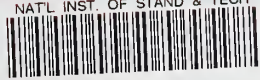


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U.S. DEPARTMENT OF COMMERCE / National Bureau of Standards

A Basis for Standardization of User-Terminal Protocols for Computer Network Access

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A Basis for Standardization of User-Terminal Protocols for Computer Network Access

Technical note no. 877

A. J. Neumann

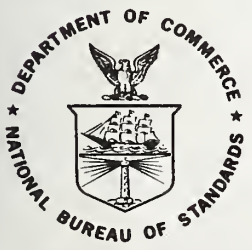
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PREFACE

The Institute for Computer Sciences and Technology of the National Bureau of Standards (NBS) is developing a basis to begin standardization of the user protocols for network access to computerized information systems. With support of the National Science Foundation's Office of Science Information Service, a proposal has been completed for a standard interactive protocol to initiate and terminate access to any computer-based service. This protocol divides the access procedure into a sequence of specific functional steps, e.g. user identification, authorization, etc., and defines the occurrence and purpose of user input messages and system output messages.

An initial NBS draft of this proposed protocol was reviewed and revised during a workshop held at NBS in October 1974. The workshop participants were selected authorities representing library and information service users, software and service producers, and Federal agencies supporting major services.

Workshop results were summarized in this report, and a draft copy was circulated to all workshop participants and a few other interested parties, with requests for comments. Most of the comments received were incorporated in this paper. All comments will be utilized in further standardization work. This report documents results as of March 1975.

Protocol standardization could proceed from this basis by refining the detailed requirements for an intended user group (e.g. Federal Government agencies), and subsequently delineating the needed codes, formats, and options.

ACKNOWLEDGEMENT

This report represents the combined inputs from a large group of contributors. Mrs. B. Marron arranged and directed the workshop, October 30-31, 1974, and contributed to the first working paper discussed at the workshop. Substantive comments regarding the candidate standard paper were received from P. Atherton, J. L. Bennett, I. Cotton, M. S. Day, R. H. Giering, R. M. Landau, B. G. Lucas, R. S. Marcus, and R. Rosenthal. Inputs to this document were received from J. L. Bennett, C. Gottschalk, J. S. Graber, R. S. Marcus, B. H. Weil, H. White, and M. E. Williams and are gratefully acknowledged. In addition, credit is due to all workshop participants who are listed in Appendix 1 of this report. This study was performed under the technical supervision of Dennis Fife, Chief of the Computer Science Section.

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A BASIS FOR STANDARDIZATION OF USER-TERMINAL PROTOCOLS FOR COMPUTER NETWORK ACCESS

A. J. Neumann

A user-terminal protocol is defined which enables a user at a terminal to access computerized information systems. The basic functions such as identification, authorization, and validation are outlined and various signals and messages making up the protocol are identified. The purpose of the paper is to establish a basis for standardization and development of a unified user protocol.

Key Words: Command languages, computers, man-machine systems, networks, system commands, user protocols.

1. PURPOSE AND SCOPE

This report outlines a user protocol, or access procedure, which permits a user to access computerized information systems from a data terminal. "User-Terminal Protocol" or "User Protocol" in the context of this document, refers to the interaction between a user at a terminal and a computer system, as needed to initiate or terminate any interactive or conversational form of computer service.

The scope of procedures defined here is directed at, but not necessarily restricted to, the interactive use of unbuffered keyboard/display terminal devices, i.e. devices in which depression of a key normally results in immediate transmission of a single character, communicating by means of the ASCII code, as defined in FIPS Pub 1 (or the American Standard Code for Information Interchange, American Standard X3.4-1968).

This paper is a revision and considerable expansion of a draft reviewed at a workshop held at the National Bureau of Standards on October 30-31, 1974. The changes made by the workshop participants are incorporated in this report. (A list of participants is given in Appendix 1.)

The original draft included considerable format detail. Since agreement of functional requirements must precede standardization of format details, the latter have been omitted and the paper now concentrates on functions performed by the user and the system. In the future, after consensus has been reached on functional requirements for user protocols, work could proceed towards definition and standardization of formats, message structures, display symbology, and procedural detail.

This paper is expected to serve as a working proposal and point of departure for standardization of user protocols for computer-based information systems.

Sections 3 through 8 are written in a format that can be converted easily into a standards document, by omission of the explanatory notes which are appended to clarify points of disagreement or the rationale behind procedural features. These notes could be incorporated in an appendix to the standard or in expository remarks accompanying the approval of the standard.

