



# A Student Oriented Toolkit to Study and Analyze Data Link Layer Protocols

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## Introduction

Without the aid of some visually representing tools, teaching the complex networking concepts and getting a good understanding of these ideas would be a difficult one. Therefore, it is essential to develop light-weight tools to explain the operations performed by these complex protocols, applications and systems. It is always true that experiments and projects are the most effective means for reinforcing the concepts taught in classes.

In this work, we have developed a light-weight, user friendly, advanced network practical tool so that the students and teachers can benefit by experimenting different data link layer protocols such as Go Back N, One bit Sliding window protocol, transport layer protocols such as TCP and UDP and watch them in execution.

## Objectives

Our approach involves ...

- Developing a component that can communicate with a similar component in remote machine (point-to-point/through a hub)-Socket
- Implementing protocols such as One Bit Sliding Window Protocol, Go-Back-N etc.
- Develop a component to simulate a practical scenario.
- Analyze the results.
- Present results with visual aids.

## Our Plan of Design

➤IP Layered architecture.

➤Socket programming concepts.

7. Application Layer
6. Presentation Layer
5. Session Layer
4. Transport Layer
3. Network Layer
2. Data Link Layer
1. Physical Layer

## Implemented DLL Protocols

### One Bit Sliding Window Protocol

- Stop-and-wait
- A protocol in which the sender sends one frame and then waits for an acknowledgement before proceeding.

### Go-back-N Protocol

- Sender's window size is N ( $>1$ )
  - At most N outstanding frames can be sent.
- Receiver's window size is one.
- After receiving a damaged frame receiver discards all subsequent frames.
- Sender retransmits the damaged frame and all its successors after the times out.

Example screen shots in Figures 1 and 2 show the dialogues between the sender and receiver for this application.

