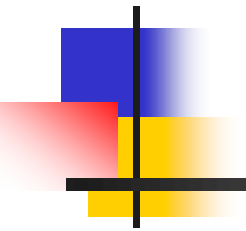
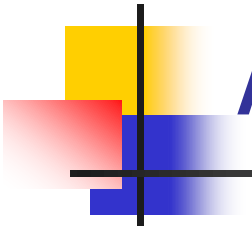


TELNET Basics

BUPT/QMUL

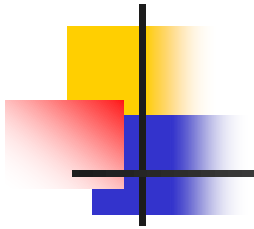
2019-04-15

Refer to Chapter 24, Textbook



Agenda

- A brief introduction to TELNET
- Concept of remote/virtual terminal
- TELNET operations
- TELNET protocol
- TELNET options negotiation
- Other remote access technologies



A Brief Introduction to TELNET

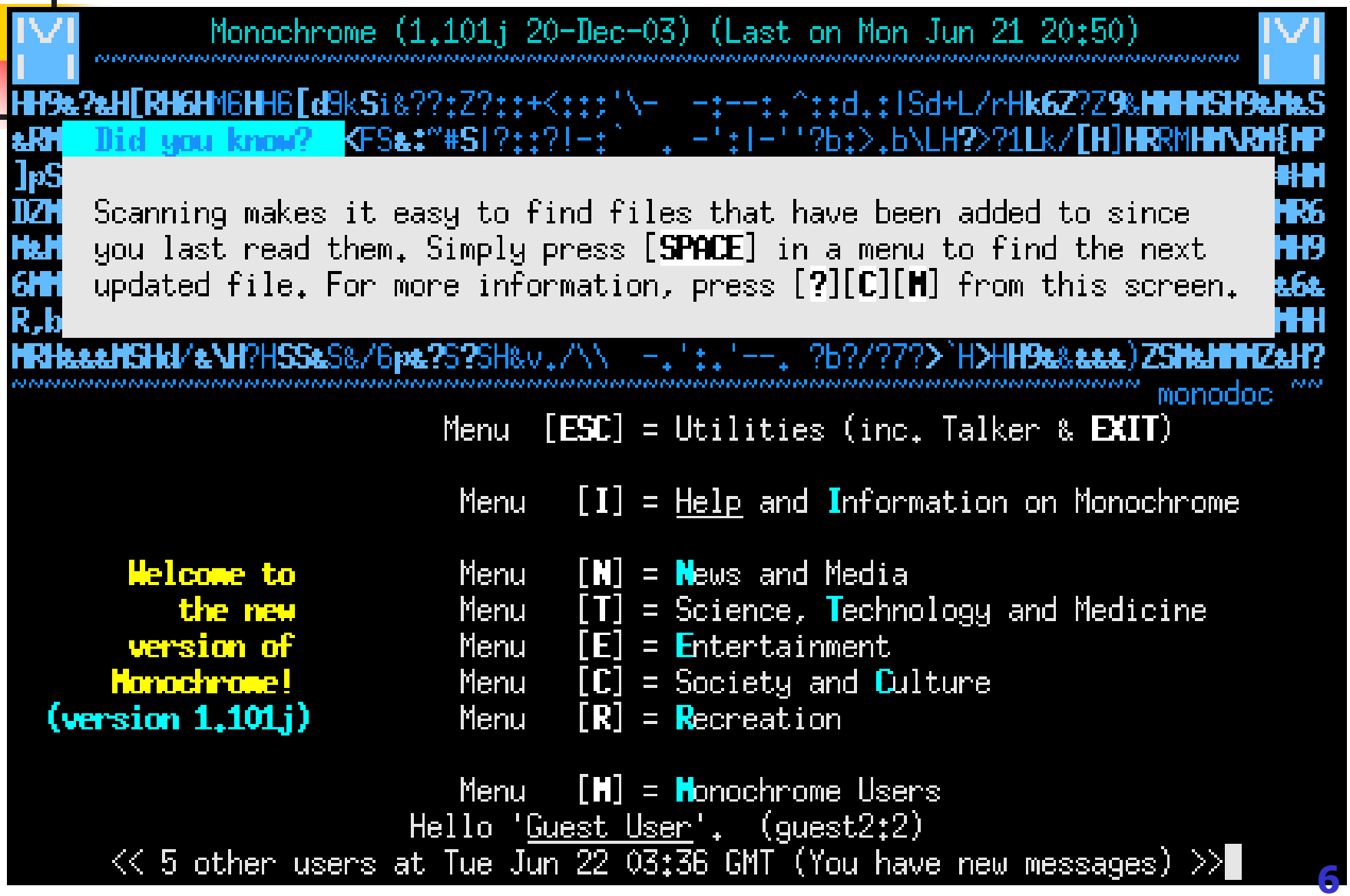
Brief Introduction To TELNET

- Use of TELNET: BBS
- What is TELNET?
- History

BBS: Bulletin Board System

- A computer system running software that allows users to connect and log in to the system using a terminal program.
- Once logged in, a user can perform functions such as
  - uploading and downloading software and data;
  - reading news and bulletins;
  - and exchanging messages with other users, either through Email or in public message boards.

Traditional BBS example:



Example of BBS Today(1)

用户名 密码 mForum 不保存 登录 游客 注册 联盟 eID登录

北邮人论坛

当前总共7719人在线：注册用户4883人，访客2836人
powered by BYR-Team©2009-2019.
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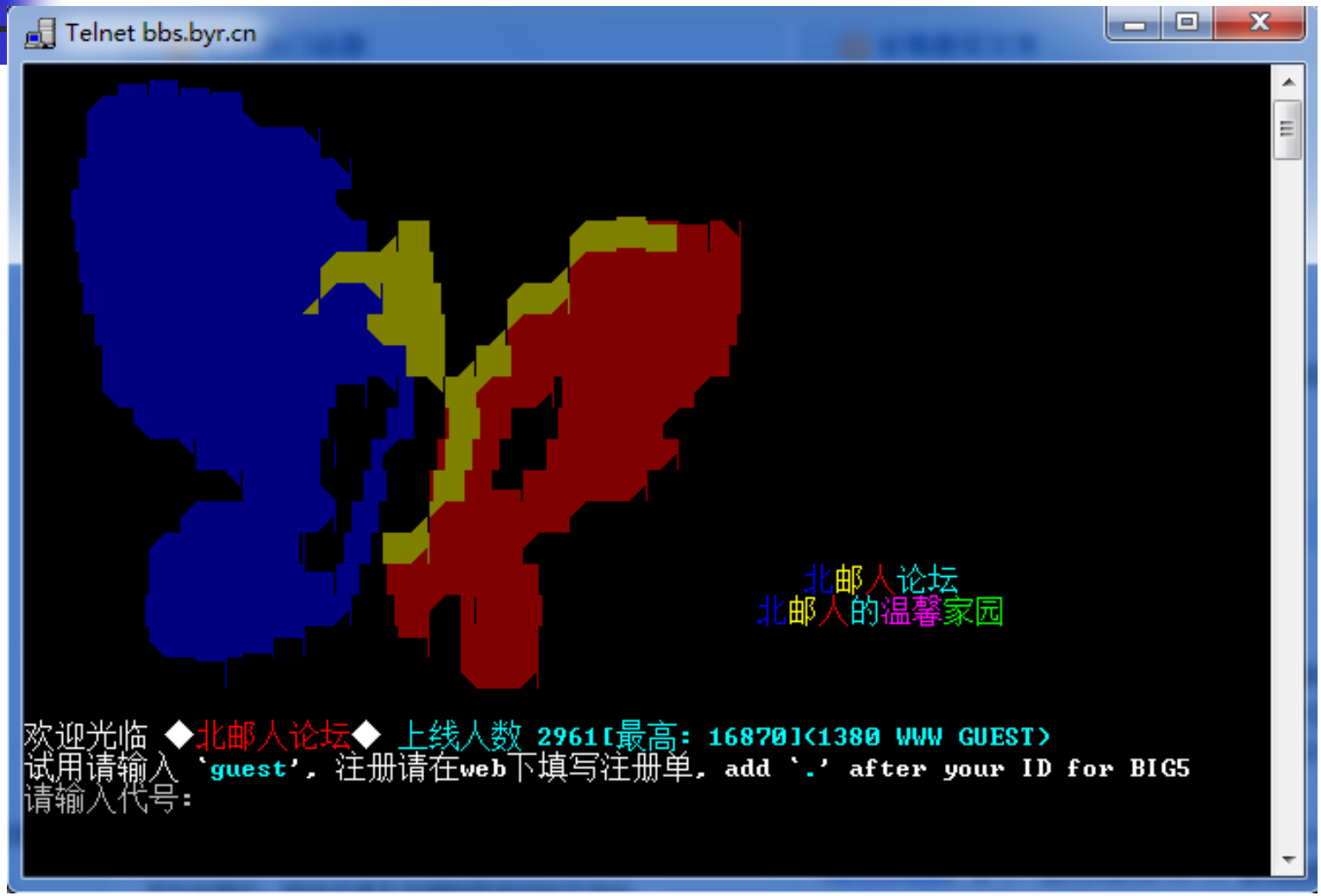
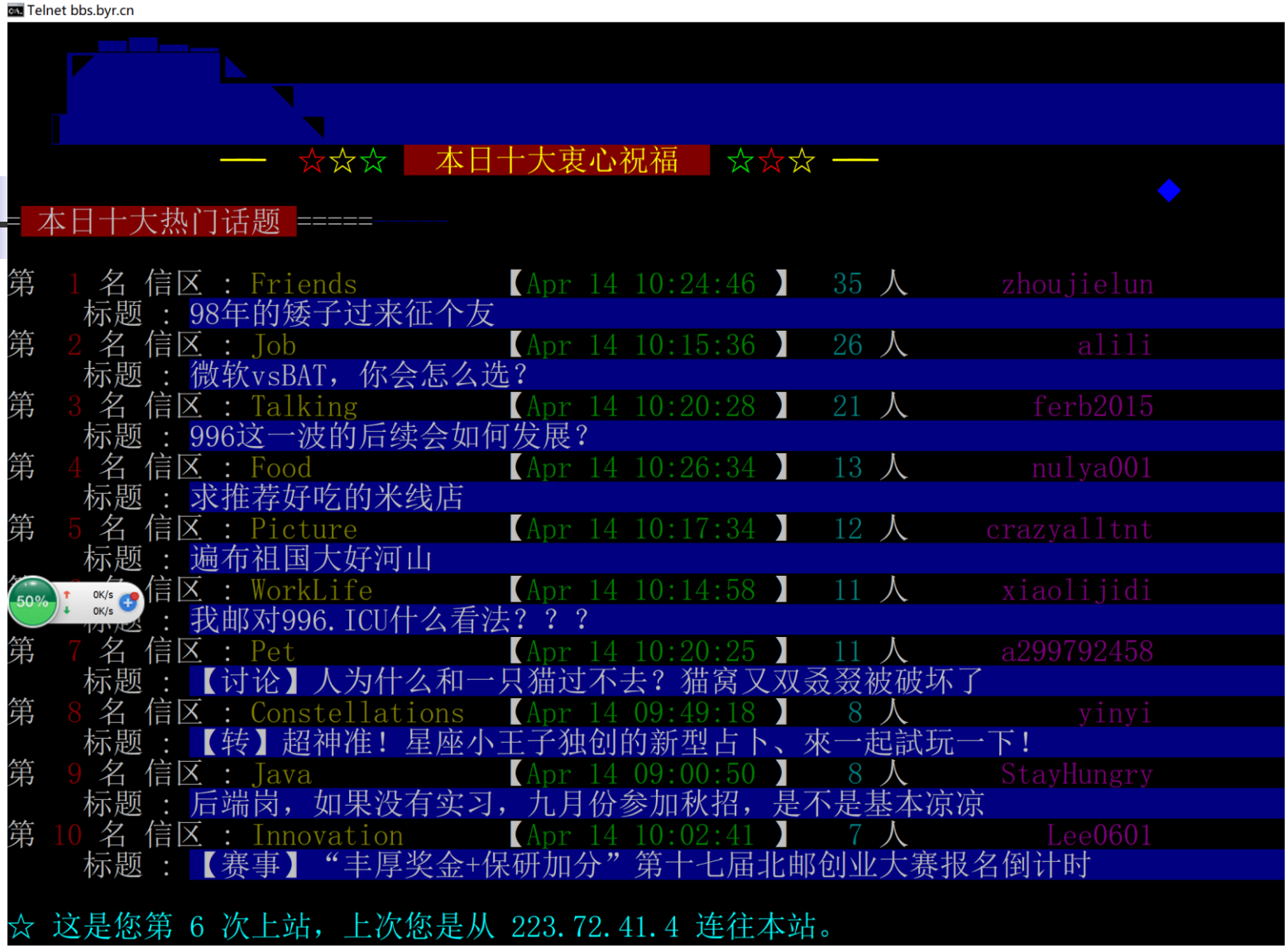
Example of BBS Today(2)