2. BASIC CONCEPTS

From a user's viewpoint, entry to a computerized information system consists of a series of user and system actions. The user protocol for entry begins at the moment a user makes his first contact with the system, by depressing a key, or turning a switch, and is completed when he begins an application use of a program, data base, or special purpose information processing capability.

Several functional phases can be outlined as seen from the user's viewpoint. The user protocol consists of an entry phase, and an exit phase. The entry phase consists of the following:

- Communications connection*
- Access request*
- User identification*
- Authentication*
- Service selection*

Similarly, the exit phase includes:

- Exit request*
- Display of accounting information*
- Communications disconnection*

Separation into these phases is based on many technical and organizational reasons. Communications connection is usually achieved through the public telephone system, and is constrained by established procedures, designed primarily for voice communication. Access request is often implied by calling a dedicated telephone number, connecting to a reserved port or computer entry channel. User identification, authentication and service selection are determined by individual service organization practices.

The present degree of standardization differs for the various phases. Communications connection is comparatively well standardized, and rather uniform procedures, directories, and facilities exist--world-wide--for the telephone plant. As far as terminals are concerned, there exists a profusion of equipments, with varying capabilities. Although there are compatible sets of standard codes available [1], [2], not all manufacturers follow the standard, and implementations of the standard code vary in subsets of the standard code. Terminal capability thus affects user protocols.

Similarly, implementations of the protocol functions differ, both as to content and form [3], [4]. Communications procedures are not considered further as subjects for standardization here, except as they may affect the other functions described.

A spectrum of possible procedures can be envisioned to accommodate the wide variety of computer service users. Two cases are considered in this paper: an interactive procedure; and, a simplified, terse procedure. The interactive procedure (see pages 5 and 6) is relatively easy to use, provides step-by-step guidance to a user, and leads him to the desired result by appropriate system responses to user entries. The terse procedure (see page 6) requires less time at the terminal, but taxes the user's capability and requires more training.

2.1 Impact of Emerging Technology

Some of the user protocols, especially those used in connection with computer networks, can be quite complex and difficult to use for the casual user. Additional automation of the user protocol may help to unburden the user. As an example, entry of a machine readable card into a terminal reader may provide user identification, possibly a service request, and other data required to provide service. Such implementation may require additional procedural standards, which though they are beyond the scope of this discussion, should be taken into account in subsequent standardization or user protocols.

2.2 The User

User protocols need to be designed and standardized for a wide variety of people. Presently, terminal access to a great extent is the prerogative of computer specialists or specially trained operators of terminals in airline reservation, banking, and retailing systems. For interactive information systems, it is envisioned that a general type of user who is not a computer professional will have access to these systems. The access procedure therefore, must be simple, easily learned, and easily understood.

2.3 The System and System Levels

The user will have access to a keyboard, similar to a typewriter keyboard, and to a display, either characters printed on a typewriter-like device, or shown on a cathode ray screen.

The terminal user knows little if anything about the various levels of communications switching, such as the local office, regional or area switching centers, and similarly knows little about the computer hardware, and the various levels of software which provide service to him. He finds it difficult to distinguish between communications handling software, operating systems, applications programs, and data base management systems while working at the terminal. Often different signals or commands are required by different levels of software, and system reactions by these levels vary for functions which appear identical to the user. Often no distinction is made between these levels by the user, although some general provisions must be made to permit user-controlled change of level during service operation. The user should not have to consider levels during the entry or exit procedure.

"System," in the context of this paper, refers to all hardware, software and procedures supporting the operation of the entry keyboard and the output display. The "system" is invisible to the user, and the only means of interaction between user and system are the keyboard and the display.

2.4 Security and Privacy

In the context of this document, we consider providing aids to the user in order to facilitate his access to the system. We must realize, however, that this may introduce the issue of security and privacy: providing aid to the user may also facilitate illegal entry to the system.

In a large number of systems such as automated library systems, these issues play a minor role. In many data or information systems, security and privacy requirements play a major role, and standardization of user protocols for these systems must take them into account. In addition, current development in hardware, software and procedures in connection with data protection and privacy will affect user protocols, and must be considered in standardization.