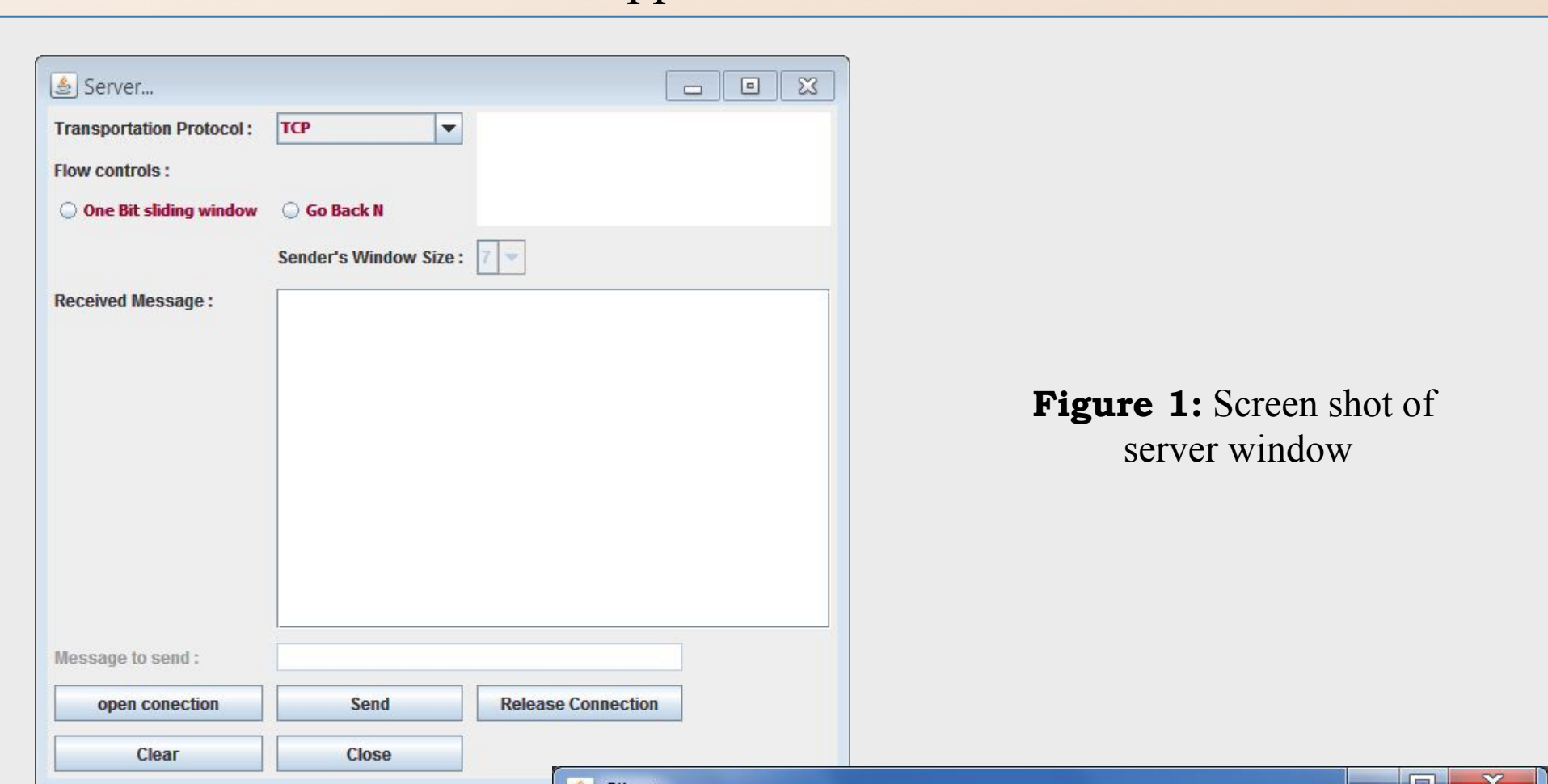


Figure 1: Screen shot of server window

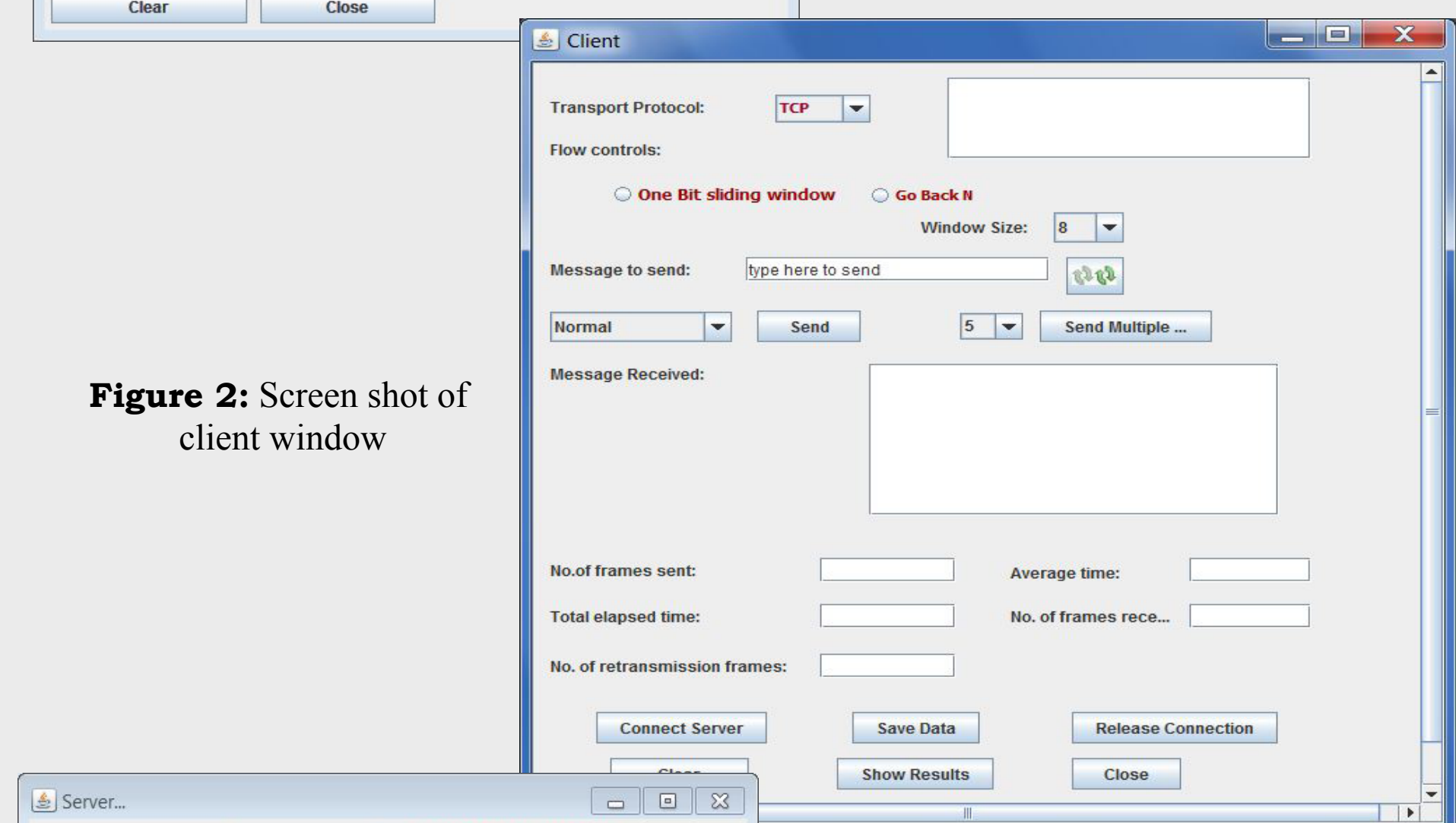


Figure 2: Screen shot of client window