telnet BBS of BYR

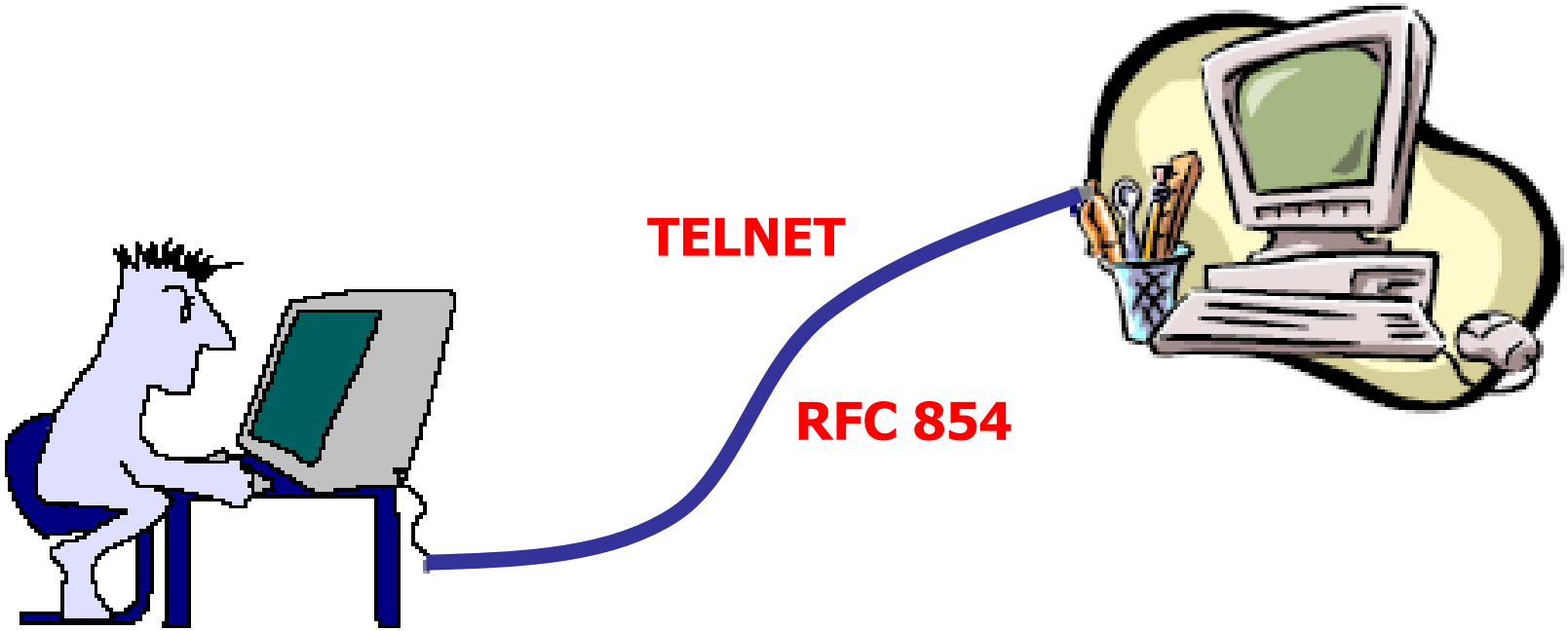




You can also type in: *telnet bbs.byr.cn*

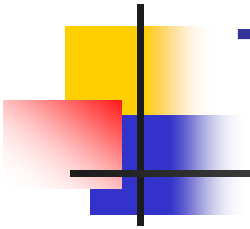
What Is TELNET? (1)

- A protocol used to establish a dumb terminal session to another computer on the Internet
- An important Internet application for remote access



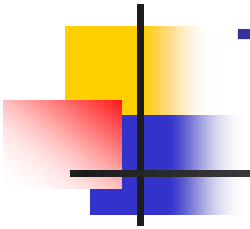
What Is TELNET? (2)

- Definition in RFC854
  - The purpose of the TELNET Protocol is to provide a general, bi-directional, byte oriented communications facility.
  - Its primary goal is to allow a standard method of interfacing terminal devices and terminal-oriented processes to each other.
  - It is envisioned that the protocol may also be used for terminal-terminal communication ("linking") and process-process communication (distributed computation).



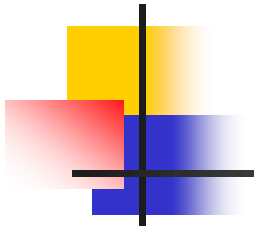
TELNET vs. telnet

- TELNET is a *protocol* that provides “a general, bi-directional, eight-bit byte oriented communications facility”
- telnet is a *program* that supports the TELNET protocol over TCP
- Many application protocols are built upon the TELNET protocol



The History Of Telnet

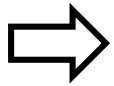
- Telnet is simple
  - Total pages of RFC 854 is 15
  - HTTP (we will see later) is 176 pages
- The idea of option negotiation was a very good design feature
  - Enables telnet to evolve to meet new demands without endless new versions of basic protocol
- Currently over 100 RFCs on telnet and its options



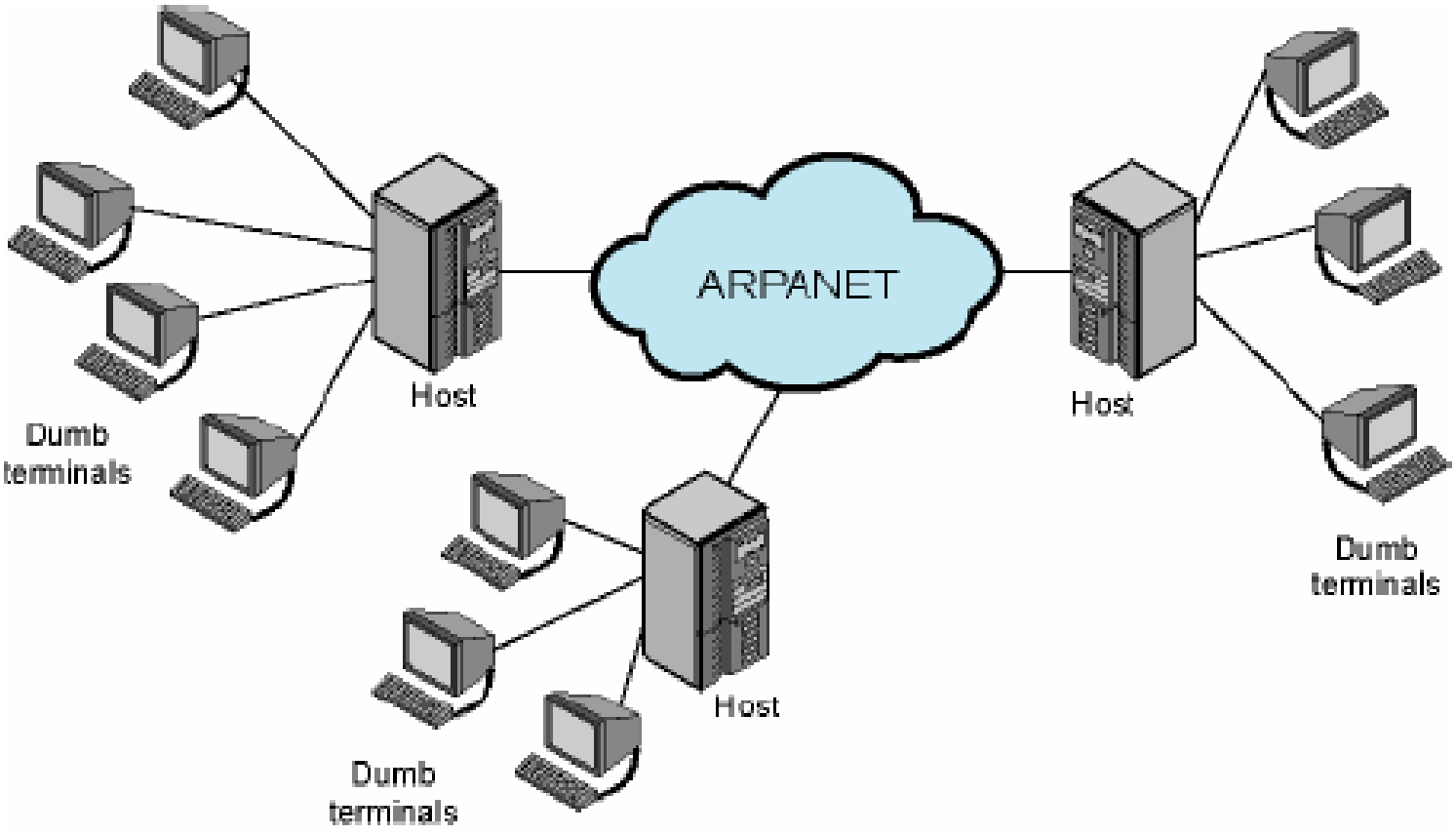
Concept Of Remote / Virtual Terminal

Remote Terminal Access

- Early motivation for networks was remote access to interactive systems
- Dumb terminals (see figure on the next slide)
  - Keyboard and screen with primitive communication hardware
  - Local host computer establish connection to remote host
- The challenge is that terminals and host systems were not standardized
  - local terminal was not speaking the same language as the remote host

