

Stock Market

The background is a dark blue gradient with a faint, glowing grid of financial data. A prominent white line chart, representing a stock price index, trends upwards from the bottom left towards the top right. The chart shows some volatility with minor dips and peaks. The grid consists of various numbers in a light blue font, some of which are partially obscured by the chart line.

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Introduction:

- As our final programming project, we chose to implement a protocol that resembles a real-time functioning stock server.
- Stocks can be bought and sold by clients connected to the server.
- Each client has its own private portfolio, that can only be accessed by him, using a unique username and password.
- New up-to-date offers are sent periodically to all clients.

Functionality:

- **Authentication: (Over TCP)**
Divided into two steps:

Step 1 – **Registration:**
A new client sends a username, password and amount of money to assign to his portfolio, an **Ack** message is sent if the username is free to use and **X** otherwise.

Step 2 – **Login:**
After registration, a client may connect to his portfolio using the username and password he has chosen. After examining the data an **Ack**, **X** or **Full** message is sent back to the client, if successful the client will receive the server's multicast IP and will be logged in.
- **Display: (Over TCP)**
A **Get** message is sent from a client to the server, which sends back a full report on the client's current state including his balance, stock shares and his current profit.
If successful the client will return a **Yes** message, else a **No**.
- **Updates: (Multicast over UDP, State change is done over TCP)**
An **M** message is sent from a client to the server, indicating he is currently observing the multicast updates, when the client wishes to exit this state an **m** message is sent back to the server.
- **Transactions: (Over TCP)**
A **Buy/Sell** offer is sent to the server including the stock number, units to buy/sell and price per unit . The server will then check if such an offer is valid and will reply with **V** for a valid offer or an **I** for an invalid offer, if the offer is valid it is added to the buying/selling offers array.

Networking:

- TCP – A reliable TCP connection is implemented with every client entering the server independently, our server can handle up to 50 clients.
- Multicast – Each client connected to the server joins the multicast group and listens for incoming reports, IP - 239.0.0.1.
- All sockets are handled with care, clients connecting will be assigned a socket and once left the socket will be closed.
- Each Undefined message received by client or server is handled by disconnecting the troublesome client or leaving the server, depends on the receiving end.
- When an old update is received in the multicast (old sequence number), it is discarded by the clients.
- Clients are not allowed to be idle more than 45 seconds disregarding the case of observing upcoming updates, if so, a client will be kicked out.
- Both cases of a server or a client shutting down unexpectedly is handled.
- Both select and threads are used in our implementation.

Screenshots:

```
Welcome to our stock market!
```

```
-----  
[+] Are you new here? Press 'R' to register and start investing today!  
[+] Already have an account? Press 'L' to login  
[-] If do you wish to leave, Press 'Q'  
R
```

```
[+] Enter a username up to 8 characters: USER  
[+] Enter a password up to 8 characters: 1234  
[+] How much money are you willing to invest? (U.S. Dollars): 56435.83
```

```
Registration Successful!  
You may now log in your account
```

