

# HTTP

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## Running server3.pl

### Installing Perl Dependencies

This is a perl script therefore we must install the required dependencies

```
cpan HTTP::Daemon HTTP::Status IO::File
```

### Running the Server

```
perl server.pl
[http] perl server.pl
Please contact me at:
<URL:http://[fe80::90fa:507d:8ecc:3a6%25enp0s31f6]:4321/>

[http] curl http://\[fe80::90fa:507d:8ecc:3a6%25enp0s31f6\]:4321
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>Index</title>
</head>
<body>
  <p>This is index.html</p>
</body>
</html>%
```

## Analyzing server3.pl

Let's analyze the code step by step.

```
use HTTP::Daemon;
```

`HTTP::Daemon` is used to create an HTTP server - to open a socket, bind it to a port and listen for incoming connections.

```
my $d = HTTP::Daemon->new(  
    LocalAddr => 'localhost',  
    LocalPort => 4321,  
)|| die;
```

We are constructing a new HTTP daemon `$d` that listens on the address `localhost` (hostname) and port `4321`. If the socket fails to bind, or the address is invalid the script will die.

```
print "Please contact me at: <URL:", $d->url, ">\n";
```

This line informs the user where the server can be accessed.

```
while (my $c = $d->accept)
```

This is the main loop of the server. It waits until a client connects to the server. `$c` object is an instance of `HTTP::Daemon::ClientConn`, which is fetched from the HTTP daemon.

```
while (my $r = $c->get_request)
```

After establishing a connection with the client, we enter another loop to handle requests from the client. `$r` is an instance of `HTTP::Request`, which represents the HTTP request sent by the client.

```
if ($r->method eq 'GET') {  
    $file_s = "./index.html";  
    $c->send_file_response($file_s);  
}  
else {  
    $c->send_error(RC_FORBIDDEN)  
}
```

We check whether the client request method is `GET`.

- Request method is `GET`, then we return the contents of `index.html`
- Request method is not `GET`, then we return an error with the status code `403 Forbidden`.

```
$c->close;  
undef($c);
```

After handling the request, the connection is closed and the `$c` is freed from memory.

## Header responder

```
go mod init netlab-header
go get -u github.com/gin-gonic/gin
code main.go
```

## WWW server

```
go mod init netlab-www
go get -u github.com/gin-gonic/gin
code main.go
```

## Packet Analysis

Let's run Wireshark to see the HTTP packets.

```
sudo wireshark # select local interface
```

The first packet is the TCP handshake, which is used to establish a connection between the client and the server.

- SYN (cli)
- SYN-ACK (srv)
- ACK (cli)

The second packet is the HTTP request sent by the client to the server.

Jun 5 7:30 AM  
Capturing from Loopback: lo

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Apply a display filter ... <Ctrl-/>

