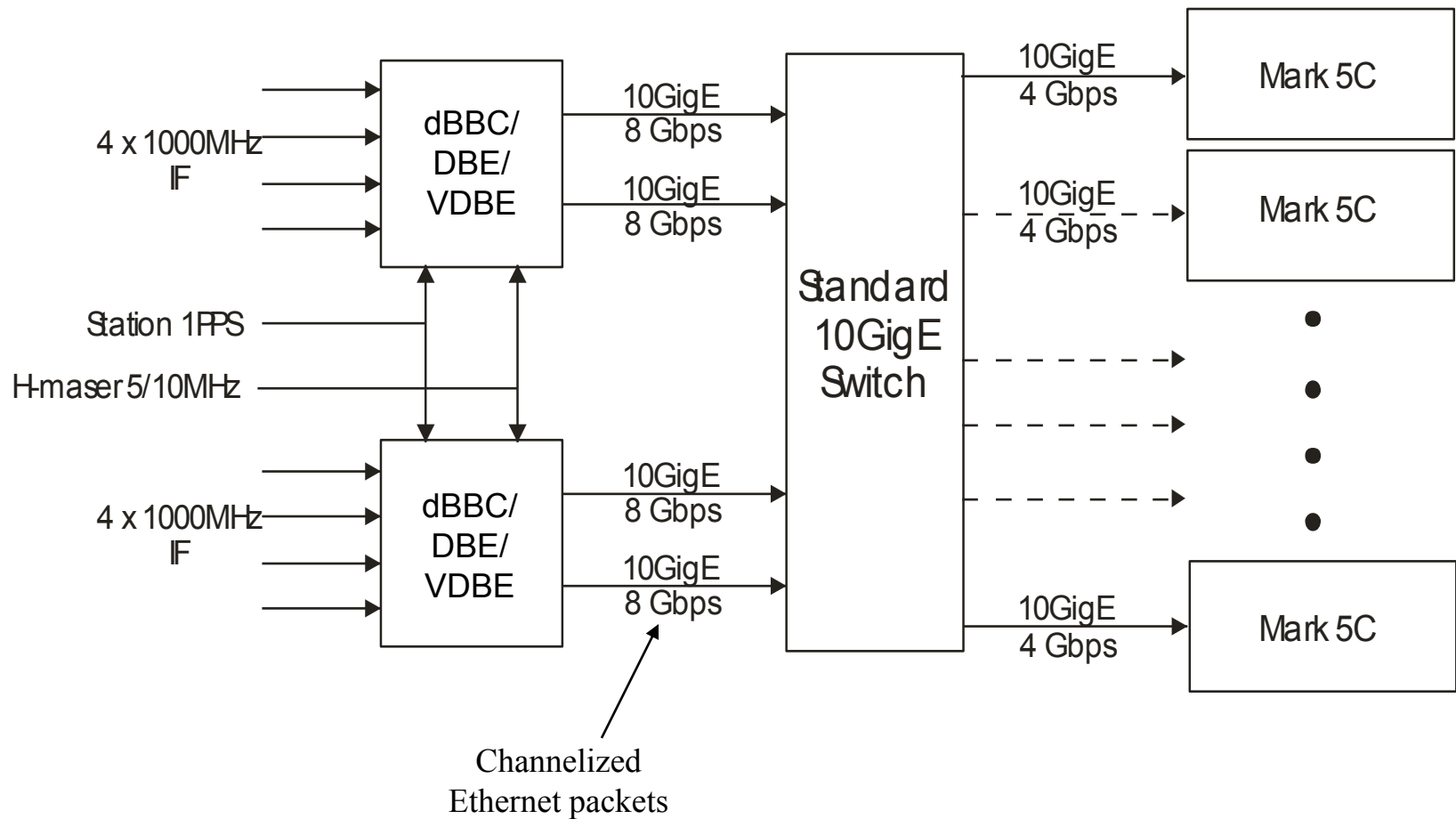


	Year introduced	Record rate (Mbps)	Interface	Cost (USk\$)	#deployed
Mark 5A	2002	1024	Mk4/VLBA	21	~130
Mark 5B	2005	1024	VSI-H	23	~40
Mark 5B+	2006	2048	VSI-H	24	~30
Mark 5C	2009	4096	10GigE	25	-

