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A User TELNET

Description of an Initial Implementation

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PREFACE

The User TELNET described in this document has been implemented within UCSB's Online System by Mark Krilanovich and makes teletype-compatible time-sharing systems in the Net accessible to Online System users.

CONTENTS

FIGURES

The primary function of a Server TELNET is to map the keys on the virtual teletype into that set of keys its local users can push on their keyboards. Again, if those keyboards are teletypes, the mapping done by the Server TELNET is straightforward. In other cases, the task may be very complex.

A similar set of mappings transforms output generated by the remote system into a form displayable on the user's output device (in UCSB's case, this device is normally a storage scope).

II. Invoking TELNET

This and succeeding sections describe a preliminary version of a User TELNET (hereafter referred to simply as TELNET) currently implemented within the Online System. This initial implementation does not provide all of the services that a final version must provide, nor does it provide all the conveniences that the next version will offer. It's a first pass which will be upgraded in the near future.

TELNET is accessible from NET, a subsystem (like MOLSE and COL) of OLS. A user is by default prohibited from loading NET. To have access to NET enabled for his user number, a user need only contact the Computer Center. Assuming the foregoing, Net can be loaded with the key sequence:

KEYBOARD ENTRY	OLS QUERY/RESPONSE
SYST	WORK AREAS UPDATED
LOAD NET	LOAD NET
RETURN	FILE LOADED

or by specifying the system name 'NET' at login.

Once in NET, TELNET is invoked by going to Level II Real and hitting LOG. TELNET responds with a query for site number. The user should enter in decimal the number of the site (as indicated in Figure 1) to which he desires access, followed by RETURN. TELNET will then query the user for the Server TELNET's socket

Figure 1.

Network Sites

Institution	Location	Computer	Site Name	Site # (HEX)	Site # (DEC)
UCLA	Los Angeles	Sigma-7	UCLA	01	1
UCLA	Los Angeles	IBM 360/91	UCL1	41	65
Stanford Research Institute	Menlo Park	PDP-10	SRI0	02	2
Stanford Research Institute	Menlo Park	PDP-15	SRI1	42	66
UCSB	Santa Barbara	IBM 360/75	UCSB	03	3
University of Utah	Salt Lake City, Utah	PDP-10	UTAH	04	4
Bolt, Beranek, and Newman	Cambridge, Mass.	PDP-10	BBN0	05	5
Bolt, Beranek, and Newman	Cambridge, Mass.	DDP-516	BBN1	45	69
MIT	Cambridge, Mass.	GE 645	MIT0	06	6
MIT	Cambridge, Mass.	PDP-10	MIT1	46	70
Rand Corporation	Santa Monica	IBM 1800 (IBM 360/65)	RAND	07	7
System Development Corporation	Santa Monica	DDP-516 (IBM 360/67)	SDC	08	8
Harvard University	Cambridge, Mass.	PDP-10	HRV0	09	9
Harvard University	Cambridge, Mass.	PDP-1	HRV1	49	73
Lincoln Laboratory (MIT)	Lexington, Mass.	IBM 360/67	LIN0	0A	10
Lincoln Laboratory (MIT)	Lexington, Mass.	TX2	LIN1	4A	74
Stanford University	Stanford	PDP-10	STAN	0B	11
University of Illinois	Urbana, Ill.	PDP-11	ILL	0C	12

Figure 1.
(continued)