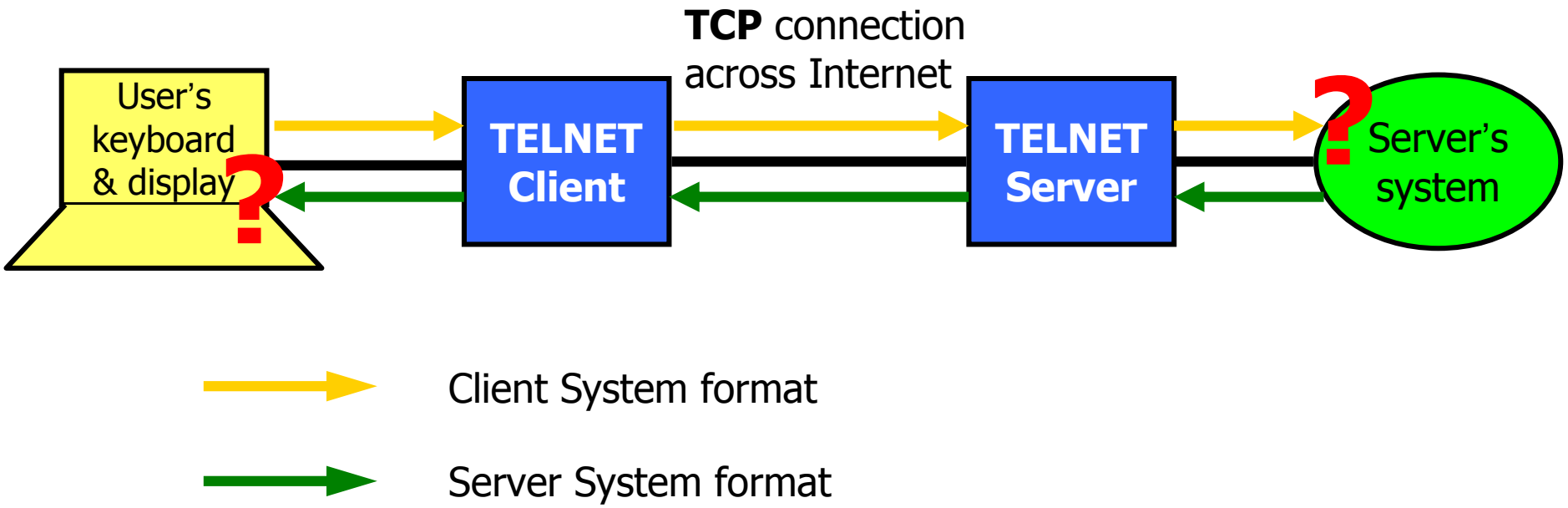


Telnet Operation Environment On Early Internet



Problem

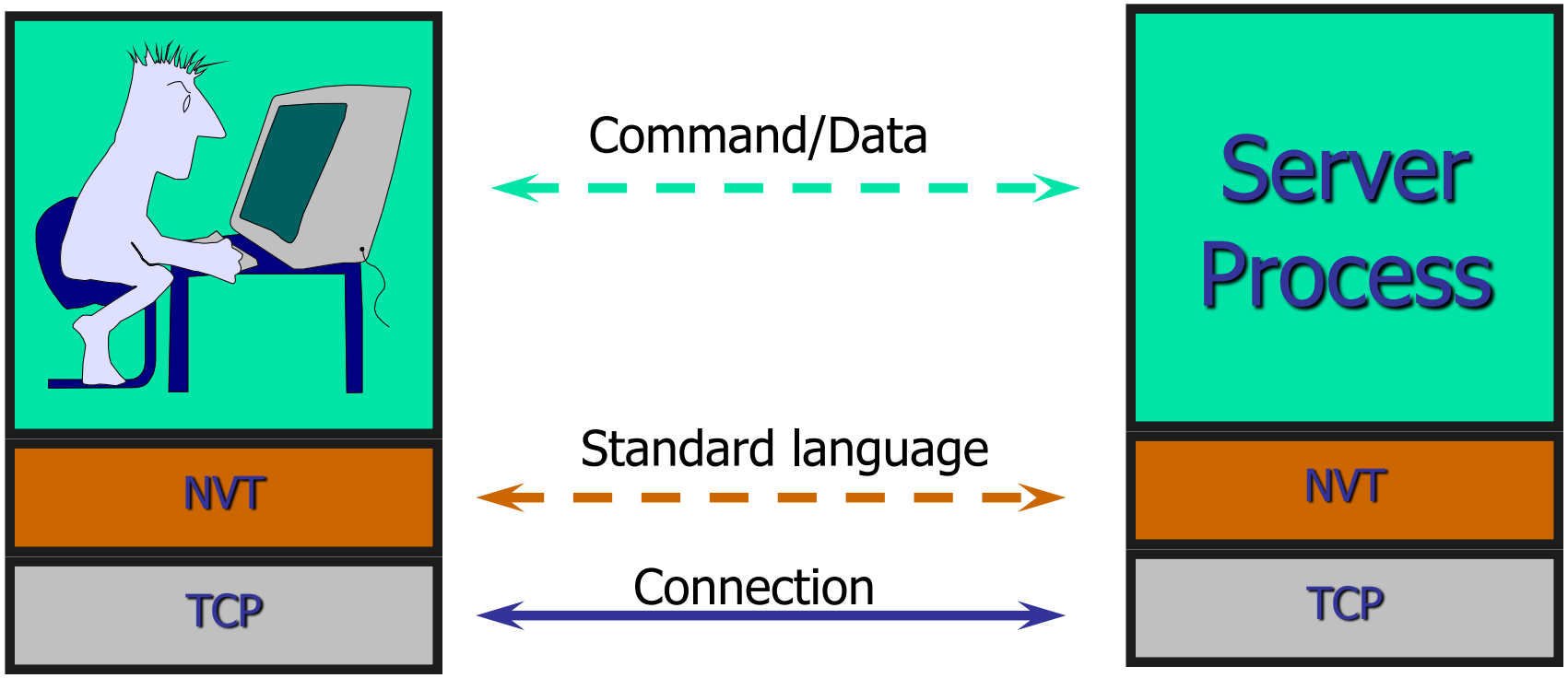
- Lack of common language between the terminal and the remote host



Network Virtual Terminal

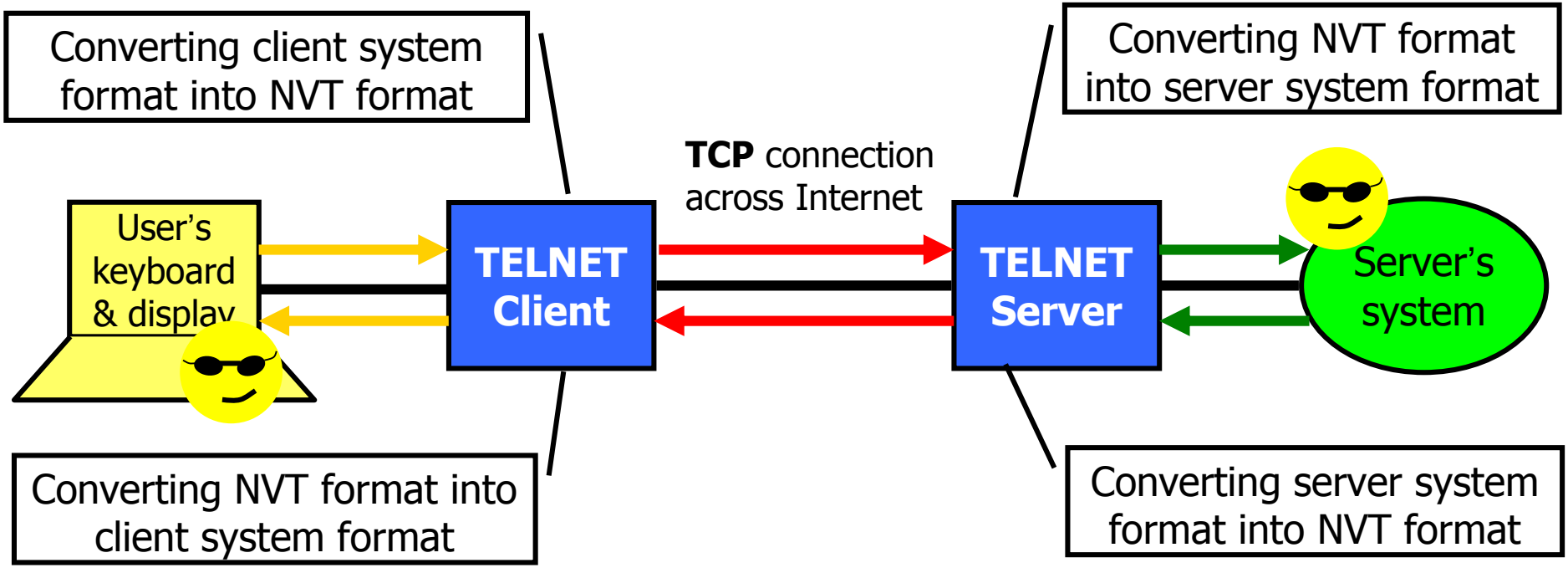
- Transform local characteristics into standardized form
  - Network virtual terminal (NVT)
- Imaginary device
  - Well defined set of characteristics
- Both sides generate data and control signals in native language but translates them to NVT form
  - The sending side translates native data and control signals into NVT form before sending out
  - The receiving side gets the NVT data and signals and translates into its native form

Network Virtual Terminal

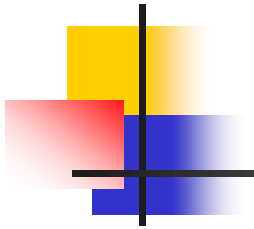


NVT Operation

- Accommodating heterogeneity



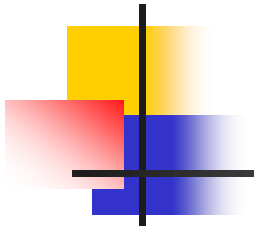
TELNET client and server convert between native format and NVT format



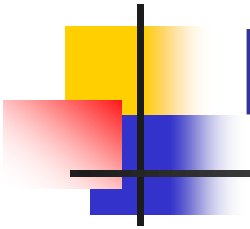
TELNET Operations

TELNET Operations

- Connection management
  - Connection request, establish and terminate
  - Telnet uses TCP (port 23) by default
- Negotiation
  - To determine mutually agreeable set of characteristics and options
- Exchange of control information (e.g. end of line), commands and transfer of data between two correspondents
- A typical telnet session is to exchange of data between terminal and host
  - Multiple rounds
  - Not only for accessing remote accounts; was also used for interactive system
    - Try “telnet bbs.byr.cn”

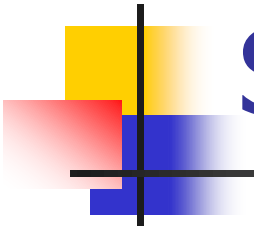


TELNET Protocol



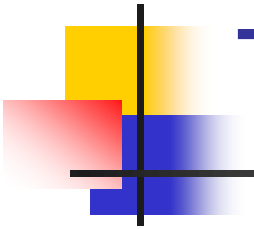
Related RFCs

- Basic protocol
  - RFC854: Telnet Protocol Specification
- Options
  - RFC855: Telnet Option Specifications
  - RFC856: Telnet Binary Transmission
  - RFC857: Telnet Echo Option
  - RFC858: Telnet Suppress Go Ahead Option
  - RFC859: Telnet Status Option
  - …



Some Features

- TCP connection: directed toward port 23 of the server being asked to perform a service
- Data and control multiplexed over the same connection
- NVT - representation of a generic terminal
- Negotiated options - Enabling Telnet to evolve to meet new demands without endless new versions of basic protocol
- A symmetric view of terminals and processes

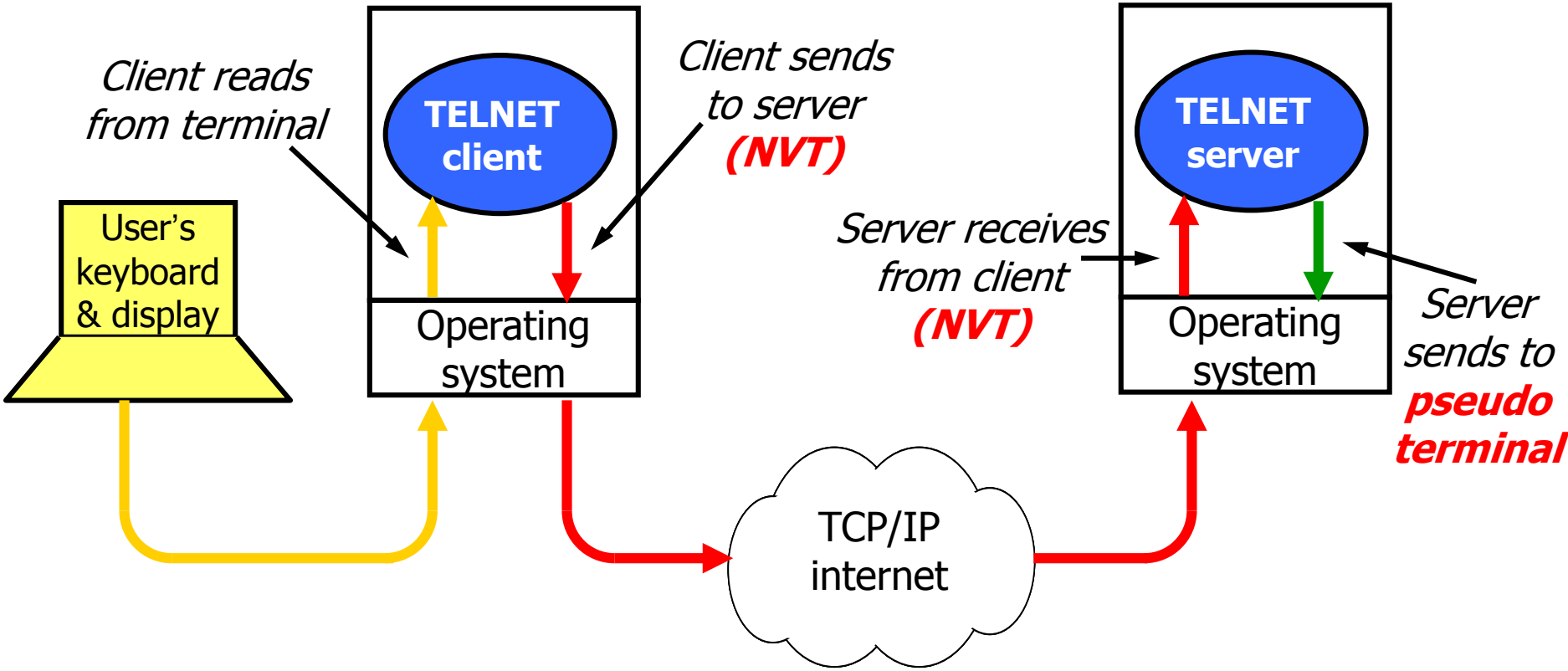


TELNET Protocol

- Transmission of data
- Standard representation of control functions

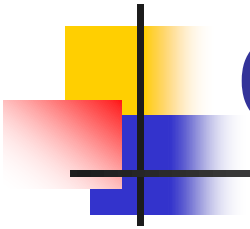
Transmission Of Data (1)

