M2 Tape Drives

18 M2 drives in AML/2 library – connected to D0En nodes

All 18 used for media and drive testing
D0 wanted to test too– I let them use 12 drives

Currently I have 12 and D0 has 6
1 broken – faceplate torn off (upside down tapes)

6 standalone (non robotic) drives – connected to RIP nodes

I use these for debugging
Firmware sanity checks
Check of new spare SCSI cards

2–3 other standalone drives on desktops
Used for debugging enstore.

All drives have

Firmware Revision:	8ck3v02r	(released in Dec)
Boot Version:	8BK1–V0C	
Configuration Version:	8E002103	

Early drives had to be swapped – hardware mods
Firmware upgraded many times (1st test rev was g)

Software to Query M2 drives

Exabyte wrote and provided M2Mon to us

"Application for configuring, testing, and upgrading M2"
Runs under windows
Get dumps of errors/crashes – send to Exabyte
Upgrade firmware and make code–load tape
Get tape stats (previous & lifetime stats don't work ?)
Get drive stats

Uses serial connection or SCSI
Since our SCSI is connected to D0En nodes, we are using serial connections for M2Mon
ADIC – rewired Exabyte's serial lines to their standard. We reversed engineered this and have a converter to RS232.

Tedious – have to wheel a cart around and attach to each M2 drive to get dump.

ISD wrote M2Probe

Provides same capabilities that we need from M2Mon, but under UNIX to get info over SCSI
Get dumps – most important reason for M2Probe
Get tape drive stats
Get firmware stats
Exabyte SCSI manuals designate appropriate calls.

Tape history:

Tape ID:	62710498–663
Current Blocks Written:	0
Current Blocks Rewritten:	0
Current Blocks Read:	14663318
Current Blocks ECC'd:	4287
Current Write Retries:	0
Current Read Retries:	624
Current Tracking Retries:	48 <–––––––––––––––––?
Current Data Underruns:	0
Current Data Overruns:	9 <–––––––––––––––––?
Current Rewinds:	35
Current Max Temperature:	26
Current Drive Serial Number:	62707894
<repeats for previous>	not working <–––––––––?
<repeats for lifetime>	not working <–––––––––?

Write Error Counters:

Total Rewrites:	0
Total Errors Corrected:	0
Total Times Errors Processed:	0
Total Bytes Processed:	0
Total Unrecoverable Errors:	0

Read Error Counters:

Total Rereads: 624
Total Errors Corrected: 4912
Total Times Errors Processed: 4289
Total Bytes Processed: –452933301
Total Unrecoverable Errors: 18 <–––––––––––––––––?

Drive Usage Information:

Total Blocks Written: 1474152
Total Blocks Rewritten: 0
Total Blocks Read: 25915163
Total ECC Corrections: 4994
Total Blocks Reread: 1236
Total Load Count: 236
Minutes Since Last Clean: 1148
Minutes of Powered Time: 28999
Minutes of Tensioned Time: 3076
Cleaning Count: 29

Dump Type: MAMMOTH2 SCSI DUMP

Firmware Revision: 8ck3v02r
Firmware Release Date: Wed Dec 6 09:07:36 MST 2000
Boot Version: 8BK1–V0C
Configuration Version: 8E002103
Serial Number: 0062024343
Status: o–oM2 READY–TAPE
Tape ID: 62710498–663

M1 Drives

There are 17 M1 drives in the AML/2 robot. Many others outside the robot.

Even though this is a mature product, we still see drive problems (firmware bugs?) and/or media problems.

> There will always be bugs!

We didn't want to debug M1 drives – end–of–life – so we chose to write a "nanny" process

> Watch for errors and restart appropriately
> Early on, errors were from drives/media and enstore
> Now, errors mostly from drives/media

We want to debug M2 drives and M2 media

> Don't want nanny at this stage.

Other 8MM Media Issues

8MM media is fragile –very likely that AML/2 will damage some data tapes in the future. D0 must be prepared for this.