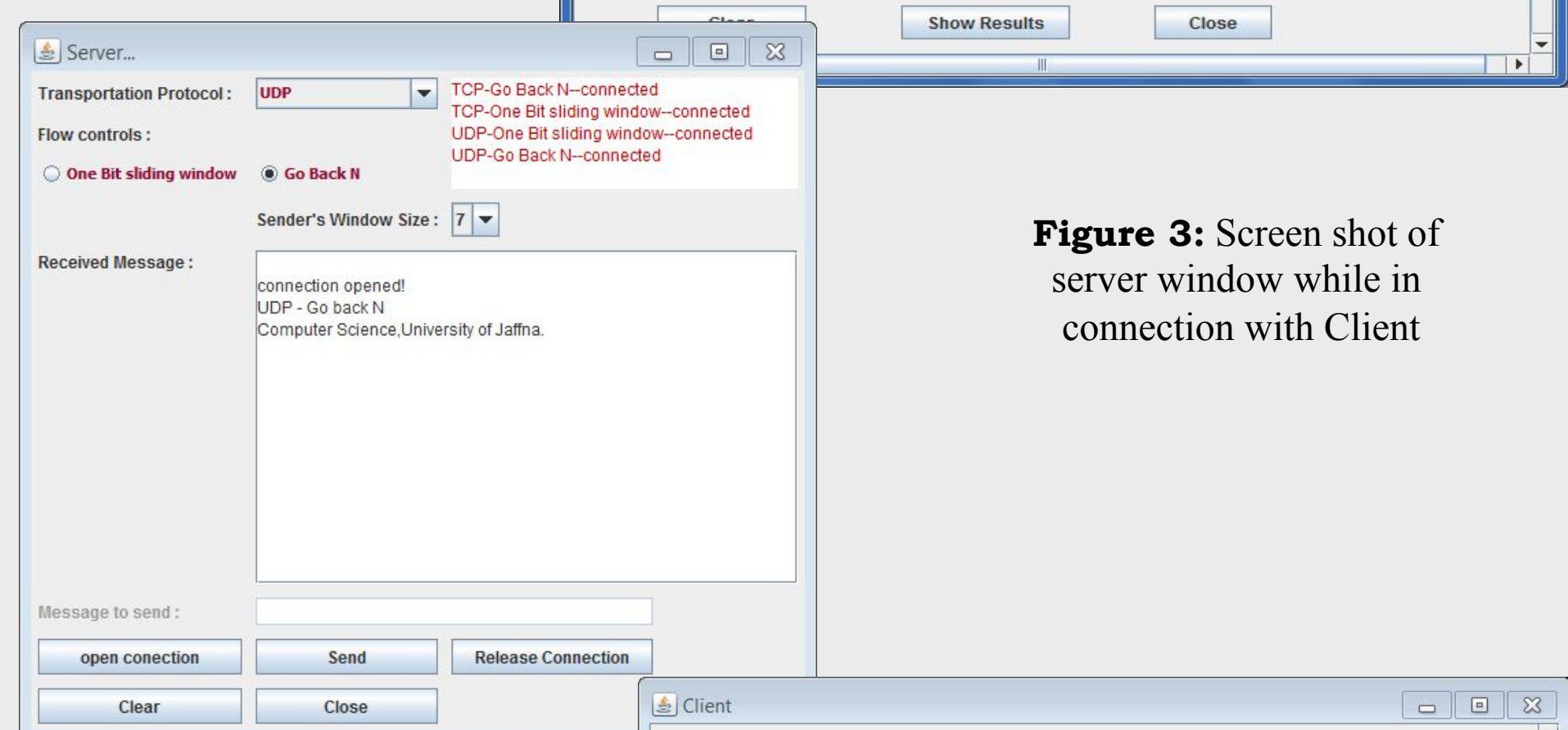


Figure 3: Screen shot of server window while in connection with Client

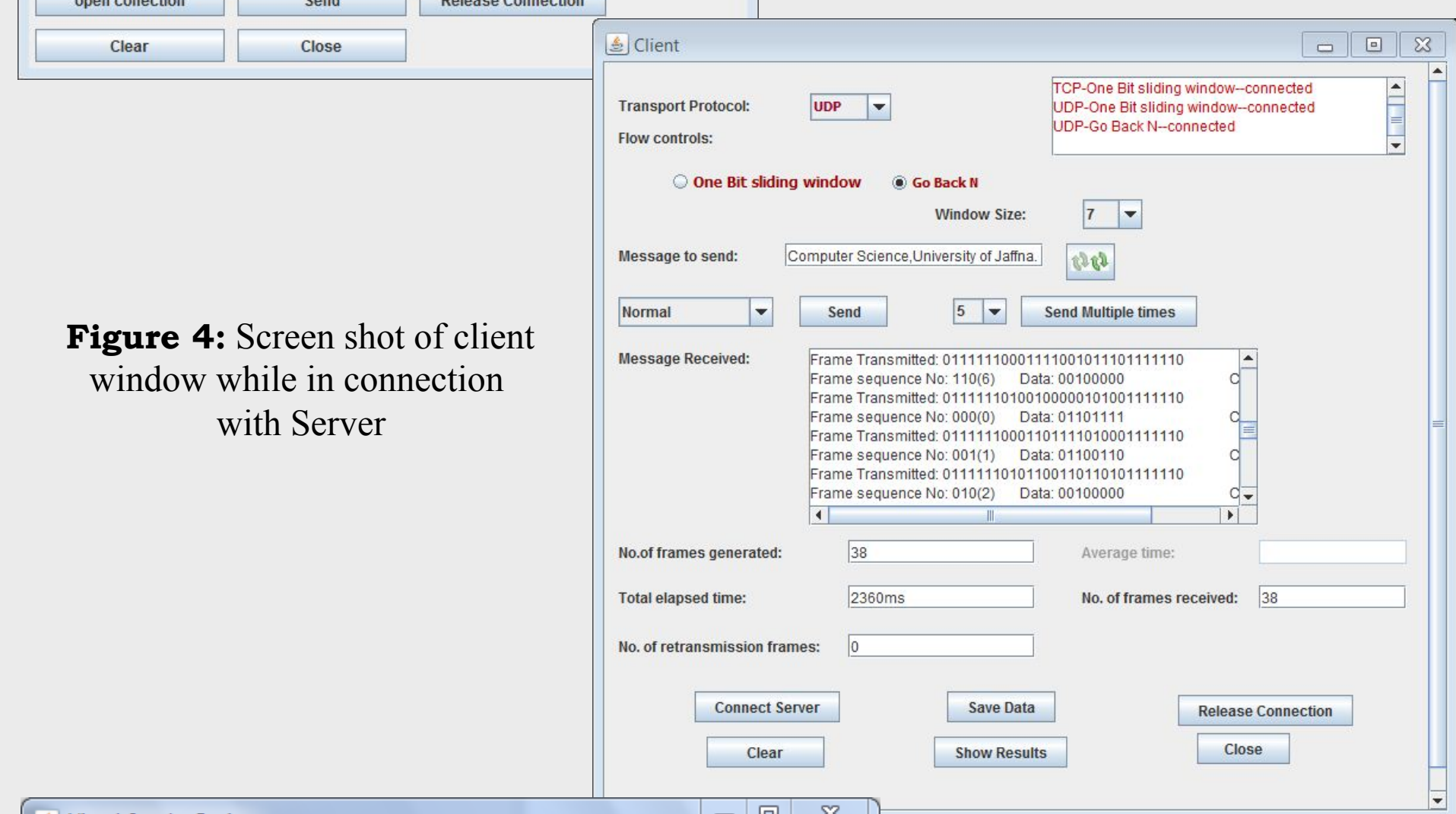


