

# Internet Fundamentals

# Lecture-16

- TELNET
- NVT

# *Remote Login: Telnet*

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## **Objectives**

*Upon completion you will be able to:*

- *Understand how TELNET works*
- *Understand the role of NVT in a TELNET communication*
- *Understand TELNET option and suboption negotiation*
- *Know how control characters are used*
- *Know the TELNET modes of operation*



Note:

*TELNET is a general-purpose client-server application program.*

# 18.1 CONCEPT

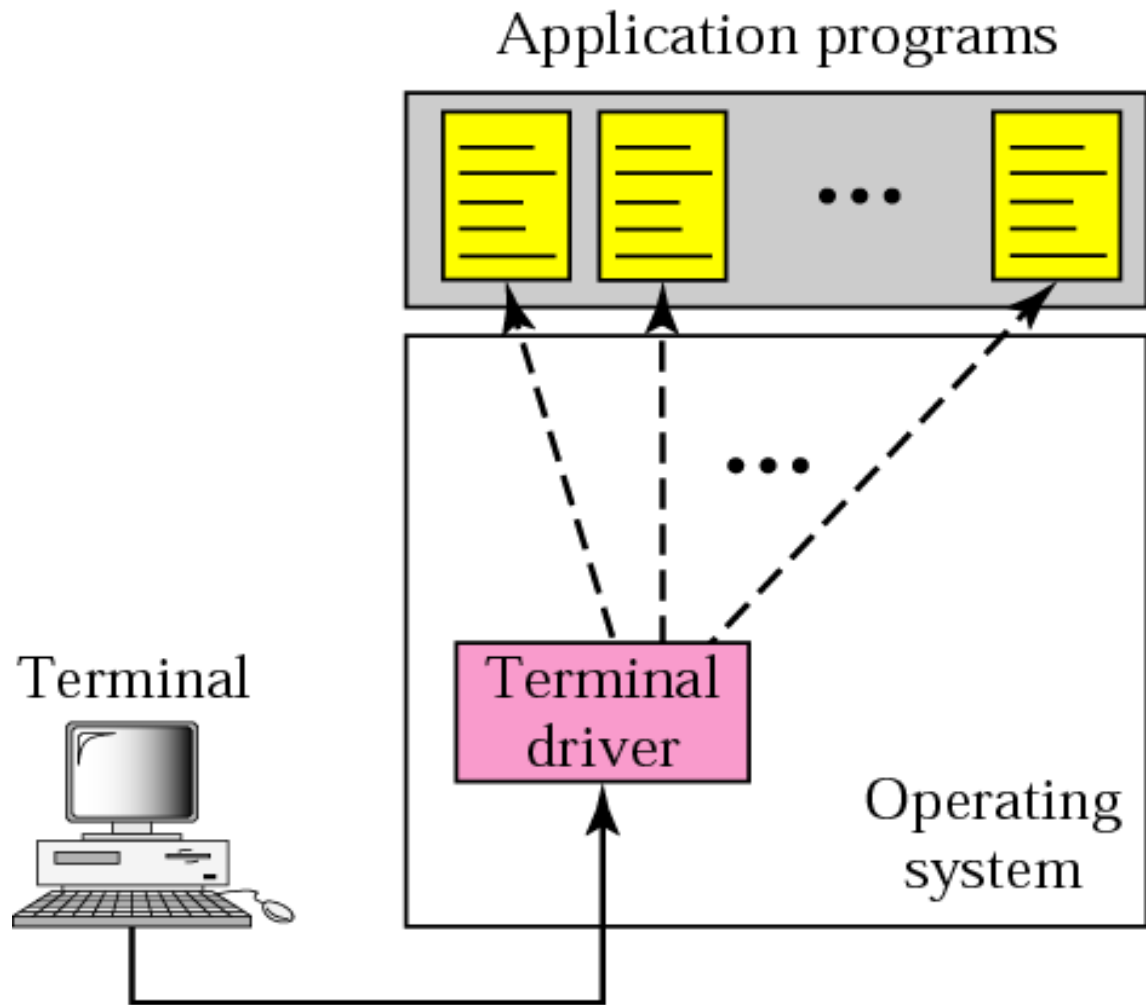
*TELNET enables the establishment of a connection to a remote system in such a way that the local terminal appears to be a terminal at the remote system.*

