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Revised FTP Reply Codes   1

This document describes a revised set of reply codes for the File
Transfer Protocol.   2

The aim of this revision is to satisfy the goal of using reply
codes to enable the command issuing process to easily determine
the outcome of each command. The user protocol interpreter should
be able to determine the success or failure of a command by
examining the first digit of the reply code.   3

An important change in the sequencing of commands and replies
which may not be obvious in the following documents concerns the
establishment of the data connection.   4

   In the previous FTP specifications when an actual transfer
   command (STOR, RETR, APPE, LIST, NLIST, MLFL) was issued the
   preliminary reply was sent after the data connection was
   established. This presented a problem for some user protocol
   interpreters which had difficulty monitoring two connections
   asynchronously.   4a

   The current specification is that the preliminary reply to the
   actual transfer commands indicates that the file can be
   transferred and either the connection was previously
   established or an attempt is about to be made to establish the
   data connection.   4b

This reply code revision is a modification of the protocol in
described in RFC 542, that is to say that the protocol
implementation associated with socket number 21 (decimal) is the
protocol specified by the combination of RFC 542 and this RFC.   5

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19 JUN 75

           A New Schema for FTP Reply Codes   7

Replies to File Transfer Protocol commands were devised to ensure
the synchronization of requests and actions in the process of
file transfer, and to guarantee that the user process always
knows the state of the Server. Every command must generate at
least one reply, although there may be more than one; in the
latter case, the multiple replies must be easily distinguished.
In addition, some commands occur in sequential groups, such as
USER, PASS and ACCT, or RNFR and RNTO. The replies show the
existence of an intermediate state if all preceding commands have
been successful. A failure at any point in the sequence
necessitates the repetition of the entire sequence from the
beginning.   8

   Details of the command-reply sequence will be made explicit in
   a state diagram.   8a

An FTP reply consists of a three digit number (transmitted as
three alphanumeric characters) followed by some text. The number
is intended for use by automata to determine what state to enter
next; the text is intended for the human user. It is intended
that the three digits contain enough encoded information that the
user-process (the User-PI described in RFC 542) will not need to
examine the text and may either discard it or pass it on to the
user, as appropriate. In particular, the text may be
server-dependent, so there are likely to be varying texts for
each reply code.   9

Formally, a reply is defined to contain the 3-digit code,
followed by Space <SP>, followed by one line of text (where some
maximum line length has been specified), and terminated by the
TELNET end-of-line code. There will be cases, however, where the
text is longer than a single line. In these cases the complete
text must be bracketed so the User-process knows when it may stop
reading the reply (i.e. stop processing input on the TELNET
connection) and go do other things. This requires a special
format on the first line to indicate that more than one line is
coming, and another on the last line to designate it as the last.
At least one of these must contain the appropriate reply code to

indicate the state of the transaction. To satisfy all factions
it was decided that both the first and last line codes should be
the same.   10

   Thus the format for multi-line replies is that the first line
   will begin with the exact required reply code, followed
   immediately by a Hyphen, "-" (also known as Minus), followed
   by text. The last line will begin with the same code,
   followed immediately by Space <SP>, optionally some text, and
   TELNET <eol>.   10a

