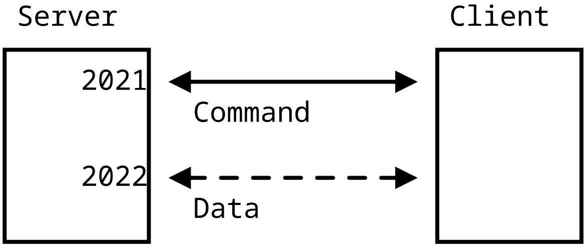
Protocolo FTP

Matías Roqueta

Ingeniería en Telecomunicaciones, Instituto Balseiro

Objetivo

Diseñar arquitectura Cliente $\leftrightarrow$ Servidor



- Puerto `2021`: Command channel, permanece abierto mientras la sesión esté activa
- Puerto `2022`: Data channel, abierto únicamente en respuesta a comandos que lo requieran

Funciones Socket

Creación de socket para Command y Data channels

```
int createSocket(int port) {
    int sockfd = socket(AF_INET, SOCK_STREAM, 0);
    int reuseAddr = 1;
    setsockopt(sockfd, SOL_SOCKET, SO_REUSEADDR, &reuseAddr, sizeof(reuseAddr))
    sockaddr_in serverAddress{};
    serverAddress.sin_family = AF_INET;
    serverAddress.sin_port = htons(port);
    serverAddress.sin_addr.s_addr = INADDR_ANY;
    bind(sockfd, (struct sockaddr*)&serverAddress, sizeof(serverAddress))
    listen(sockfd, 1)
    return sockfd;
}
```

SO_REUSEADDR=1 permite cerrar y volver a abrir el Data channel según sea requerido

Funciones Socket

Command Channel:

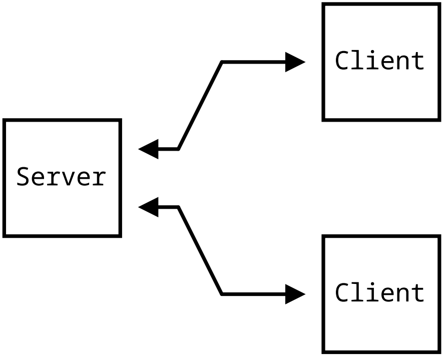
```
int acceptClientConnection(int controlSocket) {
    sockaddr_in clientAddress{};
    socklen_t clientAddressLength = sizeof(clientAddress);
    int clientSocket = accept(controlSocket,
                (struct sockaddr*)&clientAddress, &clientAddressLength);
    return clientSocket;
}
```

Data Channel:

```
int establishDataConnection(int controlClientSocket, int dataSocket,
                            std::string &dataAddress, int dataPort){
    std::string dataMessage = "PORT "+dataAddress+":"+dataPort+"\r\n";
    send(controlClientSocket, dataMessage.c_str(), dataMessage.size(), 0);
    int dataClientSocket = acceptClientConnection(dataSocket);
    return dataClientSocket;
}
```

Múltiples Clientes

El servidor debe ser capaz de atender a múltiples clientes.



- La conexión Cliente $\leftrightarrow$ Servidor debe ser no-bloqueante.
- Esto se logra con un *fork* al recibir conexión entrante.

Múltiples Clientes - Main

```
int controlSocket = createSocket(2021);
std::vector<pollfd> pollFds(1);
pollFds[0].fd = controlSocket; pollFds[0].events = POLLIN;
while (true) {
    int pollResult = poll(pollFds.data(), pollFds.size(), -1);
    if (pollFds[0].revents & POLLIN) {
        pid_t pid = fork();
        if (pid == 0) {
            int controlClientSocket = acceptClientConnection(controlSocket);
            closeSocket(controlSocket);
            handleClientConnection(controlClientSocket);
            return 0;
        }
    }
}
closeSocket(controlSocket);
```