- Data path from the user's keyboard to the remote system



Transmission Of Data (2)

- Underlying TCP full duplex
  - The underlying network is intrinsically full duplex
- Data sent half duplex
  - The communication between terminal and process is one direction at a time.
- Data sent as stream of 8-bit bytes
  - No other formatting
- Control signals and other non-data information sent as Telnet commands
  - Byte strings embedded in data stream
  - User control signals, commands between Telnet processes as part of protocol and option negotiation and subnegotiation



Control Functions (1)

- TELNET includes support for a series of control functions commonly supported by servers
- This provides a uniform mechanism for communication of (the supported) control functions
- You can imagine them as some extra virtual keys in the NVT keyboard

Control Functions (2)

- Interrupt Process (IP)
  - suspend/interrupt/abort/terminate process
- Abort Output (AO)
  - allow a process, which is generating output, to run to completion but without sending the output to the user's terminal
- Are You There (AYT)
  - check to see if system is still running
- Erase Character (EC)
  - delete last character sent
  - typically used to edit keyboard input
- Erase Line (EL)
  - delete all input in current line
  - typically used to edit keyboard input

Control Functions (3) – delivery

Command	Decimal Codes	Description
IAC	255	Interpret next octet as command
DONT	254	Denial of request to perform specific option
DO	253	Approval to allow specific option
WONT	252	Refusal to perform specific option
WILL	251	Agreement to perform specific option
SB	250	Start of option subnegotiation
GA	249	Go ahead
EL	248	Erase line
EC	247	Erase character
AYT	246	Are you there
AO	245	Abort output
IP	244	Interrupt process
BRK	243	Break
DMARK	242	Data mark
NOP	241	No operation
SE	240	End of subnegotiation
EOR	239	End of record

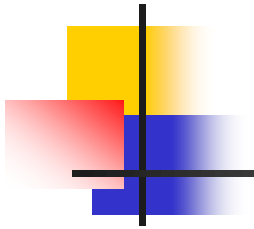
Control Functions (4) – IAC

- TELNET command structure
  - at least a two byte sequence: the IAC (Interpret as Command) escape character followed by the code for the command
- The IAC code is 255
  - If a 255 is sent as data - it must be followed by another 255
- Looking for a command
  - Each receiver must look at each byte that arrives and look for an IAC
  - If IAC is found and the next byte is “IAC” - a single data byte (value 255) is presented to the application/ terminal
  - If IAC is followed by any other code - the TELNET layer interprets this as a command

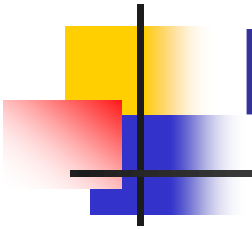
Control Functions (5) – DO, DONT, WILL, WONT

- Used for options negotiation
- Examples

Sender	Receiver	Meaning
WILL →	← DO	Sender wants to active a option, and receiver agrees
WILL →	← DON'T	Sender wants to active a option, and receiver refuses
DO →	← WILL	Sender wants receiver to active a option, and receiver agrees
DO →	← WONT	Sender wants receiver to active a option, and receiver refuses

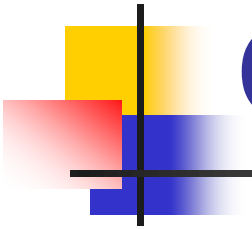


TELNET Options Negotiation



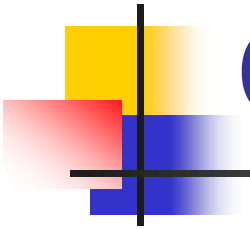
Motivations

- All NVTs support a minimal set of capabilities
- Some terminals have more capabilities than the minimal set
- The two endpoints negotiate a set of mutually acceptable options (character set, echo mode, etc.)
- The set of options is not part of the TELNET protocol, so that new terminal features can be incorporated without changing the TELNET protocol



Option Examples

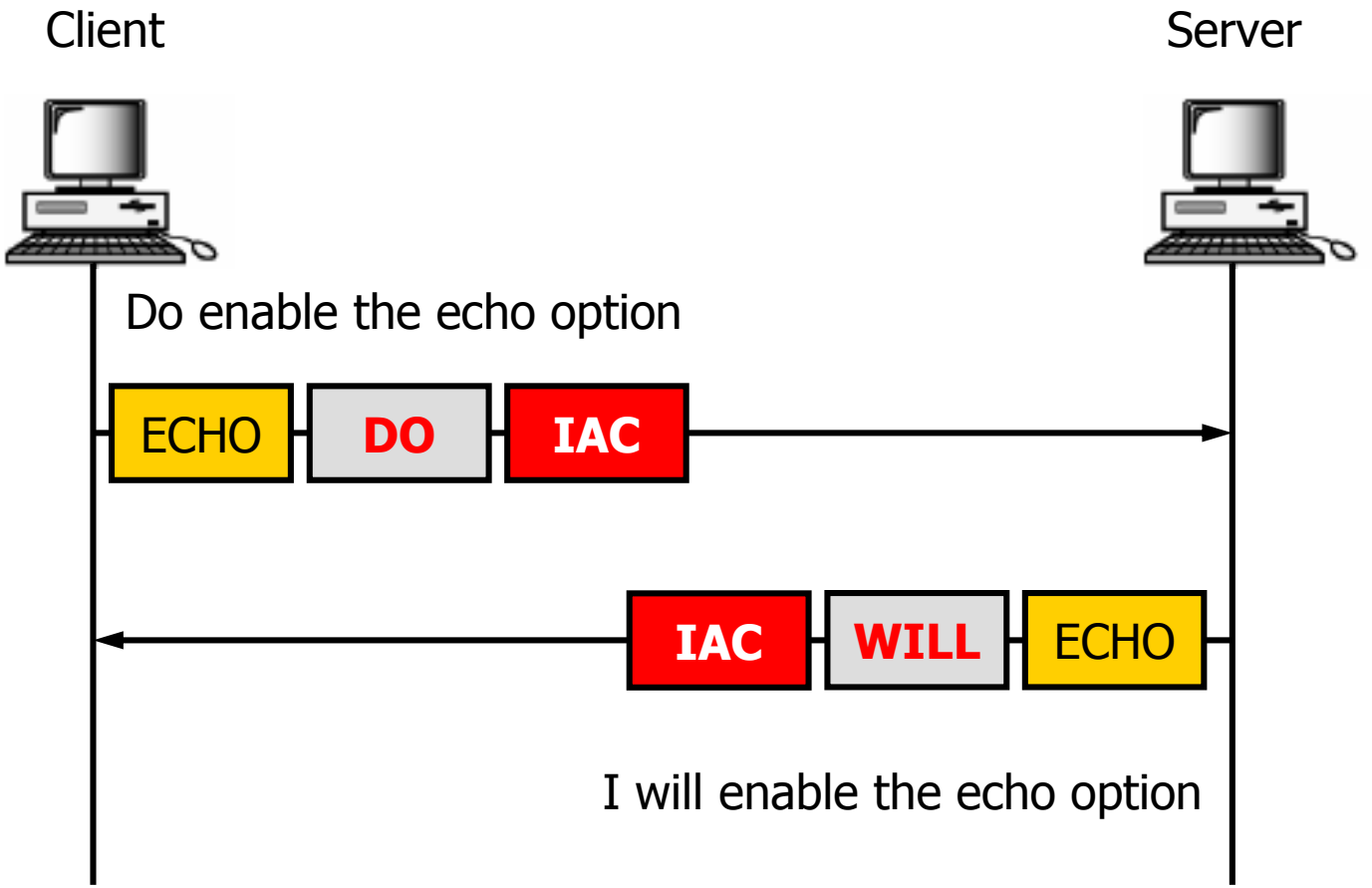
- echo modes
  - Keyboard input be echoed on the terminal side or not
- Line mode vs. character mode
  - One line or one character per transmission
- character set (EBCDIC vs. ASCII)
  - EBCDIC - Extended Binary-Coded Decimal Interchange Code
  - ASCII - American Standard Code for Information Interchange



Options Negotiation

- Each option is assigned a byte value
- The DO, DONT, WILL, and WONT commands are used to negotiate options
- Options negotiation is symmetric
- Steps must be taken to avoid option processing loops
- Subnegotiations are used when more information is needed, such as when negotiating terminal type, window size, etc

Example: Negotiation of Echo Option



TELNET Options List (1)

Options	Name	References
0	Binary Transmission	[RFC856]
1	Echo	[RFC857]
2	Reconnection	[NIC50005]
3	Suppress Go Ahead	[RFC858]
4	Approx Message Size Negotiation	[ETHERNET]
5	Status	[RFC859]
6	Timing Mark	[RFC860]
7	Remote Controlled Trans and Echo	[RFC726]
8	Output Line Width	[NIC50005]
9	Output Page Size	[NIC50005]
10	Output Carriage-Return Disposition	[RFC652]
11	Output Horizontal Tab Stops	[RFC653]
12	Output Horizontal Tab Disposition	[RFC654]
13	Output Formfeed Disposition	[RFC655]
14	Output Vertical Tabstops	[RFC656]
15	Output Vertical Tab Disposition	[RFC657]
16	Output Linefeed Disposition	[RFC657]
17	Extended ASCII	[RFC698]
18	Logout	[RFC727]
19	Byte Macro	[RFC735]

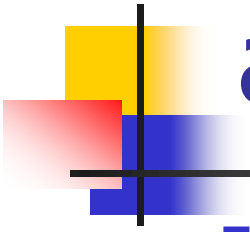
TELNET Options List (2)

20	Data Entry Terminal	[RFC1043, RFC732]
21	SUPDUP	[RFC736, RFC734]
22	SUPDUP Output	[RFC749]
23	Send Location	[RFC779]
24	Terminal Type	[RFC1091]
25	End of Record	[RFC885]
26	TACACS User Identification	[RFC927]
27	Output Marking	[RFC933]
28	Terminal Location Number	[RFC946]
29	Telnet 3270 Regime	[RFC1041]
30	X.3 PAD	[RFC1053]
31	Negotiate About Window Size	[RFC1073, DW183]
32	Terminal Speed	[RFC1079]
33	Remote Flow Control	[RFC1372]
34	Linemode	[RFC1184]
35	X Display Location	[RFC1096]
36	Environment Option	[RFC1408]
37	Authentication Option	[RFC1416]
38	Encryption Option	[Borman]
39	New Environment Option	[RFC1572]
40	TN3270E	[RFC1647]
41	XAUTH	[Barhart]
255	Extended-Options-List	[RFC861]

