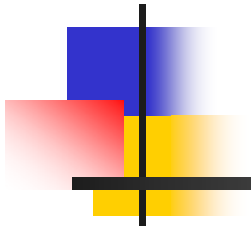
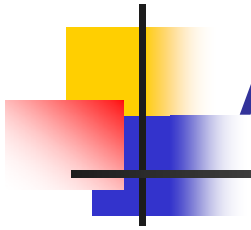


TELNET Basics

BUPT/QMUL

2010-11-16

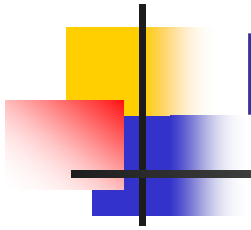
Refer to Chapter 24, Textbook



Agenda

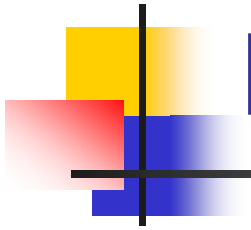
- A brief introduction to TELNET
- Concept of remote/virtual terminal
- TELNET operations
- TELNET protocol
- TELNET options negotiation
- Other remote access technologies

A Brief Introduction to TELNET



Brief Introduction To TELNET

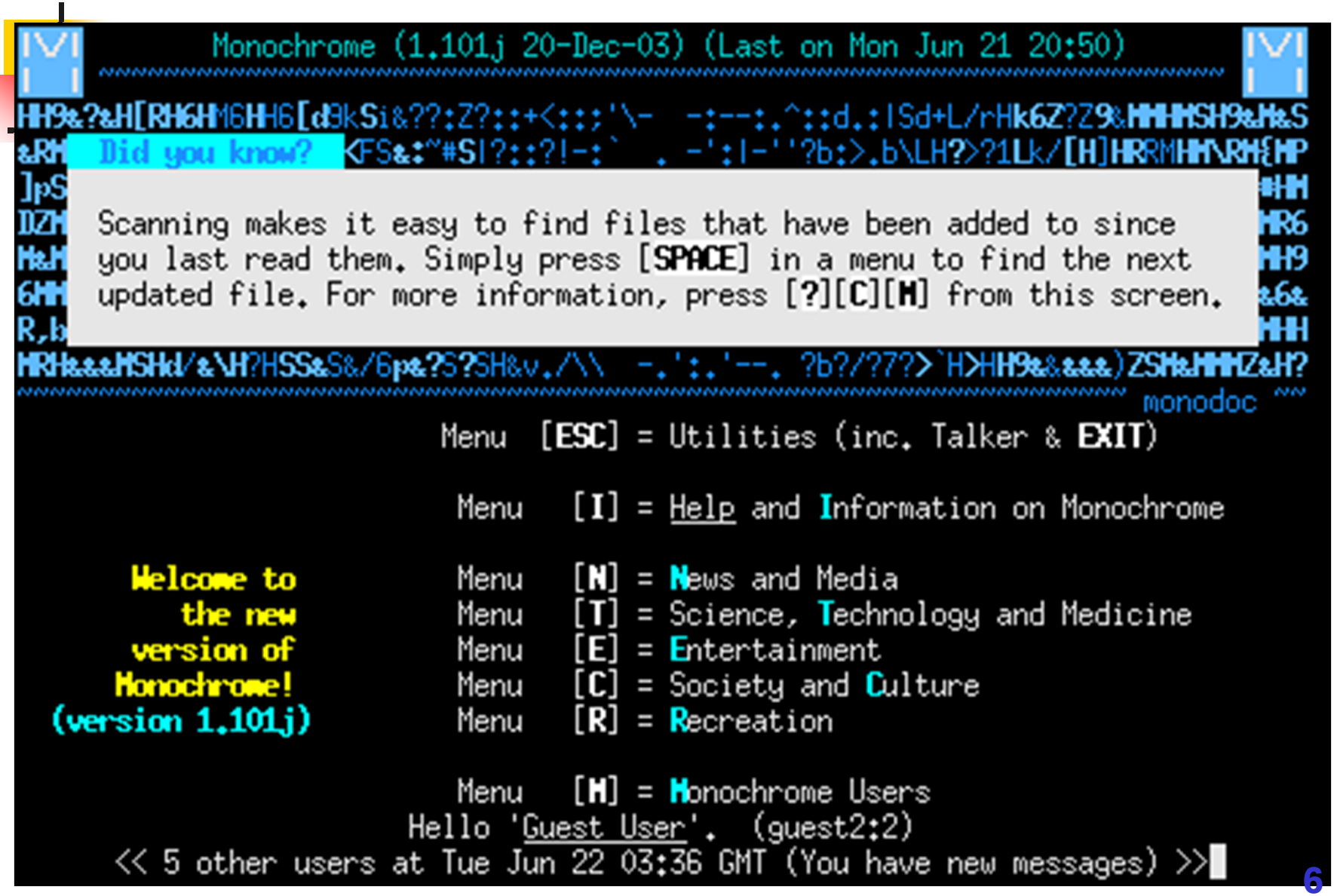
- Use of TELNET: BBS
- What is TELNET?
- History
- Major Ideas



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:

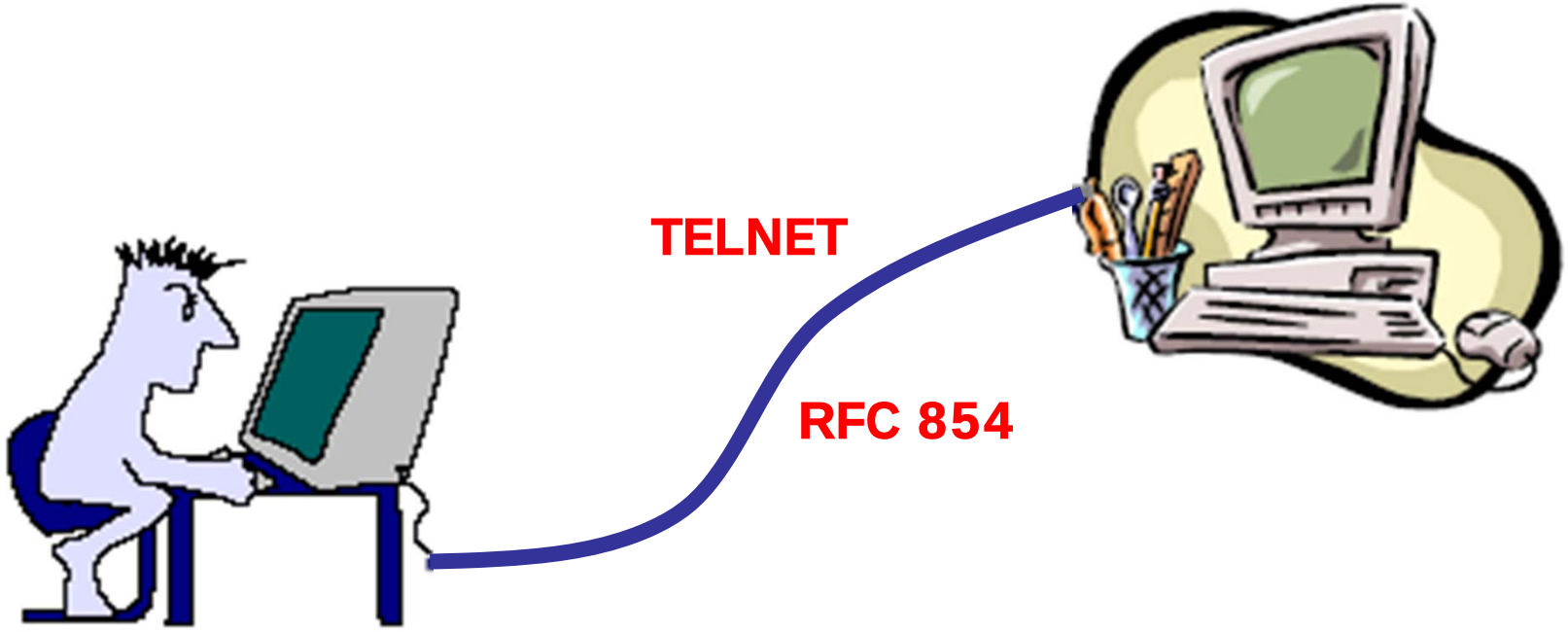


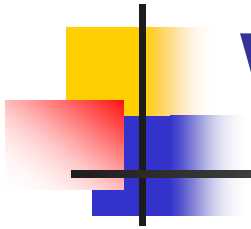
Example of BBS Today(1)

Example of BBS Today(2)

What Is TELNET? (1)

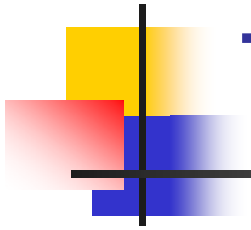
- A protocol used to establish a dumb terminal session to another computer on the Internet
- An important Internet application for remote access