      For example:
                        123-First line

```
                       Second line
                         234 A line beginning with numbers
                         123 The last line                            10a1

   The user-process then simply needs to search for the second
   occurrence of the same reply code, followed by <SP> (Space),
   at the beginning of a line, and ignore all intermediary lines.
   If an intermediary line begins with a 3-digit number, the
   Server must pad the front to avoid confusion.                       10b

      This scheme allows standard system routines to be used for
      reply information (such as for the STAT reply), with
      "artificial" first and last lines tacked on.  In the rare
      cases where these routines are able to generate three
      digits and a Space at the beginning of any line, the
      beginning of each text line should be offset by some
      neutral text, like Space.                                        10b1

   This scheme assumes that multi-line replies may not be nested.
   We  have found that, in general, nesting of replies will not
   occur, except for random system messages (called spontaneous
   replies in the previous FTP incarnations) which may interrupt
   another reply.  Spontaneous replies are no longer defined;
   system messages (i.e. those not processed by the FTP server)
   will NOT carry reply codes and may occur anywhere in the
   command-reply sequence.  They may be ignored by the
   User-process as they are only information for the human user.   10c

The three digits of the reply each have a special significance.
This is intended to allow a range of very simple to very
sophisticated response by the user-process.  The first digit
denotes whether the response is good, bad or incomplete.
(Referring to the state diagram) an unsophisticated user-process
will be able to determine its next action (proceed as planned,
redo, retrench, etc.) by simply examining this first digit.  A
user-process that wants to know approximately what kind of error
```

```
occurred (e.g. file system error, command syntax error) may
examine the second digit, reserving the third digit for the
finest gradation of information (e.g. RNTO command without a
preceding RNFR.)                                                       11

   There are four values for the first digit of the reply code:       11a

   1yz   Positive Preliminary reply                                    11b

      The requested action is being initiated; expect another
      reply before proceeding with a new command.  (The
      user-process sending another command before the  completion
      reply would be in violation of protocol; but server-FTP
      processes should queue any commands that arrive while a
      preceeding command is in progress.)  This type of reply can
      be used to indicate that the command was accepted and the
      user-process may now pay attention to the data connections,
      for implementations where simultaneous monitoring is
      difficult.                                                       11b1
```

2yz   Positive Completion reply   11c

    The requested action has been successfully completed. A
    new request may be initiated.   11c1

3yz   Positive Intermediate reply   11d

    The command has been accepted, but the requested action is
    being held in abeyance, pending receipt of further
    information. The user should send another command
    specifying this information. This reply is used in command
    sequence groups.   11d1

4yz   Transient Negative Completion reply   11e

    The command was not accepted and the requested action did
    not take place, but the error condition is temporary and
    the action may be requested again. The user should return
    to the beginning of the command sequence, if any. It is
    difficult to assign a meaning to "transient", particularly
    when two distinct sites (Server and User-processes) have to
    agree on the interpretation. Each reply in the 4yz
    category might have a slightly different time value, but
    the intent is that the user-process is encouraged to try
    again. A rule of thumb in determining if a reply fits into
    the 4yz or the 5yz (Permanent Negative) category is that
    replies are 4yz if the commands can be repeated without any
    change in command form or in properties of the User or
    Server (e.g. the command is spelled the same with the same

    arguments used; the user does not change his file access or
    user name; the server does not put up a new
    implementation.)   11e1

5yz   Permanent Negative Completion reply   11f

    The command was not accepted and the requested action did
    not take place. The User-process is discouraged from
    repeating the exact request (in the same sequence). Even
    some "permanent" error conditions can be corrected, so the
    human user may want to direct his User-process to
    reinitiate the command sequence by direct action at some
    point in the future (e.g. after the spelling has been
    changed, or the user has altered his directory status.)   11f1

The following function groupings are encoded in the second
digit: 11g

    x0z   Syntax - These replies refer to syntax errors,
           syntactically correct commands that don't fit any
           functional category, unimplemented or superfluous
           commands.   11g1

    x1z   Information - These are replies to requests for
           information, such as status or help.   11g2

x2z   Connections - Replies referring to the TELNET and
                  data connections.   11g3

          x3z   Authentication and accounting - Replies for the logon
                  process and accounting procedures.   11g4

          x4z   Unspecified as yet   11g5

          x5z   File system - These replies indicate the status of
                  the Server file system vis-a-vis the requested
                  transfer or other file system action.   11g6

     The third digit gives a finer gradation of meaning in each of
     the function categories, specified by the second digit. The
     list of replies below will illustrate this. Note that the
     text associated with each reply is suggestive, rather than
     mandatory, and may even change according to the command with
     which it is associated. The reply codes, on the other hand,
     should strictly follow the specifications in the last section;
     that is, Server implementations should not invent new codes
     for situations that are only slightly different from the ones
     described here, but rather should adapt codes already defined.

