厦門大學

信息学院软件工程系

《计算机网络》实验报告

题　　目	实验七 代理服务器软件
班　　级	软件工程 2019 级 3 班
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1、 实验目的

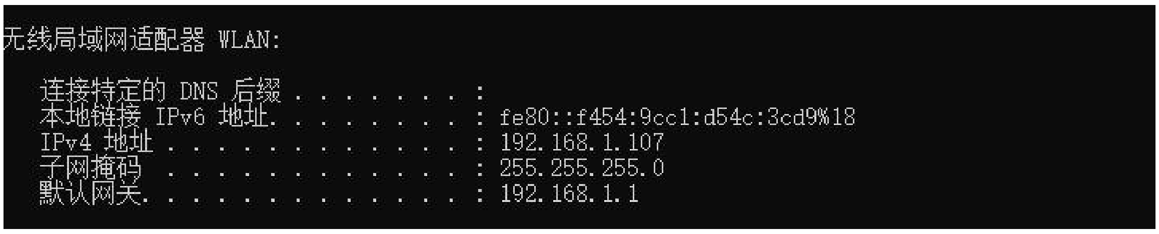
通过完成实验，掌握基于 RFC 应用层协议规约文档传输的原理，实现符合接口且能和已有知名软件协同运作的软件。

2 实验环境

Windows10

3 实验结果

本机 ip



```
无线局域网适配器 WLAN:

   连接特定的 DNS 后缀 . . . . . . . :
   本地链接 IPv6 地址. . . . . . . . : fe80::f454:9cc1:d54c:3cd9%18
   IPv4 地址 . . . . . . . . . . . . : 192.168.1.107
   子网掩码  . . . . . . . . . . . . : 255.255.255.0
   默认网关. . . . . . . . . . . . . : 192.168.1.1
```