*The topics discussed in this section include:*

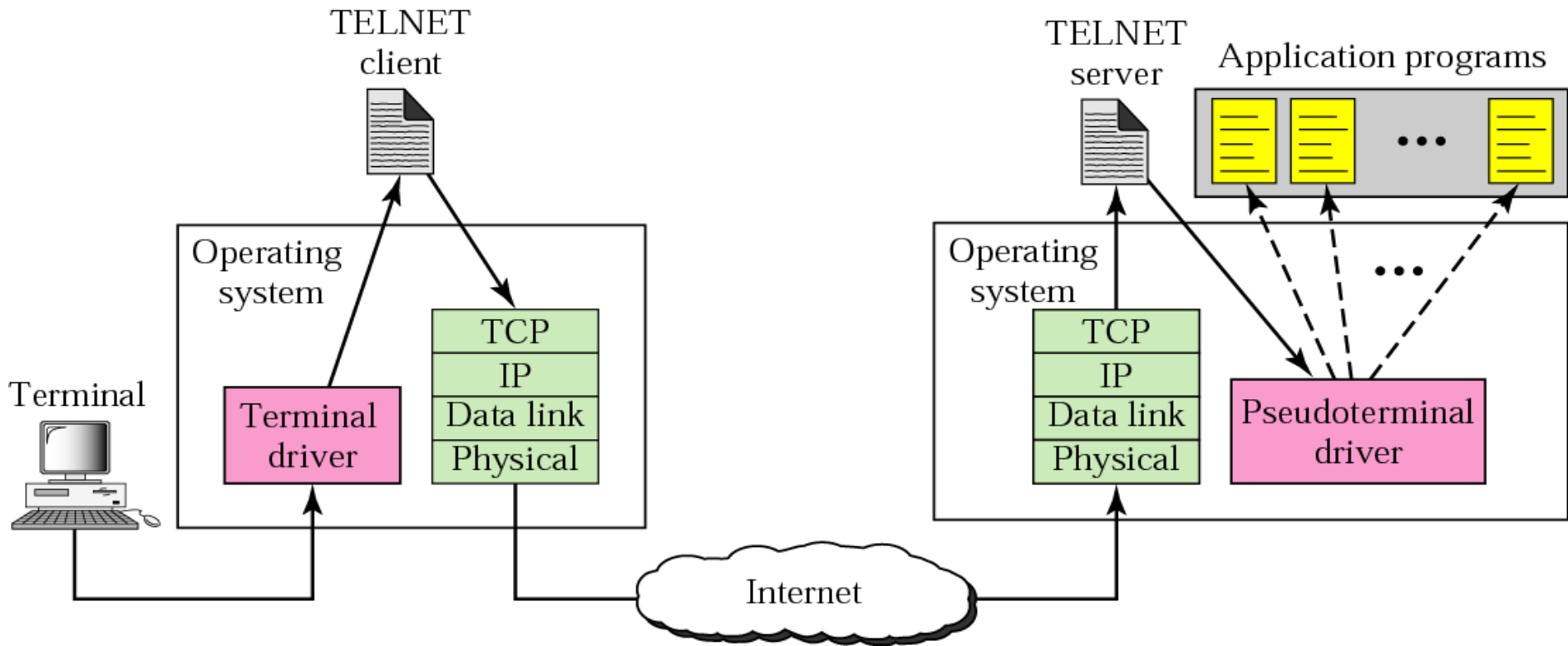
*Time-Sharing Environment*

*Login*

Figure 18.1 *Local login*



**Figure 18.2** *Remote login*

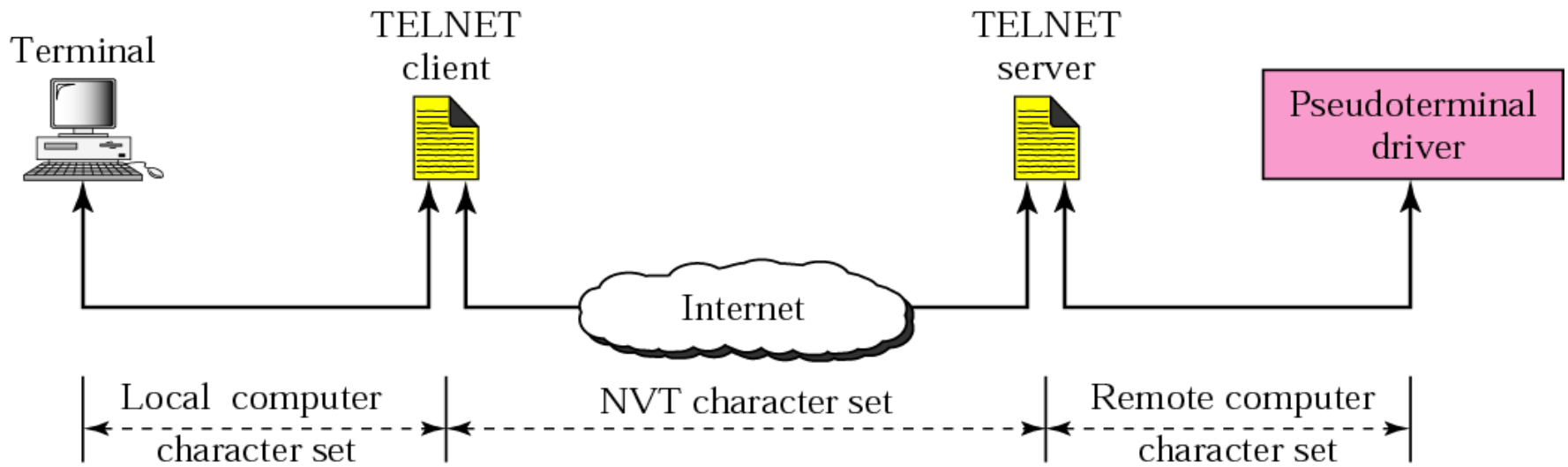


## 18.2 NETWORK VIRTUAL TERMINAL (NVT)

*Via a universal interface called the Network Virtual Terminal (NVT) character set, the TELNET client translates characters (data or commands) that come from the local terminal into NVT form and delivers them to the network. The TELNET server translates data and commands from NVT form into the form acceptable by the remote computer.*



**Figure 18.3** *Concept of NVT*



## 18.3 NVT CHARACTER SET

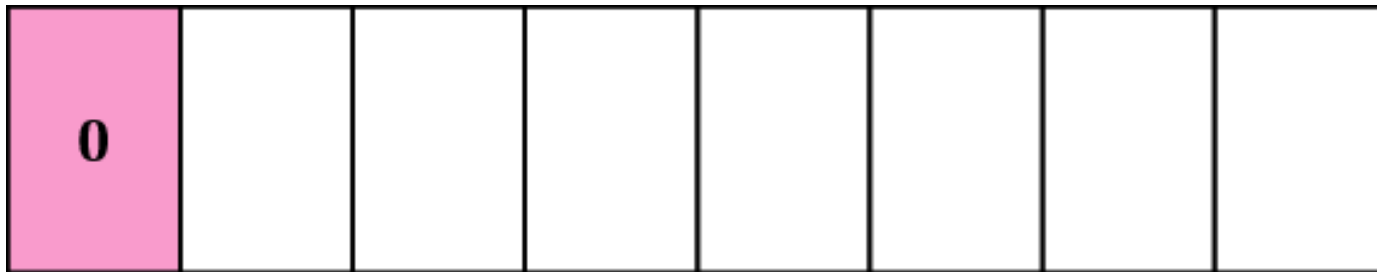
*NVT uses two sets of characters, one for data and one for control. Both are 8-bit bytes.*