     If additional codes are found to be necessary, the details
     should be submitted to the FTP committee, through Jon Postel.   11h

        A command such as TYPE or ALLO whose successful execution
        does not offer the user-process any new information will
        cause a 200 reply to be returned. If the command is not
        implemented by a particular Server-FTP process because it
        has no relevance to that computer system, for example ALLO
        at a TENEX site, a Positive Completion reply is still
        desired so that the simple User-process knows it can
        proceed with its course of action. A 202 reply is used in
        this case with, for example, the reply text: "No storage
        allocation necessary." If, on the other hand, the command
        requests a non-site-specific action and is unimplemented,
        the response is 502. A refinement of that is the 504 reply
        for a command that IS implemented, but that requests an
        unimplemented parameter.   11h1
                                                                      11i
        200 Command okay   11i1
        500 Syntax error, command unrecognized
                [This may include errors such as command line too
                long.]   11i2
        501 Syntax error in parameters or arguments   11i3
        202 Command not imlemented, superfluous at this site.   11i4
        502 Command not implemented   11i5
        503 Bad sequence of commands   11i6
        504 Command not implemented for that parameter   11i7
                                                                      11j
        110 Restart marker reply.
                In this case the text is exact and not left to the
                particular implementation; it must read:
                        MARK yyyy = mmmm

```
              where yyyy is User-process data stream marker, and
              mmmm is Server's equivalent marker.  (note the
              spaces between the markers and "=".)              11j1
    211  System status, or system help reply                   11j2
    212  Directory status                                       11j3
    213  File status                                            11j4
    214  Help message (on how to use the server or the meaning
              of a particular non-standard command.  This reply
              is useful only to the human user.)                11j5
                                                                11k
    120  Service ready in nnn minutes                           11k1
    220  Service ready for new user                             11k2
    221  Service closing TELNET connection (logged off if
              appropriate)                                      11k3
    421  Service not available, closing TELNET connection.
              [This may be a reply to any command if the service
              knows it must shut down.]                         11k4
```

```
    125  Data connection already open; transfer starting        11k5
    225  Data connection open; no transfer in progress          11k6
    425  Can't open data connection                             11k7
    226  Closing data connection; requested file action
              successful (for example, file transfer or file
              abort.)                                           11k8
    426  Connection trouble, closed; transfer aborted.          11k9
    227  Entering [passive, active] mode                        11k10
                                                                11l
    230  User logged on, proceed                                11l1
    530  Not logged in                                          11l2
    331  User name okay, need password                          11l3
    332  Need account for login                                 11l4
    532  Need account for storing files                         11l5
                                                                11m
    150  File status okay; about to open data connection.       11m1
    250  Requested file action okay, completed.                 11m2
    350  Requested file action pending further information      11m3
    450  Requested file action not taken: file unavailable
              (e.g. file not found, no access)                  11m4
    550  Requested action not taken:  file unavailable (e.g.
              file busy)                                        11m5
    451  Requested action aborted: local error in processing    11m6
    452  Requested action not taken:  insufficient storage
              space in system                                   11m7
    552  Requested file action aborted:  exceeded storage
              allocation (for current directory or dataset)     11m8
    553  Requested action not taken: file name not allowed      11m9
    354  Start mail input; end with <CR><LF>.<CR><LF>           11m10
```