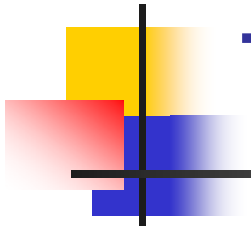
What Is TELNET? (2)

- 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

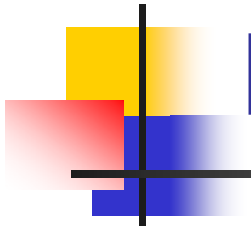
- TELNET is a *protocol* that provides “a general, bi-directional, eight-bit byte oriented communications facility”
- telnet is a *program* that supports the TELNET protocol over TCP
- Many application protocols are built upon the TELNET protocol



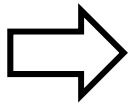
The History Of Telnet

- 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

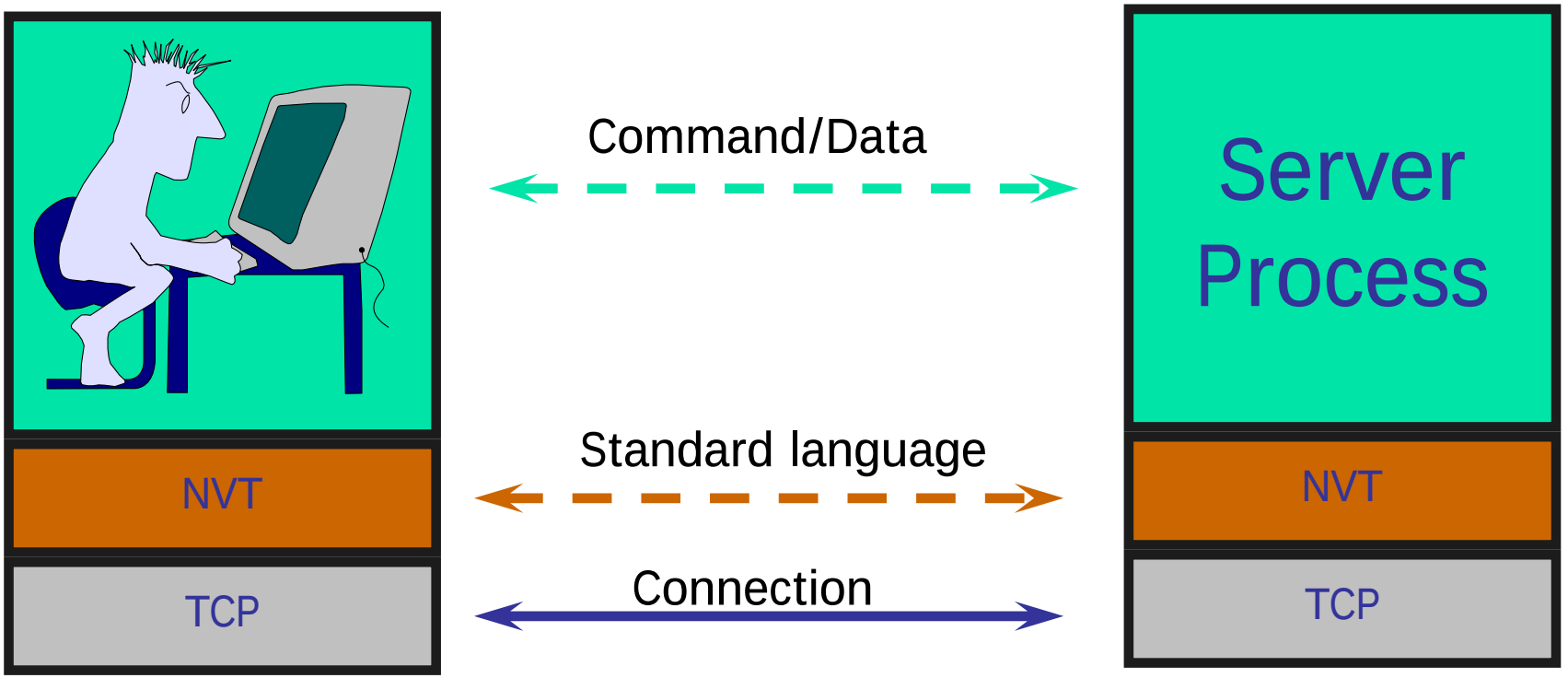
Major Ideas Of TELNET



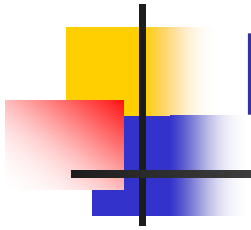
- The concept of a NVT (Network Virtual Terminal)
  - Providing a standard interface to remote systems
- The principle of negotiated options
  - Enabling Telnet to evolve to meet new demands without endless new versions of basic protocol
- A symmetric view of terminals and processes
  - Allowing an arbitrary program to become a client