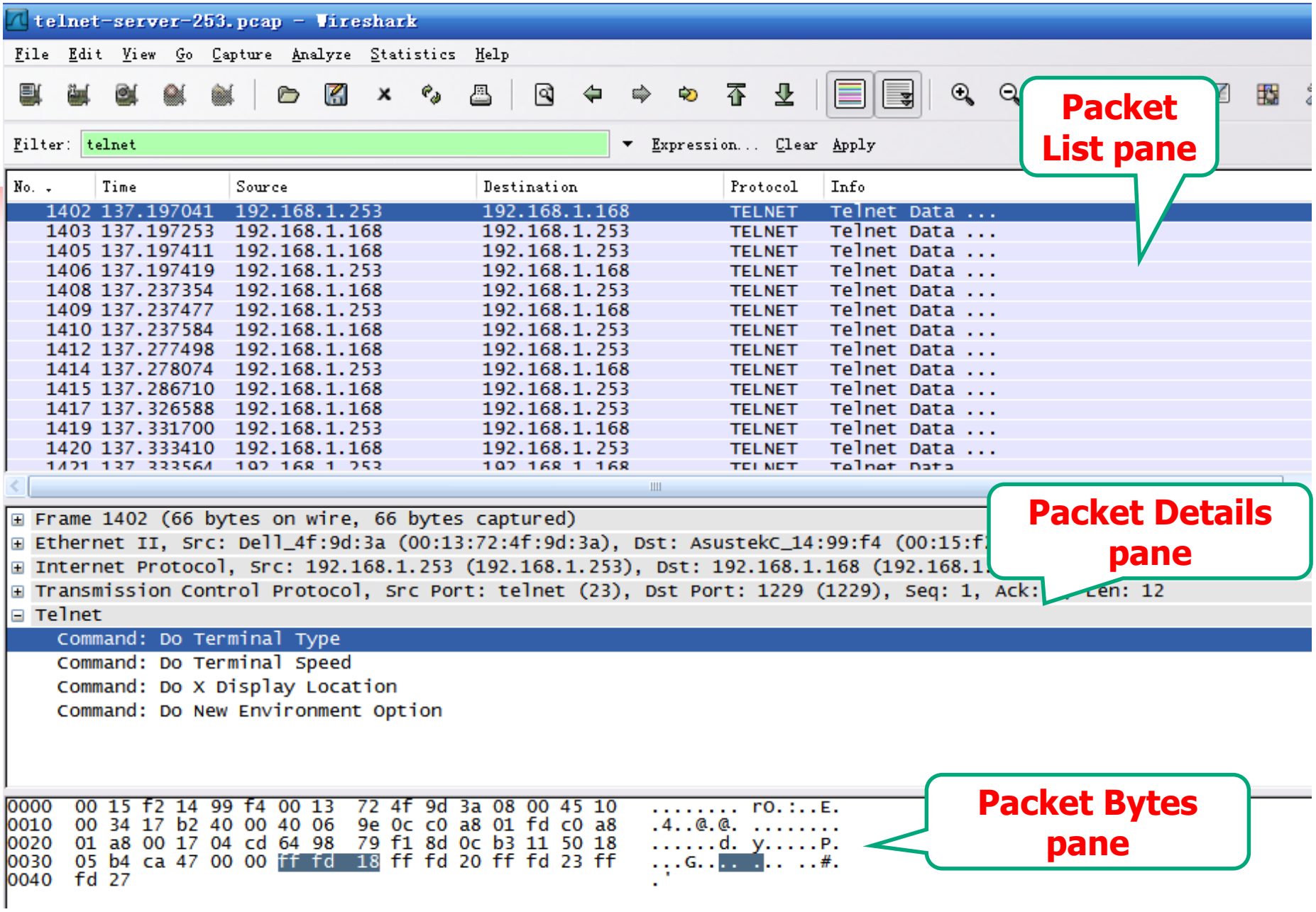
A Telnet Session Example (1)

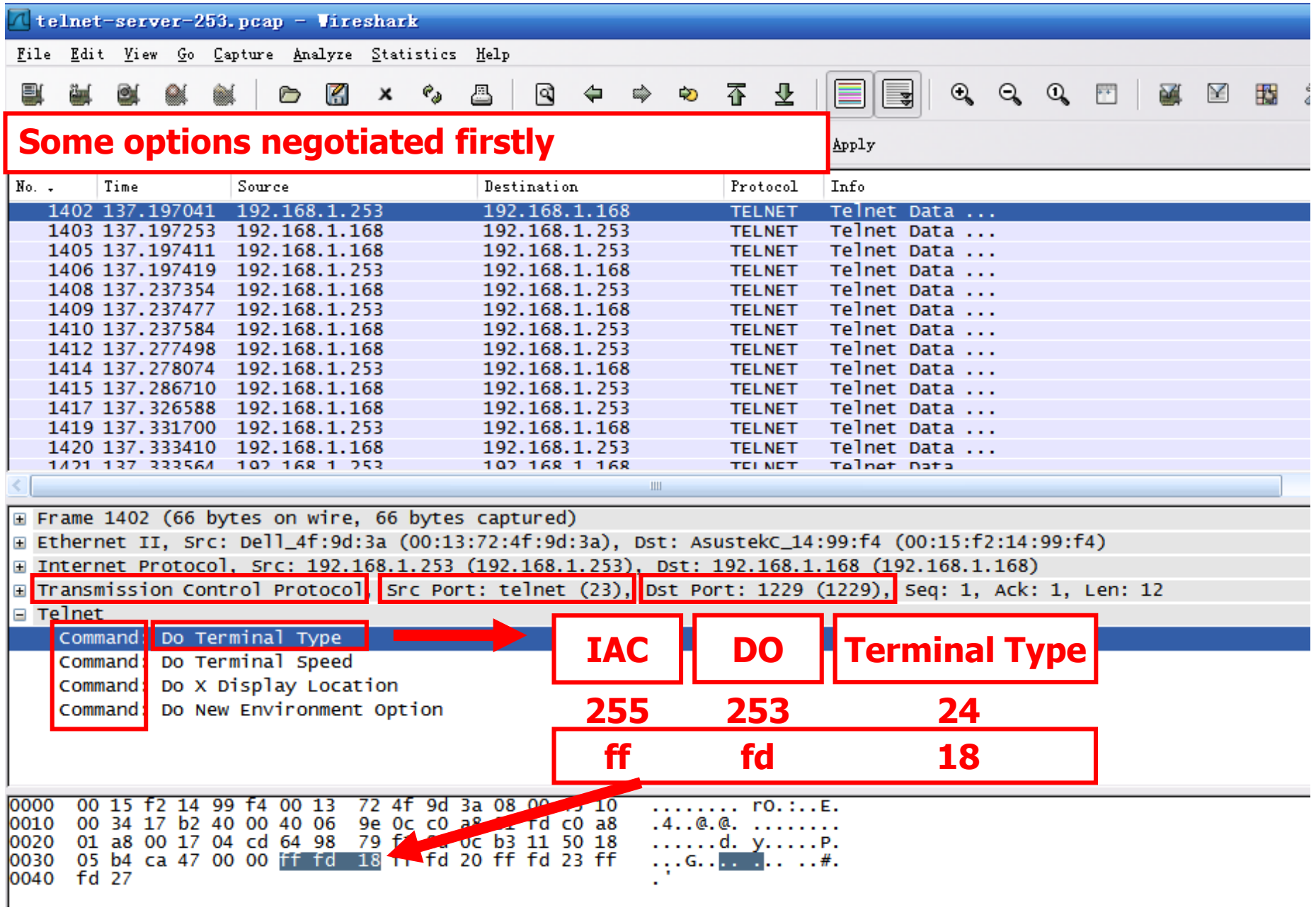
```
C:\Documents and Settings\Administrator> telnet 192.168.1.253
Red Hat Enterprise Linux AS release 4 <Nahant Update 1>
Kernel 2.6.9-11.Elsmp on an i686
Login: shiyan
Password:
Last login: Sun Nov 11 17:48:30 from 192.168.1.168
[shiyan@localhost ~]$
```

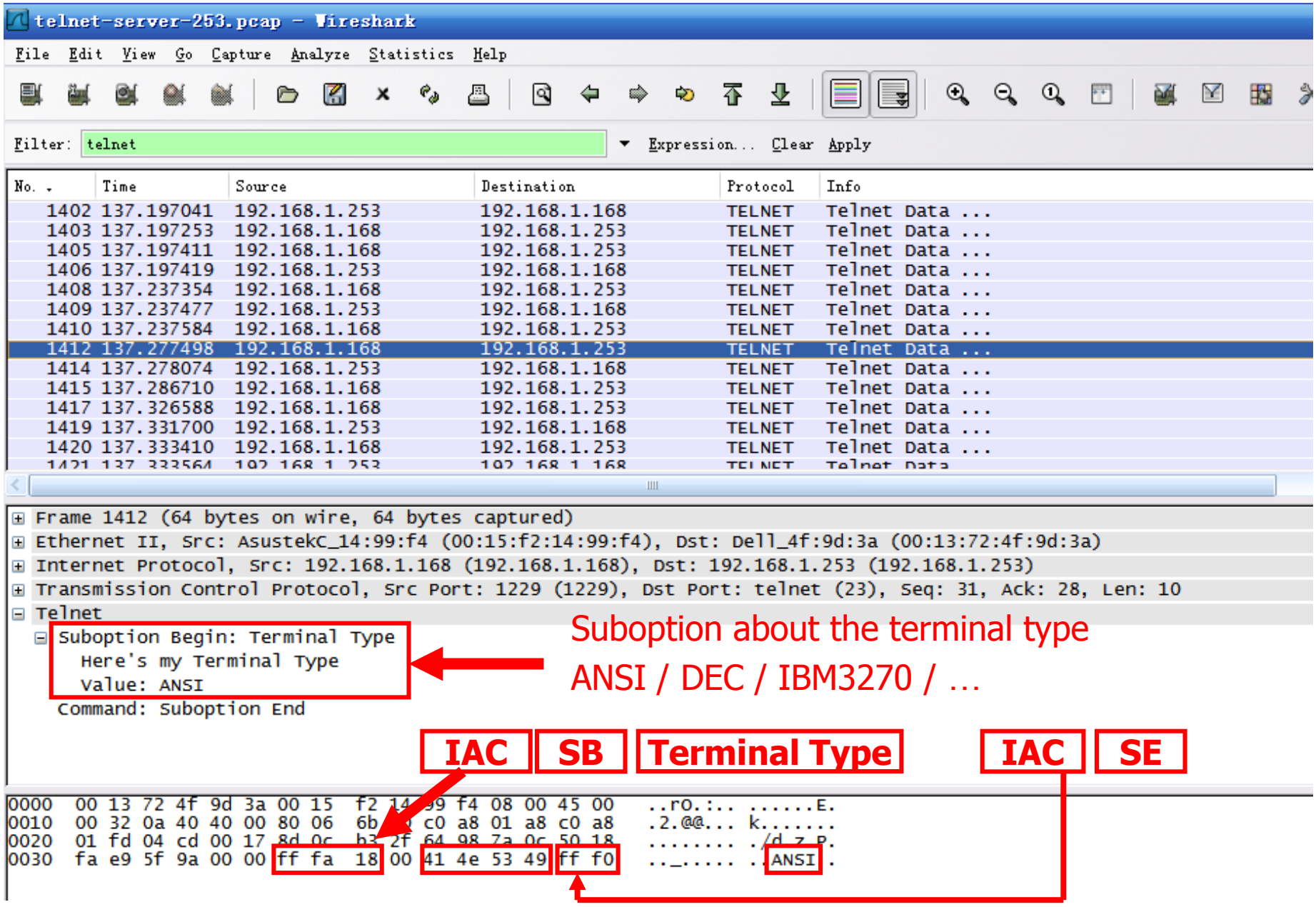
Using wireshark to know what are sent and received