Figure 4: Screen shot of client window while in connection with Server

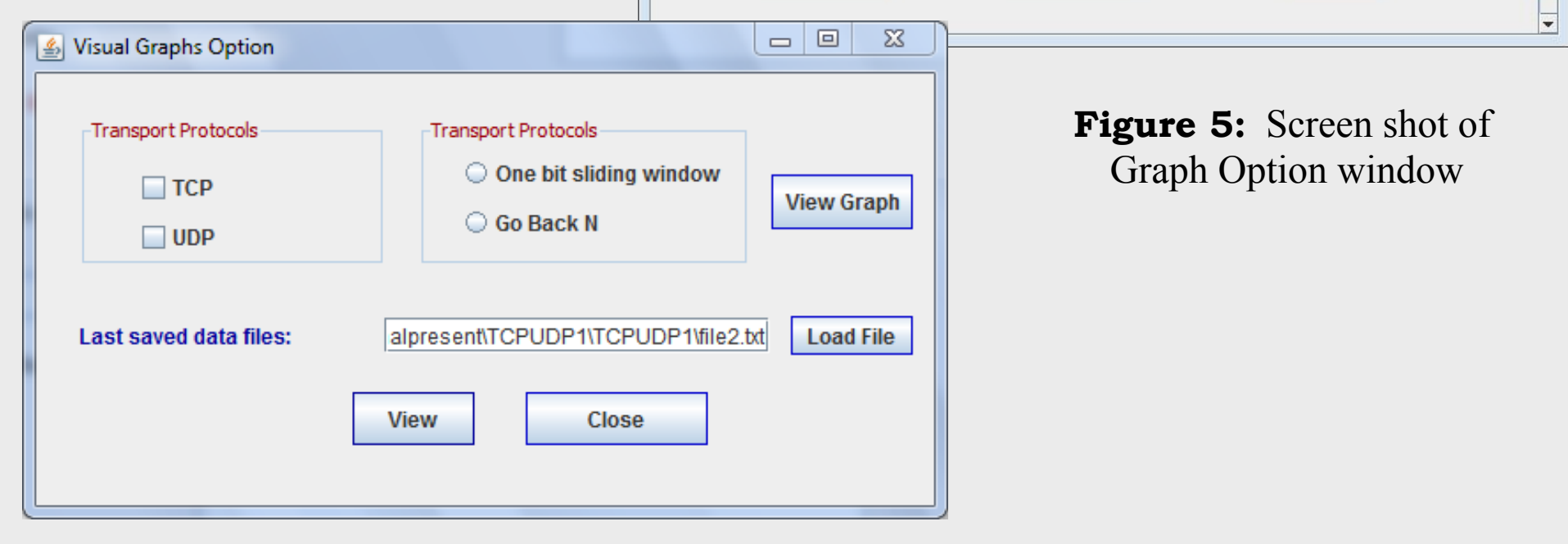


Figure 5: Screen shot of Graph Option window

The following figures shows the elapsed time obtained for each frame to transmit while using the two different protocols and the flow controls:

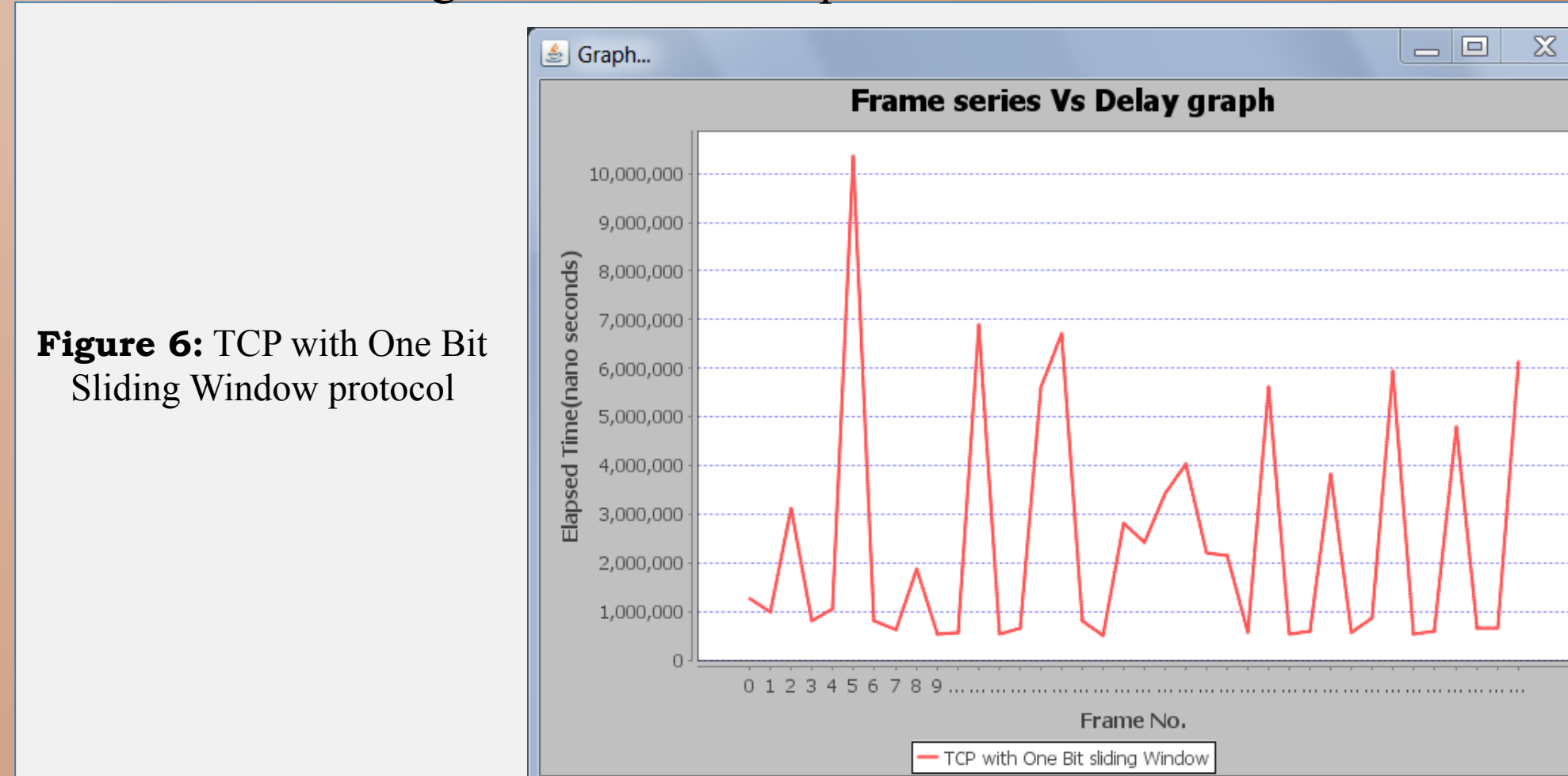


Figure 6: TCP with One Bit Sliding Window protocol

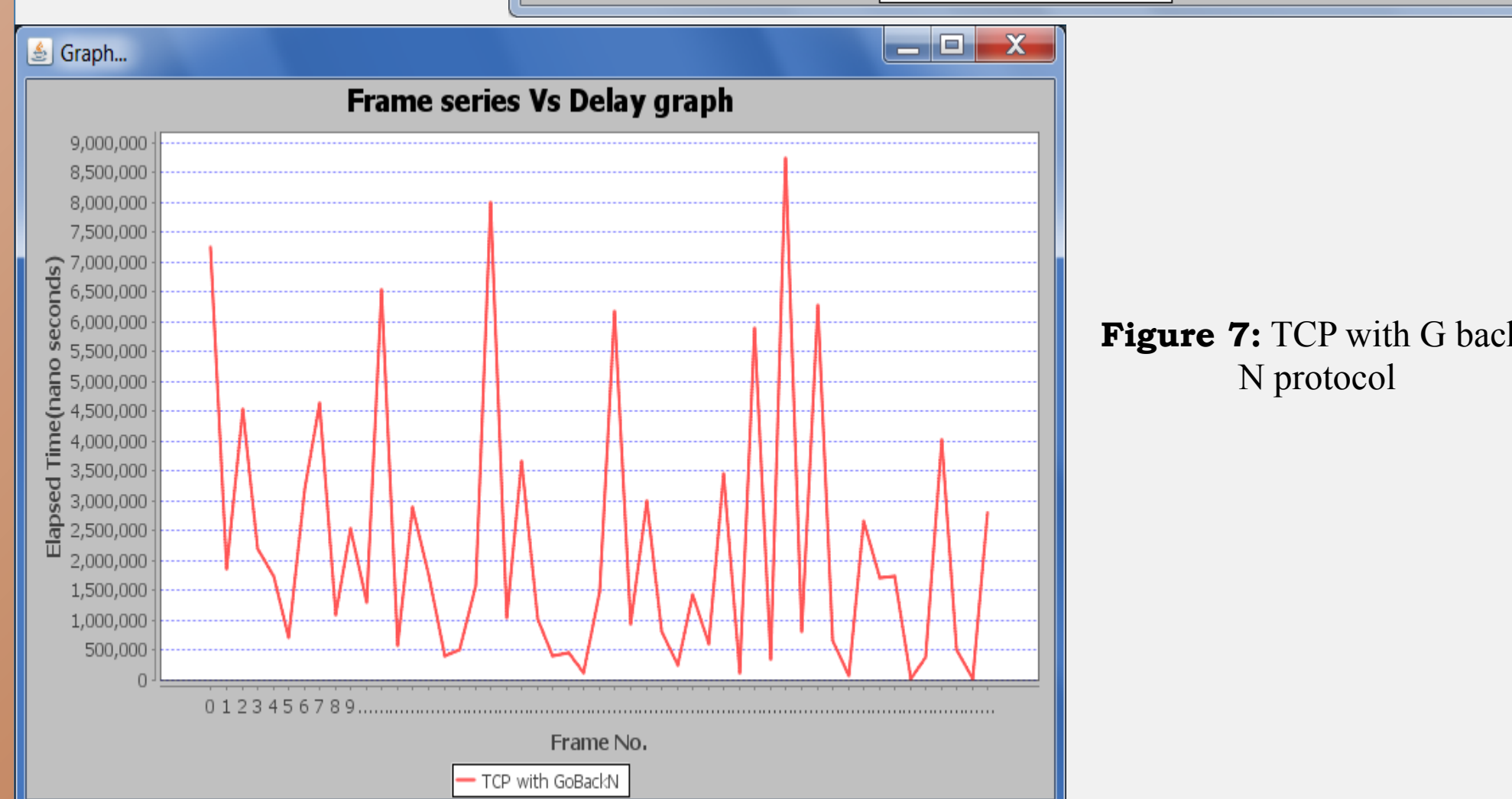


Figure 7: TCP with G back N protocol

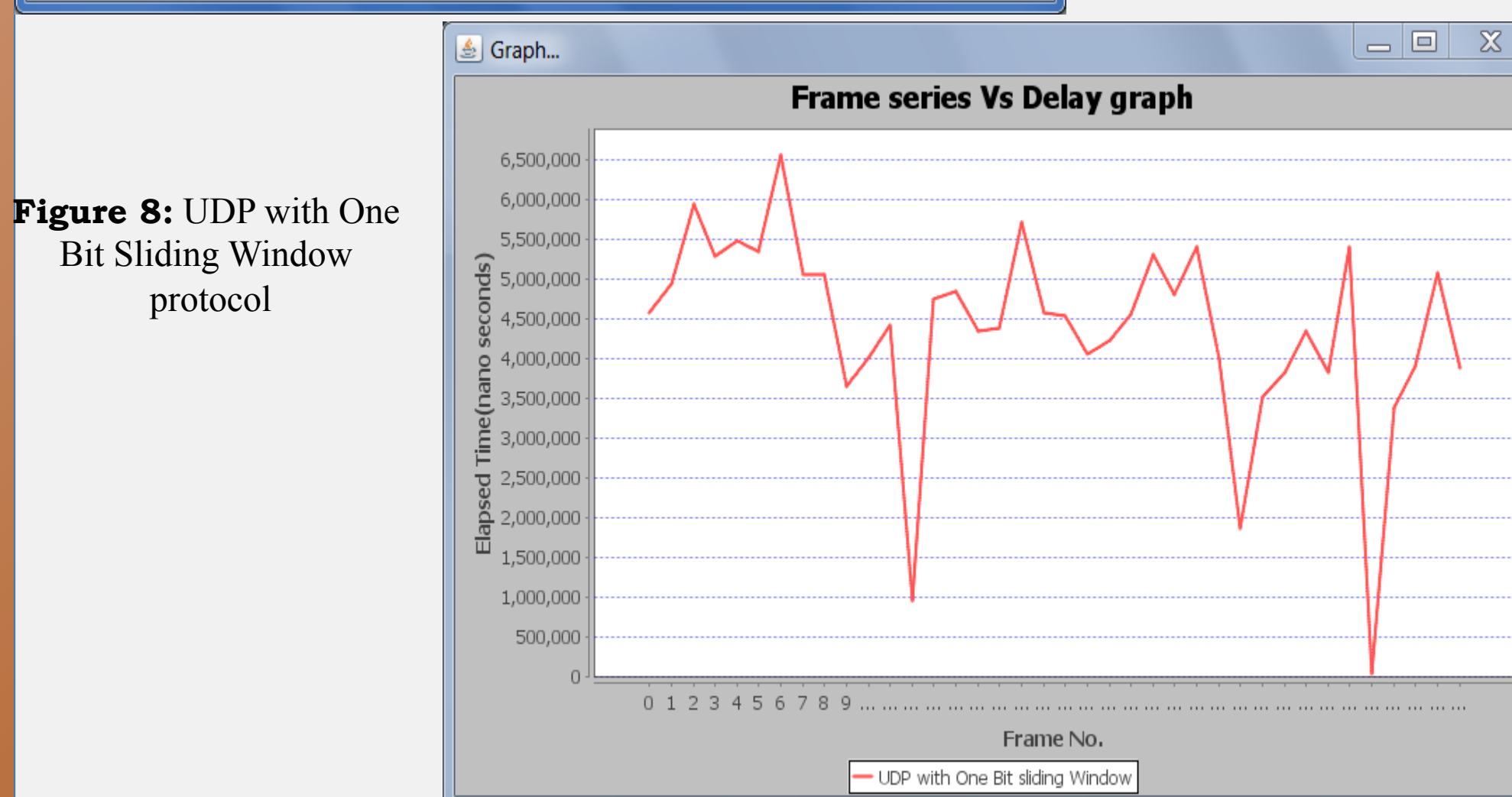


Figure 8: UDP with One Bit Sliding Window protocol

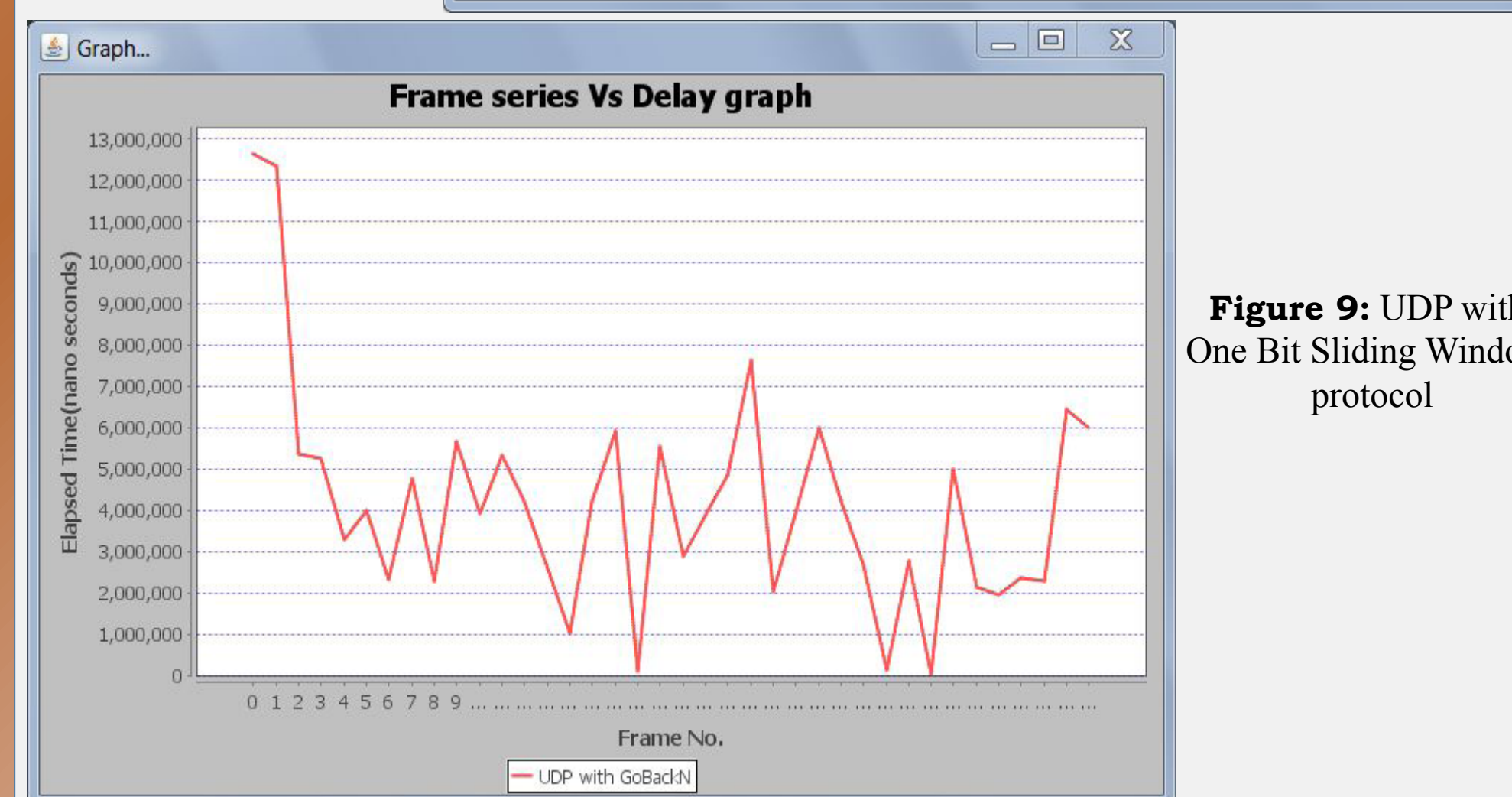


Figure 9: UDP with One Bit Sliding Window protocol

## Results

The following tables shows the comparison of delay performance obtained in examining our tool. Results given in Table 1 and 2 are the average of 10 independent runs.

Table 1: A comparison of delay performance:

Packet Size	TCP with One Bit sliding window (ms)	TCP with Go Back N (ms)	UDP with One Bit sliding window (ms)	UDP with Go Back N (ms)
20	151	106	148	99