Network Virtual Terminal

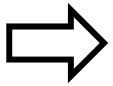


Concept Of Remote / Virtual Terminal

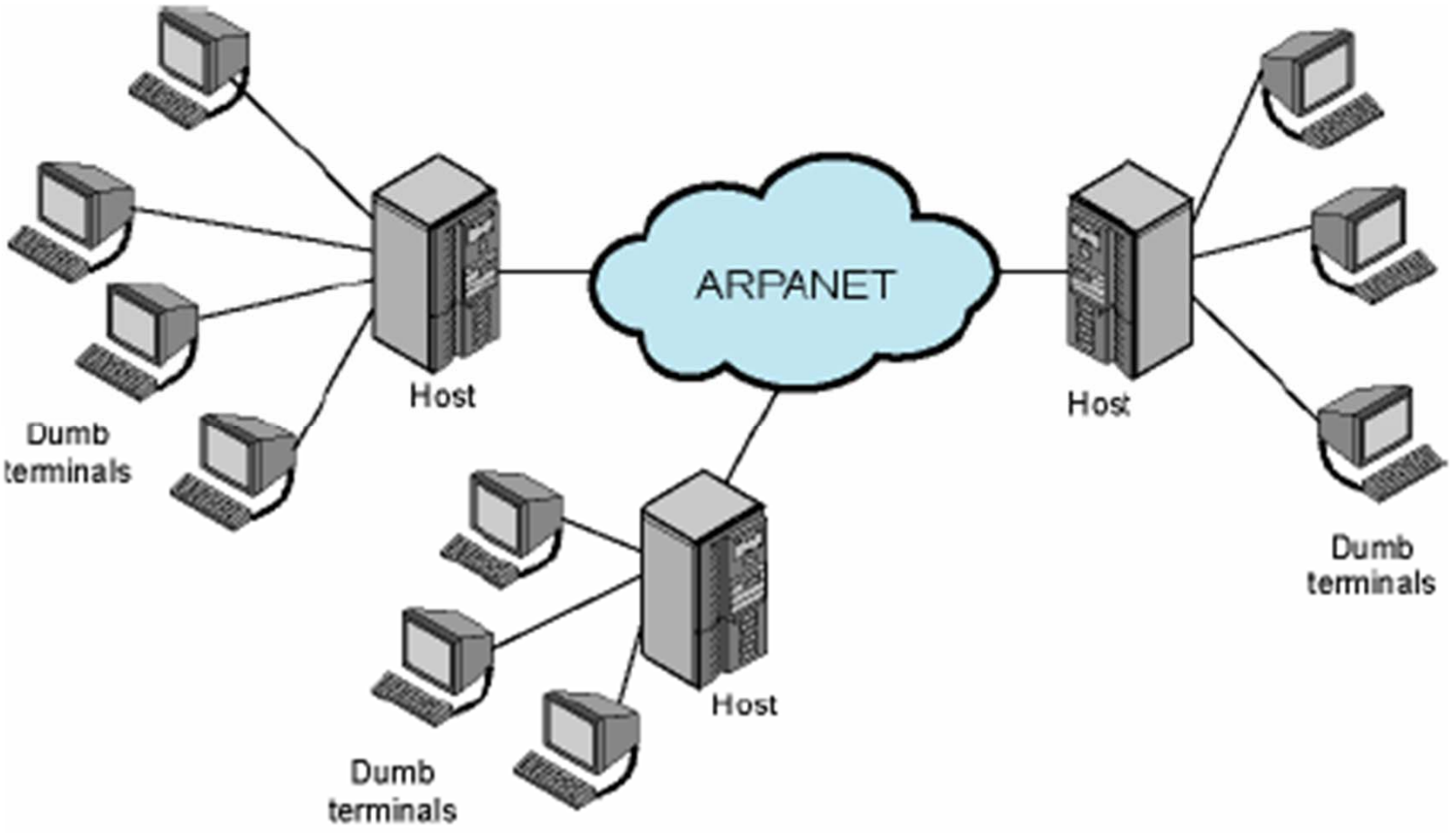


Remote Terminal Access

- 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

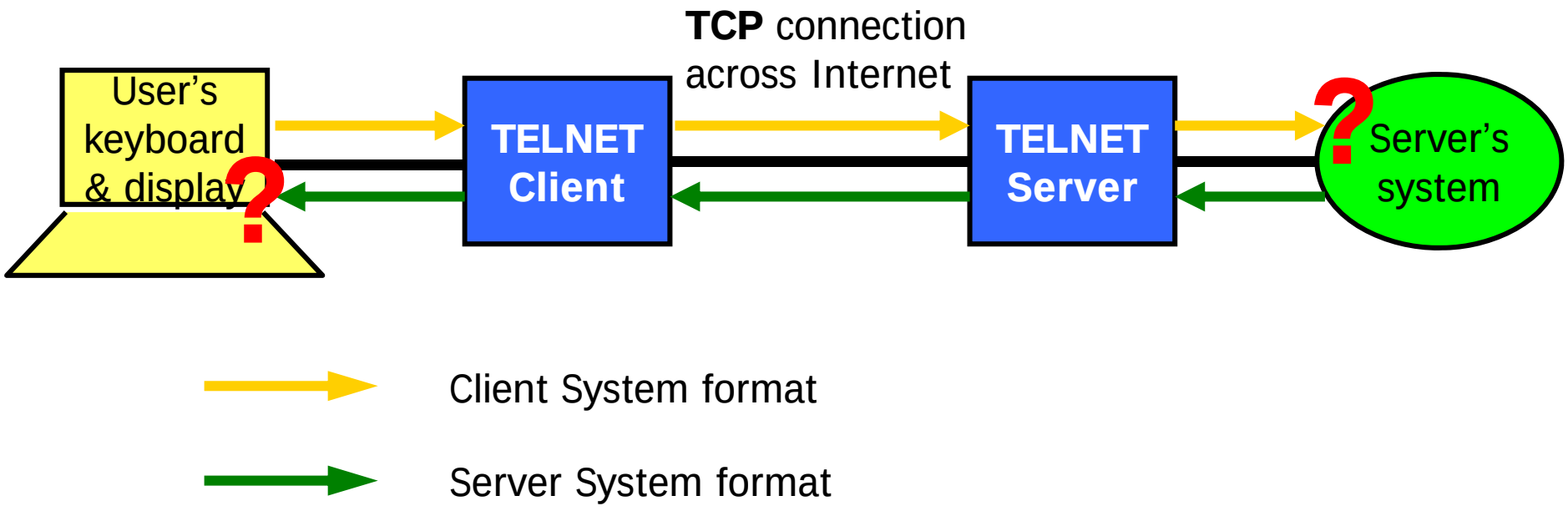


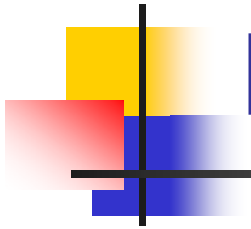
Telnet Operation Environment On Early Internet



Problem

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



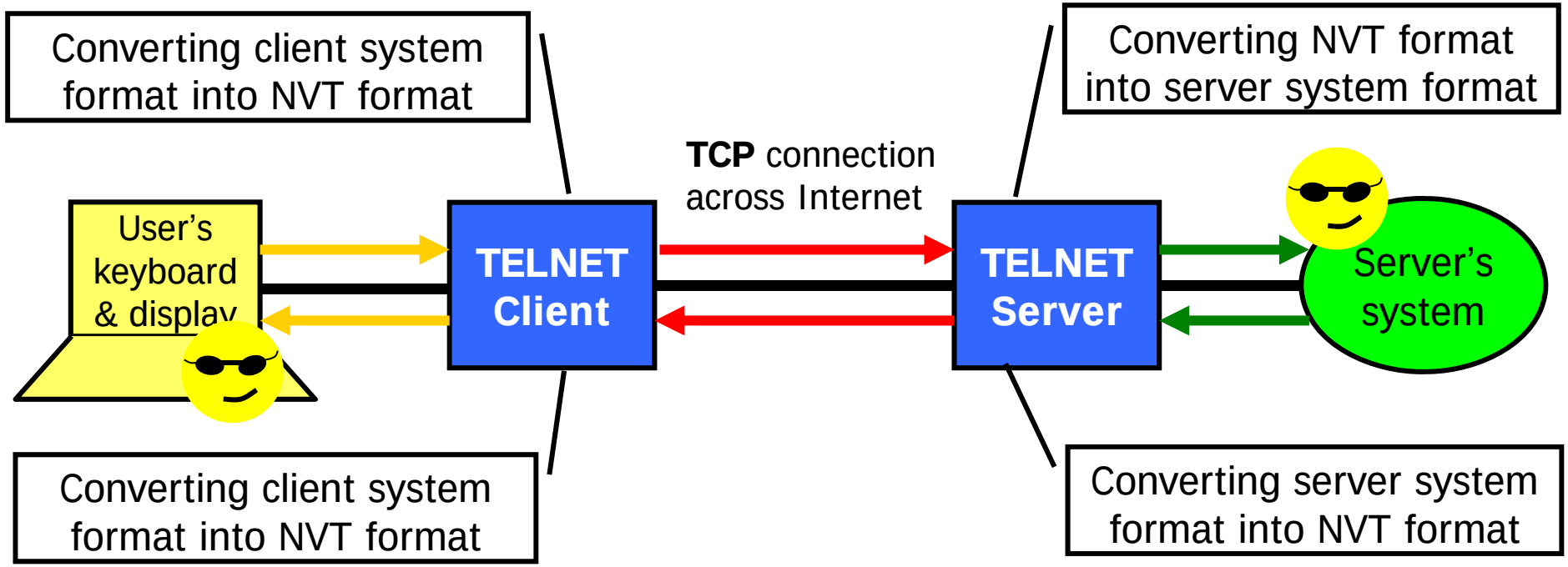


Network Virtual Terminal

- The approach to solve the problem of lack of a common language was to define a common language
  - Virtual terminal protocol (VTP)
- 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

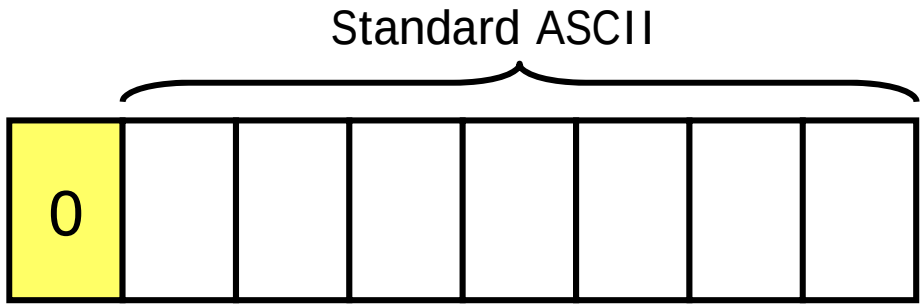
NVT Operation

- Accommodating heterogeneity

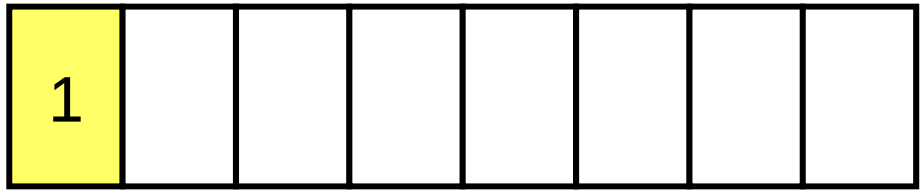


NVT Format

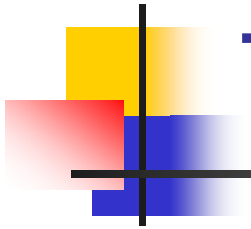
- NVT use two sets of characters: data and control
- Format of data characters



- Format of control characters



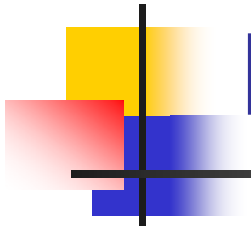
TELNET Operations



TELNET Operations

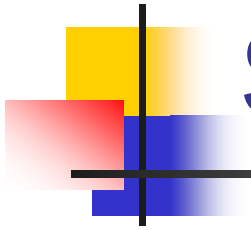
- Connection management
  - Connection request, establish and terminate
  - Telnet uses TCP (port 23) by default
- Negotiation
  - To determine mutually agreeable set of characteristics and options
- Exchange of control information (e.g. end of line), commands and transfer of data between two correspondents
- A typical telnet session is 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.edu.cn”

TELNET Protocol



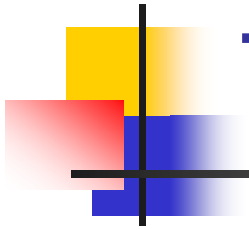
Related RFCs

- 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 - provides a standard language for communication of terminal control functions