No.	Time	Source	Destination	Protocol	Length	Info
4	0.001861053	127.0.0.1	127.0.0.1	TCP	74	56288 → 8080 [SYN] Seq=0 Win=65495 Len=0 MSS=65495 SACK_PERM TSval=1764246858 TSecr=0 WS=128
5	0.001881142	127.0.0.1	127.0.0.1	TCP	74	8080 → 56288 [SYN, ACK] Seq=0 Ack=1 Win=65483 Len=0 MSS=65495 SACK_PERM TSval=1764246858 TSecr=1764246858 WS=128
6	0.001896704	127.0.0.1	127.0.0.1	TCP	66	56288 → 8080 [ACK] Seq=1 Ack=1 Win=65536 Len=0 TSval=1764246858 TSecr=1764246858
7	0.001973355	127.0.0.1	127.0.0.1	HTTP	1458	GET / HTTP/1.1
8	0.001983318	127.0.0.1	127.0.0.1	TCP	66	8080 → 56288 [ACK] Seq=1 Ack=1393 Win=76032 Len=0 TSval=1764246858 TSecr=1764246858
9	0.002292149	127.0.0.1	127.0.0.1	HTTP	723	HTTP/1.1 200 OK (text/html)
10	0.002312336	127.0.0.1	127.0.0.1	TCP	66	56288 → 8080 [ACK] Seq=1393 Ack=658 Win=64896 Len=0 TSval=1764246858 TSecr=1764246858
11	0.029697471	127.0.0.1	127.0.0.1	HTTP	1458	GET /favicon.ico HTTP/1.1
12	0.029821292	127.0.0.1	127.0.0.1	HTTP	242	HTTP/1.1 404 Not Found (text/plain)
13	0.070633738	127.0.0.1	127.0.0.1	TCP	66	56288 → 8080 [ACK] Seq=2785 Ack=834 Win=64768 Len=0 TSval=1764246927 TSecr=1764246886
14	0.289605146	127.0.0.1	127.0.0.1	TCP	66	[TCP Keep-Alive] 56288 → 8080 [ACK] Seq=2784 Ack=834 Win=64768 Len=0 TSval=1764246927 TSecr=1764246886
15	0.289713103	127.0.0.1	127.0.0.1	TCP	66	[TCP Keep-Alive ACK] 8080 → 56288 [ACK] Seq=834 Ack=2785 Win=76032 Len=0 TSval=1764246927 TSecr=1764246927
16	0.409758105	127.0.0.1	127.0.0.1	TCP	66	[TCP Keep-Alive] 8080 → 56288 [ACK] Seq=833 Ack=2785 Win=76032 Len=0 TSval=1764246927 TSecr=1764246927
17	0.409789878	127.0.0.1	127.0.0.1	TCP	66	[TCP Keep-Alive ACK] 56288 → 8080 [ACK] Seq=2785 Ack=834 Win=64768 Len=0 TSval=1764246927 TSecr=1764246927
18	0.529801992	127.0.0.1	127.0.0.1	TCP	66	[TCP Keep-Alive] 56288 → 8080 [ACK] Seq=2784 Ack=834 Win=64768 Len=0 TSval=1764246927 TSecr=1764246927
19	0.529843423	127.0.0.1	127.0.0.1	TCP	66	[TCP Keep-Alive ACK] 8080 → 56288 [ACK] Seq=834 Ack=2785 Win=76032 Len=0 TSval=1764246927 TSecr=1764246927
20	0.769630921	127.0.0.1	127.0.0.1	TCP	66	[TCP Keep-Alive] 8080 → 56288 [ACK] Seq=833 Ack=2785 Win=76032 Len=0 TSval=1764246927 TSecr=1764246927
21	0.769675874	127.0.0.1	127.0.0.1	TCP	66	[TCP Keep-Alive ACK] 56288 → 8080 [ACK] Seq=2785 Ack=834 Win=64768 Len=0 TSval=1764246927 TSecr=1764246927
22	0.769677623	127.0.0.1	127.0.0.1	TCP	66	[TCP Keep-Alive] 56288 → 8080 [ACK] Seq=2784 Ack=834 Win=64768 Len=0 TSval=1764246927 TSecr=1764246927
23	0.769694322	127.0.0.1	127.0.0.1	TCP	66	[TCP Keep-Alive ACK] 8080 → 56288 [ACK] Seq=834 Ack=2785 Win=76032 Len=0 TSval=1764246927 TSecr=1764246927
24	0.009624013	127.0.0.1	127.0.0.1	TCP	66	[TCP Keep-Alive] 56288 → 8080 [ACK] Seq=2784 Ack=834 Win=64768 Len=0 TSval=1764246927 TSecr=1764246927
25	0.009632488	127.0.0.1	127.0.0.1	TCP	66	[TCP Keep-Alive ACK] 8080 → 56288 [ACK] Seq=834 Ack=2785 Win=76032 Len=0 TSval=1764246927 TSecr=1764246927
26	0.129618910	127.0.0.1	127.0.0.1	TCP	66	[TCP Keep-Alive] 8080 → 56288 [ACK] Seq=833 Ack=2785 Win=76032 Len=0 TSval=1764246927 TSecr=1764246927
27	0.129659169	127.0.0.1	127.0.0.1	TCP	66	[TCP Keep-Alive ACK] 56288 → 8080 [ACK] Seq=2785 Ack=834 Win=64768 Len=0 TSval=1764246927 TSecr=1764246927

Frame 7: 1458 bytes on wire (11664 bits), 1458 bytes captured (11664 bits) on interface lo, id 0  
Ethernet II, Src: 00:00:00:00:00:00 (00:00:00:00:00:00), Dst: 00:00:00:00:00:00 (00:00:00:00:00:00)  
Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1  
Transmission Control Protocol, Src Port: 56288, Dst Port: 8080, Seq: 1, Ack: 1, Len: 1392  
Hypertext Transfer Protocol  
GET / HTTP/1.1\r\n  
Host: localhost:8080\r\n  
User-Agent: Mozilla/5.0 (X11; Linux x86\_64; rv:139.0) Gecko/20100101 Firefox/139.0\r\n  
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,\*/\*;q=0.8\r\n  
Accept-Language: en-US,en;q=0.5\r\n  
Accept-Encoding: gzip, deflate, br, zstd\r\n  
Connection: keep-alive\r\n  
Cookie: mp\_9bfb1deals74f9ea59453846a9cccd7d3\_mlxpanel=47B\*222distinctid%2d22424device%3Aal...  
Upgrade-Insecure-Requests: 1\r\n  
Sec-Fetch-Dest: document\r\n  
Sec-Fetch-Mode: navigate\r\n  
Sec-Fetch-Site: none\r\n  
Sec-Fetch-User: ?1\r\n  
Priority: u=0, i\r\n  
Pragma: no-cache\r\n  
Cache-Control: no-cache\r\n  
\r\n  
[Response in frame: 9]  
[Full request URI: http://localhost:8080/]

