Identification

The Printer Interface Module

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Purpose

This section describes the collection of modules which manage physical printer output.

General

The Printer Interface Module (PIM) is responsible for producing the printed image of strings of ascii characters on the PRT-202. In doing so, it must translate the ascii characters which it is given into a format suitable for printing on the PRT-202, buffer the translated print lines in some efficient fashion, and cope with the errors encountered in the printing process.

A description of the PRT-202 ascii interface

The General Electric extended character line printer PRT-202 is a unit record device capable of printing the 95 graphic characters in the seven bit ascii set. However, it has only a six bit interface with the indirect common peripheral adapter. In order to simulate a seven bit interface, an extra information bit is provided through a case shifting mechanism similar in concept to that of a typewriter. Under control of characters embedded in the print line, the PRT-202 sub-system sets the seventh information bit independent of which six bit character is to be printed next. This somewhat awkward arrangement requires that a one to many mapping be made from a string of nine bit characters with embedded ascii to a string of six bit characters suitable for printing their image. Thus, for example, the ascii string "AaAa" which will be represented in core by the 36 bit sequence "141101141101" will be translated into ten six bit characters "A" escape escape "A" escape escape "A" escape escape "A" or in octal "217777721777721777721".

The PRT-202 has no ability to deal with the ascii control characters. All such characters must be handled by the software. In particular, the hardware lacks the buffering necessary for overstriking. Hence, overstriking must be accomplished by the

software on a line by line basis. At most thirteen overstruck characters are allowed in any single print position.

The Interpretation of Ascii Data

All input to the PIM is constrained to be strings of nine-bit characters. Since the PRT-202 can only print 95 graphics, certain transformations of the input data must take place if the original data is to be identifiable from its printed image. These transformations must conform to the MULTICS policy of permitting 'effortless' switching of output streams between classes of output devices; i.e. characters which are normally encountered in output streams directed to teletypes must not cause the PIM to prepare unreadable printed output. In order to achieve this compatibility while maintaining the programmer's ability to decode the original nine-bit data, two modes of output are available: the unambiguous (or normal) mode, in which it is assumed that the user wishes to represent all of his data on the printed page, even if escape conventions are needed; and the edited mode, in which the PIM scans the data written by the user and edits certain sequences which would require escape conventions for their representation.

For the following discussion it is convenient to name several subsets of the nine-bit characters:

,print character. ::= any ascii graphic except space
,special character. ::= BEL ° HLF ° HLR ° BRS ° RRS
,overstrike character. ::= BS ° CR
,slew character. ::= NL ° VT ° FF
,skip character. ::= HT ° SP
,error character. ::= any undefined ascii control character °
                      any non-ascii nine-bit character

The Unambiguous Mode

In the normal mode of printing, the occurrence of error or special characters will cause the printer dim to use the escape conventions appropriate to their representation. Print characters are printed normally. Skip characters are given the following interpretation:

HT (011) Insert blanks in the print line to simulate horizontal
       tab settings at 11, 21, 31, ... , 131 (depending upon
       the width of the form being used).
Sp (040) Insert one blank.

Slew characters and their interpretations are:

NL (012) Starting with the next character, begin a new print
          line at print position one.

VT   (013) Insert slew characters to simulate vertical tab
           settings at lines 11, 21, 31, ..., 171 (depending upon
           the length of the form being used). Begin printing at
           the current print position in the line plus one. (But,
           see position paper).
NP (014) Starting with the next character, print on the top line
          of the next page beginning at the first print position.

The overstrike characters are limited in their effect to causing
13 overstrikes in any given print position. Any number of print
positions within a line may be overstruck.   Characters which
would be in excess of 13 for a given print position are ignored.
In order to determine which 13 characters are selected from an
offering of more than 13, consult the algorithm in the translater
module. Within these limitations the interpretations of the
overstrike characters are:

BS (010) Prepare an overstrike line such that the next character
          will be printed on top of the last character.
CR (015) Call the canonicalizer for a more appropriate encoding
          of the data.

If, for a given print line, more print positions are generated
than would fit on one printed line, the PIM will indicate this
fact by inserting "escape" "concealed character" at the end of
the line which overflowed, continuing the data at the beginning
of the next print line (see BC.1.03).

The Edited Mode

In the edited mode of printing, the PIM treats special characters
differently than in normal mode.   All other characters are
treated in the same way. The special character interpretations
are:

all   Ignore this character.

This mode is included in the PIM in order to allow users to print
files which would normally be directed to a typewriter without
maintaining two copies -- one "edited" and one for the TTY.

If, in linear mode, more print positions are generated than will
fit on one line, the following characters will be printed on the
next line. No escape conventions will be employed.

Status

The physical status conditions and appropriate actions are given
below. The code shown below each heading indicates the four bit
major status returned by the subsystem; the six bit minor status
is shown in parentheses after the name of the substatus
condition. In all cases a maximum limit for number of retries
will be specified.