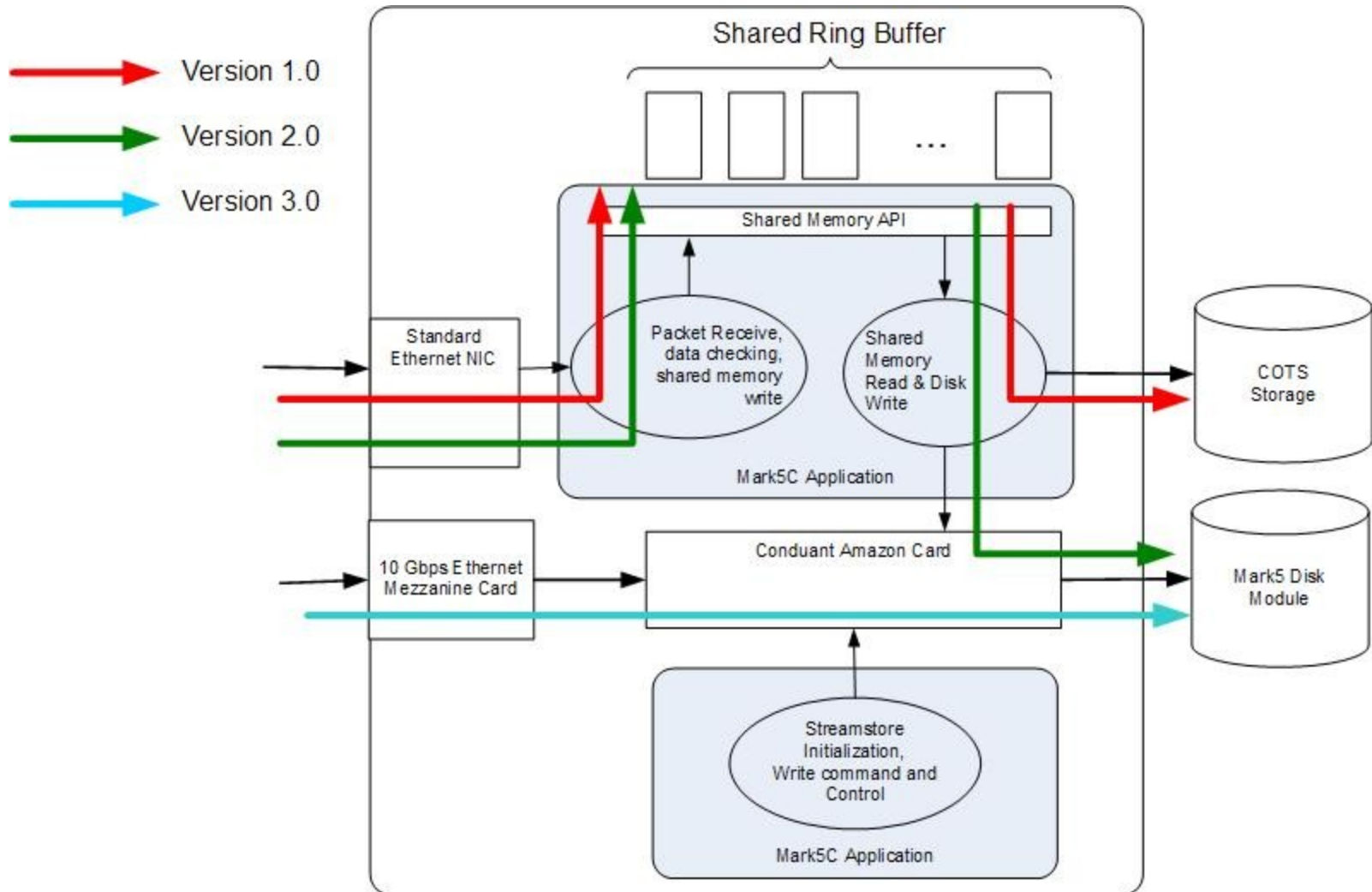
Mark 5C Characteristics

- Mark 5C specification developed jointly by Haystack & NRAO; comments solicited from global community in early 2007
 - 4096 Mbps max data rate to two standard Mark 5 disk modules
 - 10GigE data interface
- A “dumb” Ethernet packet recorder (accepts OSI Layer 2 or higher)
 - Not VLBI specific
- Data source is responsible for data formatting and Ethernet packet creation
 - Expect most applications will create VDIF-compliant data streams
- Record through real-time hardware 10GigE interface
- Playback of Mark 5C will be through host computer accessed as standard Linux files using FUSE
 - Natural for software correlators

Generalized 10GigE Data Distribution Concept



Evolving Mark 5C Functionality



Status

- First Mark 5C prototype hardware has been delivered
 - Hardware testing starting soon, software development underway
 - Expect first 4Gbps demonstration in few months
- 2nd-generation digital backends currently being designed as 10GigE VDIF data sources
 - dBBC with Fila10 board (Europe)
 - DBE2 – based on ROACH board; 2nd generation iBOB (US)
 - Also possible developments in Australia, China, Japan
 - Some prototypes expected mid-late 2009