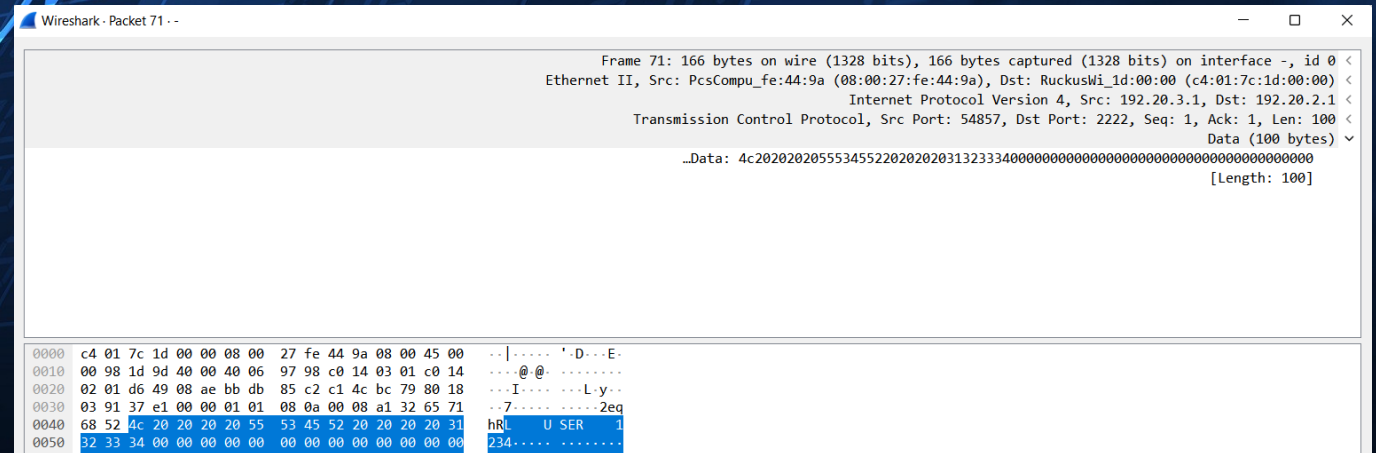
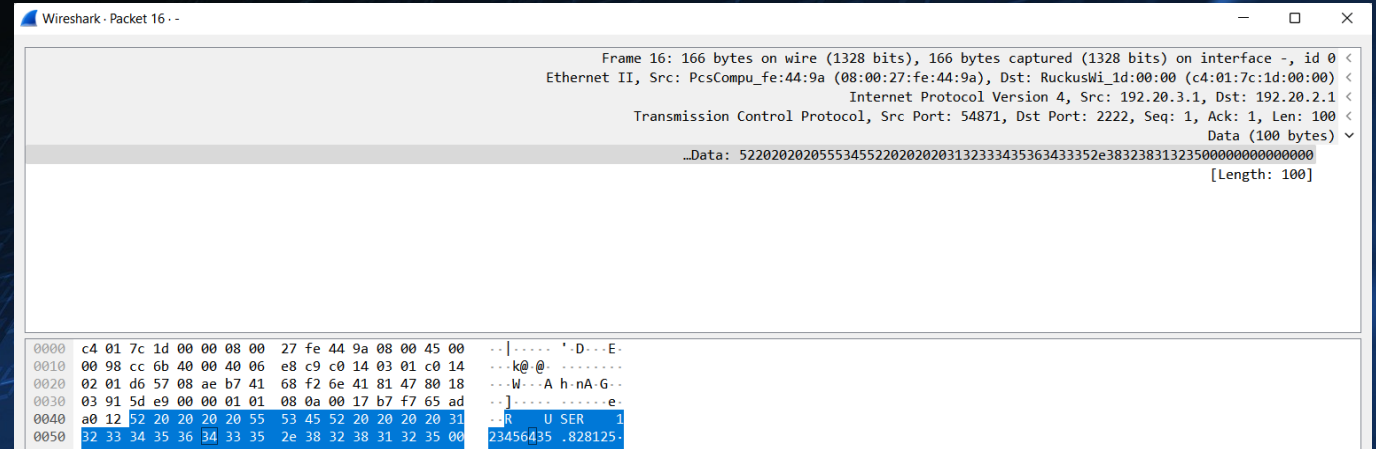
```
[+] Are you new here? Press 'R' to register and start investing today!  
[+] Already have an account? Press 'L' to login  
[-] If do you wish to leave, Press 'Q'  
L
```

```
Login Interface:  
[+] Username: USER  
[+] Password: 1234
```

```
Login Successful
```

```
Welcome Back, USER.  
[+] Your Account Balance is: 56435.83  
[-] Your portfolio is empty! Make sure you don't miss good opportunities...
```

```
Main Menu:  
-----  
[1] Display Full Investment Portfolio & Account Details  
[2] Real-Time Stock Prices  
[3] Buy/Sell Stocks  
[4] Exit
```