Loopback: lo: <live capture in progress>

Packets: 27

Profile: Default

Frame 7: 1458 bytes on wire (11664 bits), 1458 bytes captured (11664 bits) on interface lo, id 0  
Ethernet II, Src: 00:00:00\_00:00:00:00 (00:00:00:00:00:00), Dst: 00:00:00\_00:00:00:00 (00:00:00:00:00:00)  
Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1  
Transmission Control Protocol, Src Port: 56288, Dst Port: 8080, Seq: 1, Ack: 1, Len: 1392  
Hypertext Transfer Protocol  
GET / HTTP/1.1\r\n  
Host: localhost:8080\r\n  
User-Agent: Mozilla/5.0 (X11; Linux x86\_64; rv:139.0) Gecko/20100101 Firefox/139.0\r\n  
Accept:  
text/html,application/xhtml+xml,application/xml;q=0.9,\*/\*;q=0.8\r\n  
Accept-Language: en-US,en;q=0.5\r\n  
Accept-Encoding: gzip, deflate, br, zstd\r\n  
Connection: keep-alive\r\n  
Cookie: ...  
Upgrade-Insecure-Requests: 1\r\n  
Sec-Fetch-Dest: document\r\n  
Sec-Fetch-Mode: navigate\r\n  
Sec-Fetch-Site: none\r\n  
Sec-Fetch-User: ?1\r\n  
Priority: u=0, i\r\n  
Pragma: no-cache\r\n  
Cache-Control: no-cache\r\n  
\r\n  
[Response in frame: 9]  
[Full request URI: http://localhost:8080/]

There is some information in the HTTP request:

- GET method, of the HTTP protocol version 1.1
- Uses CRLF (`\r\n`) as a line ending, which is the standard for HTTP requests.

Server responds with the contents of `index.html` file, which is sent as a response body.

```
Frame 9: 723 bytes on wire (5784 bits), 723 bytes captured (5784 bits) on
interface lo, id 0
Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst:
00:00:00_00:00:00 (00:00:00:00:00:00)
Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1
Transmission Control Protocol, Src Port: 8080, Dst Port: 56288, Seq: 1,
Ack: 1393, Len: 657
Hypertext Transfer Protocol
  HTTP/1.1 200 OK\r\n
  Accept-Ranges: bytes\r\n
  Content-Length: 472\r\n
  Content-Type: text/html; charset=utf-8\r\n
  Last-Modified: Thu, 05 Jun 2025 05:23:48 GMT\r\n
  Date: Thu, 05 Jun 2025 05:29:38 GMT\r\n
  \r\n
  [Request in frame: 7]
  [Time since request: 0.000315794 seconds]
  [Request URI: /]
  [Full request URI: http://localhost:8080/]
  File Data: 472 bytes
Line-based text data: text/html (18 lines)
```

Jun 5 7:35 AM

\*Loopback: lo

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Apply a display filter ... <Ctrl-/>