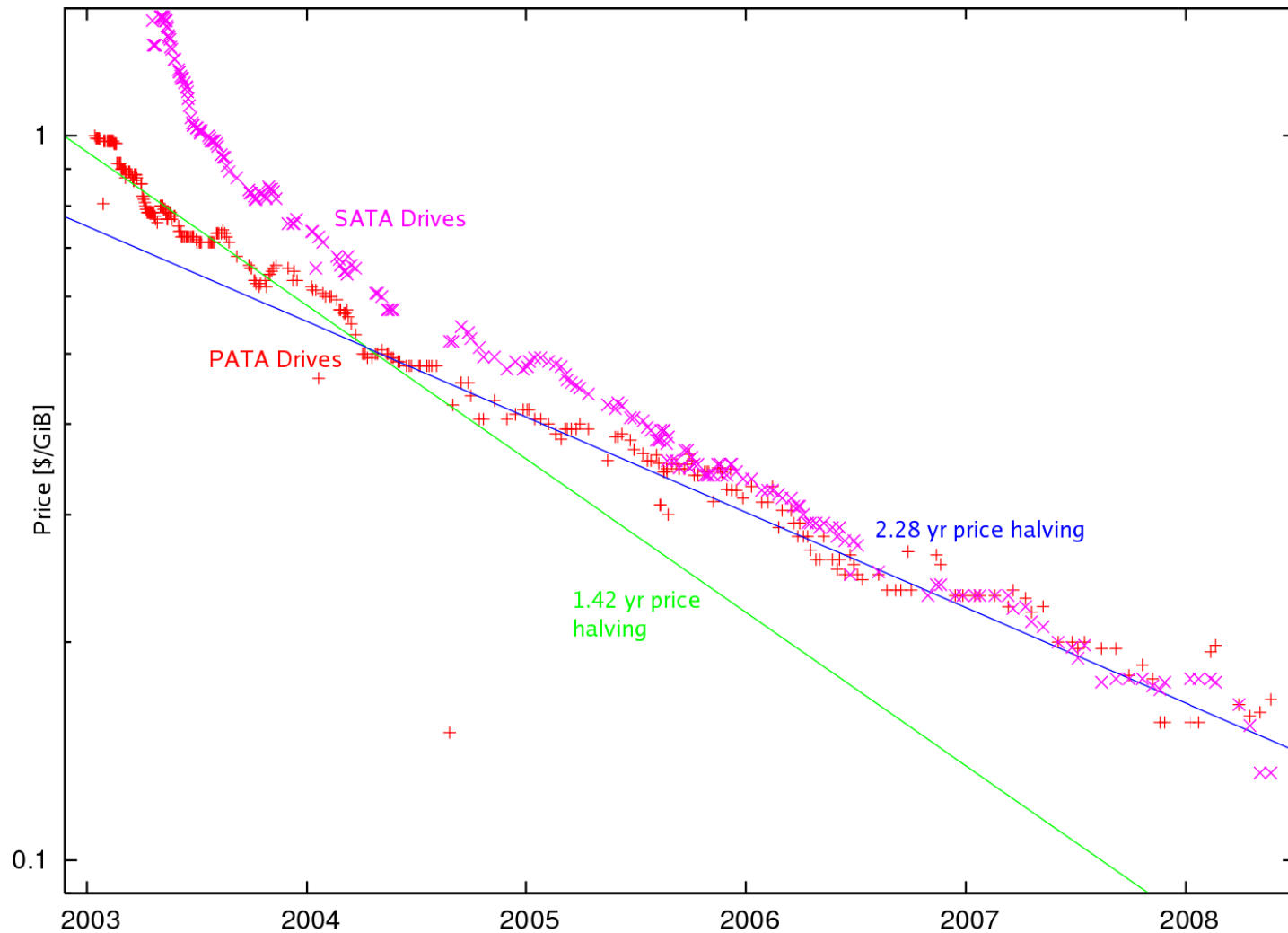
Mark 5 Upgrade Costs

Target Existing	Mk5A	Mk5B (requires VSI-H data source)	Mk5B+	Mk5C (not yet available; estimates)
0	Unavailable	\$23K	~\$24K	~\$25K
Mk5A	-	~\$3K (Mk5B I/O)	~\$12K (Amazon plus Mk5B I/O)	~\$13K (Amazon plus 10GigE DB)
Mk5B	-	-	~\$9K (Amazon)	Est. \$13K (Amazon plus 10GigE DB)
Mk5B+	-	-	-	~ \$4K (10GigE DB)

Disk-Media Status

- Hard disk price vs capacity/performance continues to drop
 - Now below ~\$0.15/GB and continues to drop
(Mark 4/VLBA tape was ~\$2.00/GB)
- 750 GB disks –
Two 8-packs of 750GB disks comparable to ~24 VLBA/Mark 4 tapes;
~26 hours @ 1 Gbps unattended!
- 2 TB disks – two 8-pack modules will sustain 4 Gbps for ~18 hours
- Currently ~1500 Mark 5 data modules with >2PB capacity

PATA & SATA: \$/GB vs. time



courtesy Walter Briskin; data based on pricewatch.com monitoring

Possible Future Directions

- Higher data rates (8-16 Gbps)
 - New module connector with many high-speed serial data streams
 - Suitable connector has been identified
 - Would not be backwards compatible with current modules
 - Move to 16 or more 2.5" SATA disk drives in current module geometry
 - Data rates to $\geq 8\text{Gbps}$ with single module;
 $\geq 16\text{Gbps}$ with two modules
 - Possibility to use solid-state disk drives for higher reliability
(currently too expensive, but prices dropping rapidly)
- Possible data interface upgrades
 - Multiple 10GigE interfaces
 - 100GigE

Thank you