                      Command-Reply Sequences   12

   In this section, the command-reply sequence is presented. Each
command is listed with its possible replies; command groups are

```
listed together.  Preliminary replies are listed first (with
their succeeding replies under them), then positive and negative
completion, and finally intermediary replies with the remaining
commands from the sequence following.  This listing forms the
basis for the state diagrams, which will be presented separately.     13

    ICP                                                              13a
       120                                                           13a1
          220                                                        13a1a
       220                                                           13a2
       421                                                           13a3
```

```
    Logon                                                            13b

       USER                                                          13b1
          230                                                        13b1a
          530                                                        13b1b
          500, 501, 421                                              13b1c
          331, 332                                                   13b1d
       PASS                                                          13b2
          230                                                        13b2a
          202                                                        13b2b
          530                                                        13b2c
          500, 501, 503, 421                                         13b2d
          332                                                        13b2e
       ACCT                                                          13b3
          230                                                        13b3a
          202                                                        13b3b
          530                                                        13b3c
          500, 501, 503, 421                                         13b3d

    Logoff                                                           13c

       QUIT                                                          13c1
          221                                                        13c1a
          500                                                        13c1b
       REIN                                                          13c2
          120                                                        13c2a
             220                                                     13c2a1
          220                                                        13c2b
          421                                                        13c2c
          500, 502                                                   13c2d

    Transfer parameters                                              13d

       SOCK                                                          13d1
          200                                                        13d1a
          500, 501, 421, 530                                         13d1b
       PASV                                                          13d2
          227                                                        13d2a
          500, 501, 502, 421, 530                                    13d2b
       ACTV                                                          13d3
          227                                                        13d3a
          202                                                        13d3b
          500, 501, 421, 530                                         13d3c
       BYTE, MODE, TYPE, STRU                                        13d4
```

```
            200                                                   13d4a
            500, 501, 504, 421, 530                               13d4b
```

```
      File action commands                                       13e

         ALLO                                                     13e1
            200                                                   13e1a
            202                                                   13e1b
            500, 501, 504, 421, 530                               13e1c
         REST                                                     13e2
            500, 501, 502, 421, 530                               13e2a
            350                                                   13e2b
         STOR                                                     13e3
            125, 150                                              13e3a
               (110)                                              13e3a1
               226, 250                                           13e3a2
               425, 426, 451, 552                                 13e3a3
            532, 450, 452, 553                                    13e3b
            500, 501, 421, 530                                    13e3c
         RETR                                                     13e4
            125, 150                                              13e4a
               (110)                                              13e4a1
               226, 250                                           13e4a2
               425, 426, 451                                      13e4a3
            450, 550                                              13e4b
            500, 501, 421, 530                                    13e4c
         LIST, NLST                                               13e5
            125, 150                                              13e5a
               226, 250                                           13e5a1
               425, 426, 451                                      13e5a2
            450                                                   13e5b
            500, 501, 502, 421, 530                               13e5c
         APPE                                                     13e6
            125, 150                                              13e6a
               (110)                                              13e6a1
               226, 250                                           13e6a2
               425, 426, 451, 552                                 13e6a3
            532, 450, 550, 452, 553                               13e6b
            500, 501, 502, 421, 530                               13e6c
         MLFL                                                     13e7
            125, 150                                              13e7a
               226, 250                                           13e7a1
               425, 426, 451, 552                                 13e7a2
            532, 450, 550, 452, 553                               13e7b
            500, 501, 502, 421, 530                               13e7c
         RNFR                                                     13e8
            450, 550                                              13e8a
            500, 501, 502, 421, 530                               13e8b
            350                                                   13e8c
         RNTO                                                     13e9
            250                                                   13e9a
            532, 553                                              13e9b
```

```
        500, 501, 502, 503, 421, 530                              13e9c
     DELE                                                         13e10
        250                                                       13e10a
        450, 550                                                  13e10b
        500, 501, 502, 421, 530                                   13e10c
     ABOR                                                         13e11
        225, 226                                                  13e11a
        500, 501, 502, 421                                        13e11b
     MAIL                                                         13e12
        354                                                       13e12a
           250                                                    13e12a1
           451, 552                                               13e12a2
        450, 550, 452, 553                                        13e12b
        500, 501, 502, 421, 530                                   13e12c

   Informational commands                                         13f

     STAT                                                         13f1
        211, 212, 213                                             13f1a
        450                                                       13f1b
        500, 501, 502, 421, 530                                   13f1c
     HELP                                                         13f2
        211, 214                                                  13f2a
        500, 501, 502, 421                                        13f2b

   Miscellaneous commands                                         13g

     SITE                                                         13g1
        200                                                       13g1a
        202                                                       13g1b
        500, 501, 530                                             13g1c
     NOOP                                                         13g2
        200                                                       13g2a
        500                                                       13g2b
```