*The topics discussed in this section include:*

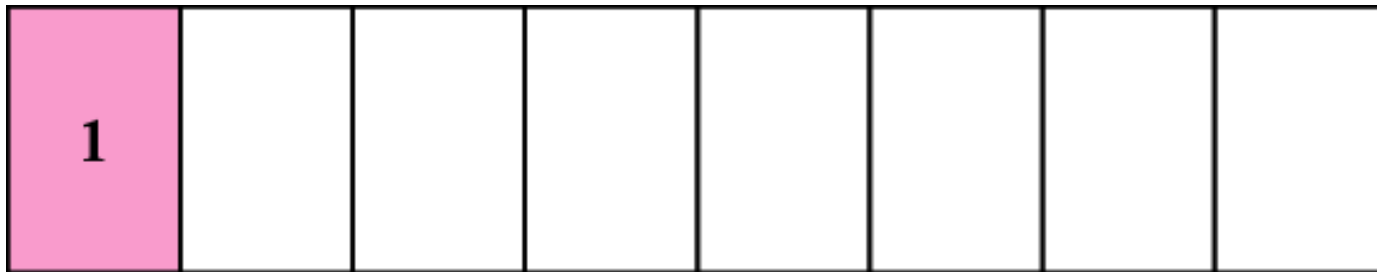
*Data Characters*

*Control Characters*

**Figure 18.4** *Format of data characters*



**Figure 18.5** *Format of control characters*



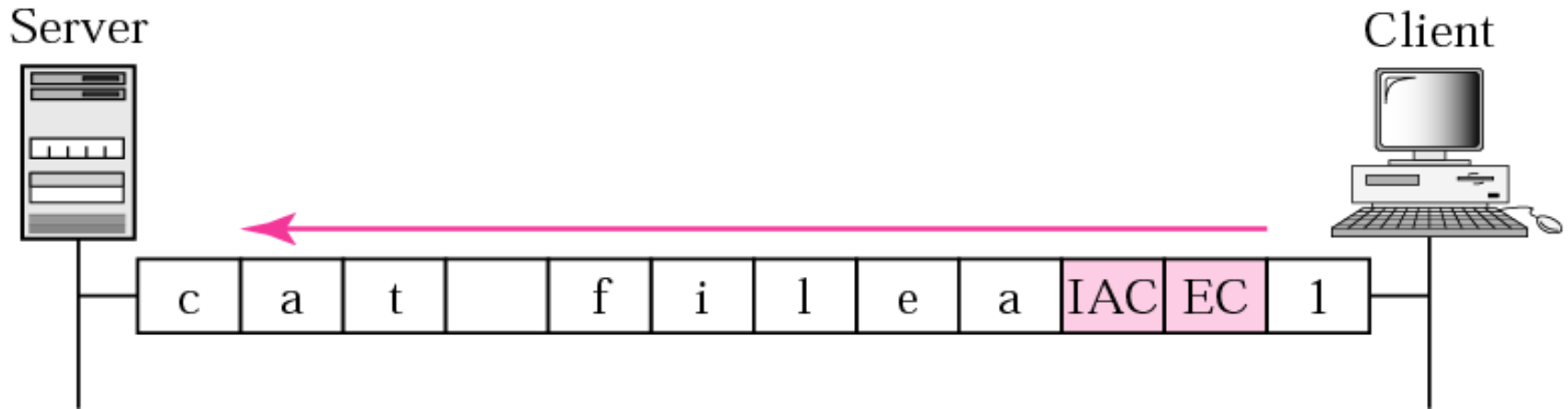
***Table 18.1 Some NVT control characters***

<i>Character</i>	<i>Decimal</i>	<i>Binary</i>	<i>Meaning</i>
EOF	236	11101100	End of file
EOR	239	11101111	End of record
SE	240	11110000	Suboption end
NOP	241	11110001	No operation
DM	242	11110010	Data mark
BRK	243	11110011	Break
IP	244	11110100	Interrupt process
AO	245	11110101	Abort output
AYT	246	11110110	Are you there?
EC	247	11110111	Erase character
EL	248	11111000	Erase line
GA	249	11111001	Go ahead
SB	250	11111010	Suboption begin
WILL	251	11111011	Agreement to enable option
WONT	252	11111100	Refusal to enable option
DO	253	11111101	Approval to option request
DONT	254	11111110	Denial of option request
IAC	255	11111111	Interpret (the next character) as control

## 18.4 EMBEDDING

*The same connection is used by TELNET for sending both data and control characters. TELNET accomplishes this by embedding the control characters in the data stream.*

**Figure 18.6** *An example of embedding*



## 18.5 OPTIONS

*TELNET lets the client and server negotiate options before or during the use of the service. Options are extra features available to a user with a more sophisticated terminal.*



***Table 18.2 Options***

<i>Code</i>	<i>Option</i>	<i>Meaning</i>
0	Binary	Interpret as 8-bit binary transmission
1	Echo	Echo the data received on one side to the other
3	Suppress go ahead	Suppress go-ahead signals after data
5	Status	Request the status of TELNET
6	Timing mark	Define the timing marks
24	Terminal type	Set the terminal type
32	Terminal speed	Set the terminal speed
34	Line mode	Change to line mode

## 18.6 OPTION NEGOTIATION

*To use any of the options first requires option negotiation between the client and the server. Four control characters are used for this purpose.*