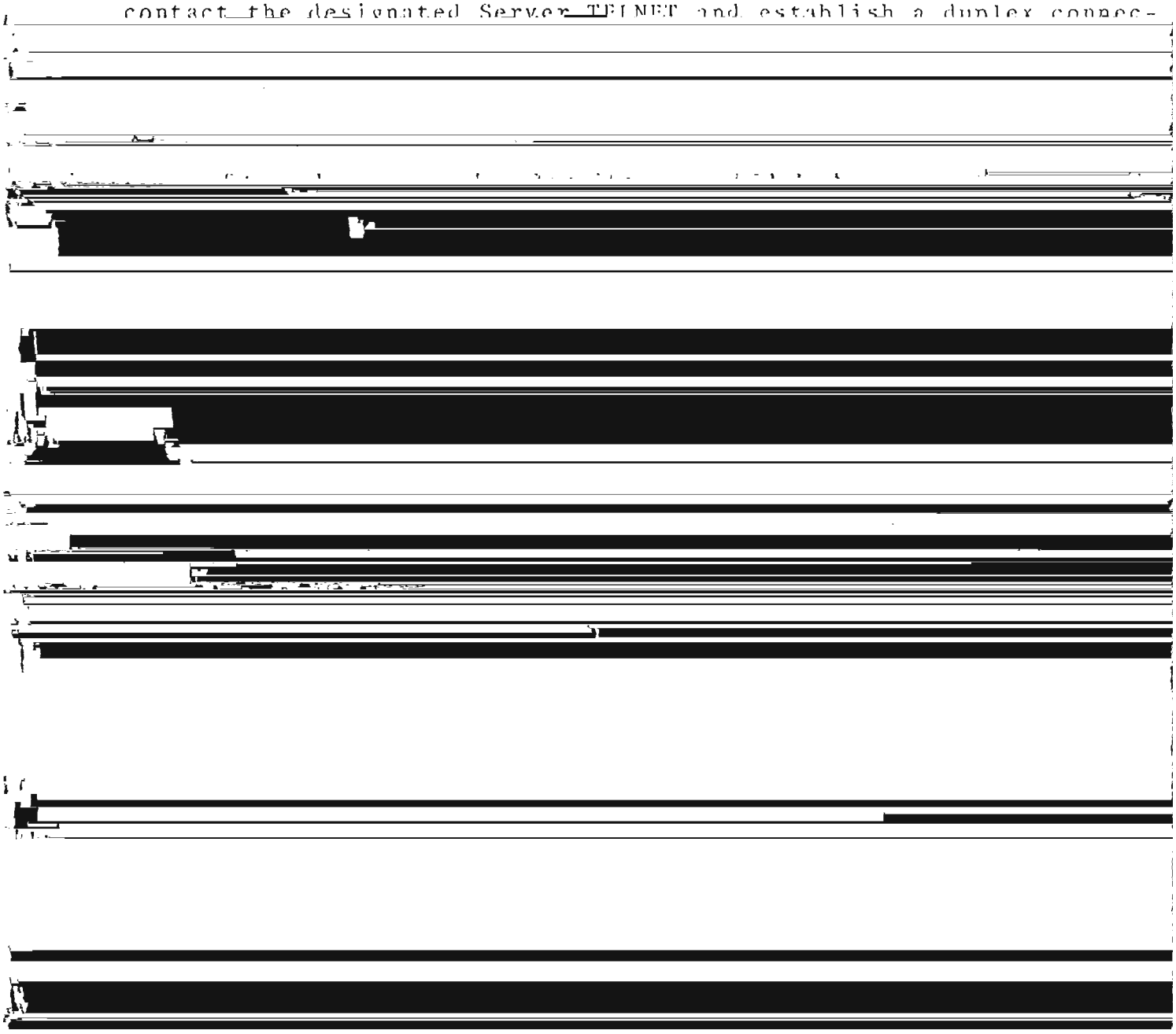
Network Sites

Institution	Location	Computer	Site Name	Site # (HEX)	Site # (DEC)
Case Western Reserve University	Cleveland, Ohio	PDP-10	CASE	0D	13
Carnegie-Mellon University	Pittsburgh, Pa.	PDP-10	CARN	0E	14
Burroughs	Paoli, Pa.	B-6500 (Illiac IV)	BURR	0F	15

number. By convention, this number is normally 1, but in certain cases some other socket may be appropriate. In any case, the user should enter the socket number in decimal and hit RETURN. The dialogue, then, goes like this:

KEYBOARD ENTRY	OLS QUERY/RESPONSE
II LOG	FOREIGN SITE NO. = (site number)
site number RETURN	FOREIGN SCK NO. = 1
1 RETURN	

When the second RETURN is depressed, TELNET will attempt to contact the designated Server TELNET and establish a duplex connec-



OLS keyboard. TELNET sends to the remote system an 8-bit character with the value X'0A'. Whenever 'LF' is received from the foreign system, TELNET displays it by rolling the carriage down one line.