   FTP State Diagrams   14

Here we present state diagrams for a very simple minded FTP
implementation. Only the first digit of the reply codes is used.
There is one state diagram for each group of FTP commands or
command sequences.   15

The command groupings were determined by constructing a model for
each command then collecting together the commands with
structurally identical models.   16

For each command or command sequence there are three possible
outcomes: success (S), failure (F), and error (E). In the state
diagrams below we use the symbol B for "begin", and the symbol W
for "wait for reply".   17

We first present the diagram that represents the largest group of
FTP commands: 18
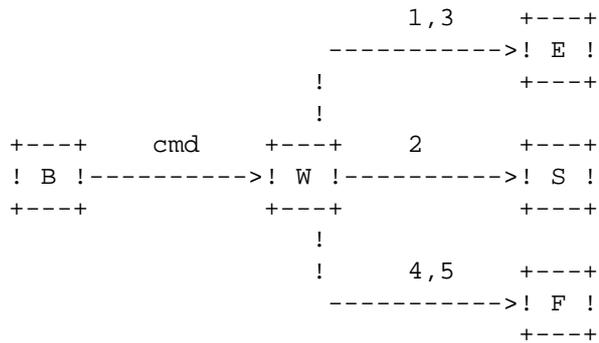
```
                          1,3     +---+
                        ---------->! E !
                        !          +---+
                        !
   +---+    cmd    +---+    2       +---+
   ! B !---------->! W !---------->! S !
   +---+           +---+           +---+
                        !
                        !   4,5    +---+
                        ---------->! F !
                                   +---+
```
                                                                      18a

    This diagram models the commands: 18b

   ABOR, ACTV, ALLO, BYTE, DELE, HELP, MODE, NOOP, PASV, QUIT,
        SITE, SOCK, STAT, STRU, TYPE.   18b1

The other large group of commands is represented by a very
similar diagram: 19
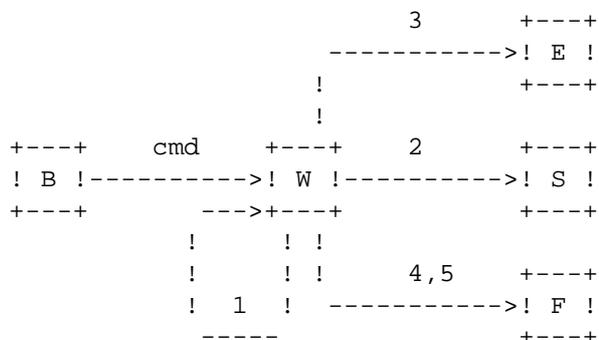

```
                          3       +---+
                        ---------->! E !
                        !          +---+
                        !
   +---+    cmd    +---+    2       +---+
   ! B !---------->! W !---------->! S !
   +---+      --->+---+            +---+
              !    ! !
              !    ! !    4,5     +---+
              !  1 !  ---------->! F !
               -----              +---+
```
                                                                      19a

    This diagram models the commands: 19b

        APPE, (ICP), LIST, MLFL, NLST, REIN, RETR, STOR.   19b1

Note that this second model could also be used to represent the
first group of commands, the only difference being that in the
first group the 100 series replies are unexpected and therefore
treated as error, while the second group expects (some may
require) 100 series replies.   20