3. MINIMUM USER PROTOCOLS

Minimum protocols are defined to be the entry procedure and the exit procedure. These two procedures are outlined in tables 1, 2, and 3, and are explained further below. Note that the heavy outlined boxes in these tables describe those protocols which are candidates for standardization. Related procedures shown outside of these boxes, need to be recognized, but are not considered for standardization themselves at this time.

COMMUNICATIONS CONNECTION VERIFICATION (Not part of entry procedure)

USER ACCESS REQUEST (Not part of entry procedure)

User sends access request

SYSTEM ACKNOWLEDGEMENT

System receives access request (5.1)*

System sends system identification message (5.2)

System sends identification request (5.3)

USER IDENTIFICATION

User receives identification request (5.3)

User sends identification message (5.4)

VALIDATION (5.5)

USER AUTHENTICATION (Optional)

System requests authentication message (Password) (5.6)

User receives authentication (Password) request

User sends authentication message (Password) (5.7)

SYSTEM SENDS AUTHORIZATION MESSAGE (5.8)

SYSTEM SENDS OPERATIONAL STATUS MESSAGE (Optional) (5.9)

USER SERVICE SELECTION (May be implicit) (5.10)

SERVICE OPERATION (Not part of entry procedure)

* Reference numbers point to message detail in section 5.

USER OPERATES SYSTEM, decides to stop (Not part of exit procedure)

User sends exit request (not part of exit procedure)

EXIT REQUEST

System receives exit request

System processes accounting data

System sends accounting message (5.15)

System sends end message (5.16)

COMMUNICATIONS DISCONNECTION (Not part of exit procedure)

Table 2. Exit Procedure

Hardware Connection Verification

User sends access request (Not part of entry procedure)

SYSTEM ACKNOWLEDGEMENT

System receives access request (5.1)

System sends system identification message (implying user identification and password as next user steps) (5.2)

USER ENTRY

User sends: User Identification, Password, Service Selection Message (5.4, 5.7, 5.10)

System sends operational status message (implying authorization (5.9)

Service operation (Not part of entry procedure)

Table 3. Abbreviated (terse) Entry Procedure

4. USER AND SYSTEM COMMANDS

The following control signals and commands (this section) and messages (Section 5) form the detailed access procedures outlined in tables 1, 2, and 3.

4.1 Special Control Signals

Two types of unique messages occur frequently in access procedures and receive special attention: the user signal and the system signal. [5]

Each user message is ended with a user signal.

Each system message is followed by a system signal.

4.1.1 User Signal. This signal is generated by the terminal user; it indicates that an immediate task of data or command entry has been completed, and that the user is waiting for system action.

Code*: CARRIAGE RETURN or NEW LINE**

4.1.2 System Signal. This signal is generated by a computer, or a processor and indicates to the terminal user that the immediate processing task is completed, and that the next action is up to the user.

Code: CARRIAGE RETURN or LINE FEED and COLON**

Note: In an instructional, or verbose mode, an additional request to the user may be desirable such as: "USER:", "READY:", "TYPE", etc.

4.2 Restart

This signal is used by the user to reinitiate the entry procedure, for any reason.

Code: BELL (BEL)

Note: Restarting or interrupting a specific operation once initiated is now regularly done by the BREAK signal, which however is not provided for in the ASCII code. This is an important and often used function, and further investigation is needed. A special "restart" key may need to be recommended to keyboard designers and standardizing agencies.

* Code refers to the ASCII Character Code Designations.

** Implementation depends on terminal capabilities and communication modes. Several different options need to be determined.

4.3 Literal

This signal, when preceding control characters or control signals eliminates the control significance, and causes the character following the literal prefix to lose its special significance.

Code: *SUBSTITUTE (SUB)* Also: *CONTROL-Z*

Note: A literal convention is also needed for character strings. The double quotation mark has been recommended for this use.

4.4 Word Separator

This signal is used to separate command words or data elements in the abbreviated access procedure.

Code: *COMMA*

Note: A strong case can be made to use the space character as a separation device. It is in almost universal use now in interactive systems. One difficulty with this is that it cannot be seen; this difficulty is reduced if the input device has a reasonably good type-position indication. Further discussion is needed to resolve this.

4.5 Delete Commands

These commands are used by the user to delete portions of the access procedure messages.

4.5.1 *Delete Last Character Entered (Delete Character)*. This command deletes the last character entered by the user, and frees the character position for a new character entry. In the case of a literal, it deletes both the character and the literal prefix.