Upside down tapes cause very bad damage:

Tape themselves break when inserted or ejected

Tapes catch on faceplate of M2 drive and robot pulls faceplate of drive off – broken drive + broken tape

Lot number printed on bottom of cassette – this gets covered up by the bar–code label.

Early M2 Standalone Tests

All early tests were done on 6 M2 drives on a shelf outside the robot. Number of tapes tested is ~50

Summary of these tests – frequent hangs, inconsistent
--> Drives were non–functional.

Trip to Boulder by Diesburg, Bakken, Huang
Martin Dahl, Exabyte CE, visits us

Dahl notes that all our M2 drives were "old hardware" type and needed to be replaced.
Dahl expedites exchange quickly for 5/6 drives

Dahl notes that all our M2 media is from MEI and is known bad and needs to be replaced.
Dahl expedites exchange quickly – we get SONY.

Dahl also shows us how to use M2Mon

After exchange of drives and media,I repeated R/W tests
Drives mostly performed according to spec
Some firmware errors – sent to Exabyte via Dahl
never heard back whether they were solved
but did hear that they had made it Boulder

Summary: Early tests looked very promising with good drives and media

Initial Tests of M2 in AML/2 Library

Since R/W ability was tested in standalone tests, I started tests in robot by investigating mounting/dismount tapes in the M2 drives.

18 drives, ~80 tapes

This was really a combined test of the ADIC robot and the M2 drives as a unit.

> Test was mount, wait for BOT, dismount, repeat.
>
> These tests were successful. No problems.

More Tests of M2 in AML/2 Library

Began test of more realistic operation of
18 M2 drives + AML/2 robot + 80 tapes

Tried various tests. Worst stress case was:
Test was mount, write 250 MB at EOD, dismount, or
mount, read random 250 MB, dismount
Tapes were randomly mounted in different drives.
These results were abysmal.

Dahl came in and looked at error logs and agreed tests were failing. He diagnosed 3 failure modes:

Bad hardware – These were new drives and we did expect some infant mortality.
Firmware errors – We were running "2P", the latest available at the time.
Media errors – We had MEI and SONY media in the library. (These were different MEI than the ones Dahl said were bad.)

Problem was that the errors were all highly correlated:
Bad media caused firmware errors
Firmware errors reported as servo/hardware failures

There was also a new error type – drives would hang and had to be power–cycled before they would respond. SCSI resets didn't work.

Effort on fixing problem:

Dropped down from 18 drives to 5 drives to simplify

I tried to remove bad media when I found it – impossible
- Removed all MEI media in desperation.
  - only SONY left – 30 tapes (20 used by D0)
- Situation improved dramatically

1 drive pair replaced by ADIC

Firmware errors reported to Exabyte via Dahl
- No report back
- Heard they were sent to Boulder

Summary: If there is good media, the M2 drives work reasonably well. But there are problems that are hard to pinpoint if you have bad media.

Exabyte Phone Meetings

Petravick sets up phone meetings with Shadegg and Skaar
- Very useful meetings

- Sent us "2R" firmware code

Stephan arranged swap of media for TDK media with local Exabyte office
- Gave us 1 box of 50 TDK tapes so we could try it too

- We were told the TDK media was the current best media that Exabyte offers.

Wrote data to 5 tapes using 2R code on 5 drives.
- Went smoothly, no issues
- Files were mixture of 250 MB and 1 GB files
- Didn’t keep detailed info on writes.

TDK M2 Read Tests

Started reading tapes in streaming mode since was simpler than mount, random pick, dismount test.

Test was read each file using dd to EOD, rewind to BOT and repeat.

Summary: current set of M2 TDK tape and M2 2R firmware drives can be used, but it is not operationally sound.

There are 3 error types:

1. Failure to read a random file on a tape. Tape drive remains functional. Subsequent reads of file pass on same or different drive. We can handle this error type.

2. Failure to read a group of files (in my case 6 files) on the tape. Tape drive remains functional. The 6 files are lost and can not be read on other drives either. We can not handle this error.

3. Failure to read a random file on a tape. Tape drive hangs and needs to be power cycled before it can be used again. Enstore can not handle this error.