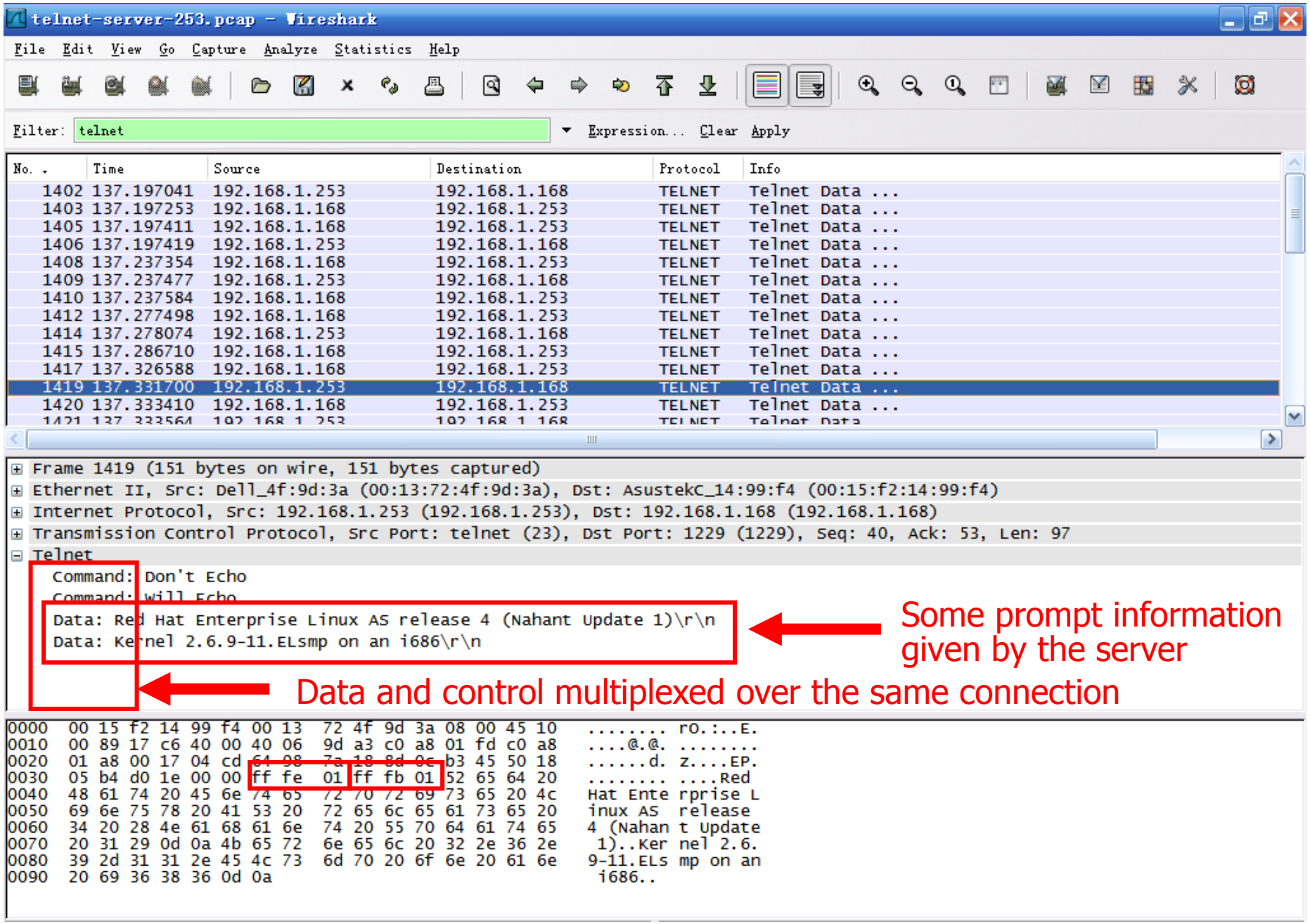


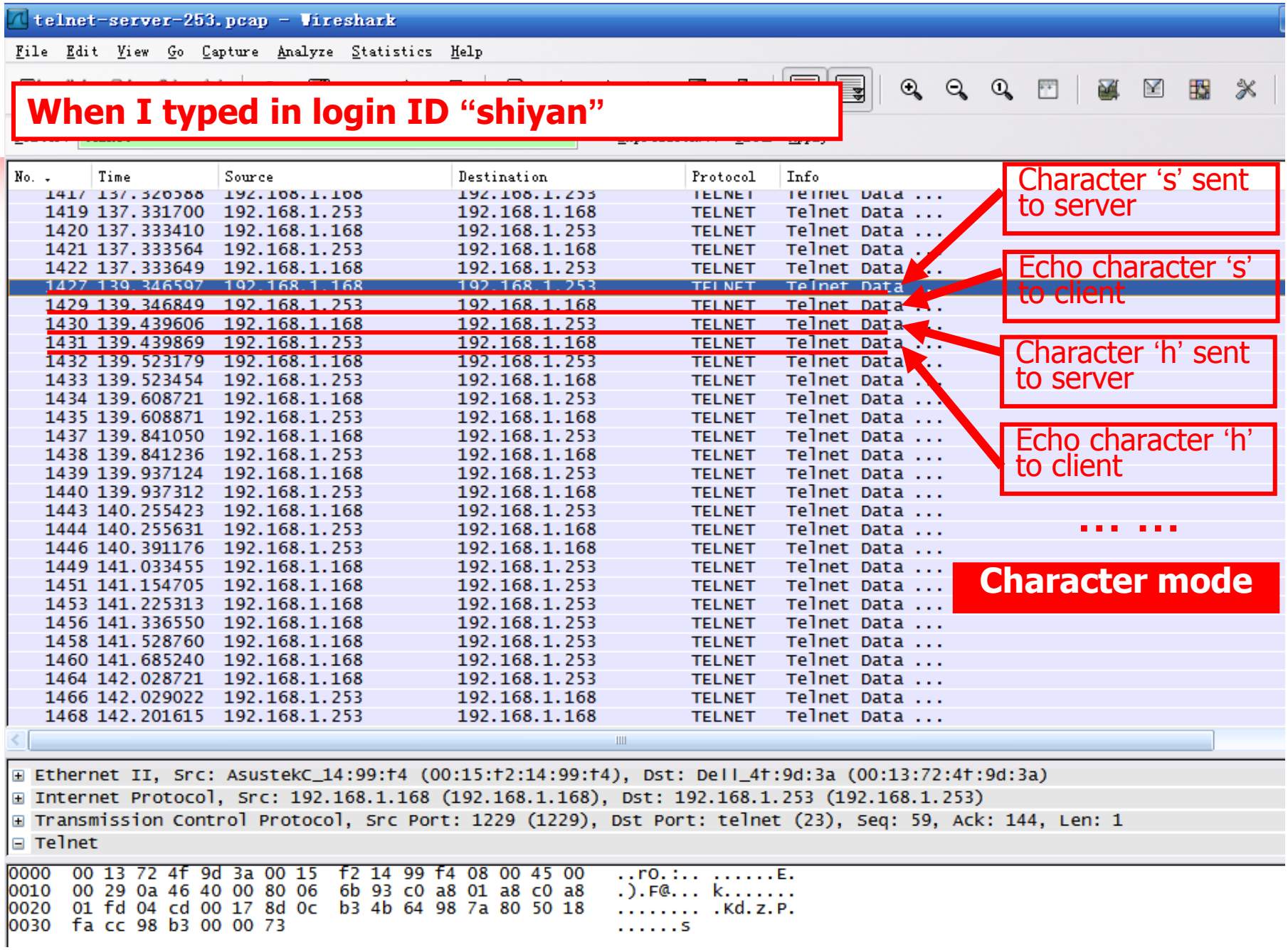
- Wireshark: A network protocol analyzer (packet sniffer)
- Renamed from Ethereal in 2006
- Able to capture packets transferred on the network and display packet fields and their meanings
- Used for network troubleshooting, analysis, software and communications protocol development, and education.

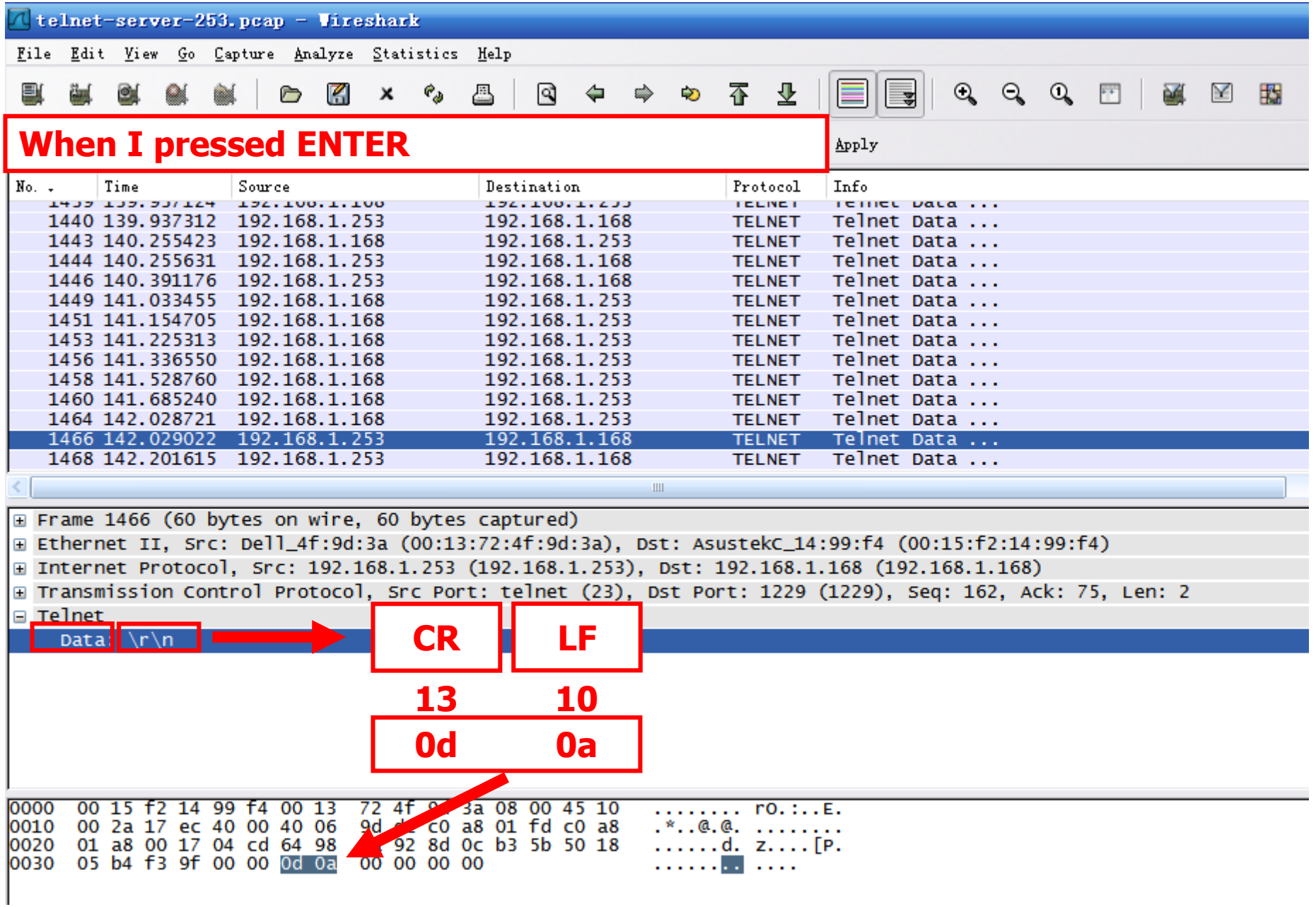

telnet-server-253.pcap - Wireshark
File Edit View Go Capture Analyze Statistics Help
Filter: telnet
Expression... Clear Apply
No. Time Source Destination Protocol Info
1402 137.197041 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1403 137.197253 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1405 137.197411 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1406 137.197419 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1408 137.237354 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1409 137.237477 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1410 137.237584 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1412 137.277498 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1414 137.278074 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1415 137.286710 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1417 137.326588 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1419 137.331700 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1420 137.333410 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
Packet List pane
Frame 1402 (66 bytes on wire, 66 bytes captured)
Ethernet II, Src: Dell_4f:9d:3a (00:13:72:4f:9d:3a), Dst: AsustekC_14:99:f4 (00:15:f
Internet Protocol, Src: 192.168.1.253 (192.168.1.253), Dst: 192.168.1.168 (192.168.1
Transmission Control Protocol, Src Port: telnet (23), Dst Port: 1229 (1229), Seq: 1, Ack: , Len: 12
Telnet
Command: Do Terminal Type
Command: Do Terminal Speed
Command: Do X Display Location
Command: Do New Environment Option
Packet Details pane
0000 00 15 f2 14 99 f4 00 13 72 4f 9d 3a 08 00 45 10 .... rO.:..E.
0010 00 34 17 b2 40 00 40 06 9e 0c c0 a8 01 fd c0 a8 .4..@.@. ....
0020 01 a8 00 17 04 cd 64 98 79 f1 8d 0c b3 11 50 18 ......d. y.....P.
0030 05 b4 ca 47 00 00 ff fd 18 ff fd 20 ff fd 23 ff ...G..... .. ..#.
0040 fd 27 .'
Packet Bytes pane

