PROBLEM STATEMENT

Open VMS
Multiple Tape Density Support

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1. Problem Statement:

Digital currently sells tape drives for use on Open VMS VAX and Alpha systems that support a wide variety of formats and tape densities. Although the firmware/hardware in many of these tape drives support multiple densities and compression, Open VMS does not support sensing and setting them. In several cases the absence of density support has negatively impacted sales of Digital tape drives and systems and has become a critical concern for some of Digital's large customers and third party venders.

To illustrate this company A has two sites; a home site and a remote site. At the home site are tape drives that support reading and writing at both densities but OpenVMS limitations will allow writing at a high density only. The remote site contains tape drives that support reading and writing at low density only. Any tape that is written at the home site is not readable at the remote site. Currently the only solution for read/write compatibility at both sites is to upgrade the remote site with tape drives which support the high density writes. An enhancement to OpenVMS will allow the home site's tape drives to support writing in either density.

As an example of the lack of density/compression support in OpenVMS, there is no method currently available for an Open VMS user to determine the densities that a given tape drive supports. In addition, there is no mechanism to set any tape drive to any one of its wide range of possible densities beyond the limited capabilities currently present.

In the case of tape drives connected to a SCSI bus, VMS supports either a compression switch or density setting, but not both. The density setting is supported for only one type of SCSI drive.

The TMSCP server and associated driver support a larger selection of density/compression combinations but their capability is incomplete and the current implementation is reaching it limits.

Consequently, many of the OpenVMS utilities that accept density/compression as input do not support the full range of tape drive capability. Currently they pose strict limits on the variety of density/compression choices that can be set and many behave inconsistently when compared with each other. They all could benefit from a consistent and enhanced density support mechanism.

This problem spans both OpenVMS VAX and Alpha. Any resolution that involves changes to OpenVMS must be considered for both the VAX and Alpha platforms, mixed architecture VMSclusters, and mixed version VMSclusters.

1.1 Unsupported Tape Density/Compression within OpenVMS

Many of the drives Digital ships have capabilities that the OpenVMS does not exploit. Many tape drives which support multiple densities can only be set to the default density from Open VMS. Having multiple density and compression support for several of these drives have become critical for some of Digital's larger customers. It is a priority to provide an OpenVMS mechanism to set any one of the multiple densities these tape drives support. It is beneficial to make multiple density and compression support easily extensible for all drives on both platforms. To this end multiple densities and compression can be supported for all existing tapes as well as future tapes in a general way. The following table is a list of tape drives Digital ships with the density/compression formats the drives support and the density/compression formats OpenVMS currently supports for tape drives connected via TMSCP controllers and directly attached SCSI tape drives.