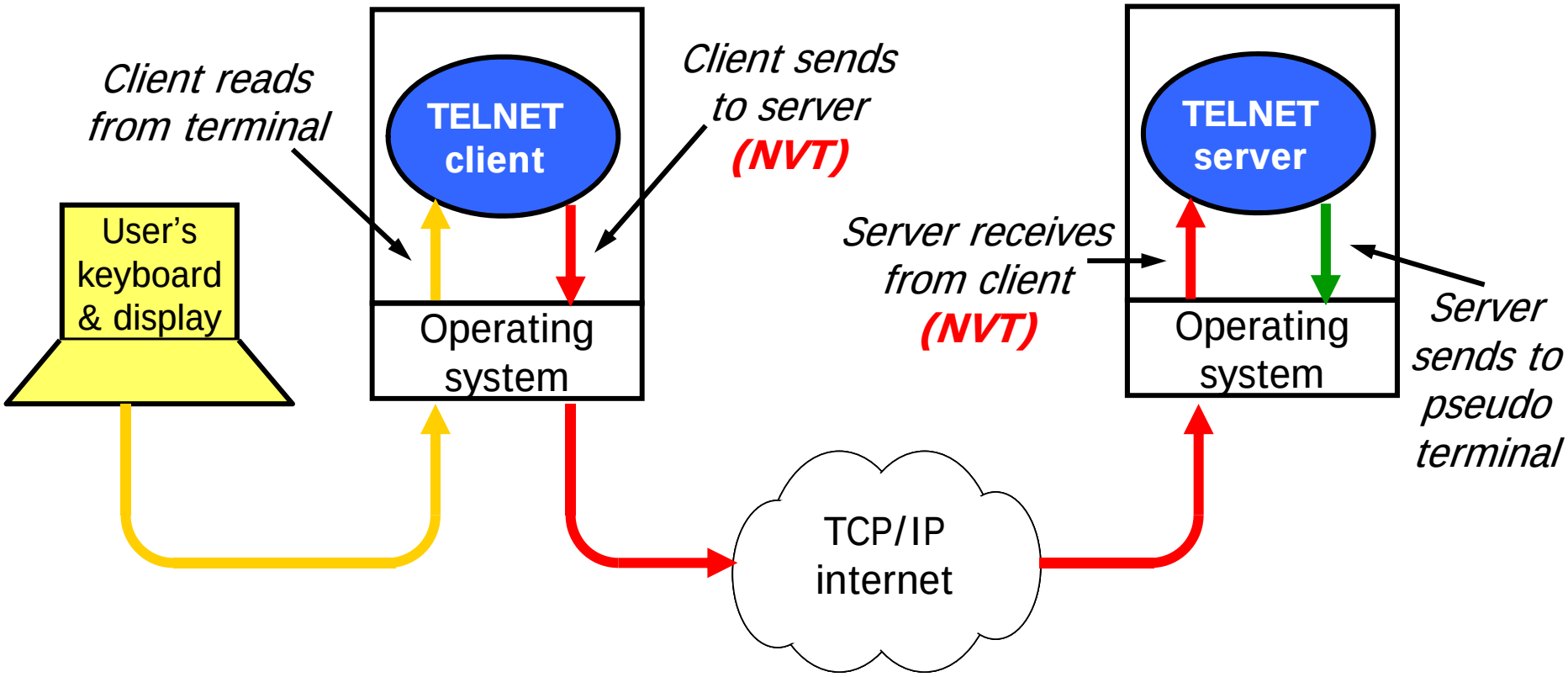


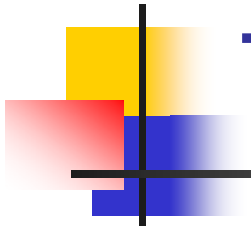
TELNET Protocol

- Transmission of data
- Standard representation of control functions

Transmission Of Data (1)

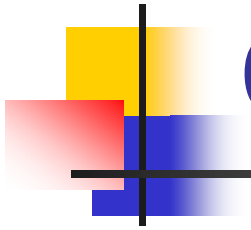
- Data path from the user's keyboard to the remote system





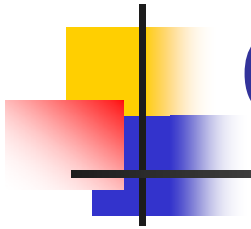
Transmission Of Data (2)

- Data sent half-duplex
  - Terminal-to-process, newline signifies end of user input
  - Process-to-terminal, Telnet Go Ahead(GA) signal used
- Underlying TCP full duplex
  - Control signals sent any time regardless of current data direction
- 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



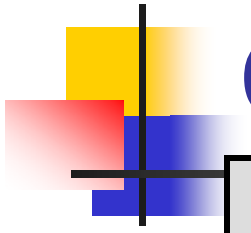
Control Functions (1)

- 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



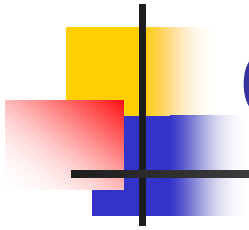
Control Functions (2)

- 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

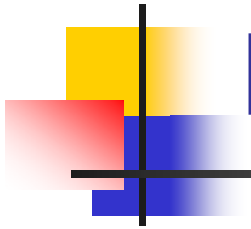
- TELNET command structure
  - at least a two byte sequence: the IAC (Interpret as Command) escape character followed by the code for the command
- The IAC code is 255
  - If a 255 is sent as data - it must be followed by another 255
- Looking for a command
  - Each receiver must look at each byte that 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

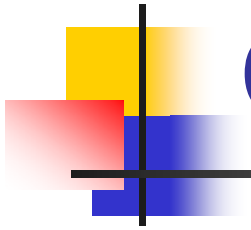
Sender	Receiver	Meaning
WILL →	← DO	Sender wants to active a option, and receiver agrees
WILL →	← DON'T	Sender wants to active a option, and receiver refuses
DO →	← WILL	Sender wants receiver to active a option, and receiver agrees
DO →	← WONT	Sender wants receiver to active a option, and receiver refuses

TELNET Options Negotiation



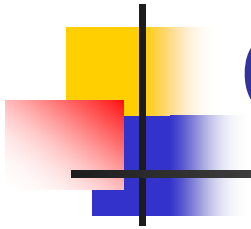
Motivations

- All NVTs support a minimal set of capabilities
- Some terminals have more capabilites 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

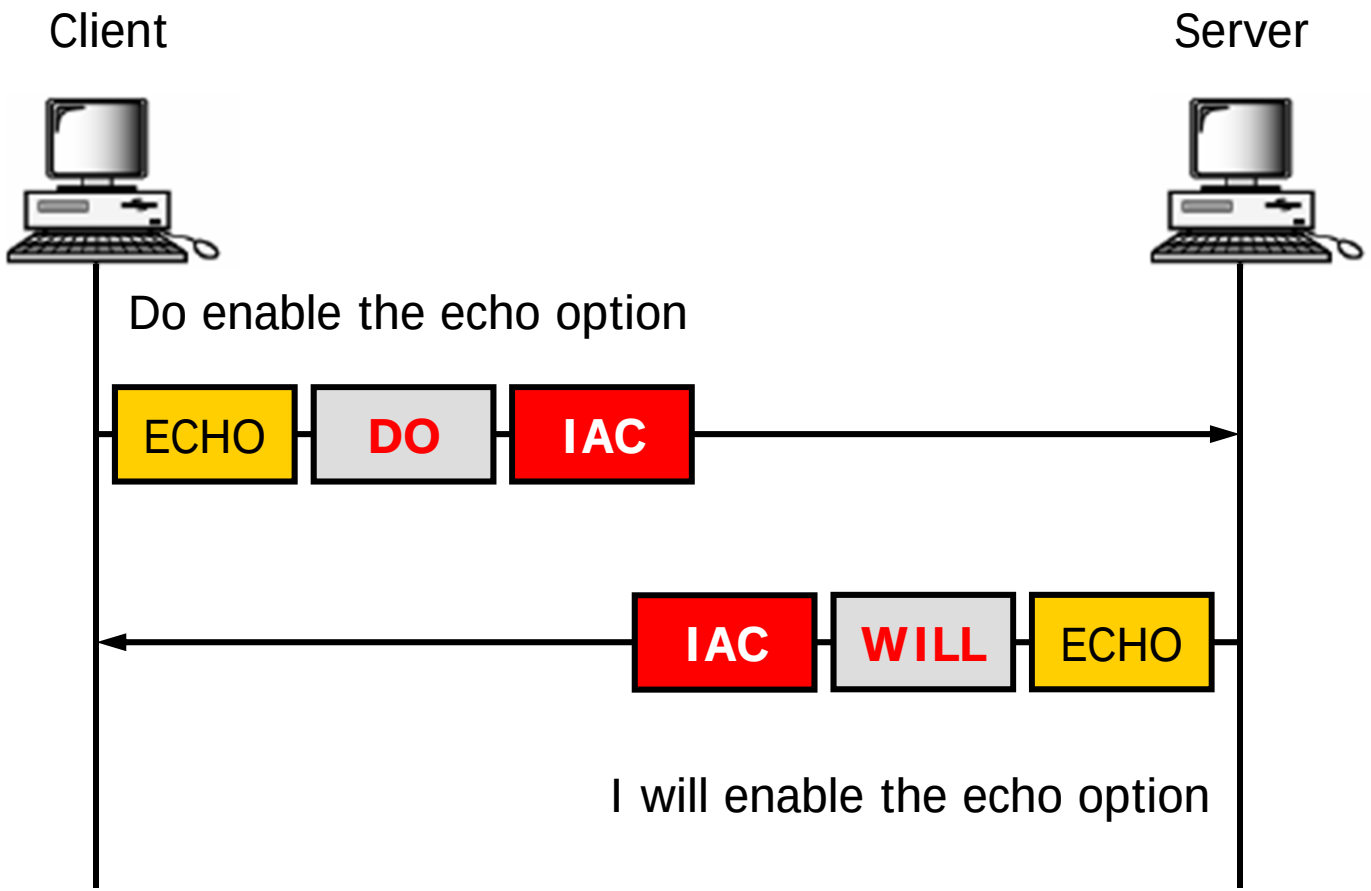
- echo modes
  - Keyboard input be echoed on the terminal side or not
- Line mode vs. character mode
  - One line or one character per transmission
- character set (EBCDIC vs. ASCII)
  - EBCDIC - Extended Binary-Coded Decimal Interchange Code
  - ASCII - American Standard Code for Information Interchange