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	127.0.0.1	127.0.0.1	TCP	66	33692 → 8080 [FIN, ACK] Seq=1 Ack=1 Win=506 Len=0 TSval=1764246856 TSecr=1764239103
2	0.000117911	127.0.0.1	127.0.0.1	TCP	66	8080 → 33692 [FIN, ACK] Seq=1 Ack=2 Win=594 Len=0 TSval=1764246856 TSecr=1764246856
3	0.000153418	127.0.0.1	127.0.0.1	TCP	66	33692 → 8080 [ACK] Seq=2 Ack=2 Win=506 Len=0 TSval=1764246856 TSecr=1764246856
4	0.001861053	127.0.0.1	127.0.0.1	TCP	74	56288 → 8080 [SYN] Seq=0 Win=65495 Len=0 MSS=65495 SACK_PERM TSval=1764246858 TSecr=0 WS=128
5	0.001891142	127.0.0.1	127.0.0.1	TCP	74	8080 → 56288 [SYN, ACK] Seq=0 Ack=1 Win=65495 Len=0 MSS=65495 SACK_PERM TSval=1764246858 TSecr=1764246858 WS=128
6	0.001896704	127.0.0.1	127.0.0.1	TCP	66	56288 → 8080 [ACK] Seq=1 Ack=1 Win=65536 Len=0 TSval=1764246858 TSecr=1764246858
7	0.001976355	127.0.0.1	127.0.0.1	HTTP	1458	GET / HTTP/1.1
8	0.001985318	127.0.0.1	127.0.0.1	TCP	66	8080 → 56288 [ACK] Seq=1 Ack=1393 Win=76032 Len=0 TSval=1764246858 TSecr=1764246858
9	0.002292149	127.0.0.1	127.0.0.1	HTTP	723	HTTP/1.1 200 OK (text/html)
10	0.002312336	127.0.0.1	127.0.0.1	TCP	66	56288 → 8080 [ACK] Seq=1393 Ack=658 Win=64896 Len=0 TSval=1764246858 TSecr=1764246858
11	0.029697471	127.0.0.1	127.0.0.1	HTTP	1458	GET /favicon.ico HTTP/1.1
12	0.029821292	127.0.0.1	127.0.0.1	HTTP	242	HTTP/1.1 404 Not Found (text/plain)
13	0.070633738	127.0.0.1	127.0.0.1	TCP	66	56288 → 8080 [ACK] Seq=2785 Ack=834 Win=64768 Len=0 TSval=1764246927 TSecr=1764246886
14	0.289695148	127.0.0.1	127.0.0.1	TCP	66	[TCP Keep-Alive] 56288 → 8080 [ACK] Seq=2784 Ack=834 Win=64768 Len=0 TSval=1764257146 TSecr=1764246886
15	0.289713103	127.0.0.1	127.0.0.1	TCP	66	[TCP Keep-Alive] 8080 → 56288 [ACK] Seq=834 Ack=2785 Win=76032 Len=0 TSval=1764257146 TSecr=1764246927
16	0.409758105	127.0.0.1	127.0.0.1	TCP	66	[TCP Keep-Alive] 8080 → 56288 [ACK] Seq=833 Ack=2785 Win=76032 Len=0 TSval=1764262266 TSecr=1764246927
17	0.409789878	127.0.0.1	127.0.0.1	TCP	66	[TCP Keep-Alive] 56288 → 8080 [ACK] Seq=2785 Ack=834 Win=64768 Len=0 TSval=1764262266 TSecr=1764257146
18	0.529801992	127.0.0.1	127.0.0.1	TCP	66	[TCP Keep-Alive] 56288 → 8080 [ACK] Seq=2784 Ack=834 Win=64768 Len=0 TSval=1764267386 TSecr=1764257146
19	0.529843423	127.0.0.1	127.0.0.1	TCP	66	[TCP Keep-Alive] 8080 → 56288 [ACK] Seq=834 Ack=2785 Win=76032 Len=0 TSval=1764267386 TSecr=1764262266
20	0.769630921	127.0.0.1	127.0.0.1	TCP	66	[TCP Keep-Alive] 8080 → 56288 [ACK] Seq=833 Ack=2785 Win=76032 Len=0 TSval=1764277626 TSecr=1764262266
21	0.769675874	127.0.0.1	127.0.0.1	TCP	66	[TCP Keep-Alive] 56288 → 8080 [ACK] Seq=2785 Ack=834 Win=64768 Len=0 TSval=1764277626 TSecr=1764267386
22	0.769677623	127.0.0.1	127.0.0.1	TCP	66	[TCP Keep-Alive] 56288 → 8080 [ACK] Seq=2784 Ack=834 Win=64768 Len=0 TSval=1764277626 TSecr=1764267386
23	0.769694322	127.0.0.1	127.0.0.1	TCP	66	[TCP Keep-Alive] 8080 → 56288 [ACK] Seq=834 Ack=2785 Win=76032 Len=0 TSval=1764277626 TSecr=1764277626
24	0.009624013	127.0.0.1	127.0.0.1	TCP	66	[TCP Keep-Alive] 56288 → 8080 [ACK] Seq=2784 Ack=834 Win=64768 Len=0 TSval=1764287866 TSecr=1764277626
25	0.006433488	127.0.0.1	127.0.0.1	TCP	66	[TCP Keep-Alive] 8080 → 56288 [ACK] Seq=834 Ack=2785 Win=76032 Len=0 TSval=1764287866 TSecr=1764277626