Dumps were sent to Shadegg at Exabyte last Sunday.

Details

Tape PRG170 has 154 files on it.
It was tested with drive DI42.

There was a very consistent error on this media/drive combination: I was only able to read the 1st 14 files. I always got an I/O error after that.

It also failed after a rewind and a fsf 15 to fsf 19.

I could read later files after I did a rewind and a fsf 20.

Dump File: Fermilab−0062026911−010102−1711.dmp
0y 080d 19h 14m 17s 0x16 0x00 0x00 0062026911−733 0 24°C

FSC: Medium error during Read

On the next day, tape PRG170 was tested on Drive DI43.

This drive had the exact same behavior as DI42 – it could not read files 14−19.

I could skip beyond the 1st 19 files and successfully read files 20−154 (to EOD) without errors.

Tape PRG172 has 148 files on it.
It was tested with drive DI43.

I managed to read every file on the tape 10 times without error.

On one pass there was an I/O error after file 112. I could read this file on subsequent passes.

Dump File: Fermilab–0062019794–010103–0546.dmp
0y 095d 14h 59m 12s 0x0b 0x00 0x00 0062026937–711 0 25°C

FSC: Uncorrectable block during Read

On the next day, tape PRG172 was tested on drive DI44.

It failed to read file 116 on the 1st pass. The drive needed to be power cycled before it was usable.

Tape PRG175 has 127 files on it.
It was tested with drive DI44.

I was able to read every file on the tape for the 1st pass.

On the 2nd pass, there was an I/O error file 108.

Dump File: Fermilab–0062026956–010102–2030.dmp
0y 057d 05h 45m 15s 0x0b 0x00 0x00 0062022635–228 0 25°C

FSC: Uncorrectable block during Read

After that, I rewound the tape, but it didn't work – that is, I could not read any more data and the drive had to be power–cycled to get it out of this non–recoverable state.

On the next day, tape PRG175 was tested in drove DI45. The tape was DOA at the start of the test.

Tape PRG177 has 137 files on it.
It was tested with drive DI45.

I was able to read every file on the tape 20 times without error.

On the 21st pass, there was an I/O error after file 124.

Dump File: Fermilab−0062026937−010103−0858.dmp
0y 076d 04h 45m 57s 0x16 0x00 0x00 0062026911−733 0 23°C

FSC: Medium error during Read

After that, I rewound the tape, but it didn't work – that is, I could not read any more data and the drive had to be power−cycled to get it out of this non−recoverable state.

On the next day, Tape PRG177 was tested on drive DI46.

I read it 23 times without any errors.

Tape PRG178 has 111 files on it.
It was tested with drive DI46.

I managed to read every file 16 times without error.

On one pass there was an I/O error after file 107. I could read past this file on subsequent passes.

Dump File:Fermilab–0062024343–010103–0010.dmp
0y 019d 22h 44m 03s 0x0b 0x00 0x00 0062019794–661 0 25°C

FSC: Uncorrectable block during Read

On another pass there was an I/O error after file 105. I could read past this file on subsequent passes.

Dump File: Fermilab–0062024343–010103–0258.dmp
0y 020d 01h 27m 36s 0x0b 0x00 0x00 0062019794–661 0 25°C

FSC: Uncorrectable block during Read

On the next day, tape PRG178 was read on drive DI42.

I read it 24 times without errors.

Summary of TDK Media Tests

TDK media was from lot number MJ0J26821

Tape	Drive	Serial#	#F	#G	#B	#D
PRG170	DI42	0062026911	154	0*	87	0
PRG170	DI43	0062019794	154	0*	214	0
PRG172	DI43	0062019794	148	10	1	0
PRG172	DI44	0062026956	148	0	0	1
PRG175	DI44	0062026956	127	1	0	1
PRG175	DI45	0062026937	127	0	0	1
PRG177	DI45	0062026937	137	20	0	1
PRG177	DI46	0062024343	137	23	0	0
PRG178	DI46	0062024343	111	16	2	0
PRG178	DI42	0062026911	111	24	0	0

#F = Number of files on tape

#G = Number of good passes, BOT to EOD

#B = Number of passes where I/O error, but drive remained functional and file could be read in next pass

#D = Number of passes where I/O error, and drive had to be power–cycled to get it working again. Ended the test.