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)

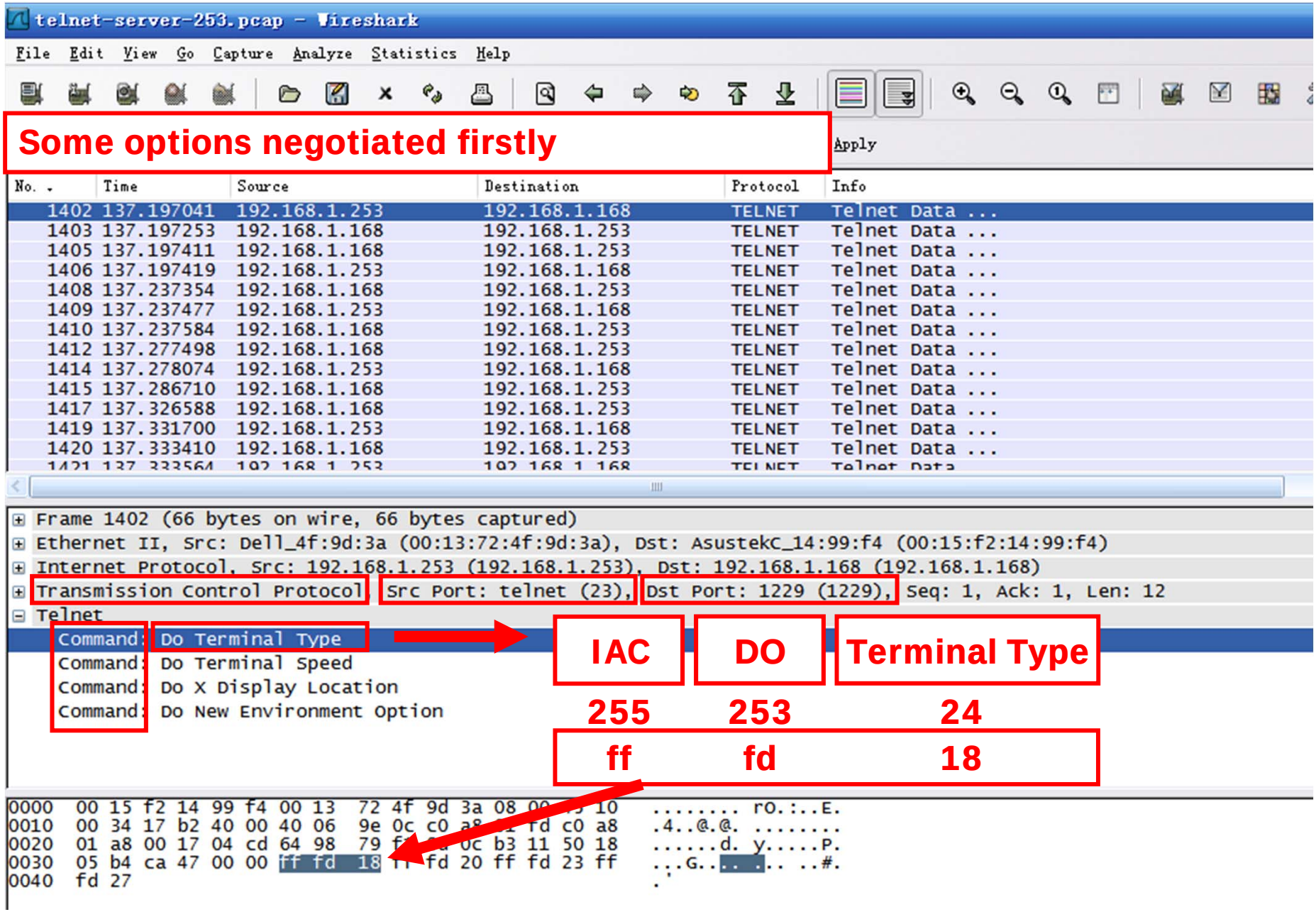
Option	Name	References
0	Binary Transmission	RFC 856
1	Echo	RFC 857
2	Reconnection	NIC 50005
3	Suppress Go Ahead	RFC 858
4	Approx Message Size Negotiation	ETHERNET
5	Status	RFC 859
6	Timing Mark	RFC 860
7	Remote Controlled Trans and Echo	RFC 726
8	Output Line Width	NIC 50005
9	Output Page Size	NIC 50005
10	Output Carriage-Return Disposition	RFC 652
11	Output Horizontal Tab Stops	RFC 653
12	Output Horizontal Tab Disposition	RFC 654
13	Output Formfeed Disposition	RFC 655
14	Output Vertical Tabstops	RFC 656
15	Output Vertical Tab Disposition	RFC 657
16	Output Linefeed Disposition	RFC 658
17	Extended ASCII	RFC 698
18	Logout	RFC 727
19	Byte Macro	RFC 735

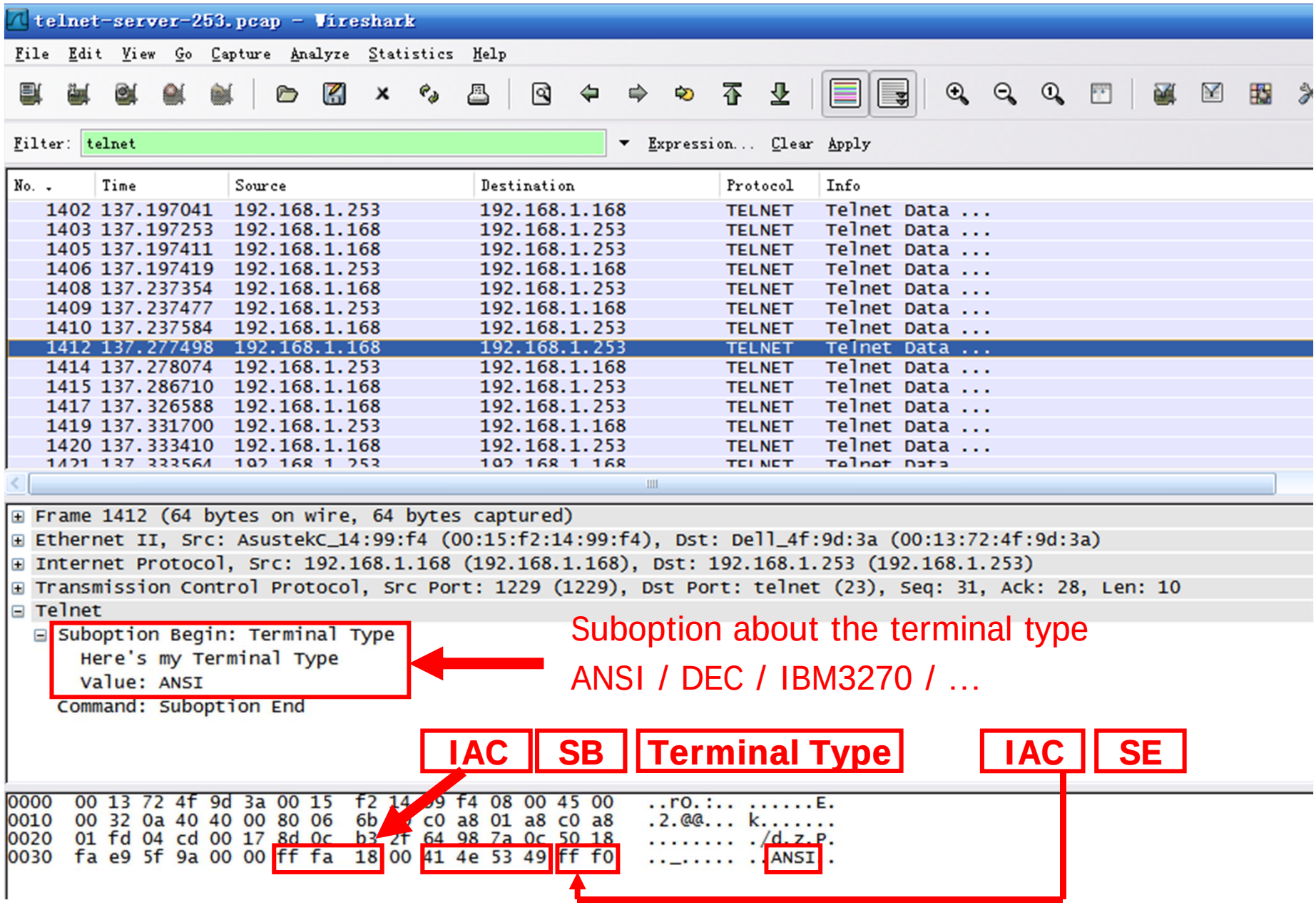
TELNET Options List (2)