Screenshots:

```
Username: USER
Balance: 48027.83

-----
Portfolio:

1. Stock-Name: Apple Inc.      | Units: 1

   Current Price Per Unit: 2778.00
   Buying Price Per Unit: 2778.00
   Stock Total Profit: 0.00
-----

2. Stock-Name: Bank Of America | Units: 18

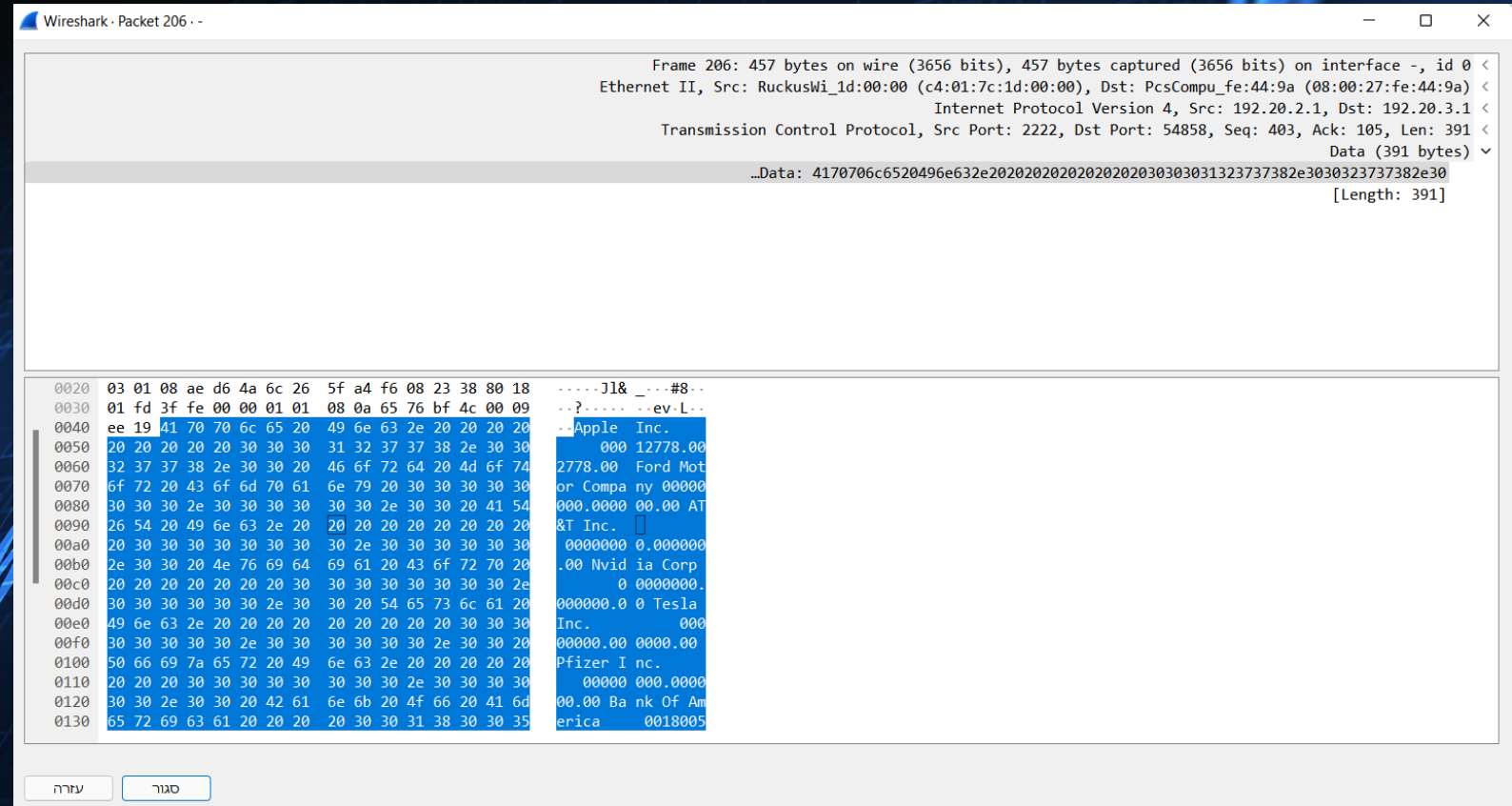
   Current Price Per Unit: 70.00
   Buying Price Per Unit: 59.00
   Stock Total Profit: 198.00
-----

3. Stock-Name: Amazon Inc.     | Units: 2

   Current Price Per Unit: 2284.00
   Buying Price Per Unit: 2284.00
   Stock Total Profit: 0.00
-----

Total Investment Portfolio Profit: 198.00
-----

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```



Screenshots:

```
Stock: Tesla Inc.
Current Price: 2687.00
Current Minimum Ask: 25 Units In Price Of 2687.00 Each.
Current Maximum Bid: -- Currently There Are No Bid Offers --

Stock: Pfizer Inc.
Current Price: 1601.00
Current Minimum Ask: 22 Units In Price Of 1601.00 Each.
Current Maximum Bid: -- Currently There Are No Bid Offers --

Stock: Bank Of America
Current Price: 70.00
Current Minimum Ask: -- Currently There Are No Ask Offers --
Current Maximum Bid: -- Currently There Are No Bid Offers --

Stock: Intel Corp
Current Price: 2682.00
Current Minimum Ask: 92 Units In Price Of 2682.00 Each.
Current Maximum Bid: -- Currently There Are No Bid Offers --

Stock: Cisco Systems
Current Price: 2415.00
Current Minimum Ask: 53 Units In Price Of 2415.00 Each.
Current Maximum Bid: 21 Units In Price Of 53.00 Each.

