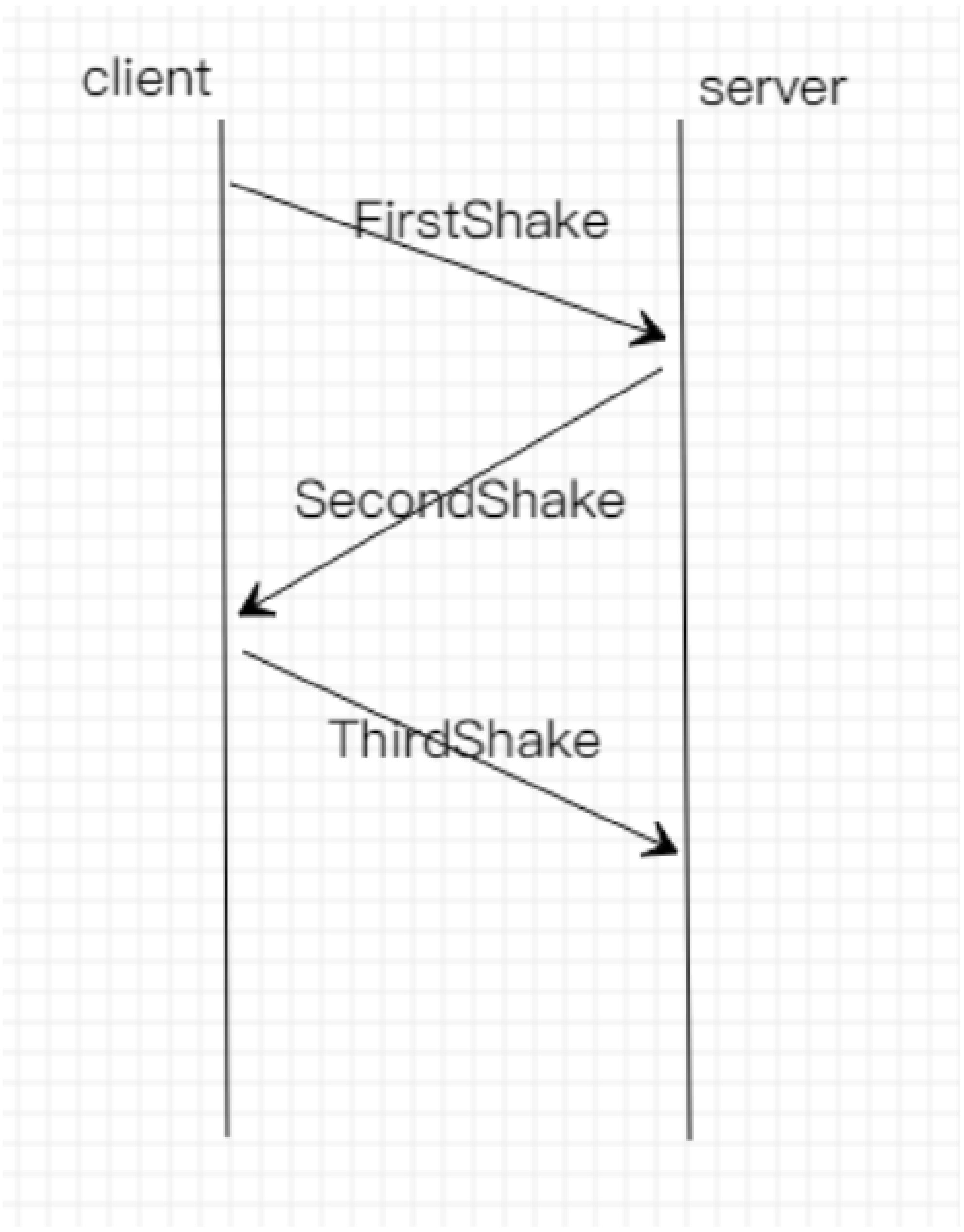
任务

> 利用数据报套接字在用户空间实现面向连接的可靠数据传输，功能包括：建立连接、差错检测、确认重传。流量控制采用停等机制，完成给定测试文件的传输.