*The topics discussed in this section include:*

*Enabling an Option*

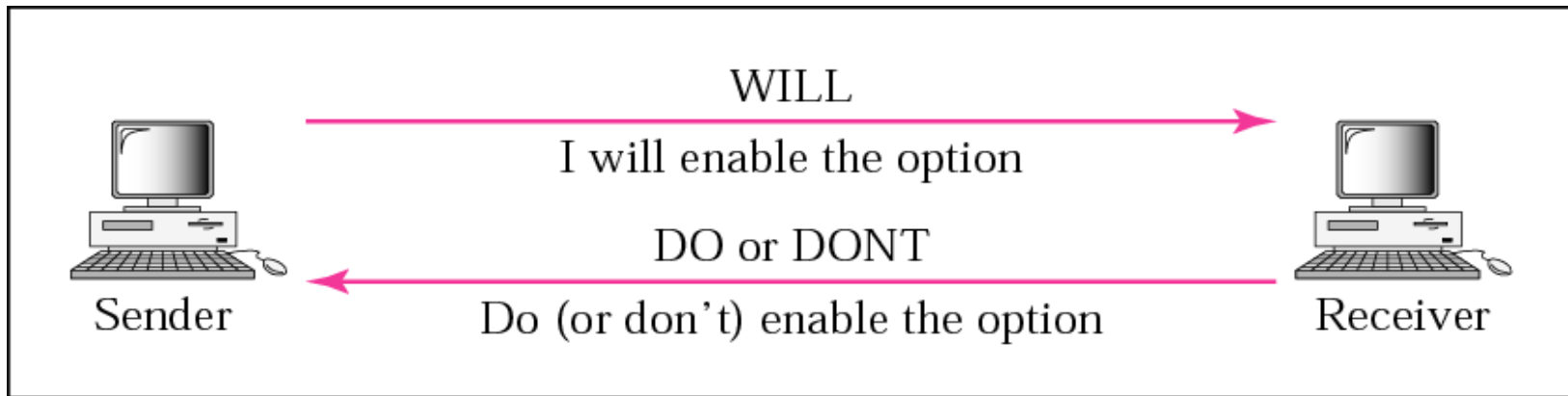
*Disabling an Option*

*Symmetry*

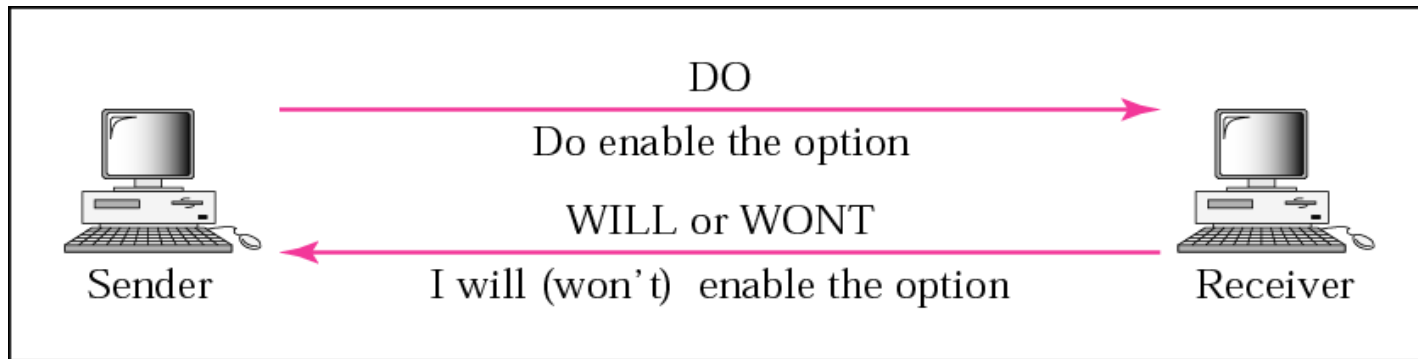
***Table 18.3 NVT character set for option negotiation***

<i>Character</i>	<i>Decimal</i>	<i>Binary</i>	<i>Meaning</i>
WILL	251	11111011	<ol style="list-style-type: none"><li>1. Offering to enable</li><li>2. Accepting a request to enable</li></ol>
WONT	252	11111100	<ol style="list-style-type: none"><li>1. Rejecting a request to enable</li><li>2. Offering to disable</li><li>3. Accepting a request to disable</li></ol>
DO	253	11111101	<ol style="list-style-type: none"><li>1. Approving an offer to enable</li><li>2. Requesting to enable</li></ol>
DONT	254	11111110	<ol style="list-style-type: none"><li>1. Disapproving an offer to enable</li><li>2. Approving an offer to disable</li><li>3. Requesting to disable</li></ol>

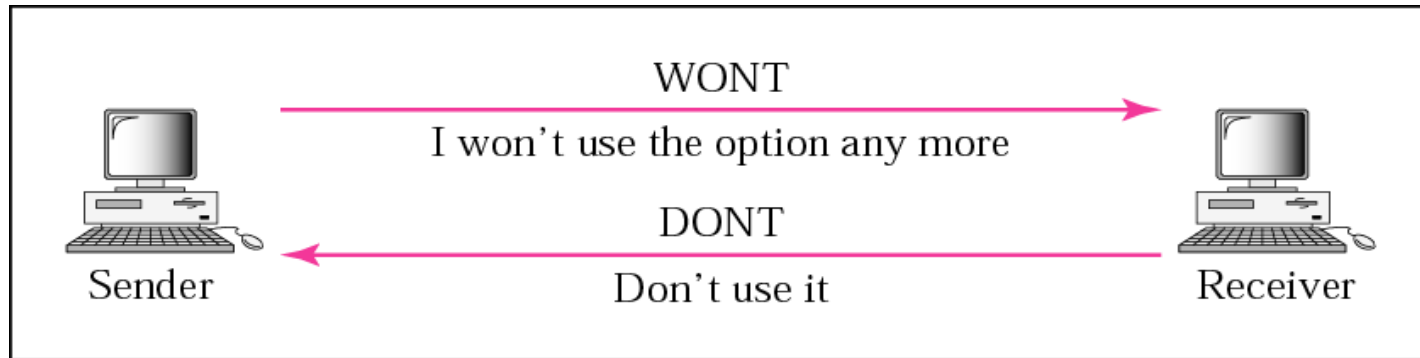
**Figure 18.7** *Offer to enable an option*



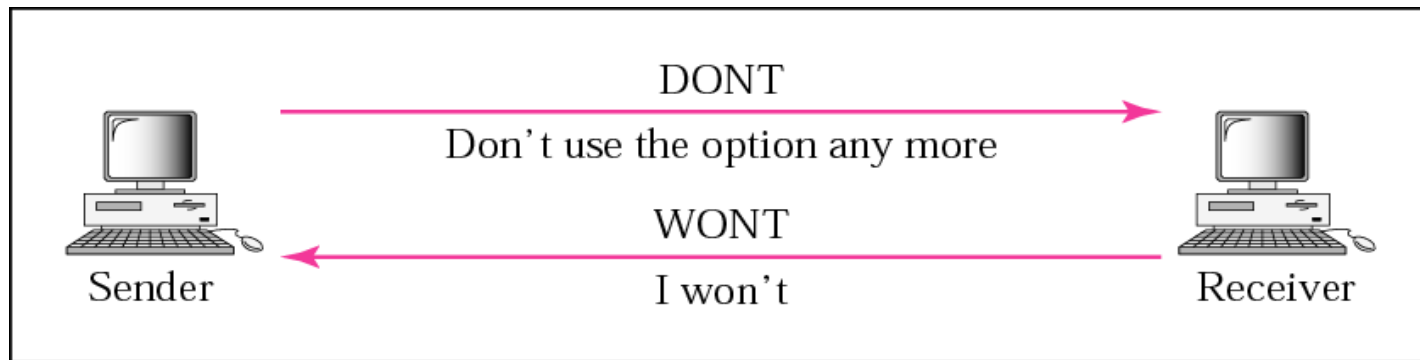
**Figure 18.8** *Request to enable an option*