Loop de Respuestas

```
void handleClientConnection(int controlClientSocket) {
    sendWelcomeMessage(controlClientSocket);
    bool authenticated = false;
    char commandBuffer[1024];
    while (true) {
        memset(commandBuffer, 0, sizeof(commandBuffer));
        ssize_t bytesRead = recv(controlClientSocket, commandBuffer,
                                 sizeof(commandBuffer), 0);
        std::vector<std::string> commandParts = splitCommand(commandBuffer);
        if (!authenticated) {
            // Rechazo de comandos excepto USER PASS o QUIT + respuesta
        } else {
            // Aceptación de otros comandos + respuesta
        }
    }
    closeSocket(controlClientSocket);
}
```

Comandos Implementados

Comandos que usan solamente Command channel:

- `USER <user>`
- `PASS <pass>`
- `CWD <dir>`
- `CDUP`
- `MKD <dir>`
- `RMD <dir>`
- `DELE <file>`
- `QUIT`

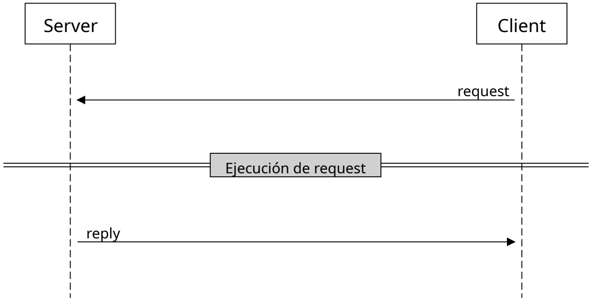
Comandos que usan ambos Command y Data channel:

- `LIST`
- `RETR <file>`
- `STOR <file>`

La distinción principal en la implementación de los diferentes comandos depende de si estos usan o no el Data channel.

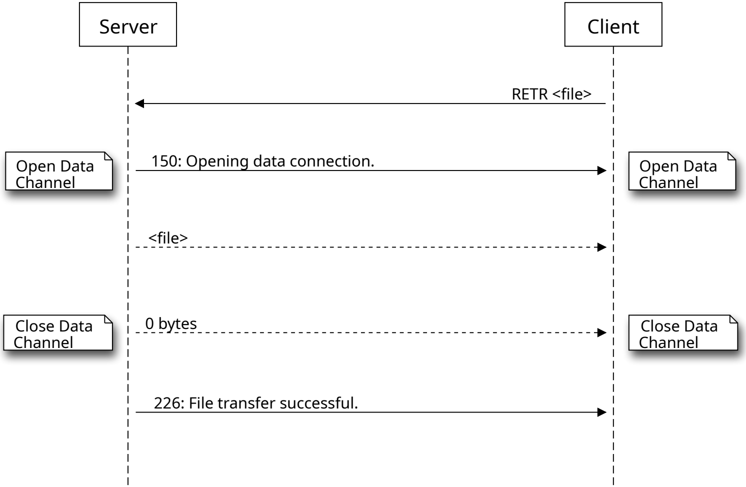
Ejecución general de comandos

- Cliente inicia request envíando un código FTP por el Command channel



- Servidor eventualmente responde envíando un código de respuesta FTP por el command channel
- Ejecución de request puede incluír intercambio de más mensajes y/o uso del Data channel.

Comando RETR <file>



RETR - Server side

```
void handleRETRCommand(int controlClientSocket, const std::string& args) {
    sendResponse(controlClientSocket, "150 Opening data connection.\r\n");
    int dataSocket = createSocket(dataPort);
    int dataClientSocket = establishDataConnection(controlClientSocket,
                                                   dataSocket, dataAddress, dataPort);
    if (sendFile(dataClientSocket, filename)) {
        std::string response = "226 File transfer successful.";
    } else {
        std::string response = "451 File transfer failed.";
    }
    closeSocket(dataClientSocket);
    closeSocket(dataSocket);
    sendResponse(controlClientSocket, response);
    return;
}
```

