LINC-to-PDP-11 tape translation

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One of the several problems our laboratory had to solve when we updated from a LINC computer to a PDP-11 was the conversion of several dozen LINC data tapes to PDP-11-compatible tapes. Although the two tapes are physically compatible (width, length, reel size), neither the LINCtape controller nor the PDP-11 tape controller is capable of reading the other's format (Digital Equipment Corporation, 1973). Furthermore, the LINCtapes have 512 blocks of 256 12-bit words, while the PDP-11 tapes have 578 blocks of 256 16-bit words.

Description. Since our LINCtapes contained data organized only in a user-defined file system (no operating system file structure), we could utilize the data easily if the LINCtapes could be written block for block onto the first 512 blocks of the PDP-11 tape, with the 12-bit words right justified in the 16-bit PDP-11 words, and the high-order 4 bits of the PDP-11 words zeroed. Most of the data represented unsigned magnitudes only, so bit-for-bit transfer without concern for number representation differences (e.g., no need to extend sign bit in the 16-bit word) was adequate.

The translation process involves two steps. The first was a resolution of the format differences. The PDP-12 computer, which is an updated LINC-8, is available with a tape option that allows the conversion between different Digital Equipment Corporation tape formats. The hardware option is designated TC12-F and the software PRTC12-F (Digital Equipment Corporation, 1970). This option allows conversions between LINCtapes and any of PDP-8, PDP-9, PDP-10, and PDP-15 tape formats. Although direct conversion to PDP-11 format is not provided, the PDP-11 format is identical to PDP-15 format, except that word length is 18 bits instead of 16 bits. The LINC-to-PDP-15 translation, as performed by PRTC12-F, packs three 12-bit LINC words into two 18-bit PDP-15 words, as shown in Figure 1. Once we located a PDP-12 owner with the tape option that allowed us to convert LINCtapes to PDP-15 tapes, the first step of the translation was complete.

The second and final step was to read the 18-bit PDP-15 words with the PDP-11 tape controller. The TC11 controller can be programmed so that all 18 bits

on a PDP-11 tape (the two high-order bits are normally unused) can be accessed (Digital Equipment Corporation, 1973). This mode of tape reading is called "read all," and in this mode, the 18-bit words are available with the low-order 16-bit words in the data register (TCDT) and the two high-order bits in the two low-order bits of the status register (TCST). It thus becomes a simple matter to read each 18-bit word as two 16-bit words (i.e., TCDT and TCST for each 18-bit word) and shuffle the bits around according to Figure 1 to recover the three original LINC words as three PDP-11 words.

Program. Software for the second conversion step consists of an assembler subroutine to read the PDP-15 tape with the TC11 controller and shuffle the bits into PDP-11 words and a FORTRAN main program to write the decoded data onto a blank PDP-11 tape using a system software block-level tape-writing routine.

FORTTRAN main program TRAN15 is written for the RT-11 V2C operating system, but a similar program can be written for any other operating system. TRAN15

Figure 1. Translation from LINCtape to PDP-11 tape is a two-step process. Represented at the top of the figure are three contiguous LINC words as they would be read from a LINCtape, starting with the first block and the first word of the block. Using a PDP-12 computer with the TC12-F option and system program PRTC12-F, the LINCtape is read, and the words are packed three at a time onto two PDP-15 words and written onto a DECtape that is formatted for either the PDP-15 or PDP-11 (the formats are identical). The second step of the translation uses a PDP-11 machine with dual tape drives and the program described in the text. The result is that the original LINC words are packed into three PDP-11 words, as shown in the bottom part of the figure.

This work was supported in part by Public Health Service Grants NS 10865, RR 0533, and DE 02668. General facilities were provided in part by Program Project Grant NS 11132.

utilizes SYSLIB, the system-services FORTRAN library. The line clock interrupt must be disabled (TRAN15 does this) in order to avoid data-missed errors while reading the PDP-15 words. The clock interrupts interfere with the time-critical loop that stores the PDP-15 words as the tape moves across the head.

Subroutine READ15 is written in MACRO-11 and does not use system services. The routine reads two PDP-15 tape blocks and decodes the data into three PDP-11 blocks for TRAN15 to write onto the blank PDP-11 tape. A variety of error conditions are monitored and reported by the routine, but the only error we have encountered is an occasional data-missed error (see Digital Equipment Corporation, 1973, for details of possible tape error conditions). TRAN15 allows six re-tries on an error condition before admitting failure.

Equipment necessary to run this software includes a PDP-11, TC11 DECTape controller, TU56 dual

tape drives, and RT-11 V2C operating system with FORTRAN. Slight modification of the program may be necessary to allow the software to run under different operating systems.

Availability. Copies of this paper, a descriptive source listing of the programs TRAN15 and READ15, and documented output from an illustrative example are available at no charge from Robert Schreiner, Physiology Department, Medical Sciences Research Wing 206H, University of North Carolina, Chapel Hill, North Carolina 27514.

REFERENCES

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(Accepted for publication September 13, 1978.)