深 圳 大 学 实 验 报 告

课程名称：计算机网络（Computer Networks）

实验名称：Transport Layer Assignment

学院：电子与信息工程学院

专业：电子信息工程

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教务部制

1. Purpose of experiment

- Using the socket program in Python.
- Familiar with the conception of TCP/UDP
- Creating TCP/UDP socket

2. Experimental principle

- “Stop-and-wait” protocol
- Application of socket package in Python
- “Random” series function

3. Content

(1) communication in “localhost”

① Sending 10 packets, packet loss rate is set to 0.5

```
Received Packet 8 from ('192.168.3.11', 51877)
Packet 8 is lost
Received Packet 8 from ('192.168.3.11', 51877)
Packet 8 is successfully transmitted
Received Packet 9 from ('192.168.3.11', 51877)
Packet 9 is lost
Received Packet 9 from ('192.168.3.11', 51877)
Packet 9 is successfully transmitted
```

Fig1.1.1 Server

```
Timeout for Packet 8, resending...
Received ACK for Packet 8 with RTT 2.02s
Sending packet 9...
Timeout for Packet 9, resending...
Received ACK for Packet 9 with RTT 1.02s
Packet loss rate: 47.37%
Average RTT: 0.91s
Total time9.11s
```

Fig 1.1.2 Client

② **Sending 100 packets, packet loss rate is set to 0.2**

```
Received Packet 89 from ('192.168.3.11', 62130)
Packet 89 is lost
Received Packet 89 from ('192.168.3.11', 62130)
Packet 89 is successfully transmitted
Received Packet 90 from ('192.168.3.11', 62130)
Packet 90 is lost
Received Packet 90 from ('192.168.3.11', 62130)
Packet 90 is successfully transmitted
```

Fig 1.2.1 Server

```
Received ACK for Packet 97 with RTT 0.00s
Sending packet 98...
Received ACK for Packet 98 with RTT 0.00s
Sending packet 99...
Received ACK for Packet 99 with RTT 0.00s
Packet loss rate: 18.03%
Average RTT: 0.22s
Total time22.22s
```

Fig 1.2.2 Client

③ **Sending 100 packets, packet loss rate is set to 0.5**

```
Received Packet 98 from ('192.168.3.11', 56220)
Packet 98 is lost
Received Packet 98 from ('192.168.3.11', 56220)
Packet 98 is successfully transmitted
Received Packet 99 from ('192.168.3.11', 56220)
Packet 99 is lost
Received Packet 99 from ('192.168.3.11', 56220)
Packet 99 is successfully transmitted
```

Fig 1.3.1 Server

```
Timeout for Packet 98, resending...
Timeout for Packet 98, resending...
Timeout for Packet 98, resending...
Received ACK for Packet 98 with RTT 3.04s
Sending packet 99...
Timeout for Packet 99, resending...
Received ACK for Packet 99 with RTT 1.01s
Packet loss rate: 54.55%
Average RTT: 1.21s
Total time121.24s
```

Fig 1.3.2 Client

(2) Communication with partner

① Sending 10 packets, packet loss rate is set to 0.5

```
Packet 8 is successfully transmitted
Received Packet 9 from ('192.168.72.108', 54270)
Packet 9 is lost
Received Packet 9 from ('192.168.72.108', 54270)
Packet 9 is lost
Received Packet 9 from ('192.168.72.108', 54270)
Packet 9 is lost
```

Fig 2.1.1 Server

```
Received ACK for Packet 8 with RTT 0.02s
Sending packet 9...
Timeout for Packet 9, resending...
Timeout for Packet 9, resending...
Timeout for Packet 9, resending...
Received ACK for Packet 9 with RTT 3.06s
Packet loss rate: 37.50%
Average RTT: 0.62s

Process finished with exit code 0
```

Fig2.1.2 Client

② Sending 100 packets, packet loss rate is set to 0.2

```
Received Packet 97 from ('192.168.72.108', 50946)
Packet 97 is successfully transmitted
Received Packet 98 from ('192.168.72.108', 50946)
Packet 98 is successfully transmitted
Received Packet 99 from ('192.168.72.108', 50946)
Packet 99 is lost
Received Packet 99 from ('192.168.72.108', 50946)
Packet 99 is successfully transmitted
```

Fig 2.2.1 Server

```
Sending packet 98...
Received ACK for Packet 98 with RTT 0.01s
Sending packet 99...
Timeout for Packet 99, resending...
Received ACK for Packet 99 with RTT 1.05s
Packet loss rate: 14.53%
Average RTT: 0.19s
```

Fig 2.2.2 Client

③ Sending 100 packets, packet loss rate is set to 0.5

```
Received Packet 98 from ('192.168.72.108', 56416)
Packet 98 is successfully transmitted
Received Packet 99 from ('192.168.72.108', 56416)
Packet 99 is lost
Received Packet 99 from ('192.168.72.108', 56416)
Packet 99 is lost
Received Packet 99 from ('192.168.72.108', 56416)
Packet 99 is lost
Received Packet 99 from ('192.168.72.108', 56416)
Packet 99 is successfully transmitted
```

Fig 2.3.1 Server

```
Sending packet 98...
Received ACK for Packet 98 with RTT 0.01s
Sending packet 99...
Timeout for Packet 99, resending...
Timeout for Packet 99, resending...
Timeout for Packet 99, resending...
Received ACK for Packet 99 with RTT 3.10s
Packet loss rate: 51.92%
Average RTT: 1.11s
```

Fig 2.3.2 Client

4. Conclusion and discussion

Conclusion:

In this experiment, I successfully implemented the "Stop-and-wait" protocol using Python socket programming. Through this experiment, I gained a deep understanding of basic concepts in network communication, such as the creation and use of TCP/UDP sockets, the sending and receiving of data packets, the mechanism of timeout and retransmission, and the simulation of packet loss.

Discussion:

1. **TCP vs UDP:** We noticed that the use of TCP and UDP protocols significantly affects the reliability and efficiency of data transmission. TCP provides built-in error detection and correction mechanisms, while these mechanisms need to be implemented at the application layer for UDP.
2. **Impact of Packet Loss Rate:** The experiment showed that different packet loss rates have a direct impact on the performance of data transmission. A higher packet loss rate leads to more retransmissions, increasing the overall transmission time.
3. **Local Network and Remote Communication:** Communication within a "localhost" environment and in an actual network environment (such as between two separate computers) showed different characteristics. Especially in remote communication, network latency and instability are more pronounced.
4. **Setting of Timeout:** The setting of the timeout is crucial for the efficiency of the protocol. Too short a timeout may lead to unnecessary retransmissions, while too long a timeout will increase the total waiting time for responses.
5. **Others:** In this experiment, it is necessary to disable all firewalls and pay attention to the IP address. Even under the same WiFi, the fourth segment of the IP address might be different. The IP

address should be determined based on the location of the server. When using UDP transmission, the client_address changes every time because UDP sends each data packet from a new temporary port.

指导教师批阅意见：

成绩评定：

指导教师签字：

年　　月　　日

备注：

注：1、报告内的项目或内容设置，可根据实际情况加以调整和补充。

2、教师批改学生实验报告时间应在学生提交实验报告时间后 10 日内。