Here we explore the sequence of interactions in a typical FTP (File Transfer Protocol) session. The example here illustrates the use of multiple TCP connections by FTP. We will cover how FTP establishes a telnet TCP connection (TCP Port 21) to control the overall flow of the FTP transfer. Then we examine the use of TCP Port 21 for establishing TCP connections for directory transfer and file retrieval.

The complete sequence diagram can be divided into the following steps:

- DNS Query to obtain the IP address for the FTP Server
- FTP Telnet connection setup and login. (USER and PASS commands)
- Obtaining a directory listing (PORT and LIST command)
- Changing directory (CWD command)
- Downloading a file using FTP get (PORT and RETR command)

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**DNS Query to obtain the IP address for the FTP Server.**

<table>
<thead>
<tr>
<th>DNS Query</th>
<th>DNS Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>recdesired = 1, queries = 1, name = ftp.any-domain.com, type = A, class = IN</td>
<td>recdesired = 1, answers = 1, IP Address</td>
</tr>
</tbody>
</table>

*Invoked FTP client with ftp.any-domain.com*

- The FTP client sends a DNS query for domain name ftp.any-domain.com
- The DNS responds back with the IP address.

**FTP Telnet connection setup and login. (USER and PASS commands).**

<table>
<thead>
<tr>
<th>TCP SYN</th>
<th>TCP SYN+ACK</th>
<th>TCP ACK</th>
<th>FTP 220</th>
<th>Display welcome message</th>
<th>FTP 331</th>
<th>Password prompt</th>
<th>Password information</th>
</tr>
</thead>
<tbody>
<tr>
<td>srcport = 1175, dstport = 21, syn = 1</td>
<td>srcport = 21, dstport = 1175, syn = 1, ack = 1</td>
<td>srcport = 1175, dstport = 21, ack = 1</td>
<td>ftp.response.code = 220, ftp.response.arg = ANY-DOMAIN.COM FTP Service</td>
<td></td>
<td>code = 331, arg = Anonymous access allowed, send identity (e-mail name) as password.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*FTP client initiates establishment of the telnet session TCP connection by sending a SYN to TCP port 21*

- The FTP server responds with SYN+ACK
- The client machine responds with an ACK, this completes the TCP three way handshake.
- The FTP server then sends a 220 response to indicate that the FTP server is ready to accept a login.

*The client machine acknowledges the FTP 220 TCP packet.*

<table>
<thead>
<tr>
<th>TCP ACK</th>
<th>USER ftp</th>
<th>TCP ACK</th>
<th>FTP 331</th>
<th>Enter login information</th>
<th>FTP 331</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>srcport = 21, dstport = 1175, ack = 1</td>
<td>ftp</td>
<td>srcport = 21, dstport = 1175, ack = 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*User’s login name is transported in a TCP segment. In this example an anonymous FTP is being initiated with the user name “ftp”*

*FTP server indicates that anonymous FTP is allowed.*
User enters his or her e-mail address as the password. This password is being transported by this TCP segment.

Welcome message after login.

User login notification.

Login successful prompt

Obtaining a directory listing (PORT and LIST command).

FTP client provides port number information.

FTP server positively acknowledges the PORT command.

User requests a directory listing.

FTP server notifies the client that it is about to transfer the requested listing.

TCP three way handshake for connection establishment on port 5001.

The directory listing completion is signaled by this TCP segment.

Changing directory (CWD command).
FTP Transfer (FTP Session Sequence Diagram)

<table>
<thead>
<tr>
<th>Internet</th>
<th>FTP Client PC</th>
<th>Console</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNS</td>
<td>FTP Server</td>
<td>FTP Client</td>
</tr>
<tr>
<td>Port 53</td>
<td>Port 20</td>
<td>Port 21</td>
</tr>
<tr>
<td>Port 1030</td>
<td>1175</td>
<td>5001</td>
</tr>
<tr>
<td>User</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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### FTP Transfer (FTP Session Sequence Diagram)

**FTP Client PC**

1. **FTP get for readme.txt**
   - FTP client provides port number information.
   - FTP client provides port number information.
   - The user issues an FTP get for readme.txt.
   - FTP server acknowledges the RETR command from the client.
   - Three way handshake for TCP connection on Port 5002.
   - TCP segment carrying contents of readme.txt.
   - This is the last TCP segment containing data, it also includes the FIN to initiate the release of the TCP connection.
   - FTP client also initiates the release of the TCP connection.
   - Signal to the client that the FTP transfer has been completed.

### FTP Transfer (FTP Session Sequence Diagram)

**FTP Client PC**

1. **Change working directory (cwd)**
   - User issues the change working directory command.
   - FTP server positively acknowledges the Change Working Directory command.

**FTP Client PC**

1. **User issues the change working directory command.**
   - **FTP server positively acknowledges the Change Working Directory command.**
User initiates a "bye" on the FTP client console. This is translated to the quit command.

TCP connection release initiated.