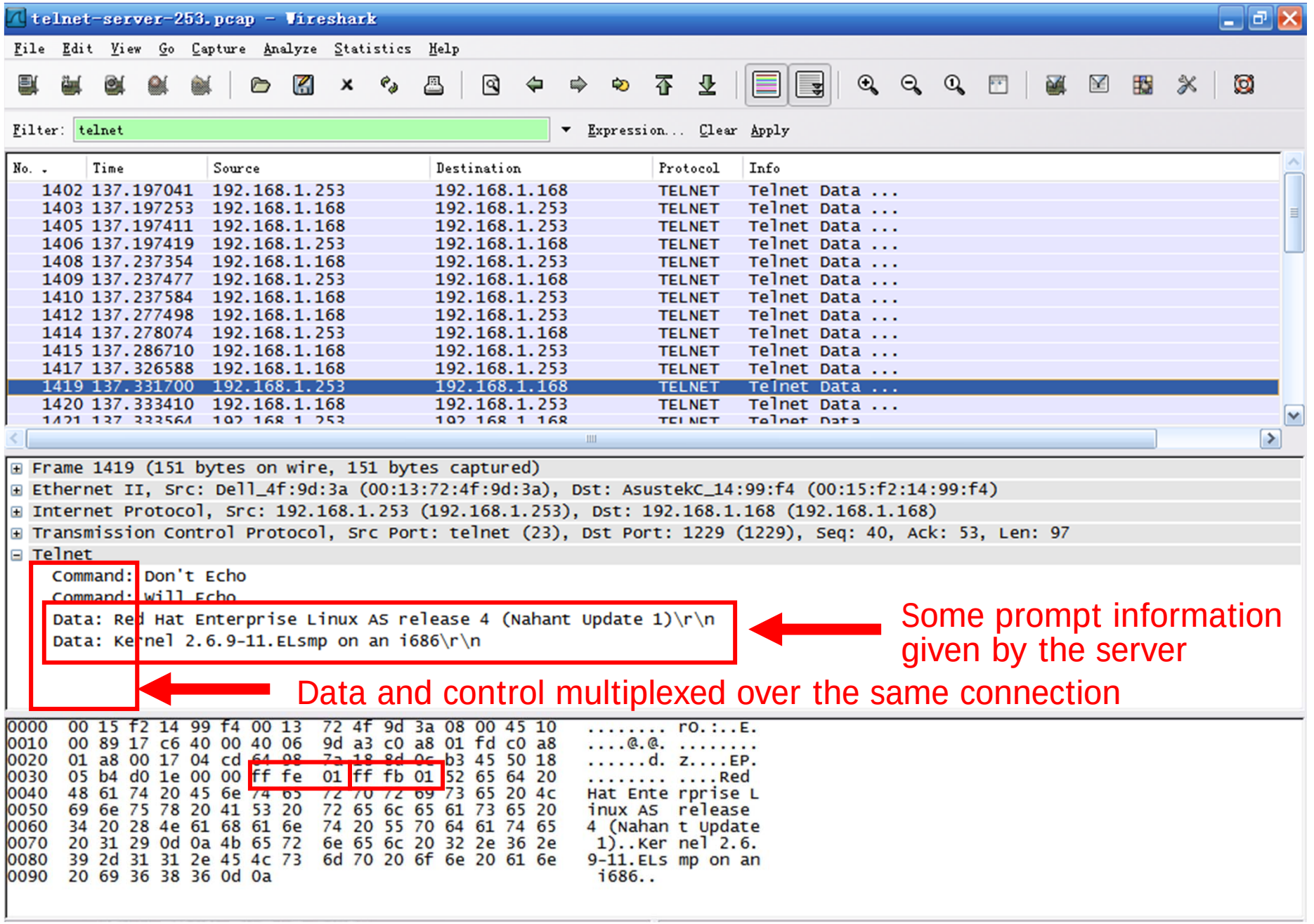
Option	Name	References
20	Data Entry Terminal	RFC 1043, RFC 732
21	SUPDUP	RFC 736, RFC 734
22	SUPDUP Output	RFC 749
23	Send Location	RFC 779
24	Terminal Type	RFC 1091
25	End of Record	RFC 885
26	TACACS User Identification	RFC 927
27	Output Marking	RFC 933
28	Terminal Location Number	RFC 946
29	Telnet 3270 Regime	RFC 1041
30	X.3 PAD	RFC 1053
31	Negotiate About Window Size	RFC 1073
32	Terminal Speed	RFC 1079
33	Remote Flow Control	RFC 1372
34	Linemode	RFC 1184
35	X Display Location	RFC 1096
36	Environment Option	RFC 1408
37	Authentication Option	RFC 2941
38	Encryption Option	RFC 2946

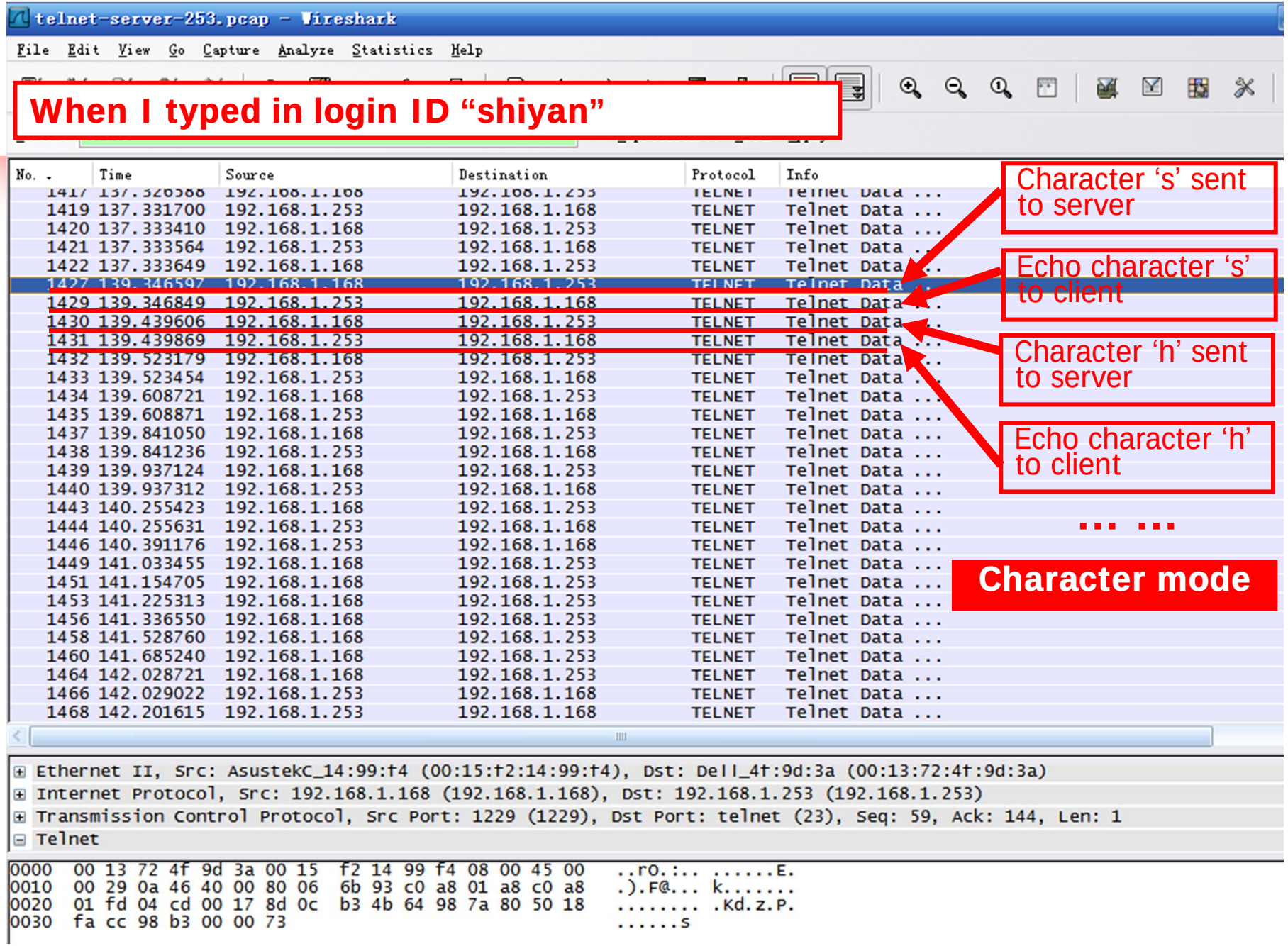
A Telnet Session Example (1)