TABLE 1. Digital Tape Drives with Density/Compression Support

Tape	Density	Compress	TMSCP	SCSI
TA90	Default Density	Yes (DCE bit)	Default density Default density Compressed	N/A
TA90E	Default Density	Yes (DCE bit)	Default density Default density Compressed	N/A
TA91	Default Density	Yes (DCE bit)	Default density Default density Compressed	N/A
TKZ08	00h - Default Density (EXB-8200) 14h - EXB-8200 - 54000bpi - 1 Track 7Fh - No change	No	EXB-8200	EXB-8200
TKZ09	00h - Default (EXB-8500 no error checking) 14h - EXB-8200 - 54000bpi - 1 Track 7Fh - No change 85h - EXB-8500 - 2 Track	No	EXB-8200 EXB-8500	EXB-8200 read only EXB-8500
TKZ15	00h - Default (EXB-8500 no error checking) 14h - EXB-8200 - 54000bpi - 1 Track 7Fh - No change 85h - EXB-8500 - bpi - 2 tracks	Yes (DCE bit) 8500 only	EXB-8200 EXB-8500 EXB-8500 Compressed	EXB-8200 read only EXB-8500 EXB-8500 Compressed
TKZ60	00h - Default Density 02h - 1600bpi - 9 Tracks 03h - 6250bpi - 9 Tracks (default) 09h - 3480/3490 - 37871 bpi - 18 Tracks 7Fh - No change	No	1600bpi read only 3480/3490 bpi 6250 bpi	1600 bpi read only 3480/3490 read only 6250bpi
TKZ61/ TKZ62/ TKZ63/ TKZ64	00h -Default Density 09h - 3480/3490 37871 bpi 18 tracks 28h- 3490E 36 tracks 01h, 02h, 03h, 06h and7Fh - No change	Yes (DCE bit)	3480/3490 3480/3490 Compressed 3490E 3490E Compressed	3480/3490 read only 3480/3490 Compress read only 3490E 3490E Compressed
TLZ04	00h - Default Density 13h - HP/Sony DDS-format - 61000bpi 7Fh - No change	No	DDS-1 format	DDS-1 format
TLZ06 and TLZ6L	00h - Default Density 13h - HP/Sony DDS-1 format - 61000bpi 7Fh - No change	No	DDS-1 format	DDS-1 format
TLZ07, TLZ7L, TLZ09, and TLZ9L	00h - Default Density 13h - DDS-1 format - 61000bpi 24h - DDS-2 format - 4.0 GB/ 8.0 GB 7Fh - No change FDh - Current Density - Compression Disabled FEh - Current Density - Compression Enabled	Yes (DCE bit, Density field)	DDS-1 format read only[2] DDS-1 Compressed read only[2] DDS-2 format DDS-2 Compressed	DDS-1 format read only DDS-1 Compressed read only DDS-2 format DDS-2 Compressed
TSZ05	00h - Default Density 13h - DDS-1 format - 61000bpi 7Fh - No change	No	DDS-1 format	DDS-1 format
TSZ07[3]	00h - Default Density 02h - 1600 bpi 03h - 6250 bpi 7Fh -No change	No	1600 bpi read only[2] 6250 bpi	1600 bpi 6250 bpi
TZ30	00h - Default Density 0Ah - 6667bpi 7Fh - No Change	No	6667bpi	6667bpi
TZ85, TZ857 (TF85, TF857)	00h -Default Density (TK85) 0Ah - 6667bpi (TK50) read only 16h - 10000bpi (TK70) read only 17h - 42500bpi - 2.6 GB (TK85) 24-tracks 7Fh - No change	No	TK50 read only TK70 read only TF85	TK50 read only TK70 read only TZ85
TZ86, TZ867 (TF86, TF867)	00h - Default Density (TK86) 0Ah - 6667bpi (TK50) read only 16h - 10000bpi (TK70) read only 17h - 42500bpi - 2.6 GB (TK85) 24-tracks 18h - 42500bpi - 6.0 GB (TK86) 56-tracks 7Fh - No change	No	TK50 read only TK70 read only TF85 TF86	TK50 read only TK70 read only TZ85 read only TZ86
TZ87N	00h - Default Density (TK87) 0Ah - 6667bpi (TK50) read only 16h - 10000bpi (TK70) read only 17h - 42500bpi - 2.6 GB (TK85) 24-tracks 18h - 42500bpi - 6.0 GB (TK86) 56-tracks 19h - 62500bpi - 10 GB (TK87) 64-tracks 7Fh -No change	Yes (DCE bit, Density field)	TK50 read only TK70 read only TZ85 TZ86 TZ87 TZ87 Compressed	TK50 read only TK70 read only TZ85 read only TZ86 read only TZ87 TZ87 Compressed

