              INTERFACING AN ILLINOIS PLASMA TERMINAL TO THE ARPANET

INTRODUCTION

   The PLATO IV System based at the University of Illinois at Urbana is
   a highly sophisticated and very powerful approach to Computer Aided
   Instruction. The PLATO IV system makes use of a plasma display
   terminal that is a unique device with capabilities not presently
   found on computer terminals. A number of ARPA supported projects
   intend to use the plasma terminal on local connection to computer
   resources or by long-distance connection to the PLATO IV System.

   One problem in using the PLATO System from any appreciable distance,
   is the communication costs involved (i.e. long-distance telephone
   rates for many consecutive hours). Also, use of the plasma terminal
   in other applications is hampered since the communications scheme
   employed in the PLATO System in non-standard.

   One approach to reducing the communications cost is to use the
   ARPANET for the long-distance connection, since the Network is
   potentially one of the most reliable and cost effective means of
   transmitting computer data. This approach is reasonable the is a
   Network node near the PLATO System, (the PDP-11/ANTS system at the
   Center for Advanced Computation at the University of Illinois at
   Urbana) and with the increasing number of TIPS and IMPS on the
   ARPANET access is becoming easier ad more widespread.

   The plasma terminals are designed to be connected directly to
   telephone lines using Frequency Shift Keying (FSK) modulation. Using
   dedicated telephone lines, the plasma terminal may be run at a data
   rate of 1200 bits/sec in full-duplex operation. Using dial-up lines,
   the terminal may be run with display information being received at
   1200 bits/sec and data to the computer being transmitted at 120
   bits/sec using a reverse chanel scheme.

   The data and command words used by the plasma terminal differ for
   input and output. Input received from the computer arrives in 20-bit
   words plus one start bit. Data transmitted to the computer is sent
   in 11-bit words plus one start bit.

   In order to make the plasma terminal more generally applicable for
   standard communication, and specifically adapted to the ARPANET
   connection by way of a TIP, the terminal must be interfaced in such a

way as to communicate using Teletype-like codes. In addition, if the
PLATO System is to be linked by way of the Network with no changes to
the system, then a special interface must be provided to allow the
Network to communicate with the PLATO System using the FSK
communication scheme.

APPROACH

So that the plasma terminal would communicate like a Teletype when
tied to a TIP, and still be able to work with the PLATO System
through the Network, it was decided to build an interface that could
be operated in two modes. There would be an "ASCII" mode to send and
receive Network oriented data (such as TIP log-on or running at some
arbitrary Network site); and a "PLATO System" mode to allow data,
imbedded in 8-bit codes, to pass transparently through the Network.

Since there is a possibility that when in the PLATO mode, re-
formatted codes can appear to be standard ACSII characters that will
be seized upon by intervening TIPs or HOSTs, the interface must
insure that no recognizable codes be sent. For example, the @ is
recognized by a TIP as the beginning of a TIP command string.
Therefore the interface must either "double-up" this code (@@) or not
send it at all.

With the above requirement, and with other limitations, the proto-
type interface, now in use at UCSB, operates as follows:

1. In ASCII mode, the plasma terminal has been made to send and
   receive 8-bit ASCII code. In this mode, there is no graphics
   capability. The keyboard that is provided can only send 124
   codes, therefore 4 seldom used ASCII codes have been excluded, and
   certain ASCII characters cannot be displayed.

2. In PLATO mode, PLATO data is embedded in 8-bit codes. The
   capability of running the keyboard in ASCII mode while the display
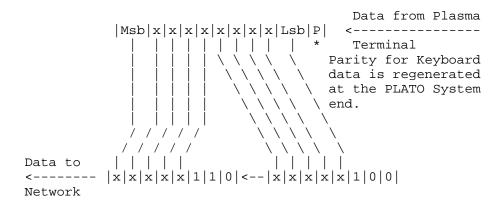   remains in PLATO mode has also been provided.

SUBSEQUENT WORK

After discusion, it became clear that the flexability of the
interface to do such things as emulate standard graphics
terminals, implement a cursor, and to respond to Network Graphics
Protocols, will be highly desirable. So it has been decided that
the original hardware will be re-packaged using a micro-computer
with a ROM for the control program. With the addition of more RAM
and/or ROM, the micro-computer will have the capability of being
programmed to allow the plasma terminal to do a wide variety of
tasks. Work on developing this interface has begun at UCSB.

Figure 1 shows the planned version of plasma data format for
Network use.

          PACKING SCHEME FOR PLASMA TERMINAL DATA

```
                                        Data from Plasma
          |Msb|x|x|x|x|x|x|x|Lsb|P|  <----------------
           |   | | | | | | | |  |  *   Terminal
           |   | | | | \ \ \ \   \   Parity for Keyboard
           |   | | | |  \ \ \ \   \  data is regenerated
           |   | | | |   \ \ \ \   \ at the PLATO System
           |   | | | |    \ \ \ \   \ end.
           |   | | | |     \ \ \ \   \
          /  / / / /        \ \ \ \   \
         /  / / / /          \ \ \ \   \
 Data to   | | | | |             | | | | |
 <-------- |x|x|x|x|x|1|1|0|<--|x|x|x|x|x|1|0|0|
 Network
```

For the second part of Figure 1, please view the PDF version of this
document.

NOTE: NO-OP codes are removed from the data stream at the PLATO
System end by the hardware.

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