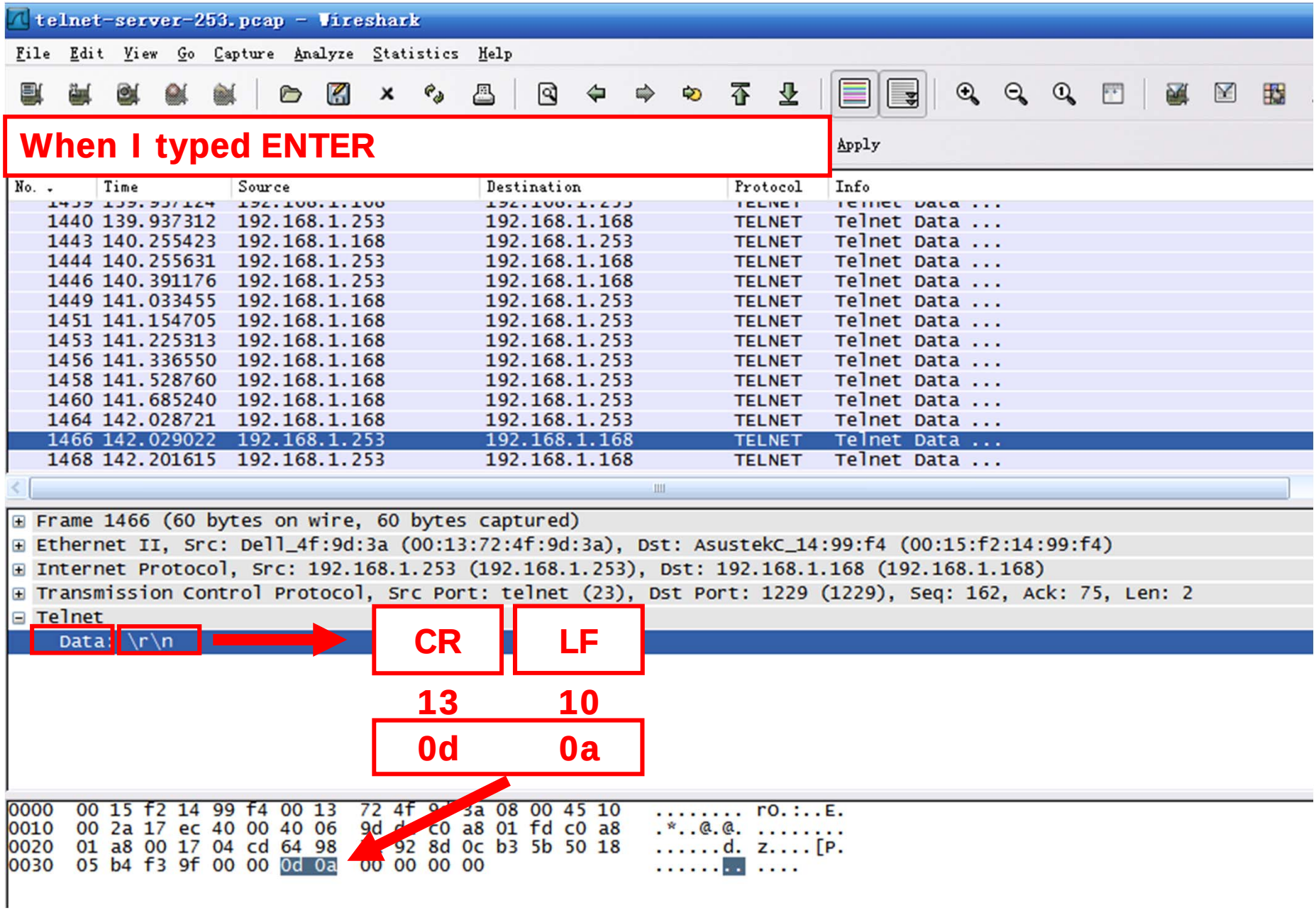
```
C:\Documents and Settings\Administrator> telnet 192.168.1.253
Red Hat Enterprise Linux AS release 4 <Nahant Update 1>
Kernel 2.6.9-11.Elsmp on an i686
Login: shiyan
Password:
Last login: Sun Nov 11 17:48:30 from 192.168.1.168
[shiyan@localhost ~]$
```

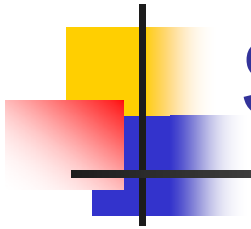

telnet-server-253.pcap - Wireshark
File Edit View Go Capture Analyze Statistics Help
Apply
Some options negotiated firstly
No. Time Source Destination Protocol Info
1402 137.197041 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1403 137.197253 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1405 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..

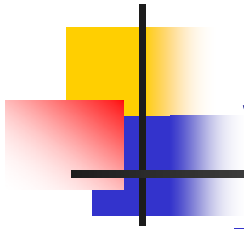

telnet-server-253.pcap - Wireshark
File Edit View Go Capture Analyze Statistics Help
When I typed in login ID "shiyan"
No. Time Source Destination Protocol Info
1419 137.331700 192.168.1.253 192.168.1.168 TELNET Telnet Data ...
1420 137.333410 192.168.1.168 192.168.1.253 TELNET Telnet Data ...
1421 137.333564 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 typed 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 d5 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

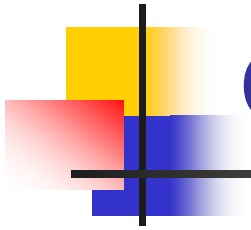
- Use Internet accounts you may have on remote computers
  - you need an account (login ID) and password on the remote computer to permit access
- Use free services accessible with telnet, e.g.
  - library catalogues
  - databases
  - BBS (Bulletin Board System)



Summary (2) – Disadvantages of telnet

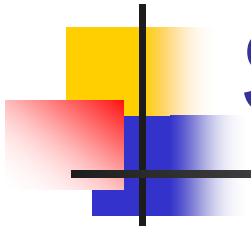
- Poor user interface
  - Based on dumb terminal
  - Text-only display
  - Monochrome
    - One color for text, one for background
  - Have to type command-line commands
    - Often have complex syntax
  - Not very secure, SSH made enhancement
    - TELNET does not encrypt any data sent over the connection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