**Figure 18.9** *Offer to disable an option*



**Figure 18.10** *Request to disable an option*





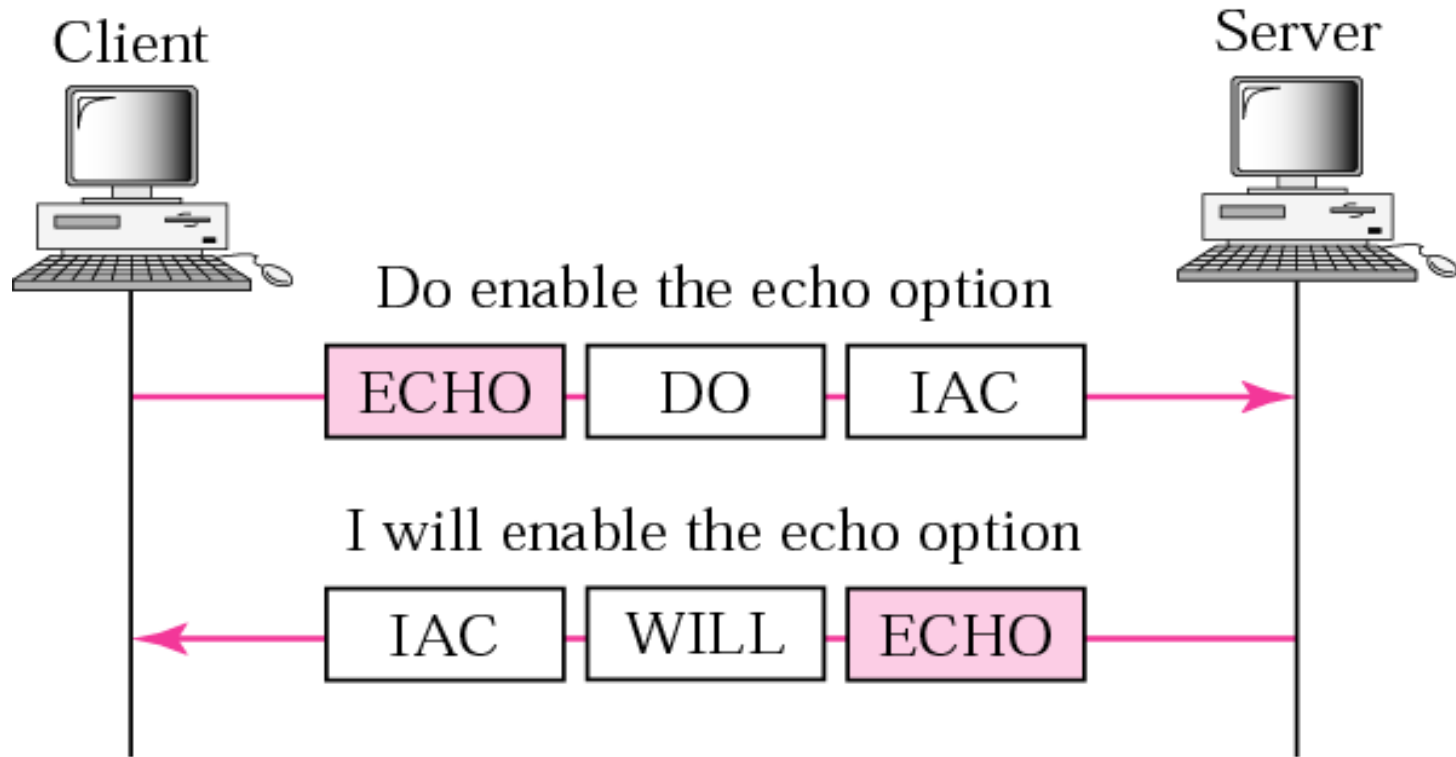
## Example 1

*Figure 18.11 shows an example of option negotiation. In this example, the client wants the server to echo each character sent to the server. In other words, when a character is typed at the user keyboard terminal, it goes to the server and is sent back to the screen of the user before being processed. The echo option is enabled by the server because it is the server that sends the characters back to the user terminal. Therefore, the client should request from the server the enabling of the option using DO. The request consists of three characters: IAC, DO, and ECHO. The server accepts the request and enables the option. It informs the client by sending the three character approval: IAC, WILL, and ECHO.*

**See Next Slide**



**Figure 18.11** *Example 1: Echo option*



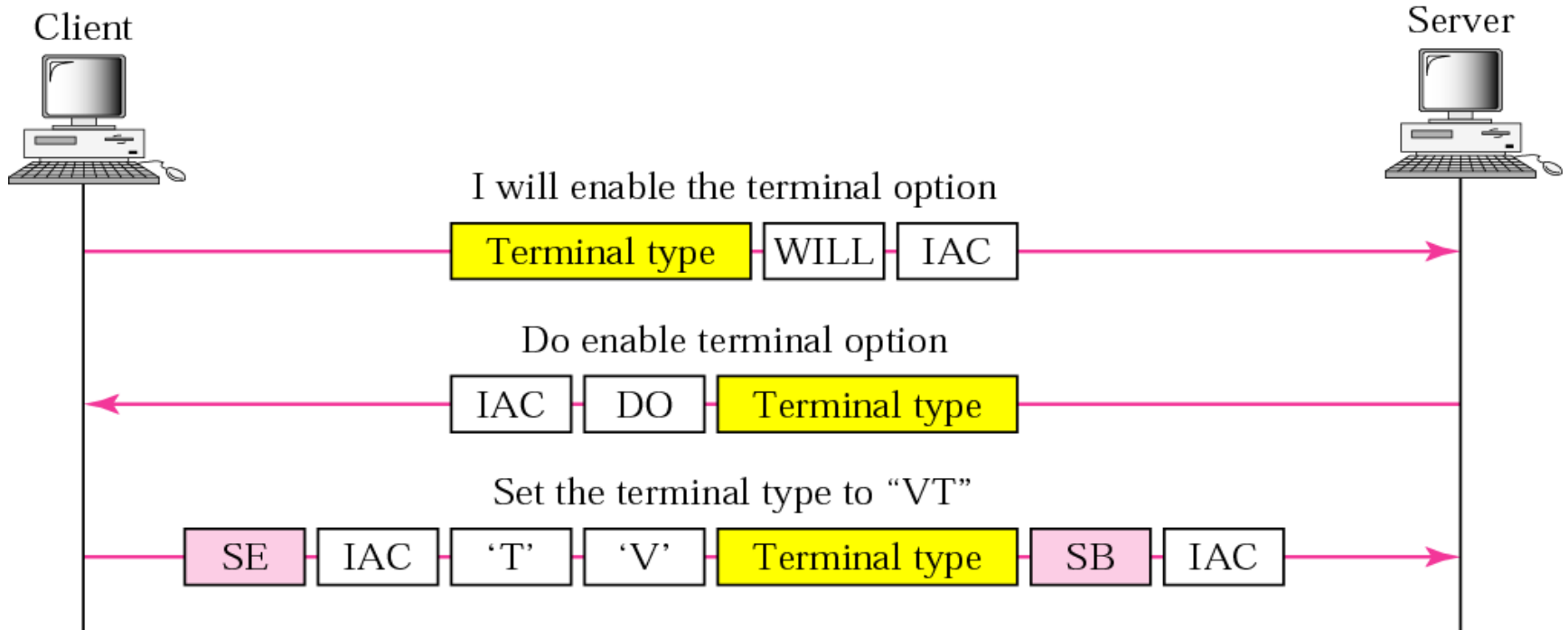
## 18.7 SUBOPTION NEGOTIATION

*Some options require additional information. The client and server agree through a process called suboption negotiation.*

***Table 18.4 NVT character set for suboption negotiation***

<i>Character</i>	<i>Decimal</i>	<i>Binary</i>	<i>Meaning</i>
SE	240	11110000	Suboption end
SB	250	11111010	Suboption begin

