TO: MSPM Distribution
FROM: N.I. Morris
SUBJ: Multics Standard Magnetic Tape Format (BB.3.01)
DATE: 06/02/67

Several changes have been made to the standard tape format.
They are summarized below:

1.   Error indicator records have been removed.

2.   The record number for the reel sequence is now
     contained in the trailer.

3.   The format of certain header and trailer words has
     been clarified.

Identification

Multics Standard Magnetic Tape Format
J.C. Noll, R.C. Daley, J.H. Saltzer, and N.I. Morris

Purpose

This section describes the standard physical format to
be used on seven-track and nine-track magnetic tapes on
Multics. Any magnetic tape not written in the standard
format described here is not a Multics standard tape.
(A magnetic tape device interface module which reads and
writes tape in the standard format is described in section
BF.6.05).

Standard Record Format

Each physical record consists of a 256-word (9216-bit)
data space enclosed by an eight-word header and an eight-word
trailer. The total record length is then 272 words (9792
bits). The header and trailer are each 288 bits. This
physical record will require 1224 frames on nine-track
tape and 1632 frames on seven-track tape. This is approximately
1.54 inches on nine-track tape and 2.04 inches on seven-track
tape, not including inter-record gaps. (Record gaps on
nine-track tapes are approximately 0.6 inches and on seven-track
tapes are approximately 0.75 inches).

Physical Record Header

The following is the format of the physical record header:

word 1:   constant with octal representation 670314355245.

words 2 and 3:   Multics standard unique identifier (70 bits,
                 left-justified). Each record will have a
                 different "unique identifier". (See MSPM
                 section BY.15.01).

word 4:   bits 0-17: number of this physical record
                 in this physical file, beginning with record
                 0.
                 bits 18-35: number of this physical file
                 on this physical reel, beginning with file 0.

word 5:   bits 0-17: number of data bits in data space,
                 not including padding;
                 bits 18-35: total number of bits in data space.
                 (This should be a constant equal to 9216.)

word 6:   flags indicating the type of record. Bits are assigned considering the leftmost bit to be bit 0 and the rightmost bit to be bit 35. Word 6 also contains a count of the rewrite attempt, if any:

Bit	Meaning if Bit is 1
0	This is an administrative record (one of bits 1 thru 13 is 1).
1	This is a label record.
2	This is an end-of-reel (EOR) record.
3-13	Reserved.
14	One or more of bits 15-26 are set.
15	This record is a rewritten record.
16	This record contains padding.
17	This record was written following an End of Tape (EOT) condition.
18	This record was forced out by drain.
19-26	Reserved.
27-35	If bits 14 and 15 are 1, this quantity indicates the number of the attempt to rewrite this record. If bit 15 is 0, this quantity must be 0.

word 7:   contains the checksum of the header and trailer excluding word 7, i.e., excluding the checksum word. (See section BB.6.01 for description of standard checksum computation.)

word 8:   constant with octal representation 512556146073.

Physical Record Trailer

The following is the format of the trailer:

word 1:   constant with octal representation 107463422532.

words 2 and 3:   standard Multics unique identification (duplicate of header).

word 4:   total accumulative number of data bits for this logical tape (not including padding and not including administrative records).

word 5:   padding bit pattern.

word 6:   bits 0-11: reel sequence number (multi-reel number), beginning with reel 0;
bits 12-35: physical file number, beginning with physical file 0 of reel 0.

word 7:   the number of the physical record for this logical tape, beginning with record 0.

word 8:   constant with octal representation 265221631704.

Note: The octal constants listed above were chosen to form elements of a single-error-correcting code whether read as eight-bit tape characters (nine-track tape), or s six-bit tape characters (seven-track tape).

<u>Administrative records</u>

The standard tape format includes two types of administrative records:

    tape label

    End of Reel (EOR) record

The administrative records are of standard length: 8-word header, 256-word data area, and 8-word trailer.

The tape label record is written in the standard record format. The data space of the tape label record contains:

words 1-8   32 character ASCII installation code. This identifies the installation which labelled the tape.

words 9-16   32 character ASCII reel identification. This is the reel identification by which the operator stores and retrieves the tape.

remaining words Padding pattern.

The EOR record contains only padding bits in its data
space. The standard record header of the EOR record contains
the information which identifies it as an EOR record.
(Word six, bits zero and two are <u>one</u>.)

Standard Tape Format

The first record on the tape following the beginning of
tape (BOT) mark will be the <u>tape label</u> record. Following
the tape record will be an end-of-file mark (EOF). Subsequent
reels of a multi-reel sequence will also have a tape label
followed by EOF. (An EOF mark is the standard sequence
of bits on a tape which is recognized as an end-of-file
by the hardware. See BF.6.04 for description of standard
EOF.)

Following the tape label and its associated EOF are the
data records. An EOF will be written after every 128
<u>data</u> records with the objective of increasing reliability
and efficiency of reading and positioning within a logical
tape. Records which are repeated because of transmission,
parity, or other data alerts are not included in the count
of 128 records. The first record following the EOF will
have a physical record count of 0 mod 128.

An end-of-reel sequence will be written at the end of
recorded data.

An EOR sequence is:

EOF mark

EOR record

EOF mark

EOF mark

Density and Parity

Both nine-track and seven-track standard tapes will be
recorded in binary mode with odd ones lateral parity.
Standard tape density is 800 frames per inch (bpi).

Data Padding

The padding bit pattern will be used to fill administrative
records and the last data record of a reel sequence.
The padding bit pattern is not specified in this section.

Write Error Recovery

Multics standard tape error recovery procedures differ
from the past standard technique in that no attempt is
made to backspace the tape on write errors. If a data
alert occurs while writing a record, the record will be
rewritten. If an error occurs while rewriting the record,
that record will again be rewritten. As many attempts
as desired may be made to write the record. No backspace
record is issued.

The above write error recovery procedure is to be applied
to both administrative records and data records.