因附录的程序时基于 linux 环境下编写的，在 windows 环境无法运行，故在此写下注解

```
#define _GNU_SOURCE

#include <sys/types.h>
```

```
#include <stdio.h>

#include <stdarg.h>

#include <time.h>

#include <errno.h>

#include <unistd.h>

#include <signal.h>

#include <stdlib.h>

#include <stdint.h>

#include <string.h>

//#include <sys/socket.h>

#include <winsock2.h>

#pragma comment(lib,"ws2_32.lib")



#include <sys/fcntl.h>

#include <sys/stat.h>

#include <netdb.h>

#include <sys/select.h>

#include <arpa/inet.h>

#include <netinet/tcp.h>

#include <pthread.h>
```

```
#define BUFSIZE 65536

#define IPSIZE 4

#define ARRAY_SIZE(x) (sizeof(x) / sizeof(x[0]))

#define ARRAY_INIT       {0}


unsigned short int port = 1080;

int daemon_mode = 0;

int auth_type;

char *arg_username;//用户名

char *arg_password;//密码

FILE *log_file;

pthread_mutex_t lock;


enum socks {

    RESERVED = 0x00,

    VERSION4 = 0x04,

    VERSION5 = 0x05

};


enum socks_auth_methods {

    NOAUTH = 0x00,

    USERPASS = 0x02,
    NOMETHOD = 0xff
};

enum socks_auth_userpass {
    AUTH_OK = 0x00,
    AUTH_VERSION = 0x01,
    AUTH_FAIL = 0xff
};

enum socks_command {
    CONNECT = 0x01
};

enum socks_command_type {
    IP = 0x01,
    DOMAIN = 0x03
};

enum socks_status {
    OK = 0x00,
    FAILED = 0x05
};
```

```
void log_message(const char *message, ...)

{

    if (daemon_mode) {

        return;

    }



    char vbuffer[255];

    va_list args;

    va_start(args, message);

    vsnprintf(vbuffer, ARRAY_SIZE(vbuffer), message, args);//打印输出字符串

    va_end(args);



    time_t now;

    time(&now);

    char *date = ctime(&now);

    date[strlen(date) - 1] = '\0';



    pthread_t self = pthread_self();//新建线程，获得线程自身 id



    if (errno != 0) {

        pthread_mutex_lock(&lock);//互斥锁上锁
        fprintf(log_file, "[%s][%lu] Critical: %s - %s\n", date, self,
            vbuffer, strerror(errno));
        errno = 0;
        pthread_mutex_unlock(&lock);
    } else {
        fprintf(log_file, "[%s][%lu] Info: %s\n", date, self, vbuffer);
    }
    fflush(log_file);
}

//读取
int readn(int fd, void *buf, int n)
{
    int nread, left = n;
    while (left > 0) {
        if ((nread = read(fd, buf, left)) == -1) {
            if (errno == EINTR || errno == EAGAIN) {
                continue;
            }
        } else {
            if (nread == 0) {
                return 0;
            } else {
                left -= nread;
                buf += nread;
            }
        }
    }
    return n;
}

//写入
int writen(int fd, void *buf, int n)
{
    int nwrite, left = n;
    while (left > 0) {
        if ((nwrite = write(fd, buf, left)) == -1) {
            if (errno == EINTR || errno == EAGAIN) {
                continue;
            }
        } else {
            if (nwrite == n) {
                return 0;
            } else {
```

```
                left -= nwrite;

                buf += nwrite;

            }

        }

    }

    return n;

}


//退出线程

void app_thread_exit(int ret, int fd)

{

    close(fd);

    pthread_exit((void *)&ret);

}


//建立连接

int app_connect(int type, void *buf, unsigned short int portnum)

{

    int fd;

    struct sockaddr_in remote;

    char address[16];
```

```
memset(address, 0, ARRAY_SIZE(address));

//类型为 ip
if (type == IP) {
    char *ip = (char *)buf;
    snprintf(address, ARRAY_SIZE(address), "%hhu.%hhu.%hhu.%hhu",
             ip[0], ip[1], ip[2], ip[3]);
    memset(&remote, 0, sizeof(remote));
    remote.sin_family = AF_INET;
    remote.sin_addr.s_addr = inet_addr(address);
    remote.sin_port = htons(portnum);

    fd = socket(AF_INET, SOCK_STREAM, 0);
    if (connect(fd, (struct sockaddr *)&remote, sizeof(remote)) < 0) {
        log_message("connect() in app_connect");
        close(fd);
        return -1;
    }

    return fd;
} else if (type == DOMAIN) {//类型为域名
    char portaddr[6];
```

```
struct addrinfo *res;

snprintf(portaddr, ARRAY_SIZE(portaddr), "%d", portnum);

log_message("getaddrinfo: %s %s", (char *)buf, portaddr);

int ret = getaddrinfo((char *)buf, portaddr, NULL, &res);

if (ret == EAI_NODATA) {

    return -1;

} else if (ret == 0) {

    struct addrinfo *r;

    for (r = res; r != NULL; r = r->ai_next) {

        fd = socket(r->ai_family, r->ai_socktype,

                    r->ai_protocol);