Code: *DELETE (DEL)*

4.5.2 *Delete*. This command deletes all characters entered by the user on the current line.

Code: *CANCEL (CAN)* Also: *CONTROL-X*

5. USER AND SYSTEM MESSAGES

The following standard messages are part of the access procedures outlined in tables 1, 2, and 3.

5.1 User Access Request (Not part of entry procedure)

This is implied by a user calling a computer access number and receiving a communications signal indicating establishment of terminal-computer communications.

Note: In addition, as a result of the access request, certain user specified format conventions must be established, and terminal attributes must be recognized by the processor, before communications between the user at the terminal and the system can be effected. This may be done by automatic interrogation of the terminal, or by entry of format codes and terminal attribute codes by the user.

There are many other variants of generating a user access request, depending on hardware and software factors. The system should acknowledge completion of the communications connection process, which is done by the system identification message. This message from the system to the user is the first message of the access procedure, and serves as a system acknowledgement.

5.2 System Identification Message

Upon receipt of the access request, the system sends a message to the terminal which indicates the operability of the system, and which furnishes some basic system identification to the user. The message contains the following data elements:

Administrative Code (Optional)

Date (Optional)

Port Connection (Optional)

System Name

Time (Optional)

Note: There is agreement on system name as the basic ingredient of this message. Other elements listed are optional, and may be omitted in the interest of brevity. The port connection may be useful in tracing of communications errors. It may be expressed in the form of a telephone number or a port number.

5.3 Identification Request

Immediately following the system identification message, the system sends the identification request to the user. The message has one of the following forms:

"PLEASE ENTER USER IDENTIFICATION" *

"PLEASE ENTER USER ID"

"PLEASE ENTER ID"

"ID"

Note: There are divergent opinions on the desirability of the various forms shown above. The first long form, normal language, is the most understandable. The last form is highly abbreviated and would require a more experienced user. Some options should probably be allowed to provide for the explicit and abbreviated forms. Each identification request is followed by a system signal.

5.4 Identification Message

This message is sent by the user in response to the identification request (section 5.3). It consists of a string of characters generated at the keyboard which serves to identify the user, primarily for accounting and billing purposes.

Note: The length of the string will usually be limited, but within the restricted length, any ID code will be acceptable. Fields of the user identification code may be subdivided in subfields reserved for user name, user number, organizational unit code, etc. These data are used for administrative, statistical and billing purposes.

5.5 Validation

The system receives and analyzes the user identification for acceptability. If acceptable, the access procedure continues to the password request (section 5.6). If unacceptable, the access procedure provides an error message (sections 5.11 and 5.13).

* Messages or message elements enclosed in quotation marks are to be displayed literally as shown. Data element names are shown in lower case. Implementation of a displayed message is dependent on availability of upper and lower case characters, and is not considered for standardization at this time.

5.6 Password Request

A password is the most common form used for authentication by the system. A password is assigned to an individual authorized user by administrative procedure. It is the final key to entry into the system. The password is protected against misuse by overprinting, underprinting or non printing to prevent a reader of hard copy, or an observer of a visual screen from unauthorized knowledge and possible misuse of a password. After validation, the system sends a password request to the user terminal as follows:

"PLEASE ENTER PASSWORD" or

"PASSWORD" or

"PW"

5.7 Password Message

The user enters the password, which consists of a string of keyboard enterable characters, i.e. any ASCII characters including blank characters, control characters and user signals if preceded by the literal prefix.

5.8 Authorization

The system receives and analyzes the password for acceptability. If acceptable, the access procedure continues to the operational status message (section 5.9), receipt of which by the user implies to him that he now is authorized to proceed with service selection. If the password is not accepted, the access procedure provides an error message (section 5.12).

5.9 Operational Status Message

Password acceptance is immediately followed by the operational status message which furnishes the latest information on the operating status of the system. This will be in clear text and may contain such items as: planned system down time, special scheduled operating hours, unavailability of some system components, and a telephone number for user assistance.

5.10 User Service Selection

After receipt of the status message, the user is free to select the service by the method unique to the particular service being accessed. This procedure is outside of the access procedure considered in this document.