    1. Channel and peripheral subsystem ready
       code 0000
       Continue printing if and only if substatus is all
       zeroes. Else see what the operator wants.
    2. Attention condition -- manual intervention required
       code 0010
       a) out of paper (000001)
       enter blocked condition and wait for the operator to
       communicate via the switches.
       b) manual halt (000010)
       operator is taking action and will communicate via
       input control switches , see 1. above.
       c) VFU tape alert (000100)
       communicate with the driver, asking to have the
       peripheral operator notified of the problem -- when
       resuming operation, resend the command which was
       aborted.
       d) check (001000)
       There are three possibilities:
           1) the line was not completely printed
           2) a hammer driver fuse has burned out
           3) a paper slew fuse has burned out
       Try to reset status; on failure, communicate with the
       driver asking to have the peripheral operator notified
       of the problem.
    3. Data alert
       code 0011
       a) transfer timing error -- resend line (000001)
       b) detected alert before printing commenced (000010)
           1) parity error on print lines.
           2) buffer overflow -- more than 136 characters.
           3) internal parity error.
           4) transfer timing error, also get a) above.
       In any case, retry a couple times then ask for help.
       c) detected alert after printing (000100)
       has to be internal parity error, resend page.
       d)paper low -- this page can be completed (001000)
       complete the page a line at a time (unless we can
       suppress this status return) since this status is

generated after every line.
e) slew error (010000)
will also get b) or c) above, resend line or page
f) top of page echo (100000)
check line count.
4. Command reject
code 0101
a) invalid op code -- resend (000001)
b) slew error last op -- new page (010000)
c) top of page echo last slew -- check line position, may be ok (100000)
5. channel and peripheral subsystem busy
code 1000
hopefully, the GIM will take care of this.

Input Control Switches

These switches allow the operator to communicate directly with the software. The generated substatuses and their interpretations are given below. Where "block" is specified, wait for the operator's next communication is meant.

Substatus	Meaning and action
000000	Normal/Halt -- no action
000001	Print One Line -- print one line, then block
000010	Forward Space -- slew one line, then block
000011	Forward To Top Of Page -- slew to top of next page, then block
000100	Invalid Line -- resend line, then block
000101	Reverse Rewind -- finish this page, then return to the driver . Give a pointer to the amount of data processed, so that the driver can have the file resumed without redoing the work.
000110	Backspace -- resend line
000111	Backspace To Top Of Page -- resend entire printed page on next paper page, then block

Call Interface

Most IØ system calls are accepted by the PIM. An explicit listing of the interpretations given to the calls by the PIM is below. For further information about the calls in general see MSPM section bf.1.0.

call attach(ioname, type, descr, mode, status)
        1. ioname is a character string of size less than 32.
        2. type is "PRT-202".
        3. descr is a printer mnemonic. The list of recognizable
           mnemonics is kept by the line printer driver. At this
           level, the mnemonic may be a channel number.
        4. mode may be output; ascii, canonical; sequential;
           linear, record; and normal(unambiguous) or edited.
           The default interpretations are output, ascii,
           sequential, record, normal. Record IØ to the PIM does
           not have the subframe capability. Such calls will
           cause error status. In effect, the record mode forces
           the beginning of a new line after each write call.

        The attach call causes the PIM to communicate with the
        GIM in some fashion in order to connect the specified
        printer.

call detach(ioname,,disposal, status)
        1. The PIM will disconnect from the printer.

call bounds(ioname, eltsiz, filsiz, recsiz, recnos, status)
        1. ioname must be a previously attached stream name, as in
           all calls except for attach.
        2. eltsiz specifies the number of bits which is to be
           considered a manipulable byte. It must be nine bits.
           That is, only ascii characters can be passed to the
           PIM.
        3. filsiz, recsiz and recnos are ignored.

        The bounds call is not of any use at the PIM level.
        For most users, the bounds call is taken care of by the
        pseudoprinter.

call breaks(ioname, breakptr, nbrks, status)

        This call is not accepted by the PIM. Error status is
        returned.

call changemode(ioname, mode, status)
        2. mode may be used to specify any of the modes mentioned
           in the argument of that name in the attach call.

        The changemode call may be made at any time.

call command(ioname, command, workspace, nelem, status)
        2. command specifies a bitstring of size six which will be
           checked against a list of legal PRT-202 commands. See
           General Electric Specification number M50EB00070.
        3. workspace points to a bitstring which will be used to
           provide data for the command if it requires data. The

data is assumed to be assimilable by the PRT-202
directly. No examination of it is made.

4. nelem specifies the number of six bit elements which
are to be used as data for the command.

Call command is likely to be useful only for the
debugging of hardware and software.

call delete(ioname, elemno, status)
    2. elemno is a non-negative integer.

    delete is interpreted differently in linear and
    sectional mode. In linear mode, it is equivalent to a
    write call specifying elemno blanks.   In sectional
    mode, it is equivalent to a write call specifying
    elemno blank records (interpreted as lines).

call first(ioname, status)

    This call will be rejected with error status. See the
    read call.

call read(ioname, elemno, workspace, nelem, nelemt, status)

    Since the PRT-202 is not a readable device, the
    characters written are not available to the PIM and can
    not be returned to the user. Therefore, this call, and
    all calls seeking to manipulate written data are
    rejected with error status.

call seek(ioname, elemno, status)
    2. elemno must be a non-negative integer.

    Seek is interpreted exactly as if a write call
    specifying elemno blank characters (records) had been
    issued.

call sizes(ioname, eltsiz, filsiz, recsiz, recnos, status)

    The sizes call requests the PIM to return in the
    appropriate parameters, the current settings of those
    parameters. For their meanings, see the bounds call.

call tail(ioname, status)

    Since the PIM is always at the end of the current file,
    this call is equivalent to a null operation.

call tell(name, elemno, stauts)

>   The tell call requests the PIM to return the current
>   element number in the second argument.

call upstate(ioname, statptr, status)

>   Status is not yet well enough defined to implement this
>   call.

call write(ioname, elemno, workspace, nelem, status)
>   2. elemno specifies an offset between the current element
>   (record) number and the one at which this write is to
>   begin.
>   3. workspace is a pointer to the data to be written.
>   4. nelem gives the number of elements to be considered in
>   the workspace.
>
>   This call causes the processing of nelem elements from
>   workspace, and their printing on the PRT-202 to which
>   this PIM is connected.

Formatting

There will be format calls which will allow the user to specify
the text space within a physical page which is to be considered
useable by the PIM. See BF.1.06 for details.