Summary: This media isn't better than SONY. 2R code still has problems when media problems.

SONY Tests

Recall that 30 SONY tapes and 5 drives passed the stress test "mount – R/W – dismount' with very few problems (firmware?)

Repeat streaming tests – using SONY tapes written by 2P firmware and reading them with 2R to check results.

Results: Perfect, no errors!

Tape	Drive	Serial#	#F	#G	#B	#D
PRG047	DI42	0062026911	254	12	0	0
PRG043	DI43	0062019794	302	7	0	0
PRG044	DI44	0062026956	265	12	0	0
PRG045	DI45	0062026937	252	12	0	0
PRG048	DI46	0062024343	241	10	0	0

Summary: We need good media and firmware that can handle bad media without hanging.

Tape history:	
Tape ID:	62024127−219
Current Blocks Written:	0
Current Blocks Rewritten:	0
Current Blocks Read:	10731439
Current Blocks ECC’d:	3630
Current Write Retries:	0
Current Read Retries:	1447
Current Tracking Retries:	1 <−−−−−−−−−−−−−−−−−−?
Current Data Underruns:	0 <−−−−−−−−−−−−−−−−−−?
Current Data Overruns:	0 <−−−−−−−−−−−−−−−−−−?
Current Rewinds:	7
Current Max Temperature:	25
Current Drive Serial Number:	62024343
<previous>	
<lifetime>	

Drive Usage Information:	
Total Blocks Written:	1462784
Total Blocks Rewritten:	0
Total Blocks Read:	67633896
Total ECC Corrections:	7214
Total Blocks Reread:	4565
Total Load Count:	239
Minutes Since Last Clean:	1623
Minutes of Powered Time:	37315
Minutes of Tensioned Time:	5087
Cleaning Count:	3

Write Error Counters:

Total Rewrites:	0
Total Errors Corrected:	0
Total Times Errors Processed:	0
Total Bytes Processed:	0
Total Unrecoverable Errors:	0

Dump Type: MAMMOTH2 SCSI DUMP

Firmware Revision:	8ck3v02r
Firmware Release Date:	Wed Dec 6 09:07:36 MST 2000
Boot Version:	8BK1−V0C
Configuration Version:	8E002103
Serial Number:	0062024343
Status:	### READ +######
Tape ID:	62024127−219

Read Error Counters:

Total Rereads:	1447
Total Errors Corrected:	5077
Total Times Errors Processed:	3630
Total Bytes Processed:	1869538896
Total Unrecoverable Errors:	0 <−−−−−−−−−−−−−−−−−

Hardened MEI Media Tests

Shadegg sent 10 sample pieces of new MEI media

To get test done quickly, I wrote 50 1GB files to 5 tapes in streaming mode using 2R code

Previous tests randomized drive that wrote file

No problems writing data – went smoothly.

Read data back in streaming mode using same drive that wrote it. (different drive used in previous tests)

Results: No errors!

Tape	Drive	Serial#	#F	#G	#B	#D
PRG100	DI42	0062026911	50	10	0	0
PRG101	DI43	0062019794	50	10	0	0
PRG102	DI44	0062026956	50	10	0	0
PRG103	DI45	0062026937	50	10	0	0
PRG104	DI46	0062024343	50	10	0	0

Need to start stress tests again on larger sample.

New Sony Media Tests

Shadegg sent 10 sample pieces of new SONY media

To get test done quickly, I wrote 51 1GB files to 3 tapes in streaming mode using 2R code (different drives than before)
    Previous tests randomized drive that wrote file

51 files 1 GB don't fit.
- Get I/O error – out of space
- 2 drives – need to be power cycled after this
  - Got a dump

Note, I also tried to write 51 files to MEI tapes.
    These drives also gave I/O error – out of space, but remained functional. I rewound, fsf and then re–wrote last file and gave a good EOD.