The remaining diagrams model command sequences, perhaps the
simplest of these is the rename sequence: 21
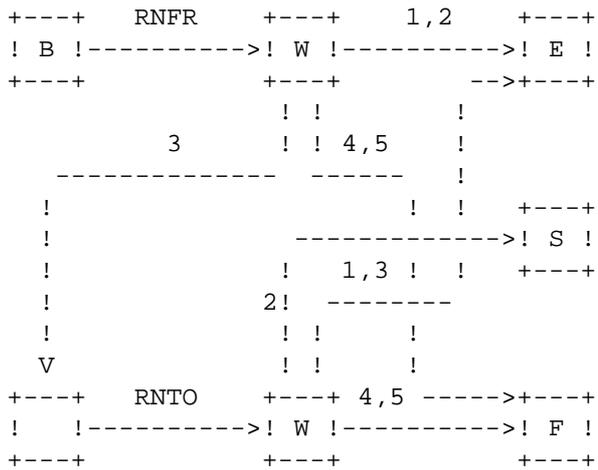
```
      +---+    RNFR    +---+      1,2    +---+
      ! B !---------->! W !---------->! E !
      +---+           +---+        -->+---+
                        ! !         !
              3         ! ! 4,5     !
         --------------  ------     !
        !                    ! !   +---+
        !                     ------------->! S !
        !                   !  1,3 ! !   +---+
        !                 2!  --------
        !                   ! !      !
        V                   ! !      !
      +---+    RNTO    +---+ 4,5 ----->+---+
      !   !---------->! W !---------->! F !
      +---+           +---+           +---+
```
                                                              21a

A very similar diagram models the Mail command: 22
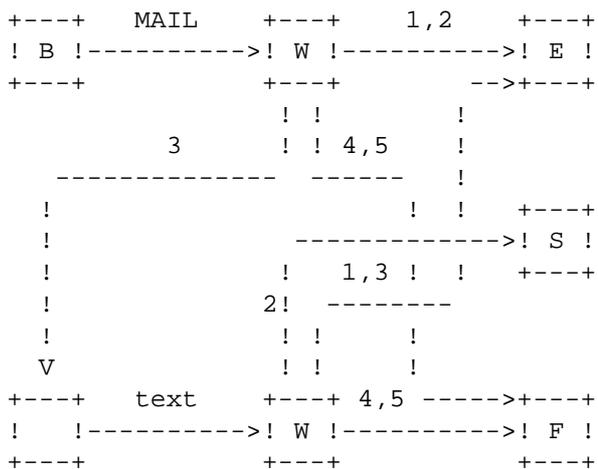

```
      +---+    MAIL    +---+      1,2    +---+
      ! B !---------->! W !---------->! E !
      +---+           +---+        -->+---+
                        ! !         !
              3         ! ! 4,5     !
         --------------  ------     !
        !                    ! !   +---+
        !                     ------------->! S !
        !                   !  1,3 ! !   +---+
        !                 2!  --------
        !                   ! !      !
        V                   ! !      !
      +---+    text    +---+ 4,5 ----->+---+
      !   !---------->! W !---------->! F !
      +---+           +---+           +---+
```
                                                              22a

   Note that the "text" here is a series of lines sent from the
   user to the server with no response expected until the last
   line is sent, recall that the last line must consist only of a
   single period.   22b

The next diagram is a simple model of the Restart command: 23


```
      +---+    REST    +---+      1,2    +---+
      ! B !---------->! W !---------->! E !
      +---+           +---+        -->+---+
                        ! !         !
```

```
              3       ! ! 4,5    !
       -------------  ------    !
       !                 ! !  +---+
       !         ------------>! S !
       !             !  3  ! !  +---+
       !          2!  --------
       !           ! !     !
       V           ! !     !
     +---+   cmd    +---+ 4,5 ----->+---+
     ! !--------->! W !---------->! F !
     +---+        -->+---+          +---+
              !     !
              !  1  !
               ------
```
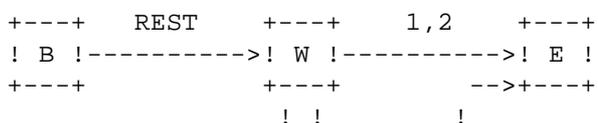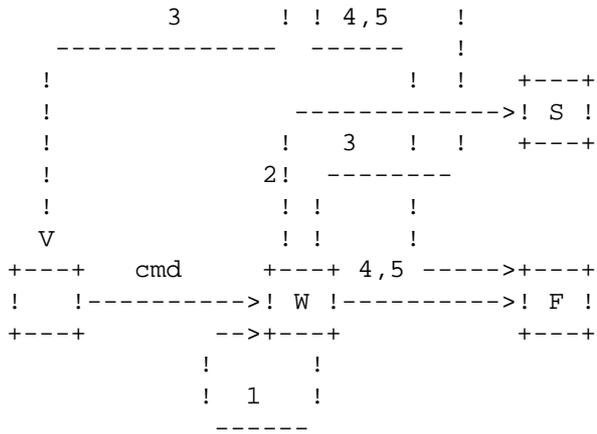
                                                               23a