	80h -Disable Comp - 62500 bpi - 10 GB TK87 81h -Enable Comp - 62500 bpi - 20 GB TK87			
TZ87, TZ875 and TZ877	00h - Default Density (TK87) 17h - 42500bpi - 2.6 GB (TK85) 24-tracks 18h - 42500bpi - 6.0 GB (TK86) 56-tracks 19h - 62500bpi - 10 GB (TK87) 64-tracks 7Fh -no change 80h -Disable Comp - 62500 bpi - 10 GB TK87 81h -Enable Comp - 62500 bpi - 20 GB TK87	Yes (DCE bit, Density field)	TZ85 TZ86 TZ87 TZ87 Compressed	TZ85 read only TZ86 read only TZ87 TZ87 Compressed
TZ88 and TZ887	00h - Default Density (TK88) 17h - 42500bpi - 2.6 GB (TK85) 24-tracks 18h - 42500bpi - 6.0 GB (TK86) 56-tracks 19h - 62500bpi - 10.0 GB (TK87) 64-tracks 1Ah - 81633 bpi - 20.0 GB (TK88) 64-tracks 7Fh - No change 80h -Disable Comp - 62500 bpi - 10 GB TK87 81h -Enable Comp - 62500 bpi - 20 GB TK87 82h -Disable Comp - 81633 bpi - 20 GB TK88 83h -Enable Comp - 81633 bpi - 40 GB TK88	Yes (DCE bit, Density field)	TZ85 TZ86 TZ87 TZ87 Compressed TZ88 TZ88 Compressed	TZ85 read only TZ86 read only TZ87 read only TZ87 Compressed read only TZ88 TZ88 Compressed
TZ89	00h - Default Density (TK89) 0Ah - 6667 bpi (read only) 16h - 10000 bpi (read only) 17h - 42500bpi - 2.6 GB (TK85) 24-tracks 18h - 42500bpi - 6.0 GB (TK86) 56-tracks 19h - 62500bpi - 10.0 GB (TK87) 64-tracks 1Ah -81633 bpi - 20.0 GB (TK88) 64-tracks 1Bh -85937 bpi - 35.0 GB (TK89) 104-tracks 7Fh - No change 80h -Disable Comp - 62500 bpi - 10 GB TK87 81h -Enable Comp - 62500 bpi - 20 GB TK87 82h -Disable Comp - 81633 bpi - 20 GB TK88 83h -Enable Comp - 81633 bpi - 40 GB TK88 84h -Disable Comp - 85937 bpi - 35 GB TK89 85h -Enable Comp - 85937 bpi - 70 GB TK89	Yes (DCE bit, Density field, EPROM, Front Panel)	TZ85 TZ86 TZ87 TZ87 Compressed TZ88 read only [2] TZ88 Compressed read only [2] TZ89 TZ89 Compressed	TZ85 read only TZ86 read only TZ87 read only TZ87 Compressed read only TZ88 read only TZ88 Compressed read only TZ89 TZ89 Compressed
TZK10	00h - Default Density (QIC-320/525) 05h - QIC-24 - read only 0Dh - QIC-120 w/ ECC - 25380 bpi - 24 tracks 0Eh - QIC-150 w/ ECC 0Fh - QIC-120 - 10000 bpi - 15 tracks 10h - QIC-150 - 10000 bpi - 18 tracks 11h - QIC-320/525 - 16000 bpi - 26 tracks 7Fh- no change	No	(Each is a different cartridge supporting only one density so setting density is not required.) QIC-120 w ECC read only QIC-120 QIC-150 w ECC read only QIC-150 QIC-320/525	(Each is a different cartridge supporting only one density so setting density is not required.) QIC-120 w ECC read only QIC-120 QIC-150 w ECC read only QIC-150 QIC-320/525
TZK11	00h - Default (Auto-Density Select) 05h - QIC-24 (read only) 0Fh - QIC-120 10h - QIC-150 11h - QIC-320/525 15h - QIC-1000 (4200) 3600bpi - 30 tracks 1Eh - QIC-1000 (TZK11) 36000 bpi -30 tracks 22h - QIC-2GB/2.5GB 7Fh- No change	No	(Each is a different cartridge supporting only one density so setting density is not required.) QIC-24 read only QIC-120 QIC-150 QIC-320/525 QIC-1000 QIC-2GB/2.5GB	(Each is a different cartridge supporting only one density so setting density is not required.) QIC-24 read only QIC-120 QIC-150 QIC-320/525 QIC-1000 QIC-2GB/2.5GB
TZK13	00h - Default (Auto-Density Select) 05h - QIC-24 - read only 0Fh - QIC-120 - 10000 bpi - 15 tracks 10h - QIC-150 - 10000 bpi - 18 Tracks 11h - QIC-320/525 - 16000bpi - 26 Tracks 15h - QIC-1000 - 36000 bpi - 30 tracks XXh - QIC-5GB 82909 - 44 Tracks - read only 22h - QIC-2GB/2.5GB - 67733 bpi - 42 tracks 21h- QIC-5010 - (13GB/26GB) - 67733 bpi - 144 Tracks. 7Fh- No change	Yes (DCE bit)	(Each is a different cartridge supporting only one density so setting density is not required but setting compression is.) QIC-24 read only[1] QIC-120[1] QIC-150[1] QIC-5GB - drive supports read only QIC-320/525 QIC-1000 QIC-2GB/2.5GB	(Each is a different cartridge supporting only one density so setting density is not required but setting compression is.) QIC-24 read only[1] QIC-120[1] QIC-150[1] QIC-5GB - drive supports read only QIC-320/525 QIC-1000 QIC-2GB/2.5GB
TZK20	00h - Default Density 23h - QIC-3040 7Fh - no change	No	QIC-3040	QIC-3040

[1] These tapes record infixed block mode and are not readable using OpenVMS Utilities. However, the contents of the tapes can be dumped.

[2] There is no provision in the current TMSCP specification that allows for setting this density on this drive.
[3] This is the only SCSI drive for which OpenVMS currently supports mulitple densities.

Table 2 shows the tapes densities/compactions that are not currently settable from Open VMS but are supported by the tape drives.