**Figure 18.12** *Example of suboption negotiation*



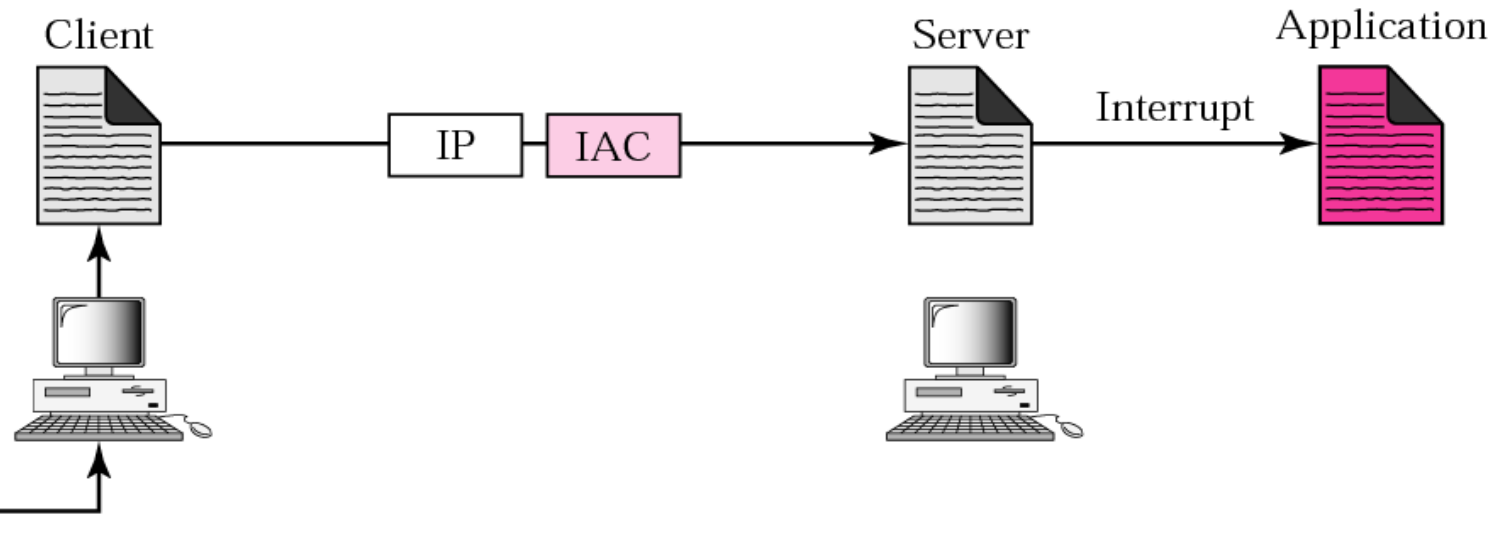
## 18.8 CONTROLLING THE SERVER

*Control characters can be used to control the remote server.*

***Table 18.5 Characters used to control the application program running on remote server***

<i>Character</i>	<i>Decimal</i>	<i>Binary</i>	<i>Meaning</i>
IP	244	11110100	Interrupt process
AO	245	11110101	Abort output
AYT	246	11110110	Are you there?
EC	247	11110111	Erase the last character
EL	248	11111000	Erase line

**Figure 18.13** *Example of interrupting an application program*

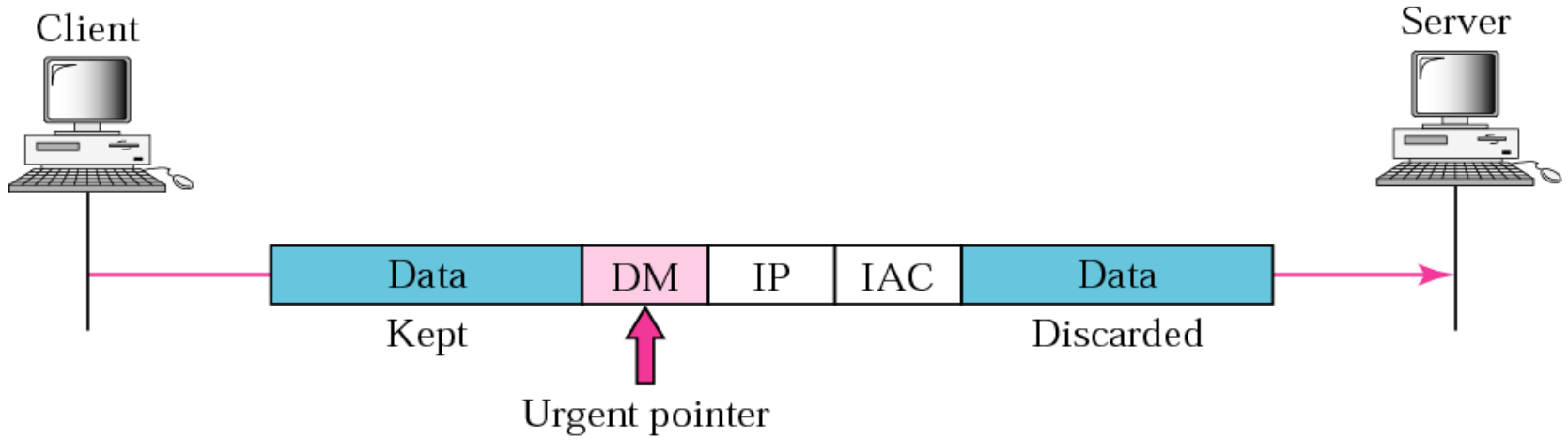


## 18.9 OUT-OF-BAND SIGNALING

*To make control characters effective in special situations, TELNET uses out-of-band signaling, a technique in which the control characters are preceded by IAC and are sent out of order to the remote process.*