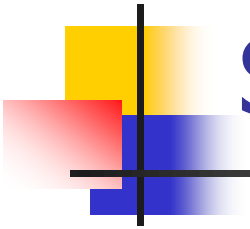

telnet-server-253.pcap - Wireshark
File Edit View Go Capture Analyze Statistics Help
Some options negotiated firstly
Apply
No. Time Source Destination Protocol Info
1402 137.197041 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1403 137.197253 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1405 137.197411 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1406 137.197419 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1408 137.237354 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1409 137.237477 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1410 137.237584 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1412 137.277498 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1414 137.278074 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1415 137.286710 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1417 137.326588 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1419 137.331700 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1420 137.333410 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
Frame 1402 (66 bytes on wire, 66 bytes captured)
Ethernet II, Src: Dell_4f:9d:3a (00:13:72:4f:9d:3a), Dst: AsustekC_14:99:f4 (00:15:f2:14:99:f4)
Internet Protocol, Src: 192.168.1.253 (192.168.1.253), Dst: 192.168.1.168 (192.168.1.168)
Transmission Control Protocol, Src Port: telnet (23), Dst Port: 1229 (1229), Seq: 1, Ack: 1, Len: 12
Telnet
Command: Do Terminal Type
Command: Do Terminal Speed
Command: Do X Display Location
Command: Do New Environment Option
IAC
DO
Terminal Type
255
253
24
ff
fd
18
0000 00 15 f2 14 99 f4 00 13 72 4f 9d 3a 08 00 45 10 .... rO.:..E.
0010 00 34 17 b2 40 00 40 06 9e 0c c0 a8 01 fd c0 a8 .4..@.@. ....
0020 01 a8 00 17 04 cd 64 98 79 f[illegible] 0c b3 11 50 18 ......d. y.....P.
0030 05 b4 ca 47 00 00 ff fd 18 ff fd 20 ff fd 23 ff ...G..... ... ..#.
0040 fd 27 .'


telnet-server-253.pcap - Wireshark
File Edit View Go Capture Analyze Statistics Help
Filter: telnet
Expression... Clear Apply
No. Time Source Destination Protocol Info
1402 137.197041 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1403 137.197253 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1405 137.197411 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1406 137.197419 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1408 137.237354 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1409 137.237477 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1410 137.237584 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1412 137.277498 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1414 137.278074 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1415 137.286710 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1417 137.326588 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1419 137.331700 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1420 137.333410 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
Frame 1412 (64 bytes on wire, 64 bytes captured)
Ethernet II, Src: AsustekC_14:99:f4 (00:15:f2:14:99:f4), Dst: Dell_4f:9d:3a (00:13:72:4f:9d:3a)
Internet Protocol, Src: 192.168.1.168 (192.168.1.168), Dst: 192.168.1.253 (192.168.1.253)
Transmission Control Protocol, Src Port: 1229 (1229), Dst Port: telnet (23), Seq: 31, Ack: 28, Len: 10
Telnet
Suboption Begin: Terminal Type
Here's my Terminal Type
Value: ANSI
Command: Suboption End
Suboption about the terminal type
ANSI / DEC / IBM3270 / …
IAC
SB
Terminal Type
IAC
SE
0000 00 13 72 4f 9d 3a 00 15 f2 14 99 f4 08 00 45 00 ..ro.:.. ......E.
0010 00 32 0a 40 40 00 80 06 6b c0 a8 01 a8 c0 a8 .2.@@... k.......
0020 01 fd 04 cd 00 17 8d 0c b3 2f 64 98 7a 0c 50 18 ..../d.z.P.
0030 fa e9 5f 9a 00 00 ff fa 18 00 41 4e 53 49 ff f0 .._..... ..ANSI..


telnet-server-253.pcap - Wireshark
File Edit View Go Capture Analyze Statistics Help
Filter: telnet
Expression... Clear Apply
No. Time Source Destination Protocol Info
1402 137.197041 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1403 137.197253 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1405 137.197411 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1406 137.197419 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1408 137.237354 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1409 137.237477 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1410 137.237584 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1412 137.277498 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1414 137.278074 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1415 137.286710 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1417 137.326588 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1419 137.331700 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1420 137.333410 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
Frame 1419 (151 bytes on wire, 151 bytes captured)
Ethernet II, Src: Dell_4f:9d:3a (00:13:72:4f:9d:3a), Dst: AsustekC_14:99:f4 (00:15:f2:14:99:f4)
Internet Protocol, Src: 192.168.1.253 (192.168.1.253), Dst: 192.168.1.168 (192.168.1.168)
Transmission Control Protocol, Src Port: telnet (23), Dst Port: 1229 (1229), Seq: 40, Ack: 53, Len: 97
Telnet
Command: Don't Echo
Command: Will Echo
Data: Red Hat Enterprise Linux AS release 4 (Nahant Update 1)\r\n
Data: Kernel 2.6.9-11.ELsmp on an i686\r\n
Some prompt information given by the server
Data and control multiplexed over the same connection
0000 00 15 f2 14 99 f4 00 13 72 4f 9d 3a 08 00 45 10 .... rO.:..E.
0010 00 89 17 c6 40 00 40 06 9d a3 c0 a8 01 fd c0 a8 ....@.@. ....
0020 01 a8 00 17 04 cd 64 98 7a 18 8d 0c b3 45 50 18 ......d. z....EP.
0030 05 b4 d0 1e 00 00 ff fe 01 ff fb 01 52 65 64 20 ....Red
0040 48 61 74 20 45 6e 74 65 72 70 72 69 73 65 20 4c Hat Ente rprise L
0050 69 6e 75 78 20 41 53 20 72 65 6c 65 61 73 65 20 inux AS release
0060 34 20 28 4e 61 68 61 6e 74 20 55 70 64 61 74 65 4 (Nahan t Update
0070 20 31 29 0d 0a 4b 65 72 6e 65 6c 20 32 2e 36 2e 1)..Ker nel 2.6.
0080 39 2d 31 31 2e 45 4c 73 6d 70 20 6f 6e 20 61 6e 9-11.ELs mp on an
0090 20 69 36 38 36 0d 0a i686..


telnet-server-253.pcap - Wireshark
File Edit View Go Capture Analyze Statistics Help
When I typed in login ID "shiyan"
No. Time Source Destination Protocol Info
1419 137.331700 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1420 137.333410 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1421 137.333564 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1422 137.333649 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1429 139.346849 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1430 139.439606 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1431 139.439869 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1432 139.523179 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1433 139.523454 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1434 139.608721 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1435 139.608871 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1437 139.841050 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1438 139.841236 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1439 139.937124 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1440 139.937312 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1443 140.255423 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1444 140.255631 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1446 140.391176 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1449 141.033455 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1451 141.154705 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1453 141.225313 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1456 141.336550 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1458 141.528760 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1460 141.685240 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1464 142.028721 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1466 142.029022 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1468 142.201615 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
Character 's' sent to server
Echo character 's' to client
Character 'h' sent to server
Echo character 'h' to client
... ...
Character mode
Ethernet II, Src: AsustekC_14:99:f4 (00:15:f2:14:99:f4), Dst: Dell_4f:9d:3a (00:13:72:4f:9d:3a)
Internet Protocol, Src: 192.168.1.168 (192.168.1.168), Dst: 192.168.1.253 (192.168.1.253)
Transmission Control Protocol, Src Port: 1229 (1229), Dst Port: telnet (23), Seq: 59, Ack: 144, Len: 1
Telnet
0000 00 13 72 4f 9d 3a 00 15 f2 14 99 f4 08 00 45 00 ..ro.:.. ......E.
0010 00 29 0a 46 40 00 80 06 6b 93 c0 a8 01 a8 c0 a8 .).F@... k.......
0020 01 fd 04 cd 00 17 8d 0c b3 4b 64 98 7a 80 50 18 .... .Kd.z.P.
0030 fa cc 98 b3 00 00 73 ......s


telnet-server-253.pcap - Wireshark
File Edit View Go Capture Analyze Statistics Help
When I pressed ENTER
Apply
No. Time Source Destination Protocol Info
1440 139.937312 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1443 140.255423 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1444 140.255631 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1446 140.391176 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1449 141.033455 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1451 141.154705 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1453 141.225313 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1456 141.336550 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1458 141.528760 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1460 141.685240 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1464 142.028721 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1466 142.029022 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1468 142.201615 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
Frame 1466 (60 bytes on wire, 60 bytes captured)
Ethernet II, Src: Dell_4f:9d:3a (00:13:72:4f:9d:3a), Dst: AsustekC_14:99:f4 (00:15:f2:14:99:f4)
Internet Protocol, Src: 192.168.1.253 (192.168.1.253), Dst: 192.168.1.168 (192.168.1.168)
Transmission Control Protocol, Src Port: telnet (23), Dst Port: 1229 (1229), Seq: 162, Ack: 75, Len: 2
Telnet
Data: \r\n
CR
LF
13
10
0d
0a
0000 00 15 f2 14 99 f4 00 13 72 4f 9d 3a 08 00 45 10 .... rO.:..E.
0010 00 2a 17 ec 40 00 40 06 9d c5 c0 a8 01 fd c0 a8 .*..@.@. ....
0020 01 a8 00 17 04 cd 64 98 92 8d 0c b3 5b 50 18 ......d. z....[P.
0030 05 b4 f3 9f 00 00 0d 0a 00 00 00 00 ....