          if (fd == -1) {

                continue;

          }

        ret = connect(fd, r->ai_addr, r->ai_addrlen);

        if (ret == 0) {

            freeaddrinfo(res);

            return fd;

          } else {

                close(fd);

          }

    }
```

```
            }

            freeaddrinfo(res);

            return -1;

        }


        return -1;

}


int socks_invitation(int fd, int *version)

{

        char init[2];

        int nread = readn(fd, (void *)init, ARRAY_SIZE(init));

        if (nread == 2 && init[0] != VERSION5 && init[0] != VERSION4) {

                log_message("They send us %hhX %hhX", init[0], init[1]);

            log_message("Incompatible version!");

            app_thread_exit(0, fd);

        }

        log_message("Initial %hhX %hhX", init[0], init[1]);

        *version = init[0];

        return init[1];

}
```

```
//读取用户名

char *socks5_auth_get_user(int fd)

{

    unsigned char size;

    readn(fd, (void *)&size, sizeof(size));


    char *user = (char *)malloc(sizeof(char) * size + 1);

    readn(fd, (void *)user, (int)size);

    user[size] = 0;


    return user;

}


//读取密码

char *socks5_auth_get_pass(int fd)

{

    unsigned char size;

    readn(fd, (void *)&size, sizeof(size));


    char *pass = (char *)malloc(sizeof(char) * size + 1);

    readn(fd, (void *)pass, (int)size);

    pass[size] = 0;
    return pass;

}


//写入密码

int socks5_auth_userpass(int fd)

{

    char answer[2] = { VERSION5, USERPASS };

    writen(fd, (void *)answer, ARRAY_SIZE(answer));

    char resp;

    readn(fd, (void *)&resp, sizeof(resp));

    log_message("auth %hhX", resp);

    char *username = socks5_auth_get_user(fd);

    char *password = socks5_auth_get_pass(fd);

    log_message("l: %s p: %s", username, password);

    if (strcmp(arg_username, username) == 0

         && strcmp(arg_password, password) == 0) {

        char answer[2] = { AUTH_VERSION, AUTH_OK };

        writen(fd, (void *)answer, ARRAY_SIZE(answer));

        free(username);

        free(password);

        return 0;
    } else {
        char answer[2] = { AUTH_VERSION, AUTH_FAIL };
        writen(fd, (void *)answer, ARRAY_SIZE(answer));
        free(username);
        free(password);
        return 1;
    }
}

int socks5_auth_noauth(int fd)
{
    char answer[2] = { VERSION5, NOAUTH };
    writen(fd, (void *)answer, ARRAY_SIZE(answer));
    return 0;
}

void socks5_auth_notsupported(int fd)
{
    char answer[2] = { VERSION5, NOMETHOD };
    writen(fd, (void *)answer, ARRAY_SIZE(answer));
}
```

```
void socks5_auth(int fd, int methods_count)
{
    int supported = 0;
    int num = methods_count;
    for (int i = 0; i < num; i++) {
        char type;
        readn(fd, (void *)&type, 1);
        log_message("Method AUTH %hhX", type);
        if (type == auth_type) {
            supported = 1;
        }
    }
    if (supported == 0) {
        socks5_auth_notsupported(fd);
        app_thread_exit(1, fd);
    }
    int ret = 0;
    switch (auth_type) {
    case NOAUTH:
        ret = socks5_auth_noauth(fd);
        break;
    case USERPASS:
        ret = socks5_auth_userpass(fd);

        break;

    }

    if (ret == 0) {

        return;

    } else {

        app_thread_exit(1, fd);

    }

}


//读取命令

int socks5_command(int fd)

{

    char command[4];

    readn(fd, (void *)command, ARRAY_SIZE(command));

    log_message("Command   %hhX   %hhX   %hhX   %hhX",   command[0],
command[1],

                command[2], command[3]);

    return command[3];

}


//读取接口

unsigned short int socks_read_port(int fd)
```

```
{

    unsigned short int p;

    readn(fd, (void *)&p, sizeof(p));

    log_message("Port %hu", ntohs(p));

    return p;

}


//读取 ip

char *socks_ip_read(int fd)

{

    char *ip = (char *)malloc(sizeof(char) * IPSIZE);

    readn(fd, (void *)ip, IPSIZE);

    log_message("IP %hhu.%hhu.%hhu.%hhu", ip[0], ip[1], ip[2], ip[3]);

    return ip;

}


void socks5_ip_send_response(int fd, char *ip, unsigned short int port)

{

    char response[4] = { VERSION5, OK, RESERVED, IP };

    writen(fd, (void *)response, ARRAY_SIZE(response));

    writen(fd, (void *)ip, IPSIZE);

    writen(fd, (void *)&port, sizeof(port));
```

```
}

//读取域名