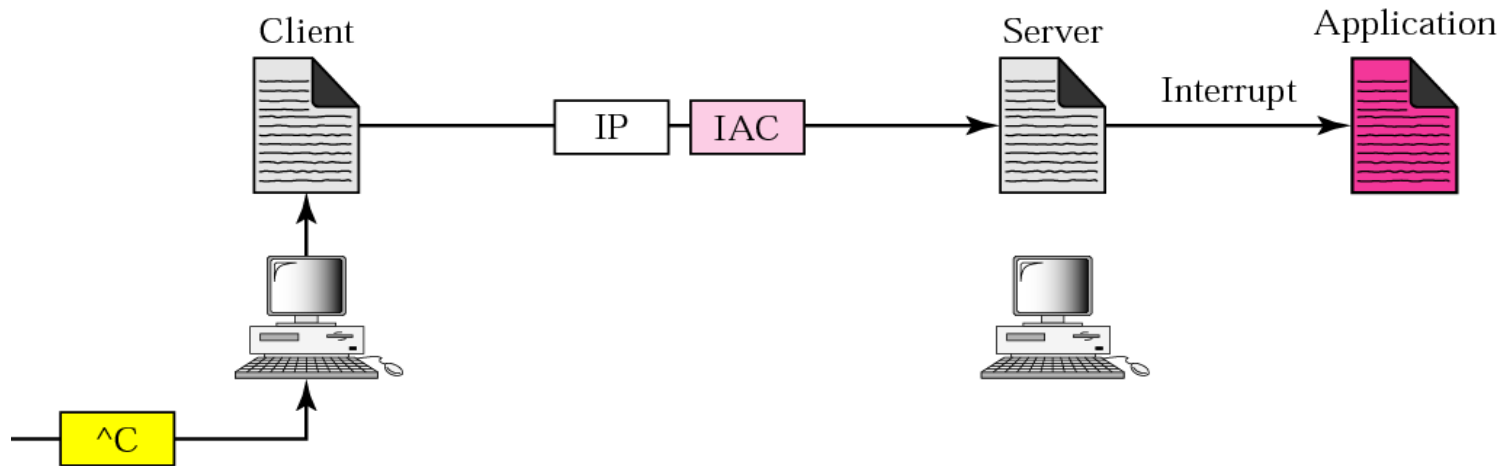
**Figure 18.14** *Out-of-band signaling*



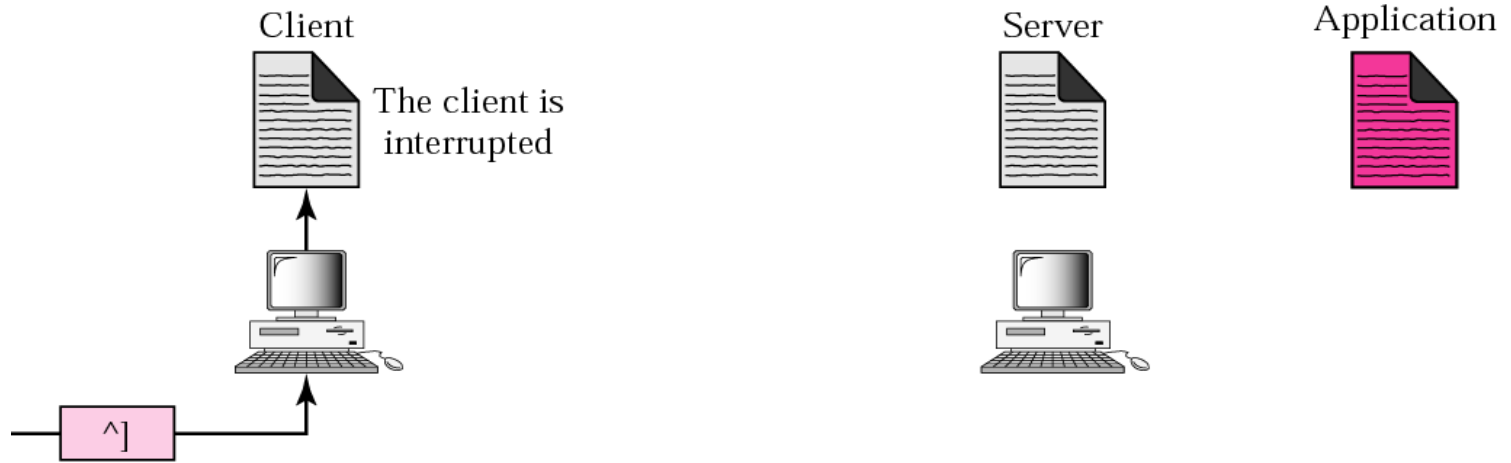
## 18.10 ESCAPE CHARACTER

*When a user wants characters interpreted by the client instead of the server, he can use an escape character, normally Ctrl+] (shown as ^]).*

**Figure 18.15** *Two different interruptions*



a. Interrupting the application program



b. Interrupting the client

# 18.11 MODE OF OPERATION

*Most TELNET implementations operate in one of three modes: default mode, character mode, or line mode.*