5.11 User Identification Error

If an error is made or time out elapses during the user identification entry, the system will allow two additional attempts to enter an acceptable user identification, through the following message:

"INVALID USER ID, PLEASE REENTER ID"

5.12 User Password Error

If an error is made in password entry, the system will allow two additional attempts to enter an acceptable password, through the following message:

"INVALID PASSWORD, PLEASE REENTER PASSWORD"

5.13 Entry Error Shutdown Message

Upon receipt of the third entry or after three minutes of inaction, either during user identification, or password entry, the system denies service, and sends the following message to the user:

"INVALID ENTRY, PLEASE CALL YOUR SYSTEM REPRESENTATIVE
FOR HELP"

or

"INVALID ENTRY, PLEASE CALL (nnn) nnn-nnnn"

where the string of "n" characters denotes the service telephone number.

Note: In most systems today, the third invalid entry causes automatic disconnect.

5.14 Exit Request (Not part of access procedure)

This message indicates to the system that the user desires to terminate the session.

Note: The exit request message is unique to the particular service system used and varies among systems. At this time, it is not considered part of the access procedure.

5.15 Accounting Message

Upon receipt of the exit request, the system provides the accounting message to the user. It contains the following data elements:

DATE
TIME SESSION STARTED
TIME SESSION ENDED
ELAPSED CLOCK TIME
SYSTEM NAME
ADMINISTRATIVE CODE

In addition, a brief statement will be furnished which will inform the user of units of resources expended in the session, from system entry to system exit. This may be in terms of dollars and cents, resource units, connect time, etc.

Note: There is some agreement on the need for the six data elements listed above. Systems use different charging algorithms, and therefore, report usage differently. Some system representatives feel that it is not necessary to report this item. Some agreement on usage units and need for reporting will be needed before this can be standardized.

5.16 End Message

End of the session is indicated by the system displaying the message:

"END"

Note: This is usually appended to the accounting message.

5.17 System Termination

If it should become necessary to terminate the session from the system side, the user will be informed as follows:

"SYSTEM TERMINATION"
DATE
TIME
SYSTEM NAME
CAUSE OF TERMINATION
"END"

5.18 Irregular User Termination

A user may purposely or inadvertently make a communications disconnection (see table 2.) while operating the system. When the system detects this event, it will close the interactive session. Upon reentry the user will receive the following message:

"IRREGULAR TERMINATION"

DATE, TIME, SYSTEM NAME and "END" will be shown as in 5.17 above.

Note: . The system should be designed to facilitate recovery and to permit user to continue work from the state at which termination occurred.

6. DATA ELEMENTS

Data elements, which are the components of user and system messages, are listed in this section.

Note: Details of format are dependent on terminal hardware characteristics, software implementation and codes of existing systems, and other factors. At this time, it is important to determine format standards. Data elements appearing in the previous section are listed, and some of the constraints are noted.

6.1 User Identification

User identification is required for system access control, accounting and statistical purposes.

Several format options exist, such as fixed length or variable length fields. In variable length codes, a maximum field size may need to be specified. All alphanumeric characters appearing on the keyboard should be permitted in user identification. It may be desirable to allow subfields for user name, user number, organization code, or other administrative classifications.

6.2 Password

The password is required for system access, for authentication of user access. It should be protected from unauthorized use by underprinting, overprinting, or by non-printing or nondisplaying.

6.3 System Name

A system name is an optional feature of the system identification message. This would be a designation coined by the system owner. It should uniquely identify the system to be accessed.

Note: Standardization of this item would be concerned with format, and appropriateness of acronyms or abbreviations. In case of duplication or similarity of system names, some coordinating procedures and ground rules would have to be established.

6.4 Administrative Code

This code permits identification of an organization entity, such as a department, a section, or a division of an organization. It is used for billing, bookkeeping, or other statistical purposes.

6.5 Calendar Date

An all numeric date should be written in the following order:

year-month-day

nnnn-nn-nn

where "n" designates Arabic numerals.

A hyphen should be used as a separator.

The year should be represented by four digits to clearly indicate the descending order. A two-digit representation for the year is optional when no confusion can arise from the omission of the century (see ISO R2014).

Note: Calendar date has been subject to National, Federal and International standardization. ISO Recommendation R2014 deals with writing of calendar date in all numeric form. ANSI X3.30 deals with representations for calendar date, when used for interchange of data among data systems. The standard was not designed for (nor does it preclude) usage by humans as input to or output from data systems. ISO 2711 deals with representation of ordinal dates for information processing interchange. Federal Information Processing Standard FIPS 4 (Calendar Date) is prescribed for interchange of formatted machine sensible coded data between and among agencies of the Federal Government.