char *socks5_domain_read(int fd, unsigned char *size)
{
    unsigned char s;
    readn(fd, (void *)&s, sizeof(s));
    char *address = (char *)malloc((sizeof(char) * s) + 1);
    readn(fd, (void *)address, (int)s);
    address[s] = 0;
    log_message("Address %s", address);
    *size = s;
    return address;
}

void socks5_domain_send_response(int fd, char *domain, unsigned char size,
                        unsigned short int port)
{
    char response[4] = { VERSION5, OK, RESERVED, DOMAIN };
    writen(fd, (void *)response, ARRAY_SIZE(response));
    writen(fd, (void *)&size, sizeof(size));
    writen(fd, (void *)domain, size * sizeof(char));
    writen(fd, (void *)&port, sizeof(port));
}


int socks4_is_4a(char *ip)
{
    return (ip[0] == 0 && ip[1] == 0 && ip[2] == 0 && ip[3] != 0);
}


//接受数据
int socks4_read_nstring(int fd, char *buf, int size)
{
    char sym = 0;
    int nread = 0;
    int i = 0;

    while (i < size) {
        nread = recv(fd, &sym, sizeof(char), 0);

        if (nread <= 0) {
            break;
        } else {
            buf[i] = sym;
            i++;

        }


        if (sym == 0) {

            break;

        }

    }


    return i;

}


//响应

void socks4_send_response(int fd, int status)

{

    char resp[8] = {0x00, (char)status, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00};

    writen(fd, (void *)resp, ARRAY_SIZE(resp));

}


void app_socket_pipe(int fd0, int fd1)

{

    int maxfd, ret;

    fd_set rd_set;
```

```
size_t nread;

char buffer_r[BUFSIZE];


  log_message("Connecting two sockets");


maxfd = (fd0 > fd1) ? fd0 : fd1;

while (1) {

       FD_ZERO(&rd_set);

       FD_SET(fd0, &rd_set);

       FD_SET(fd1, &rd_set);

       ret = select(maxfd + 1, &rd_set, NULL, NULL, NULL);


       if (ret < 0 && errno == EINTR) {

              continue;

       }


       if (FD_ISSET(fd0, &rd_set)) {

              nread = recv(fd0, buffer_r, BUFSIZE, 0);

              if (nread <= 0)

                     break;

              send(fd1, (const void *)buffer_r, nread, 0);

       }
```

```
            if (FD_ISSET(fd1, &rd_set)) {

                  nread = recv(fd1, buffer_r, BUFSIZE, 0);

                  if (nread <= 0)

                        break;

                  send(fd0, (const void *)buffer_r, nread, 0);

            }

      }

}


void *app_thread_process(void *fd)

{

      int net_fd = *(int *)fd;

      int version = 0;

      int inet_fd = -1;

      char methods = socks_invitation(net_fd, &version);


      switch (version) {

      case VERSION5: {

                  socks5_auth(net_fd, methods);

                  int command = socks5_command(net_fd);
```

```
if (command == IP) {

        char *ip = socks_ip_read(net_fd);

        unsigned short int p = socks_read_port(net_fd);



        inet_fd = app_connect(IP, (void *)ip, ntohs(p));

        if (inet_fd == -1) {

                app_thread_exit(1, net_fd);

        }

        socks5_ip_send_response(net_fd, ip, p);

        free(ip);

        break;

} else if (command == DOMAIN) {

        unsigned char size;

        char *address = socks5_domain_read(net_fd, &size);

        unsigned short int p = socks_read_port(net_fd);



        inet_fd = app_connect(DOMAIN, (void *)address, ntohs(p));

        if (inet_fd == -1) {

                app_thread_exit(1, net_fd);

        }

        socks5_domain_send_response(net_fd, address, size, p);

        free(address);
```

```
            break;
        } else {
            app_thread_exit(1, net_fd);
        }
    }
    case VERSION4: {
        if (methods == 1) {
            char ident[255];
            unsigned short int p = socks_read_port(net_fd);
            char *ip = socks_ip_read(net_fd);
            socks4_read_nstring(net_fd, ident, sizeof(ident));

            if (socks4_is_4a(ip)) {
                char domain[255];
                socks4_read_nstring(net_fd, domain, sizeof(domain));
                log_message("Socks4A: ident:%s; domain:%s;", ident, domain);
                inet_fd = app_connect(DOMAIN, (void *)domain, ntohs(p));
            } else {
                log_message("Socks4: connect by ip & port");
                inet_fd = app_connect(IP, (void *)ip, ntohs(p));
            }
```

```