As indicated in the figure, CASE substitutes for the CNTRL key on a teletype. Hence, for example, 'control-C' is represented by the key pair 'CASE C'. Note, however, that CASE and 'C' are hit in sequence, whereas on a teletype the CNTRL key is held down while 'C' is struck. 'CASE A'-'CASE Z' each have an equivalent on the upper keyboard, and the position of that key on the upper keyboard corresponds to that of its counterpart on the lower keyboard. Hence, LS is equivalent to CASE A.

Although TELNET provides the user with the means for transmitting both upper- and lower-case alphabetics (hitting 'A' sends a lower-case 'A'; holding down SHIFT and hitting 'A' sends upper-case 'A'), there is no provision in OLS for displaying lower-case characters on the storage scope. Hence, TELNET maps lower-case alphabetics into upper-case before displaying them.

The four virtual teletype keys 'ENQ', 'ACK', 'BEL', and 'NAK' are displayed by TELNET in a special manner. Two lines are reserved for these characters at the top of the display area, and whenever TELNET receives such a character from the remote system, it displays it in its assigned position within the two-line field. TELNET always positions those four characters at the top of the display area, regardless of the user's current position on the scope, then returns to it.

A storage scope has both positive and negative attributes relative to a teletype. Display is much quieter on a scope than on a teletype. However, the noise made by the return of a teletype carriage is often a valuable cue to the user, frequently signifying that the previous line of input from the user has been accepted by the system. As a substitute for this particular cue,

Figure 2. TELNET Character Set

To Send	(Explanation)	Also Known as	Push Either	Or	Code Sent is (in hex)	Upon Receipt Displayed as
NUL	Null	↑@	[1]		00	
SOH	Start of Heading	[2]↑A	LS	[4]CASE A	01	
STX	Start of Text	↑B	ATAN	CASE B	02	
ETX	End of Text	↑C	LOG	CASE C	03	
EOT	End of Transmission	↑D	REFL	CASE D	04	
ENQ	Enquiry	↑E	⊙	CASE E	05	[3] <ENQ>
ACK	Acknowledge	↑F	UP	CASE F	06	<ACK>
BEL	Bell	↑G	DOWN	CASE G	07	<BELL>
BS	Backspace	↑H	EVAL	CASE H	08	
HT	Horizontal Tab.	↑I	INV	CASE I, TAB	09	
LF	Line Feed	↑J	SUB	CASE J, ↓	0A	Carriage rolled down
VT	Vertical Tab.	↑K	MAX	CASE K	0B	
FF	Form Feed	↑L	MOD	CASE L	0C	
CR	Carriage Return	↑M	DEL	CASE M, RETURN	0D	[6]Carriage returned
SO	Shift Out	↑N	ARG	CASE N	0E	
SI	Shift In	↑O	DIFF	CASE O	0F	
DLE	Data Link Escape	↑P	SUM	CASE P	10	
DC1	Device Control 1	↑Q	⊕	CASE Q	11	
DC2	Device Control 2	↑R	∅	CASE R	12	
DC3	Device Control 3	↑S	RS	CASE S	13	
DC4	Device Control 4	↑T	SQ	CASE T	14	

Figure 2. TELNET Character Set

(continued)

To Send	(Explanation)	Also Known as	Push Either	Or	Code Sent is (in hex)	Upon Receipt Displayed as
NAK	Negative Acknowledge	↑U	CONJ	CASE U	15	<NAK>
SYN	Synchronous Idle	↑V	EXP	CASE V	16	
ETB	End of Transmission Block	↑W	⊖	CASE W	17	
CAN	Cancel	↑X	COS	CASE X	18	
EM	End of Medium	↑Y	SQRT	CASE Y	19	
SUB	Substitute	↑Z	SIN	CASE Z	1A	
ESC	Escape	Alt Mode, ↑[	NEG		1B	
FS	File Separator	↑	PROD		1C	
GS	Group Separator	↑]	SORT		1D	
RS	Record Separator	↑↑	CONV		1E	
US	Unit Separator	↑←	PWR		1F	
SP	Space		SPACE		20	blank
!	Exclamation Point		!		21	!
"	Quotation Marks	Diaeresis	"		22	"
#	Number Sign		#		23	#
$	Dollar Sign		$		24	$
%	Percent		%		25	%
&	Ampersand		&		26	&

