Viking VUS (USEIS) Format Description

- DTL tapes containing SEISF files, as received from JPL during the Viking mission, were further processed on PDP-15 in Galveston to remove padding, to unscramble and to normalize bit order. The outputs were stored on 7-track VUS tapes, and later restored on an 8-mm cassette tape in 1991-1992.

  Because of the different bit arrangements in various computers and tapes involved, the data format on the cassette tape is rather complicated.

- According to UTIG Technical Report 118, VUS files have the following format:

  - There is one file for each original 7-track Viking tape.

  - Each file contains multiple subgroups, each of which represents a copy of a single file on the original 7-track tape (no end-of-file mark between subgroups). Each subgroup consists of a 1000-byte header record followed by 11250-byte data records.

  - Header format is as follows:

Bytes	Information (16-bit integers except for bytes 3-8)
1-2	5 to identify Viking tape
3-8	original 7-track tape label
9-10	file number on the original tape
11-12	length, in bytes, of each data record to follow
13-1000	filled with zeroes

  - Data format is as follows:
    Each 6-bit byte of the original 7-track tape occupies the 6 lsb (bits 2-7) of an 8-bit byte in data record with 2 msb (bits 0-1) filled with zeroes. If the original record length is shorter than the available record length, the remaining bytes are filled with FFh (all bits set).

  - The tape ends with double end-of-file marks.

- As far as I could find out, each 11250-byte block (physical record) of data of a VUS file has the following format:

  - Each block (physical record) consists of 25 frames (logical records) of 450 bytes each.

  - The first 108 bytes of each frame contain the original header block from a SEISF file. The header data occupy the least significant 2 bits of bytes 1, 7, 13, ...,103, and the least significant 6 bits of the rest, with a total of 576 bits. This peculiar bit arrangement is due to the 6-bit byte and 36-bit long word architecture of some old computers including PDP-15.

  - The remaining 342 bytes of each frame contain the descrambled string of the original 2048-bit Viking data buffer. The data occupy the least significant 6 bits of

all bytes except the four most significant 4 bits of the 6 least significant bits of the third from the last bytes. (The number of significant bits, therefore, is 6 x 342 - 4 = 2048.) The original 2048-bit data string starts at the last 2 bits of byte 340 of the 342-byte data string, followed by 6 least significant bits each of bytes 341, 342, 337, 338, 339, 334, ..., ending at byte 3. This peculiar bit and byte arrangement again is due to the 6-bit byte and 18-bit word architecture of PDP-15.

- The last two digits of the year (76) is found in bits 137-114 (18th 8-bit byte) of the original header block and the day of the year is found in bits 85-96 (11.5-12 8-bit bytes) of the header block in BCD.

- The 2048-bit data string ends with the most significant 23 bits of the 24-bit GCSC (clock) count, preceded by 22-bit command status, 8-bit change code, and seismic data, going backward. (The least significant bit of GCSC, apparently, was not recorded.)

- The 22-bit command status consists of the following codes: spare (3 bits), cal inhibit (2), xyz trigger inhibit (3), filter frequency (2), filter step (1), trigger threshold (3), vertical attenuation (3), horizontal attenuation (3) and mode (2), from msb to lsb.

- There were three modes of operation: normal mode (code 00), high-data-rate mode (code 01) and event mode (code 10).

- The seismic data consist of 8-bit amplitudes of x, y, and z components for normal and high-data-rate modes, and 8-bit amplitude and 5-bit number of axis crossings for x, y, and z components for event mode.

- The data string may be interrupted with a change code, a 15-bit string 101 0011 0111 0000, followed by 5-bit source ID, 24-bit GCSC, 22-bit command status and seismic data in new mode.

byte\bit	0							7	0							7	0							7	
1000-byte header																									
1-2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1									Viking tape ID = 5
3-5	0	1	0	1	0	1	1	0	0	1	0	1	0	1	0	1	0	1	0	1	0	0	1	1	Original 7-track tape label 'VUS' in ASCII
6-8	0	0	1	1	0	0	0	0	0	0	1	1	0	0	0	*	0	0	1	1	*	*	*	*	Original 7-track tape number, 1-10, in ASCII
9-10	0	0	0	0	0	0	0	0	0	0	*	*	*	*	*	*									File number on original 7-track tape
11-12	0	0	1	0	1	0	1	1	1	1	1	1	0	0	1	0									Length in bytes of each data redord to follow = 11250
13-1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Filled with zeroes
11250-byte data record (25 450-byte frmaes)																									
1001-1108	0	0	0	0	0	0	*	*	0	0	*	*	*	*	*	*	0	0	*	*	*	*	*	*	SEISF header
	0	0	*	*	*	*	*	*	0	0	*	*	*	*	*	*	0	0	*	*	*	*	*	*	
1109-1447	0	0	*	*	*	*	*	*	0	0	*	*	*	*	*	*	0	0	*	*	*	*	*	*	Unscrambled 2048-bit Viking data string
1448-1450	0	0	0	0	0	0	*	*	0	0	*	*	*	*	*	*	0	0	*	*	*	*	*	*	

1451-12250 Repeat the above 450-byte frame 24 more times

12251- Repeat the above 11250-byte record as many times as needed

Repeat all of the above for each original 7-track tape file