*The topics discussed in this section include:*

*Default Mode*

*Character Mode*

*Line Mode*

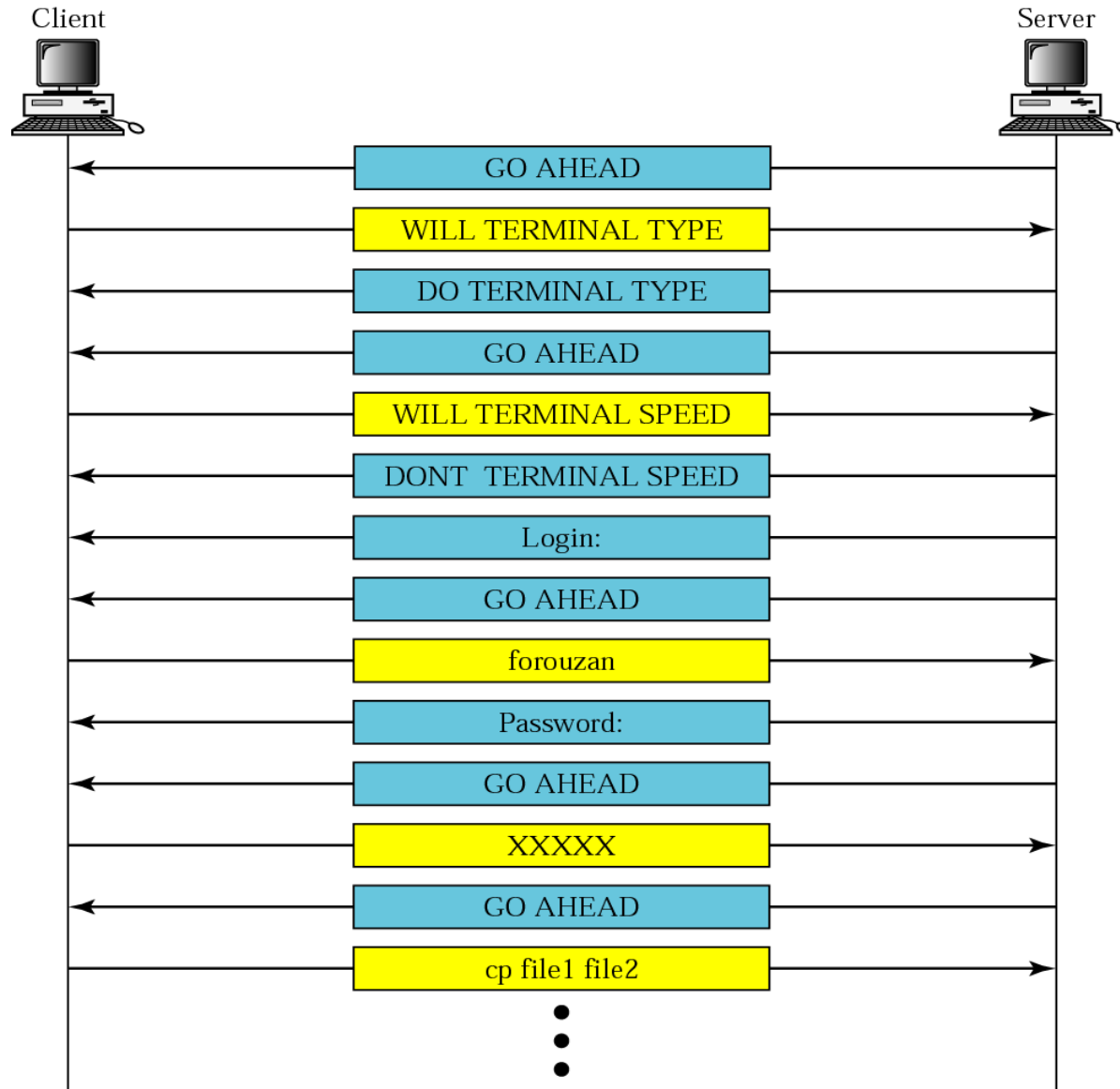


## Example 2

*In this example, we use the default mode to show the concept and its deficiencies even though it is almost obsolete today. The client and the server negotiate the terminal type and terminal speed and then the server checks the login and password of the user (see Figure 18.16).*

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Figure 18.16 Example 2



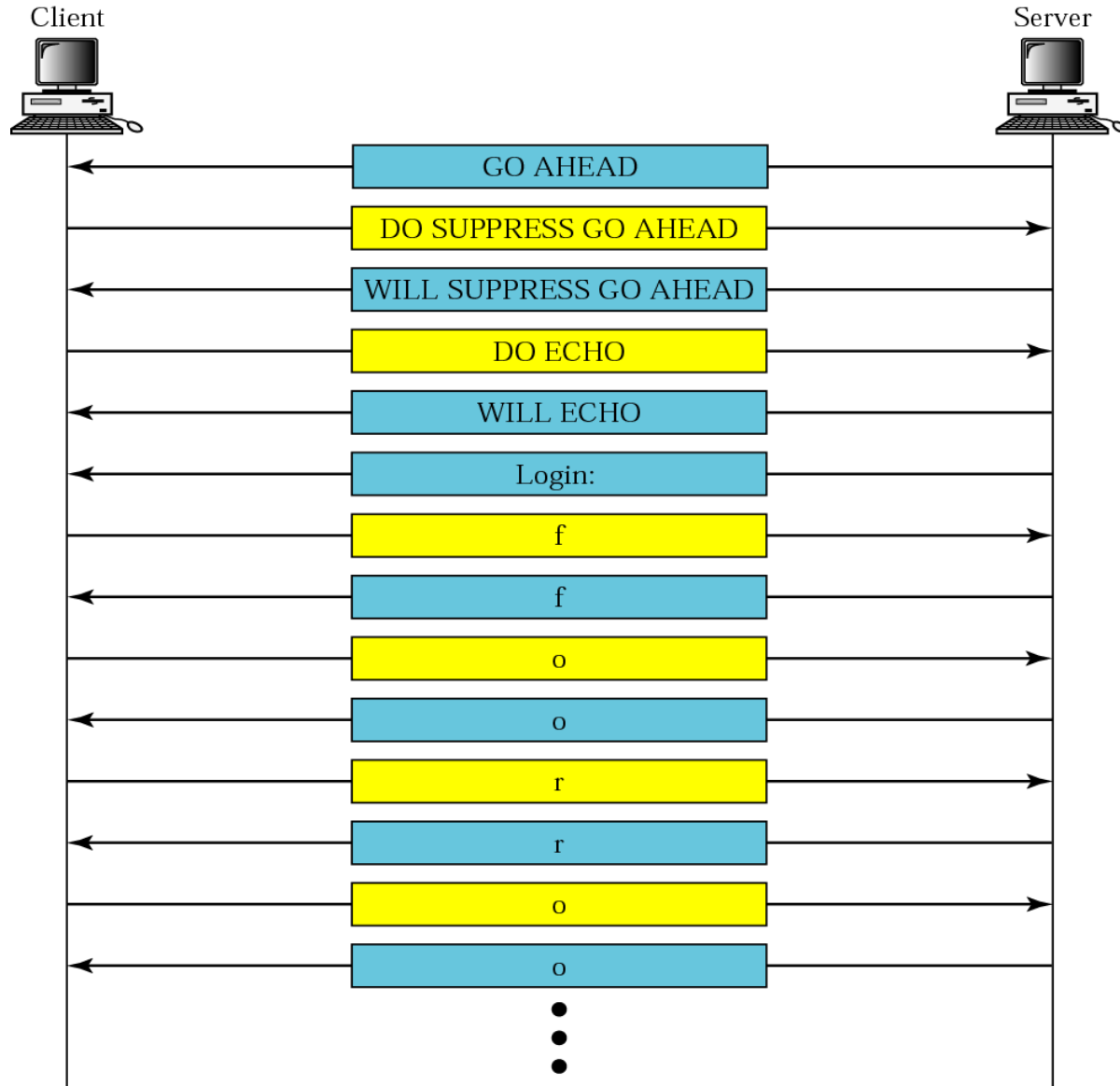


## **Example 3**

*In this example, we show how the client switches to the character mode. This requires that the client request the server to enable the **SUPPRESS GO AHEAD** and **ECHO** options (see **Figure 18.17**).*

**See Next Slide**

Figure 18.17 Example 3





## 18.12 USER INTERFACE

*The operating system (UNIX, for example) defines an interface to TELNET with user-friendly commands. The interface is responsible for translating the user-friendly commands to the TELNET commands.*

***Table 18.6 Examples of interface commands***

<i>Command</i>	<i>Meaning</i>
open	Connect to a remote computer
close	Close the connection
display	Show the operating parameters
mode	Change to line mode or character mode
set	Set the operating parameters
status	Display the status information
send	Send special characters
quit	Exit TELNET

## 18.13 SECURITY ISSUE

*TELNET suffers from security problems. TELNET requires a login name and password (when exchanging text). A microcomputer connected to a broadcast LAN can easily eavesdrop using snooper software to capture a login name and the corresponding password (even if it is encrypted).*