Figure 2. TELNET Character Set

(continued)

To Send	(Explanation)	Also Known as	Push Either	Or	Code Sent is (in hex)	Upon Receipt Displayed as
(	Opening Parenthesis		(		28	(
)	Closing Parenthesis		)		29	)
*	Asterisk		*		2A	*
+	Plus		+		2B	+
,	Comma	Cedilla	,		2C	,
-	Hyphen	Minus	-		2D	-
.	Period	Decimal Point	.		2E	.
/	Slant		/		2F	/
:	Colon		:		3A	:
;	Semicolon		;		3B	;
<	Less than		<		3C	<
=	Equals		=		3D	=
>	Greater than		>		3E	>
?	Question Mark		?		3F	?
@	Commercial At		@		40	@
[	Opening Bracket		[		5B	[
\	Reverse Slant		CASE /		5C	\
]	Closing Bracket		]		5D	]
^	Circumflex	↑	↑		5E	^
_	Underline	←	_		5F	_

Notes for Figure 2. TELNET Character Set

[1] All of the following keys send NULL:

SET, CLR, ¢, Superscript 0-9

[2] '↑A' is read 'Control A'. Same for '↑B', '↑C', etc.

[3] ENQ, ACK, BEL, and NAK are displayed as '<ENQ>', '<ACK>', '<BELL>', and '<NAK>', respectively, in an area at the top of the screen reserved especially for those characters.

[4] ↑A is sent by hitting the keys 'CASE' and 'A' in turn. Same for ↑B, ↑C, etc.

[5] Upper case 'A' is sent by holding down the SHIFT key while 'A' is struck. Same for upper case 'B', 'C', etc.

[6] CR also causes an underline '_' to be displayed in the left margin as a substitute for the often useful cue provided by the noisy return of a teletype carriage.

A storage scope is also a much faster display device than a teletype. However, in some situations this apparent attribute can be troublesome. In particular, when a system displays a whole series of lines of text without requiring input from the user, the display may be wrapped around from the bottom of the scope to the top, and begin overlaying itself before the user has had time to read it all. In such cases, the following strategy is sometimes useful (and will make sense once the next section--Section IV--has been read): hit II before the display begins to wrap around upon itself; the display will stop. After the text has been read, erase the scope and hit LOG and display will resume.

If the user hits ERASE while in TELNET, that key will have its usual effect; it will have no effect upon the remote system. However, because of a quirk in the current implementation of TELNET, ERASE will have the one additional effect of causing the display of incoming text to be suspended until another key on the virtual teletype is struck. The user is thus cautioned against erasing the scope while waiting for a resonse from the remote system. However, the user can extricate himself from the situation

connection, but all other connections that may have been previously established using the operators of Level 1 are closed as well.

VI. Abnormal Network Conditions

While the user is in TELNET and attached to a remote system, TELNET monitors the user's Network connections. If any abnormal condition is detected, it terminates its monitoring and issues a message of the form:

```
{CONNECT}
{INPUT  }  ERROR - CODE= n
{OUTPUT }
```

where 'n' is one of the values listed in Figures 3-5. A CONNECT error may occur during TELNET's initial attempt to establish connections to the remote system; an INPUT error may occur when TELNET attempts to extract incoming data from the Net; and an OUTPUT error may occur as TELNET tries to insert outgoing data into the Net.

Figure 3. CONNECT ERROR CODES

4 - A previous invokation of TELNET left a local receive socket open; the send socket is closed. Hit '_I DEL RETURN_'.

8 - A previous invokation of TELNET aborted, and '_I DEL RETURN_' failed to close the Network connections. The remote site is probably dead.

12 - All communication paths between UCSB and the specified remote site are in use.

16 - UCSB's NCP is running at capacity or is drained or stopped.