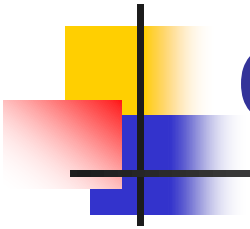
Summary (1) – usages of telnet

- Use Internet accounts you may have on remote computers
  - you need an account (login ID) and password on the remote computer to permit access
- Use free services accessible with telnet, e.g.
  - library catalogues
  - databases
  - BBS (Bulletin Board System)
  - Router/switch configuration

Summary (2) – Disadvantages of telnet

- Poor user interface
  - Based on dumb terminal
  - Text-only display
  - Monochrome
    - One color for text, one for background
  - Have to type command-line commands
    - Often have complex syntax
  - Not very secure, SSH made enhancement
    - TELNET does not encrypt any data sent over the connection (**including passwords**)

Other Remote Access Technologies

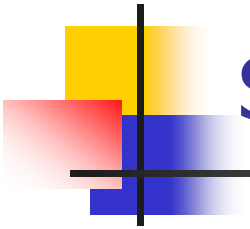


Other Remote Access Technologies

- Remote login in text-based system
  - telnet
  - SSH
  - Rlogin
- Remote desktop in windowing system
  - VNC (Virtual Network Computing)
  - RDP (Remote Desktop Protocol)

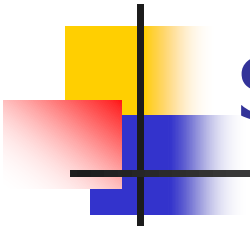
SSH (1) – brief information

- Secure Shell
- Command line terminal connection tool
- All traffic encrypted
- Both ends authenticate themselves to the other end
- Ability to carry and encrypt non-terminal traffic
- Private key kept on client, public key stored on server
- Now, it is an IETF standard
  - RFC4251, The Secure Shell (SSH) Protocol Architecture



SSH (2) – two enhancements of telnet

- Providing secure communications
- Providing users with the ability to perform additional, independent data transfer over the same connection that is used for remote login

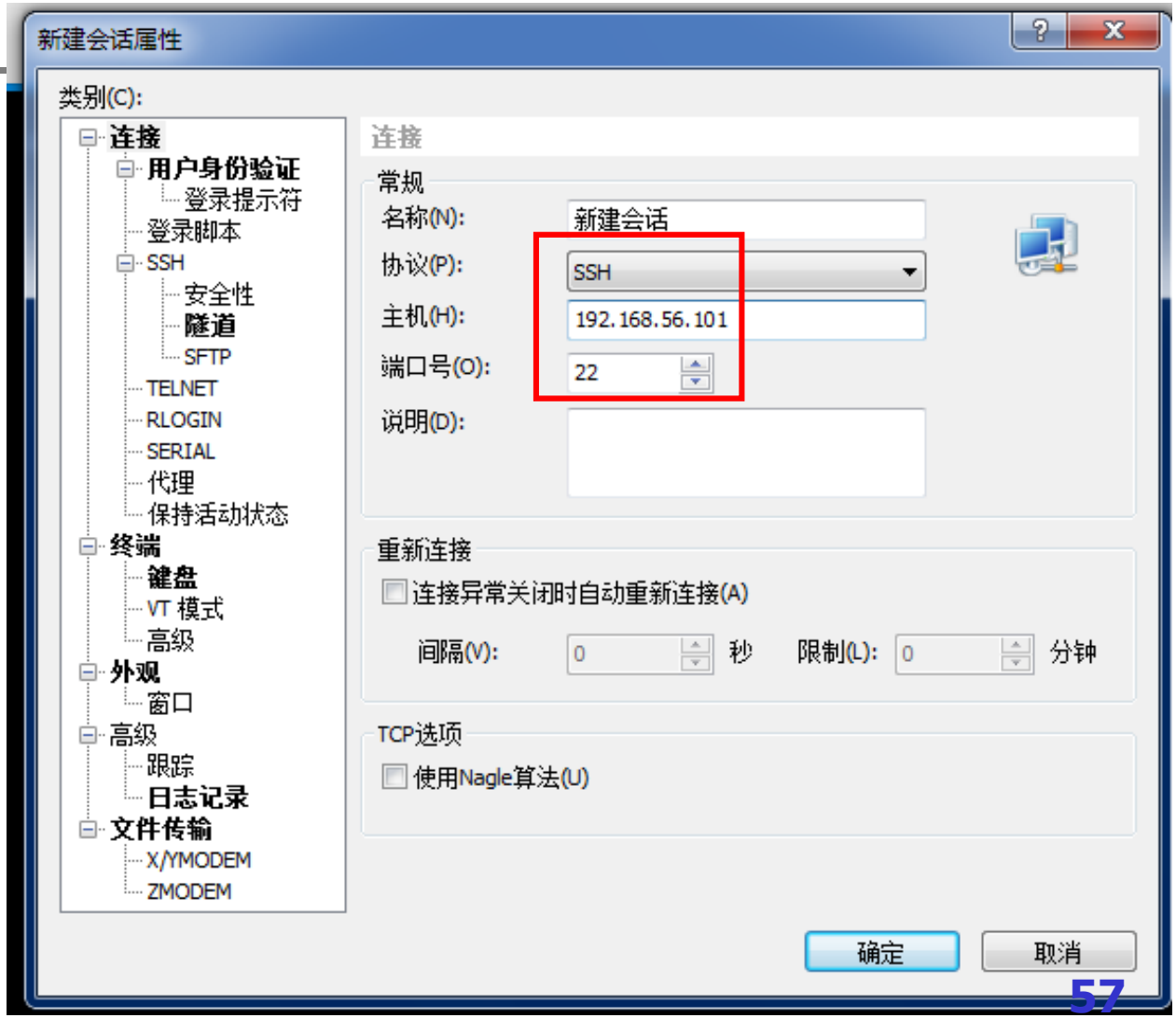


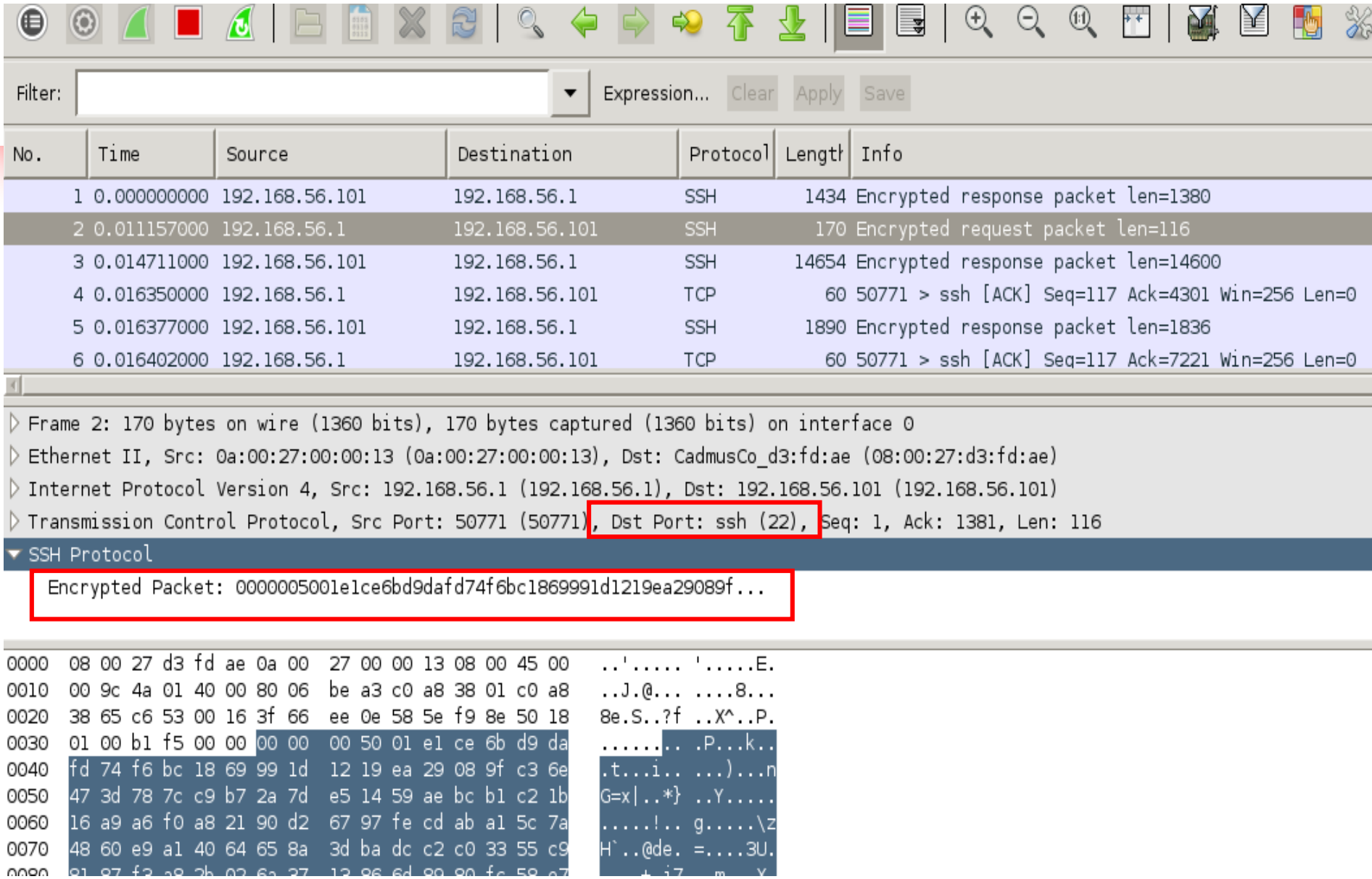
SSH (3) – three major mechanisms

- A transport layer protocol that provides sever authentication, data confidentiality, and data integrity with perfect forward secrecy
- A user authentication protocol that authenticates the user to the server
- A connection protocol that multiplexes multiple logical communications channels over a single underlying SSH connection

SSH (4) – tools

- Xshell5





Filter: Expression... Clear Apply Save

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	192.168.56.101	192.168.56.1	SSH	1434	Encrypted response packet len=1380
2	0.011157000	192.168.56.1	192.168.56.101	SSH	170	Encrypted request packet len=116
3	0.014711000	192.168.56.101	192.168.56.1	SSH	14654	Encrypted response packet len=14600
4	0.016350000	192.168.56.1	192.168.56.101	TCP	60	50771 > ssh [ACK] Seq=117 Ack=4301 Win=256 Len=0
5	0.016377000	192.168.56.101	192.168.56.1	SSH	1890	Encrypted response packet len=1836
6	0.016402000	192.168.56.1	192.168.56.101	TCP	60	50771 > ssh [ACK] Seq=117 Ack=7221 Win=256 Len=0

Frame 2: 170 bytes on wire (1360 bits), 170 bytes captured (1360 bits) on interface 0

Ethernet II, Src: 0a:00:27:00:00:13 (0a:00:27:00:00:13), Dst: CadmusCo_d3:fd:ae (08:00:27:d3:fd:ae)

Internet Protocol Version 4, Src: 192.168.56.1 (192.168.56.1), Dst: 192.168.56.101 (192.168.56.101)

Transmission Control Protocol, Src Port: 50771 (50771), Dst Port: ssh (22), Seq: 1, Ack: 1381, Len: 116

SSH Protocol

Encrypted Packet: 0000005001e1ce6bd9dafd74f6bc1869991d1219ea29089f...

```
0000  08 00 27 d3 fd ae 0a 00  27 00 00 13 08 00 45 00   ..'..... '.....E.
0010  00 9c 4a 01 40 00 80 06  be a3 c0 a8 38 01 c0 a8   ..J.@... ....8...
0020  38 65 c6 53 00 16 3f 66  ee 0e 58 5e f9 8e 50 18   8e.S..?f ..X^..P.
0030  01 00 b1 f5 00 00 00 00  00 50 01 e1 ce 6b d9 da   ........ .P...k..
0040  fd 74 f6 bc 18 69 99 1d  12 19 ea 29 08 9f c3 6e   .t...i.. ...)...n
0050  47 3d 78 7c c9 b7 2a 7d  e5 14 59 ae bc b1 c2 1b   G=x|..*} ..Y.....
0060  16 a9 a6 f0 a8 21 90 d2  67 97 fe cd ab a1 5c 7a   .....!.. g.....\z
0070  48 60 e9 a1 40 64 65 8a  3d ba dc c2 c0 33 55 c9   H`..@de. =....3U.
0080  81 87 f3 a8 2b 02 6a 37  13 86 6d 89 80 fc 58 e7   ....+.j7 ..m...X.
```

Helpful URLs

- RFCs
  - http://www.ietf.org/
- Useful utilities
  - http://winfiles.search.com/search?cat=316&tag=ex.sa.fd.srch.wf&q=TELNET
- About telnet
  - http://en.wikipedia.org/wiki/Telnet
  - http://baike.baidu.com/item/Telnet
- About SSH
  - http://www.ssh.com
- About realVNC
  - http://www.realvnc.com/