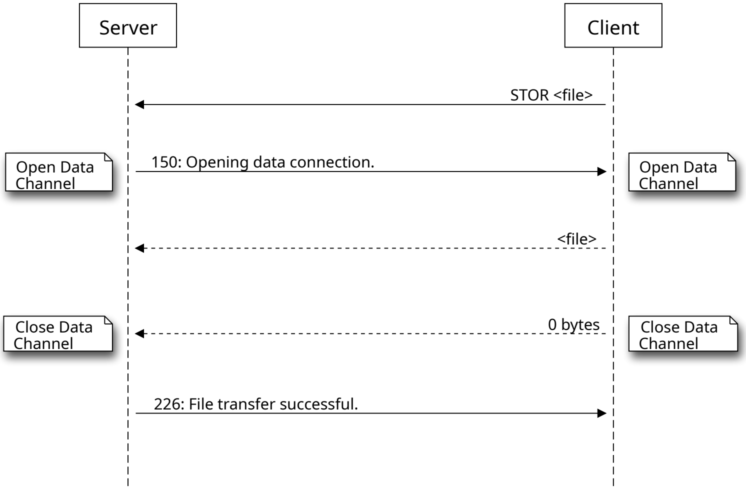
RETR - Server side

```cpp
bool sendFile(int socket, const std::string& filename) {
    std::ifstream file(filename, std::ios::binary);
    if (!file) {
        std::cerr << "Failed to open file: " << filename << std::endl;
        return false;
    }
    std::vector<char> buffer(std::istreambuf_iterator<char>(file), {});
    file.close();
    ssize_t bytesSent = send(socket, buffer.data(), buffer.size(), 0);
    if (bytesSent == -1) {
        std::cerr << "Failed to send file contents." << std::endl;
        return false;
    }
    return true;
}
```

RETR - Client side

```
void recvFile(int controlSocket, const std::string& filename) {
    std::string response;
    receiveResponse(controlSocket, response);
    if (response.substr(0, 3) != "150")
        return;
    int dataSocket = establishDataConnection(controlSocket);
    const int bufferSize = 1024;
    std::vector<char> buffer(bufferSize);
    ssize_t bytesRead;
    while (bytesRead = recv(dataSocket, buffer.data(), bufferSize, 0) > 0) {
        file.write(buffer.data(), bytesRead);
    }
    file.close();
    receiveResponse(controlSocket, response);
    closeSocket(dataSocket);
    return;
}
```

Comando STOR <file>



STOR - Server side

```
void handleSTORCommand(int controlClientSocket, const std::string& args) {
    sendResponse(controlClientSocket, "150 Opening data connection.\r\n");
    int dataSocket = createSocket(dataPort);
    int dataClientSocket = establishDataConnection(controlClientSocket,
                                                   dataSocket, dataAddress, dataPort);
    if (recvFile(dataClientSocket, filename)) {
      response = "226 File transfer successful.";
    } else {
      response = "451 File transfer failed.";
    }
    closeSocket(dataClientSocket);
    closeSocket(dataSocket);
    sendResponse(controlClientSocket, response);
    return;
}
```

STOR - Server side

```
bool recvFile(int dataSocket, const std::string& filename) {
    const int bufferSize = 1024;
    std::vector<char> buffer(bufferSize);
    std::ofstream file(filename, std::ios::binary);
    ssize_t bytesRead;
    while (bytesRead = recv(dataSocket, buffer.data(), bufferSize, 0) > 0) {
        file.write(buffer.data(), bytesRead);
        std::cout << "Read " << bytesRead << " bytes" << std::endl;
    }
    if (bytesRead < 0) {
        file.close();
        return false;
    }
    file.close();
    return true;
}
```

STOR - Client Side

```
void sendFile(int controlSocket, const std::string& filename) {
    std::string response;
    receiveResponse(controlSocket, response);
    if (response.substr(0, 3) != "150") {
        return;
    }
    int dataSocket = establishDataConnection(controlSocket);
    std::ifstream file(filename, std::ios::binary);
    std::vector<char> buffer(std::istreambuf_iterator<char>(file), {});
    file.close();
    ssize_t bytesSent = send(dataSocket, buffer.data(), buffer.size(), 0);
    closeSocket(dataSocket);
    receiveResponse(controlSocket, response);
    return;
}
```

Demostración