协议设计

建立连接阶段



```
//client:
while(true){
        //package[0]为检验和
        char shake_package[2];
        shake_package[1] = FSHAKE;
        shake_package[0] = checksum(shake_package + 1,1);
        //发送第一次握手pkt
        sendto(client, shake_package, 2, 0, (sockaddr *) &serverAddr,
sizeof(serverAddr));
        int begin = clock();
        char recv[2];
        int len = sizeof(clientAddr);
        int fail = 0;
        //接受服务端发来的第二次握手pkt
        while(recvfrom(client, recv, 2, 0, (sockaddr *) &serverAddr, &len) ==
SOCKET_ERROR){
            if (clock() - begin > MAX_WAIT_TIME) {
                fail = 1;
                //超时重新发送第一次握手pkt(重新开始连接)
                break;
            }
        }
        //不超时,pkt不出错且是第二次握手包,则发送第三次握手包-连接成功
        if(fail == 0 && checksum(recv,2) == 0 && recv[1] == SSHAKE)
        {
            shake_package[1] = TSHAKE;
            shake_package[0] = checksum(shake_package + 1,1);
            sendto(client, shake_package, 2, 0, (sockaddr *) &serverAddr,
sizeof(serverAddr));
            break;
        }
    }
//server:
    while(true){
        char revshake[2];
        int len_tmp = sizeof(clientAddr);
        while (recvfrom(server, revshake, 2, 0, (sockaddr *) &clientAddr,
&len_tmp) == SOCKET_ERROR);
        if(checksum(revshake,2)!=0 || revshake[1] != FSHAKE){
            continue;//如果收到的pkt不是第一次握手,回到接收状态
        }
        while(true){//收到第一次握手pkt之后,向客户端发送第二次握手
            revshake[1] = SSHAKE;
            revshake[0] = checksum(revshake + 1,1);
            sendto(server, revshake, 2, 0, (sockaddr *) &clientAddr,
sizeof(clientAddr));
            while (recvfrom(server, revshake, 2, 0, (sockaddr *) &clientAddr,
&len_tmp) == SOCKET_ERROR);//等待收取第三次握手pkt
            if (checksum(revshake, 2) == 0 && revshake[1] == FSHAKE)
                //如果收到的pkt是第一次握手,那么再次向客户端发送第二次握手
                continue;
            if (checksum(revshake, 2) == 0 && revshake[1] == TSHAKE)
                //收到第三次pkt,连接完成
                break;
            if (checksum(revshake, 2) != 0 || revshake[1] != TSHAKE) {
                //收到的pkt有问题,连接失败
                printf("error");
                return 0;
            }
        }
        break;
    }
```

差错检测

使用校验和进行校验

```
unsigned char checksum(char *package,int len){
    if (len == 0){
        return ~(0);
    }
    unsigned int sum = 0;
    int i = 0;
    while(len--){
        sum += (unsigned char) package[i++];
        if(sum & 0xFF00){
            sum &= 0x00FF;
            sum++;
        }
    }
    return ~(sum&0x00FF);
}
```

确认重传

```
    while(true){
        sendto(client, real_package, tmp_len, 0, (sockaddr *) &serverAddr,
sizeof(serverAddr));
        int begin = clock();
        char recv[3];
        int len_tmp = sizeof(serverAddr);
        int fail = 0;

        while (recvfrom(client, recv, 3, 0, (sockaddr *) &serverAddr, &len_tmp) ==
SOCKET_ERROR){
            if (clock() - begin > MAX_WAIT_TIME) {
                fail = 1;
                break;
            }
        }
        //出现超时,校验和,NAK或者pkt序列号不是期待序列号时,重传,否则完成传输
        if (fail == 0 && checksum(recv, 3) == 0 && recv[1] == ACK && recv[2] ==
(char)serial_num)
            return true;
    }
}
```

停等

显然,此协议是一个停等协议,当客户端发送完一个pkt时,等待接收ACK/NAK的pkt时,程序是阻塞的.