30	249	122	141	133
40	294	140	240	152
50	600	191	271	167

Table2: A comparison of time taken when introducing a frame loss:

Packet Size	TCP with One Bit sliding window (ms)	TCP with Go Back N (ms)	UDP with One Bit sliding window (ms)	UDP with Go Back N (ms)
20	546	1026	648	1034
30	889	1028	669	1092
40	920	1054	849	1095
50	945	1133	892	1109

Comparison of our tool with the existing tool Wireshark

	Wireshark	Our tool
Size	18.3MB	3.69MB
Supports for	750 protocols	2 protocols
Complexity	Very complex	User friendly

## Discussion & Conclusion

- ✳This tool will enable students to clearly understand the theoretical concepts of data communication concepts such as flow control, error control, packet losses, etc of a protocol.
- ✳ With the aid of this visually representing tool, teaching the complex networking concepts and getting a good understanding of these ideas would be easy one.
- ✳ The greatest benefit of this technique lies in its application on very large datasets.

## Reference

- [1] Data link layer. <http://web.cs.wpi.edu/~cs4514/b98/week3-dll/week3-dll.html>. [online;accessed 10-April-2011].
- [2] Deitel. P & Deitel. H Java how to program, 2010.
- [3] Graber. J An introduction to network programming with java, 2007.
- [4] Angela. O, Gilbert. R, Josh. B, Greg. M, Larry. P, and Joshua. W. Wireshark and ethereal.
- [5] Tanenbaum. A.S. Computer Networks. Prentice Hall of India Private Limited, Vrije Universiteit,Amsterdam,The Netherlands, 2003.