        Where "cmd" is APPE, STOR, RETR, or MLFL.   23a1

We note that the above three models are similar, in fact the Mail
diagram and the Rename diagram are structurally identical. The
Restart differs from the other two only in the treatment of 100
series replies at the second stage.   24

The most complicated diagram is for the Logon sequence: 25
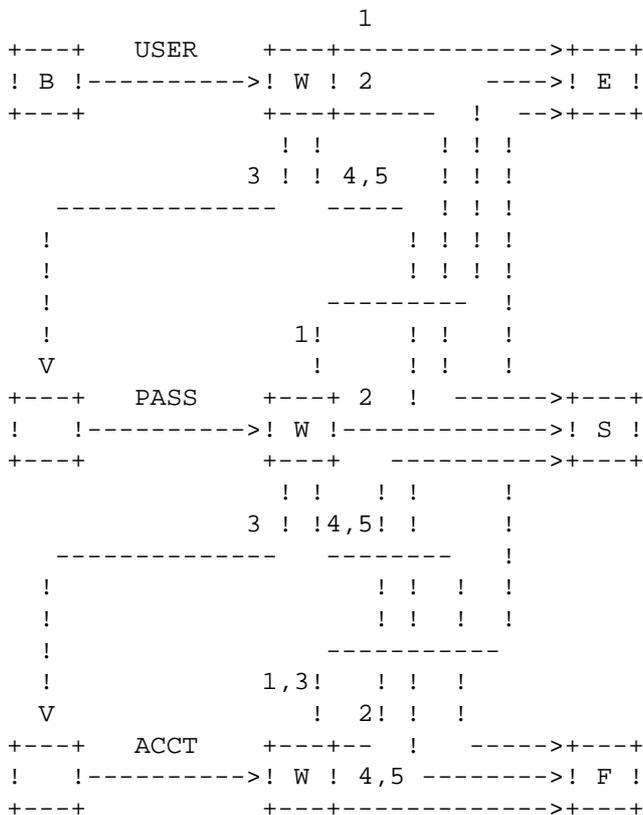
                        1
     +---+   USER   +---+------------->+---+
     ! B !---------->! W ! 2   ---->! E !
     +---+   +---+------ ! -->+---+
                      ! !   ! ! !
               3 ! ! 4,5   ! ! !
        -------------   -----   ! ! !
        !   ! ! ! !
        !   ! ! ! !
        !   --------- !
        !   1!   ! !   !
        V   !   ! !   !
     +---+   PASS   +---+ 2 ! ------>+---+
     ! !---------->! W !------------>! S !
     +---+   +---+ ---------->+---+
                      ! ! ! !   !
               3 ! !4,5! !   !
        -------------   --------   !
        !   ! ! ! !
        !   ! ! ! !
        !   -----------
        !   1,3! ! ! !
        V   ! 2! ! !
     +---+   ACCT   +---+-- !   ----->+---+
     ! !---------->! W ! 4,5 -------->! F !
     +---+   +---+------------>+---+
```

                                                               25a

Finally we present a generalized diagram that could be used to
model the command and reply interchange:                           26

```
                ------------------------------------
           !                                    !
  Begin    !                                    !
    !      V                                    !
    !   +---+  cmd    +---+ 2          +---+     !
    -->!   !------->!   !---------->!   !     !
        !   !        ! W !           ! S !-----!
    -->!   !    -->!   !-----       !   !     !
    !   +---+    !   +---+ 4,5 !       +---+     !
    !      !     !    ! !       !                !
    !      !     !   1! !3      !       +---+     !
    !      !     !    ! !       !       !   !     !
    !      !      ----  !        ---->! F !-----
    !      !           !              !   !
    !      !           !              +---+
     ------------------
           !
           !
           V
          End
```

                                                                   26a