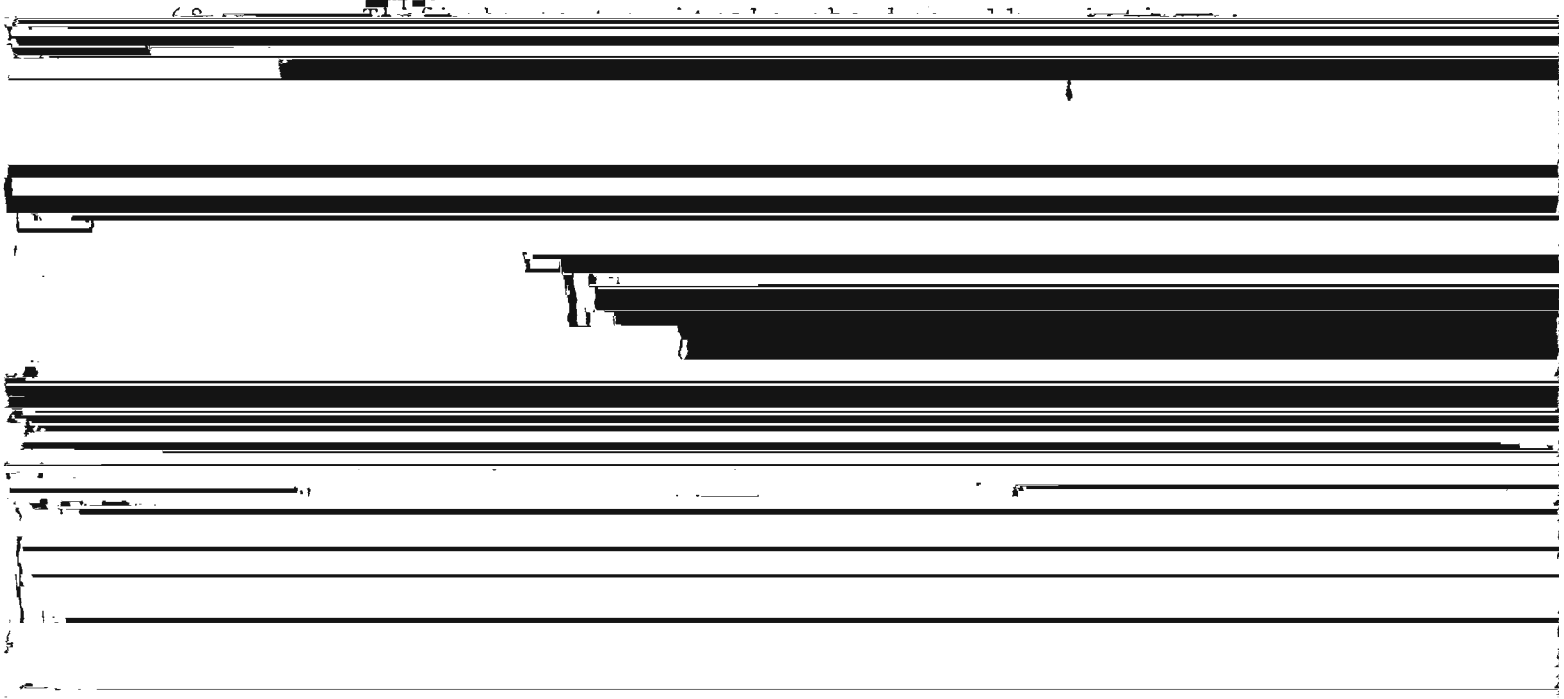
20 - The connection attempt was refused by the remote site.

28 - No such remote site.

36 - Remote site was discovered to be dead.

44 - The Operator has stopped or reset the NCP.

60 - Either the specified remote site is not accepting input from the Net, or there was a failure in the subnet.



72 - The remote site is known to be dead.

Figure 4. INPUT ERROR CODES

8 - Connections to the Server TELNET at the remote site have been broken.

16 - Connections to the Server TELNET at the remote site are being broken.

52 - An interrupt was sent by the remote system. Resume by hitting LOG.

Figure 5. OUTPUT ERROR CODES

8 - Connections to the Server TELNET at the remote site have been broken.

16 - Connections to the Server TELNET at the remote site are being broken.

20 - same as 8.

36 - Remote site has died.

44 - The Operator has stopped or reset the NCP.

52 - An interrupt was sent by the remote system. Resume by hitting LOG.

60 - Either the remote site has stopped accepting input from the Net or there was a failure in the subnet.

64 - same as 60.

68 - The remote site has broken all existing connections to UCSB.