6.6 Time

Time of the day is to be represented by the sequence: hour-minute-second in the following formats:

h m s

nn:nn:nn

Hours will be indicated in the 24 hour system (i.e. from 00:00:00 through 23:59:59).

Interval time will be indicated in the sequence:

days:hours:minutes:seconds

using the abbreviations "days", "hrs", "min", "sec", if required.

Fractions of a second will be expressed in tenths, or hundredths of a second, as for example: 1:12:15:05.8.

All time elements will be separated by a colon. Decimal fractions of a second will be indicated by a decimal point.

6.7 Time Zone

For national network operations, the time zone should be indicated as a three-character code immediately following the time designation.

Example: 13:45:08EST

For international network operations, Greenwich Mean Time will be used, followed by the international zone designator Z.

Example: 13:40:16Z

7. PROCEDURAL OPTIONS

At least two options should be available to a user for system access: an interactive option, or instructional version, where each user step is elicited by explicit instructions from the system; and an abbreviated option which requires only one user entry of all required data.

The outlines in tables 1 and 2 illustrate the interactive version. An abbreviated version is outlined in table 3.

Note: It is not clear at this time that a completely interactive access procedure would be required to access an interactive information system. The automatic, world-wide telephone system provides an example of a universal, standardized method, where a customer dials in sequence an overseas operator code, a country code, an area code, a city code, and a local number.

An interactive access procedure may be useful as an instructional device, or as an option for the casual user. An abbreviated access procedure may well be preferred by the regular user of an interactive information system.

The interactive version should be designed to be easy to use for an inexperienced user; the abbreviated, or terse version should be designed for the convenience of the experienced user. These two modes need not be mutually exclusive; to help the new user become experienced and more proficient, the system should permit and encourage a gradual transition from one extreme to the other, at the user's discretion.

8. DEFINITIONS

Access Procedure - The method of permitting a terminal user to initiate and terminate operation and use of a computer-based service.

Accounting Message - A message, usually sent to the user at the end of a terminal session, furnishing detail on resources expended during that session.

Acknowledgment - A message indicating to the user that the system is operational.

Authentication - The process of verification of user identification.

Authorization - The process of permitting access to the service.

Conversational - Pertaining to a mode of processing, that involves step-by-step interaction between the user at a terminal and a computer, by means of keyboard and display.

Entry Procedure - Part of the access procedure, which permits a user to operate a computer-based service.

Error Message - A system message indicating the nature of a fault, and often the remedial action to be taken by the user.

Exit Procedure - Part of the access procedure, which permits a user to terminate a computer-based service.

Identification - (1) The process of providing personal, equipment, or organizational characteristics or codes to gain access to computer services, programs, or data. (2) the process of determining personal, equipment, or organizational characteristics or codes to permit access.

Interactive - Pertaining to exchange of information and control between a user and the terminal and processor.

Password - A word or string of characters that is recognizable by automatic means and that permits a user access to protected storage files, or input or output devices.

Privacy - The right of an individual to control information about himself.

Protocol - A formal set of conventions governing the format and relative timing of message exchange between the user and the system.

System Message - A message or request from the system to the user.

System Security - The totality of measures taken to protect a system from unauthorized access, accidental or willful interference with normal operations, or destruction.

System Signal - A message generated by a computer, that indicates to the terminal user, that an immediate processing task is completed, and that the next action is up to the user.

Terminal - A device that permits data input into or data output from a computer system, e.g. a teletypewriter, a cathode ray tube and keyboard device, etc.

User - A terminal operator who may be a functional specialist or manager, and is not assumed to have computer or programming background.

User Command - A brief operational user message.

User Identification Message - A message entered by the user, which is used to obtain accounting data, and which is also used to permit access to the system.

User Message - A message from the user to the system.

User Number - A number assigned to a user, which is used as part of the identification process.

User Signal - A user command, indicating to the system that user entry of data has been completed.

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16. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)

A user-terminal protocol is defined which enables a user at a terminal to access computerized information systems. The basic functions such as identification, authorization, and validation are outlined and various signals and messages making up the protocol are identified. The purpose of the paper is to establish a basis for standardization and development of a unified user protocol.

17. KEY WORDS (six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)

Command languages, computers, man-machine systems, networks, system commands, user protocols

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