                    if (inet_fd != -1) {

                        socks4_send_response(net_fd, 0x5a);

                    } else {

                        socks4_send_response(net_fd, 0x5b);

                        free(ip);

                        app_thread_exit(1, net_fd);

                    }



                    free(ip);

                } else {

                       log_message("Unsupported mode");

                }

            break;

        }

    }



    app_socket_pipe(inet_fd, net_fd);

    close(inet_fd);

    app_thread_exit(0, net_fd);



      return NULL;
```

```
}


int app_loop()

{

    int sock_fd, net_fd;

    int optval = 1;

    struct sockaddr_in local, remote;

    socklen_t remotelen;

    if ((sock_fd = socket(AF_INET, SOCK_STREAM, 0)) < 0) {

        log_message("socket()");

        exit(1);

    }


    if (setsockopt

         (sock_fd, SOL_SOCKET, SO_REUSEADDR, (char *)&optval,

          sizeof(optval)) < 0) {

        log_message("setsockopt()");

        exit(1);

    }


    memset(&local, 0, sizeof(local));

    local.sin_family = AF_INET;
local.sin_addr.s_addr = htonl(INADDR_ANY);
local.sin_port = htons(port);

if (bind(sock_fd, (struct sockaddr *)&local, sizeof(local)) < 0) {
        log_message("bind()");
        exit(1);
}

if (listen(sock_fd, 25) < 0) {
        log_message("listen()");
        exit(1);
}

remotelen = sizeof(remote);
memset(&remote, 0, sizeof(remote));

log_message("Listening port %d...", port);

pthread_t worker;
while (1) {
        if ((net_fd =
                accept(sock_fd, (struct sockaddr *)&remote,
                  &remotelen)) < 0) {
              log_message("accept()");
              exit(1);
          }
            int one = 1;
            setsockopt(sock_fd, SOL_TCP, TCP_NODELAY, &one, sizeof(one));
          if (pthread_create
               (&worker, NULL, &app_thread_process,
                (void *)&net_fd) == 0) {
              pthread_detach(worker);
          } else {
              log_message("pthread_create()");
          }
     }
}

void daemonize()
{
     pid_t pid;
     int x;

     pid = fork();
```

```
if (pid < 0) {

        exit(EXIT_FAILURE);

}


if (pid > 0) {

        exit(EXIT_SUCCESS);

}


if (setsid() < 0) {

        exit(EXIT_FAILURE);

}


signal(SIGCHLD, SIG_IGN);

signal(SIGHUP, SIG_IGN);


pid = fork();


if (pid < 0) {

        exit(EXIT_FAILURE);

}
```

```
        if (pid > 0) {
            exit(EXIT_SUCCESS);
        }

        umask(0);
        chdir("/");

        for (x = sysconf(_SC_OPEN_MAX); x >= 0; x--) {
            close(x);
        }
    }

    void usage(char *app)
    {
        printf
                  ("USAGE:   %s   [-h][-n   PORT][-a   AUTHTYPE][-u   USERNAME][-p
PASSWORD][-l LOGFILE]\n",
                 app);
        printf("AUTHTYPE: 0 for NOAUTH, 2 for USERPASS\n");
        printf
             ("By default: port is 1080, authtype is no auth, logfile is stdout\n");
        exit(1);
    }
```

```
int main(int argc, char *argv[])

{

    int ret;

    log_file = stdout;

    auth_type = NOAUTH;

    arg_username = "user";

    arg_password = "pass";

    pthread_mutex_init(&lock, NULL);



    signal(SIGPIPE, SIG_IGN);



    while ((ret = getopt(argc, argv, "n:u:p:l:a:hd")) != -1) {

        switch (ret) {

        case 'd':{

                daemon_mode = 1;

                daemonize();

                break;

            }

        case 'n':{

                port = atoi(optarg) & 0xffff;

                break;
        }
    case 'u':{
            arg_username = strdup(optarg);
            break;
        }
    case 'p':{
            arg_password = strdup(optarg);
            break;
        }
    case 'l':{
            freopen(optarg, "wa", log_file);
            break;
        }
    case 'a':{
            auth_type = atoi(optarg);
            break;
        }
    case 'h':
    default:
        usage(argv[0]);
    }
}
```

```
    log_message("Starting with authtype %X", auth_type);
    if (auth_type != NOAUTH) {
        log_message("Username is %s, password is %s", arg_username,
                arg_password);
    }
    app_loop();
    return 0;
}
```

4 实验代码

本次实验的代码已上传于以下代码仓库：https://github.com/aLily11/cnii

5 实验总结

通过这次实验学习了解如何 socket4 和 socket 协议的代理服务器