TABLE 2. Density/Compressions not supported by OpenVMS

Tape	TMSCP	SCSI
TKZ09	Fully Supported	EXB-8200[1]
TKZ15	Fully Supported	EXB-8200
TKZ60	1600 bpi	1600 bpi 3480/3490
TKZ61, TKZ62, TKZ63 and TKZ64	Fully supported	3480/3490 3480/3490 Compressed[2]
TLZ07, TLZ7L, TLZ09 and TLZ9L	DDS-1 format[3] DDS-1 Compressed[3]	DDS-1 format DDS-1 Compressed
TSZ07[1]	1600 bpi [3]	Fully Supported
TZ86, TZ867[4] **(TF86,TF867)**	Fully Supported	TZ85
TZ87N	Fully Supported	TZ85 TZ86
TZ87, TZ875 and TZ877	Fully Supported	TZ85 TZ86
TZ88 and TZ887	Fully Supported	TZ85 TZ86 TZ87 TZ87 Compressed
TZ89	TZ88 [4] TZ88 Compressed[4]	TZ85 TZ86 TZ87 TZ87 Compressed TZ88 TZ88 Compressed
TZK13[6]	Must support Compression	Fully supported

[1] OpenVMS does not support multiple densities on SCSI tape drives (except TSZ07).
[2] Setting compression from OpenVMS is possible on all SCSI tape drives which support compression however setting any density other than the default density and compression is not yet supported for SCSI connected drives.
[3] The TMSCP does not yet support setting multiple densitites/compaction for DAT drives.
[4] The TZ8x class of tape drives can be condensed into having to support all the densities from TZ85-TZ89 and compaction on the TZ87-TZ89.
[5] There is no provision in the current TMSCP specification that allows for setting this TZ88 density on TZ89 drives.
[6] Since QIC drives determine their densities based on the cartridge in the drive only compression is required to be supported.

1.2 Focus of Tape Density/Compression Support

The focus of the tape density project is on providing enhanced density/compression support in OpenVMS for the following classes of tape drives and connectivity software:

1) Directly attached SCSI tape drives,
2) Tape drives on SCSI-based array controllers (HSZ family),
3) Tape drives connected via TMSCP array controllers (HSJ and HSC family),
4) TMSCP server software,
5) DSSI tape drives (HSD family),

The presence of the above support is also aimed at making the various controller based tape density work-arounds unnecessary. There will be no enhancements to Infoserver tape support.

1.3 Tape Related Utilities

Currently there are several existing Open VMS tape related utilities which exhibit inconsistent behavior with respect to accepting tape density/compression input and setting tape density/compression in the drive. In addition, none of these utilities can set the full range of densities supported by the tape drives. The tape density project will first attempt to describe the differences and then detail behavior that is workable and consistent for all of them and enhance the acceptable density/compression input. These utilities include:

1) INIT
2) MOUNT
3) BACKUP
4) SET MAGTAPE

There will be no effort to enhance the tape density/compression support in the EXCHANGE Utility.

1.4 Default Density/Compression

The current OpenVMS method of determining default density selection is not clearly understood. The Tape Density project will describe the current behavior for the Open VMS and its utilities. These include the differences between the /DENSITY= and /MEDIA= for INIT, MOUNT and BACKUP. In addition to describing the difference the effects any changes will have must be determined.

1.5 VAX Changes

Changes to the OpenVMS VAX must consider Standalone Backup. Since this utility uses and manipulates tape density any changes to tape density functionality must take into consideration the effects on these utilities.

1.6 Impact of Privileged Data Structures and Code Changes

Changes to any OpenVMS server or device driver cannot require recompilation or the need to relink any layered products and third party device drivers.

1.7 QIO Interface

The Setmode and Sensemode functions of the QIO System Service are limited to 32 density/compression possibilities. This interface must be enhance to accept a wider range of possibilities without compromising the current behavior.

1.8 TMSCP Protocol

The density/compression capabilities of TMSCP protocol are reaching a limit . VMS must track and influence where necessary the relevant TMSCP ECO tape density in the context of this larger project.

1.9 Facitiatate Support for Future Tape Drive Densities and Compression

This project should facilitate adding Open VMS support for new tape drives with muliple densities and compression by providing the operating system and utilities infrastructure and internal documentation describing how to do it. Keep track of future SCSI interconnect projects especially the Fiberchannel project.

2.0 SCSI-3

This project should keep track of any changes to the SCSI-3 specification which deal with tape density in order to maintain full tape density functionality. However, SCSI-3 enhancements will not be requirements for this project.