Frame 9: 723 bytes on wire (5784 bits), 723 bytes captured (5784 bits) on interface lo, id 0

Ethernet II, Src: 00:00:00:00:00:00 (00:00:00:00:00:00), Dst: 00:00:00:00:00:00 (00:00:00:00:00:00)

Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1

Transmission Control Protocol, Src Port: 8080, Dst Port: 56288, Seq: 1, Ack: 1393, Len: 657

Hypertext Transfer Protocol

HTTP/1.1 200 OK

Accept-Ranges: bytes

Content-Length: 472

Content-Type: text/html; charset=utf-8

Last-Modified: Thu, 05 Jun 2025 05:23:48 GMT

Date: Thu, 05 Jun 2025 05:29:38 GMT

Request in frame: 71

[Time since request: 0.000315794 seconds]

[Request URI: /]

[Full request URI: http://localhost:8080/]

File Data: 472 bytes

Line-based text data: text/html (18 lines)

0040 4b 4a 7b 54 64 50 2f 31 2c 31 20 32 40 30 3c 41 E0 HTTP/1.1 200 OK

0050 4b 6d 0a 41 63 63 45 70 74 2d 52 61 6e 67 45 73 5a Accept-Ranges

0060 3a 20 62 79 74 65 73 0d 0a 43 6f 6e 74 65 6e 74 : bytes: Content

0070 2d 4c 65 6e 67 74 68 3a 20 34 37 32 0d 0a 43 6f -Length: 472 Content

0080 6e 74 65 6e 74 2d 54 79 70 65 3a 20 74 65 78 74 ntent-Type: text

0090 2f 68 74 6d 6c 3b 20 63 68 61 72 73 65 74 3d 75 /html; charset=utf

00a0 74 66 2d 38 0d 0a 4c 61 73 74 2d 4d 6f 64 69 66 tr: Last-Modif

00b0 69 65 64 3a 20 54 68 75 2c 20 30 35 20 4a 75 6e ied: Thu, 05 Jun

00c0 20 32 30 32 35 20 30 35 3a 32 33 3a 34 38 20 47 2025 05:23:48 G

00d0 4d 54 04 0a 44 61 74 65 3a 20 54 68 75 2c 20 30 MT: Date: Thu, 0

00e0 35 20 4a 75 6e 20 32 30 32 35 20 30 35 3a 32 39 5 Jun 2025 05:29

00f0 3a 33 38 20 47 4d 54 0d 0a 0d 0a 3c 21 44 4f 43 :38 GMT: ...<DOC

0100 54 59 50 45 20 68 74 6d 6c 3e 0a 3c 68 74 6d 6c TYPE html ><html

0110 20 6c 61 6e 67 3d 22 65 6e 22 3e 0a 3c 68 65 61 lang="utf-8"><hea

0120 64 3e 0a 20 20 20 3c 6d 65 74 61 20 63 68 61 d> < meta cha

0130 72 73 65 74 3d 22 55 54 4e 2d 38 22 3e 0a 20 20 rset="UTF-8">

0140 20 20 3c 74 69 74 6c 65 3e 45 78 61 6d 70 6c 65 <title>Example

0150 20 49 6e 64 65 78 3c 2f 74 69 74 6c 65 3e 0a 3c Index< title><

0160 2f 68 65 61 64 3e 0a 3c 62 6f 64 79 3e 0a 20 20 /head>< body>

0170 20 20 3c 6e 61 76 3e 0a 20 20 20 20 20 20 20 20 <nav>

0180 3c 75 6c 3e 0a 20 20 20 20 20 20 20 20 20 20 20 <ul>

0190 20 3c 6c 69 3e 0a 20 20 68 72 65 66 3d 22 69 6e <li><a href="/in

01a0 64 65 78 2e 68 74 6d 6c 22 3e 48 6f 6d 65 3c 2f dex.html">Home<

01b0 61 3e 3c 2f 6c 69 3e 0a 20 20 20 20 20 20 20 20 a></li>

01c0 20 20 20 20 3c 6c 69 3e 3c 61 20 68 72 65 66 3d <li><a href=

01d0 22 61 62 6f 75 74 2e 68 74 6d 6c 22 3e 41 62 6f "about.html">Abo

Packets: 33 · Dropped: 0 (0.0%) Profile: Default

As you can see, the stateless nature of HTTP is evident here. The server does not maintain any state between requests.

## An interesting fact

You can force a client to use HTTP/0.9 instead of HTTP/1.1, for steganography purposes.