Stock: Amazon Inc.
Current Price: 2284.00
Current Minimum Ask: 95 Units In Price Of 2284.00 Each.
Current Maximum Bid: -- Currently There Are No Bid Offers --

Last update: 18:36:01

** Press 'Enter' To Return To Main Menu **
```

Wireshark - Packet 1 - -

Frame 1: 537 bytes on wire (4296 bits), 537 bytes captured (4296 bits) on interface -, id 0 < Ethernet II, Src: RuckusWi_1d:00:00 (c4:01:7c:1d:00:00), Dst: IPv4mcast_01 (01:00:5e:00:00:01) < Internet Protocol Version 4, Src: 192.20.2.1, Dst: 239.0.0.1 < User Datagram Protocol, Src Port: 59966, Dst Port: 6000 < Data (495 bytes) <

Offset	Hex	ASCII
0000	01 00 5e 00 00 01 c4 01 7c 1d 00 00 08 00 45 00	..^....E-
0010	02 0b 6a b0 40 00 3e 11 1f 1b c0 14 02 01 ef 00	..j.@.>.....
0020	00 01 ea 3e 17 70 01 f7 9a ce 41 70 70 6c 65 20	...>.p... Apple
0030	49 6e 63 2e 20 20 20 20 20 20 20 20 00 30 31	Inc. .01
0040	31 37 32 37 37 38 2e 30 30 2d 2d 2d 2d 2d 2d	172778.0 0-----
0050	2d 2d 2d 2d 32 37 37 38 2e 30 30 46 6f 72 64 20	----2778 .00Ford
0060	4d 6f 74 6f 72 2d 2d 43 6f 6d 70 61 6e 79 20 00 30	Motor Co mpany .0
0070	30 38 38 30 39 33 30 2e 30 30 2d 2d 2d 2d 2d 2d	0880930. 00-----
0080	2d 2d 2d 2d 2d 30 39 33 30 2e 30 30 41 54 26 54	-----093 0.00AT&T
0090	20 49 6e 63 2e 20 20 20 20 20 20 20 20 00 00 00	Inc. .
00a0	30 30 35 38 30 30 30 38 2e 30 30 2d 2d 2d 2d 2d	00580008 .00-----
00b0	2d 2d 2d 2d 2d 2d 30 30 30 38 2e 30 30 4e 76 69	-----00 08.00Nvi
00c0	64 69 61 20 43 6f 72 70 20 20 20 20 20 20 20 20	dia Corp
00d0	00 30 30 39 36 30 38 32 34 2e 30 30 2d 2d 2d 2d	.0096082 4.00----
00e0	2d 2d 2d 2d 2d 2d 30 38 32 34 2e 30 30 54 65	-----0 824.00Te
00f0	73 6c 61 20 49 6e 63 2e 20 20 20 20 20 20 20 20	sla Inc.
0100	20 00 30 30 32 35 32 36 38 37 2e 30 30 2d 2d 2d	.002526 87.00---
0110	2d 2d 2d 2d 2d 2d 2d 32 36 38 37 2e 30 30 50	----- 2687.00P
0120	66 69 7a 65 72 20 49 6e 63 2e 20 20 20 20 20 20	fizer In c.
0130	20 20 00 30 30 32 32 31 36 30 31 2e 30 30 2d 2d	.00221 601.00--
0140	2d 2d 2d 2d 2d 2d 2d 2d 31 36 30 31 2e 30 30	----- -1601.00
0150	42 61 6e 6b 20 4f 66 20 41 6d 65 72 69 63 61 20	Bank Of America
0160	20 20 20 00 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d
0170	2d 2d 2d 2d 2d 2d 2d 2d 2d 30 30 37 30 2e 30	----- --0070.0
0180	30 49 6e 74 65 6c 20 43 6f 72 70 20 20 20 20 20	0Intel C orp
0190	20 20 20 20 00 30 30 39 32 32 36 38 32 2e 30 30	.009 22682.00

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3

[+] Would you like to buy or sell? B/S B

[+] Enter Stock to buy/sell: 1

[+] Enter units to buy/sell: 3

[+] Enter price per unit: 77

Good deal! your offer is now online.

Wireshark · Packet 73 · -

Frame 73: 80 bytes on wire (640 bits), 80 bytes captured (640 bits) on interface -, id 0 <
Ethernet II, Src: PcsCompu_fe:44:9a (08:00:27:fe:44:9a), Dst: RuckusWi_1d:00:00 (c4:01:7c:1d:00:00) <
Internet Protocol Version 4, Src: 192.20.3.1, Dst: 192.20.2.1 <
Transmission Control Protocol, Src Port: 54872, Dst Port: 2222, Seq: 103, Ack: 403, Len: 14 <
Data (14 bytes) ▾
Data: 42303030303330303037372e303000
[Length: 14]

0000	c4 01 7c 1d 00 00 08 00	27 fe 44 9a 08 00 45 00	-- -----'-D---E-
0010	00 42 96 df 40 00 40 06	1e ac c0 14 03 01 c0 14	-B-@-@-
0020	02 01 d6 58 08 ae c5 92	a3 38 a3 ec 56 f9 80 18	...X-...-8-V...
0030	03 b2 98 6f 00 00 01 01	08 0a 00 18 53 43 65 af	...o-...-SCe-
0040	f1 6c 42 30 30 30 30 33	30 30 37 37 2e 30 30 00	-lB00003 0077.00-