Other Remote Access Technologies



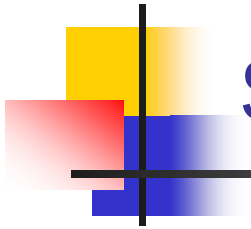
Other Remote Access Technologies

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



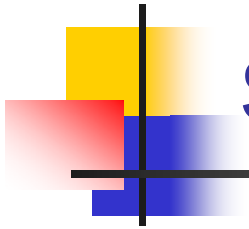
SSH (1) – brief information

- 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

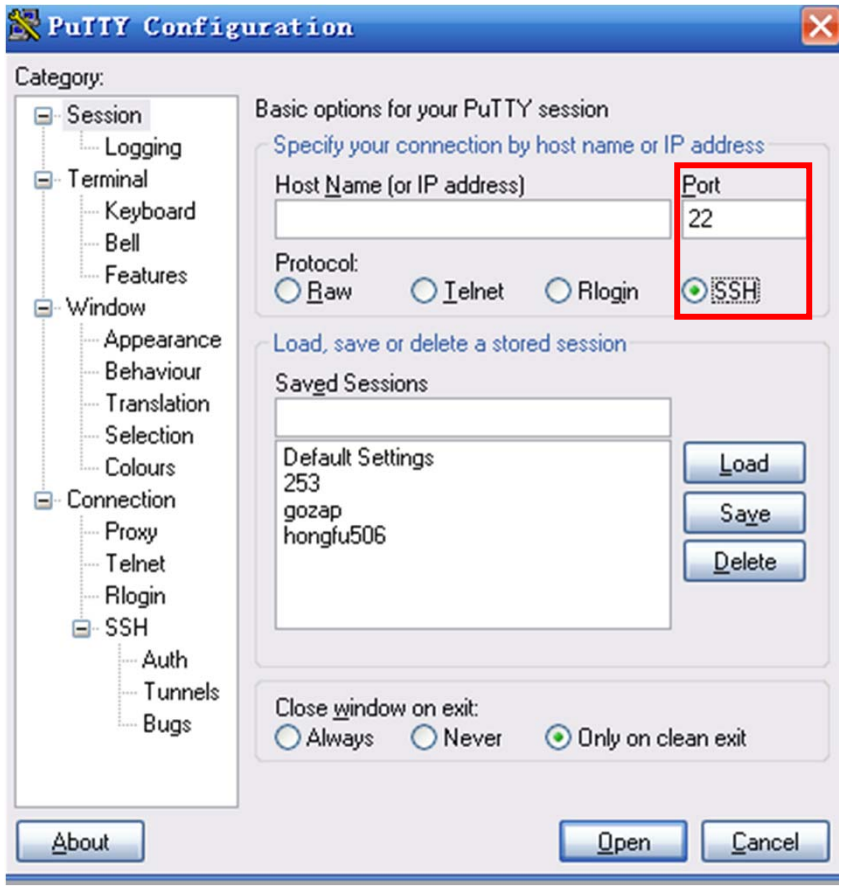


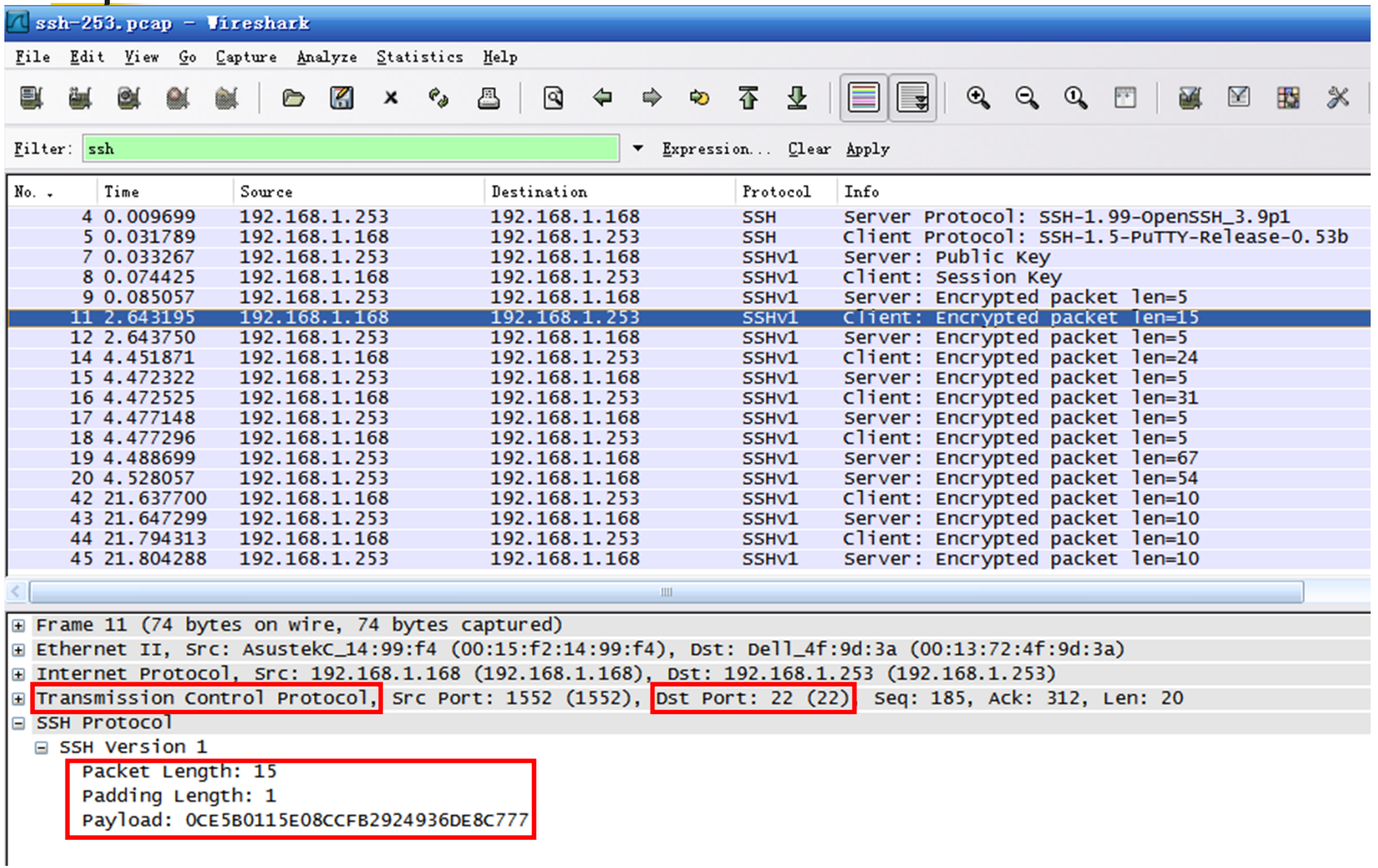
SSH (3) – three major mechanisms

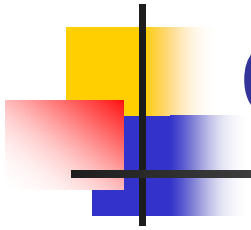
- A transport layer protocol (SSH-TRANS) that provides sever authentication, data confidentiality, and data integrity with perfect forward secrecy
- A user authentication protocol (SSH-USERAUTH) that authenticates the user to the server
- A connection protocol (SSH-CONNECT) that multiplexes multiple logical communications channels over a single underlying SSH connection
  - Port forwarding, could be used as a secure tunnel

SSH (4) – tools

- PuTTY

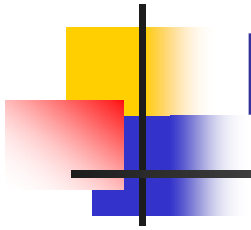



ssh-253.pcap - Wireshark
File Edit View Go Capture Analyze Statistics Help
Filter: ssh
Expression... Clear Apply
No. Time Source Destination Protocol Info
4 0.009699 192.168.1.253 192.168.1.168 SSH Server Protocol: SSH-1.99-OpenSSH_3.9p1
5 0.031789 192.168.1.168 192.168.1.253 SSH Client Protocol: SSH-1.5-PuTTY-Release-0.53b
7 0.033267 192.168.1.253 192.168.1.168 SSHv1 Server: Public Key
8 0.074425 192.168.1.168 192.168.1.253 SSHv1 Client: Session Key
9 0.085057 192.168.1.253 192.168.1.168 SSHv1 Server: Encrypted packet len=5
11 2.643195 192.168.1.168 192.168.1.253 SSHv1 Client: Encrypted packet len=15
12 2.643750 192.168.1.253 192.168.1.168 SSHv1 Server: Encrypted packet len=5
14 4.451871 192.168.1.168 192.168.1.253 SSHv1 Client: Encrypted packet len=24
15 4.472322 192.168.1.253 192.168.1.168 SSHv1 Server: Encrypted packet len=5
16 4.472525 192.168.1.168 192.168.1.253 SSHv1 Client: Encrypted packet len=31
17 4.477148 192.168.1.253 192.168.1.168 SSHv1 Server: Encrypted packet len=5
18 4.477296 192.168.1.168 192.168.1.253 SSHv1 Client: Encrypted packet len=5
19 4.488699 192.168.1.253 192.168.1.168 SSHv1 Server: Encrypted packet len=67
20 4.528057 192.168.1.253 192.168.1.168 SSHv1 Server: Encrypted packet len=54
42 21.637700 192.168.1.168 192.168.1.253 SSHv1 Client: Encrypted packet len=10
43 21.647299 192.168.1.253 192.168.1.168 SSHv1 Server: Encrypted packet len=10
44 21.794313 192.168.1.168 192.168.1.253 SSHv1 Client: Encrypted packet len=10
45 21.804288 192.168.1.253 192.168.1.168 SSHv1 Server: Encrypted packet len=10
Frame 11 (74 bytes on wire, 74 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: 1552 (1552), Dst Port: 22 (22), Seq: 185, Ack: 312, Len: 20
SSH Protocol
SSH Version 1
Packet Length: 15
Padding Length: 1
Payload: 0CE5B0115E08CCFB2924936DE8C777



Other Ways Of Remote Access

- Except telnet, there are other ways
  - rlogin family utility
  - VNC (Virtual network computing)
  - RDP (Remote Desktop Protocol)
- Comparison with Telnet



Helpful URLs

- RFCs
  - http://www.ietf.org/
- Useful utilities
  - http://bj.onlinedown.net/sort/50_1.htm
  - http://winfiles.search.com/search?cat=316&tag=ex.sa.fd.srch.wf&q=TELNET
- About telnet
  - http://www.52dot.com/other/network/TELNET/
- About SSH
  - http://www.ssh.com
  - http://www.openssh.org
- About realVNC
  - http://www.realvnc.com/