# 6 (Hyper Text Transfer Protocol - HTTP 1.0, 1.1, 2, 3)

It is a client/server communication protocol

Most of the times, client is our browser, and Web server is our server. It is a (Request/Response) Architecture

HTTP Request {
- URL
- Method Type
- Headers
- Body

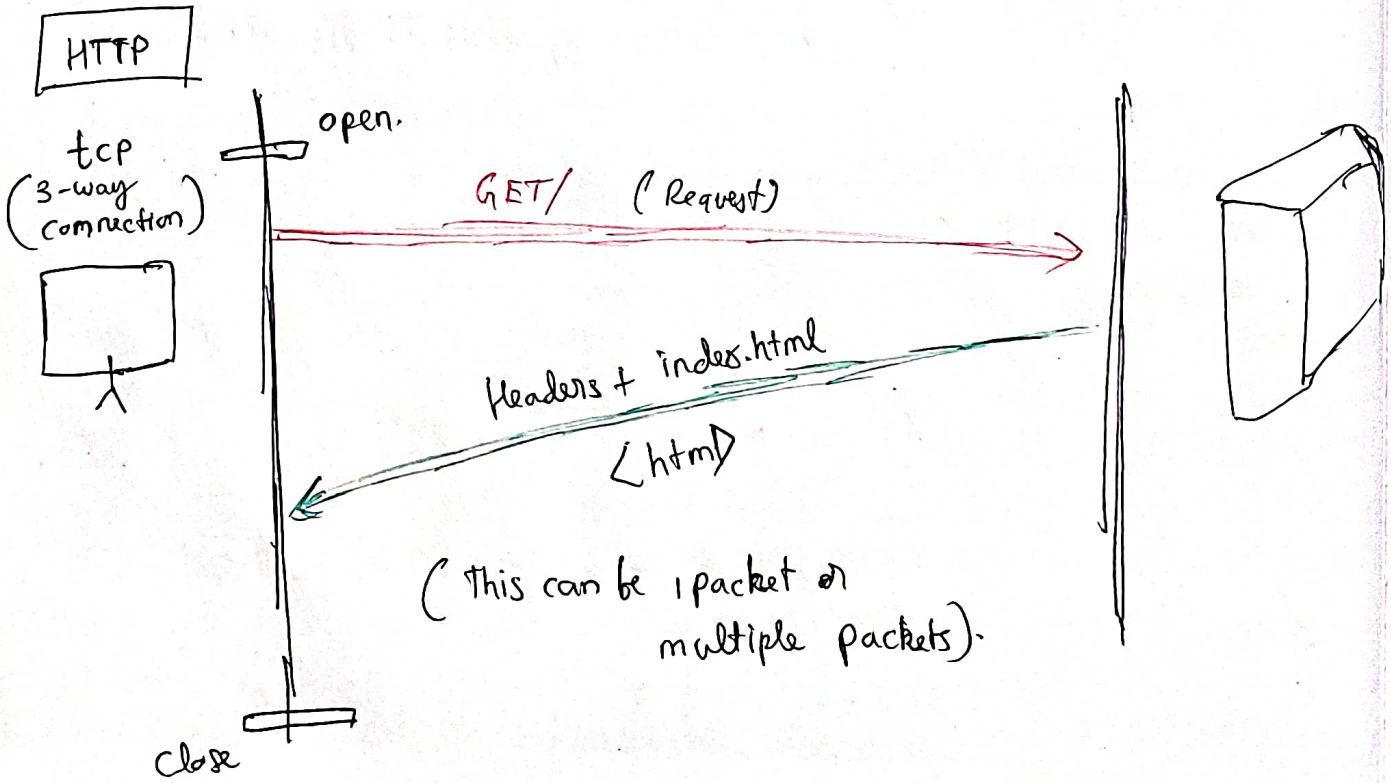
}

HTTP Response {
- Status Code
- Headers
- Body

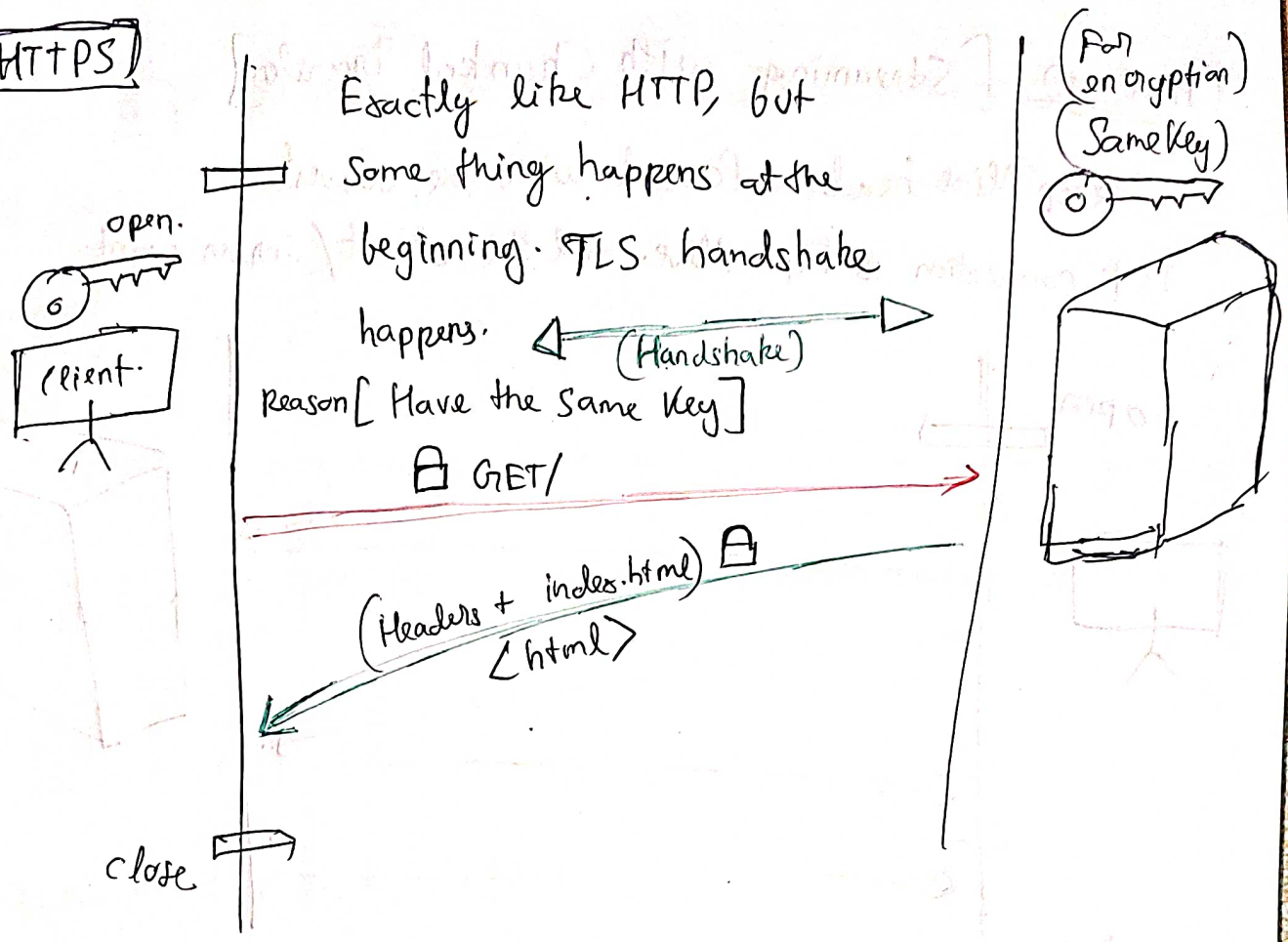
}

TCP is the vehicle that transports the blob of data packets.

~~to the~~ access



HTTPS

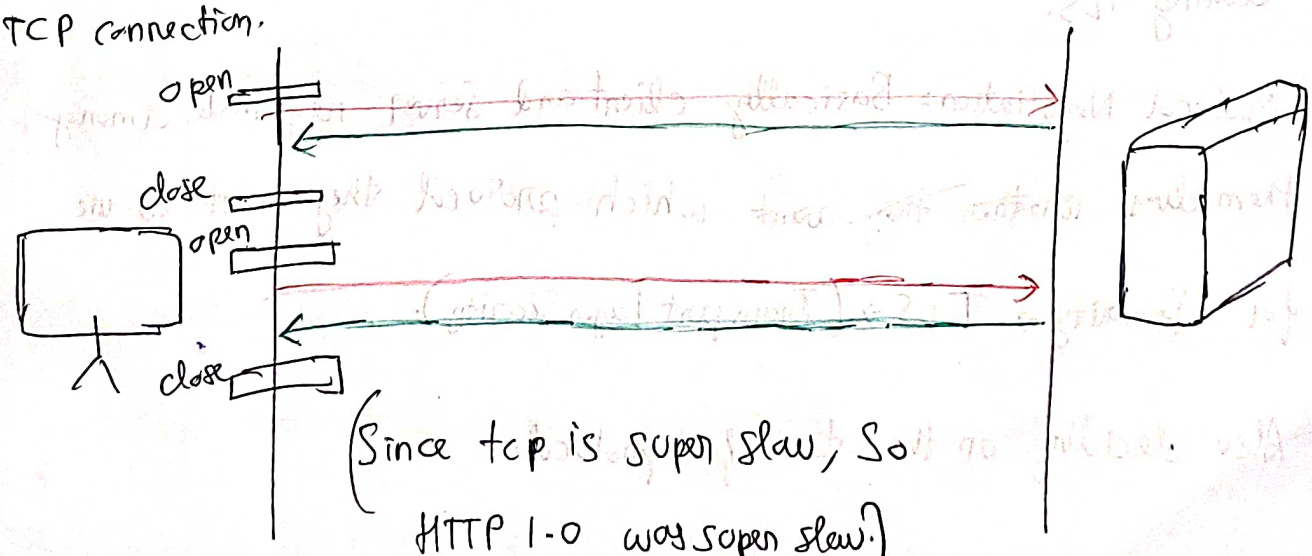



HTTP 1-0 (Deprecated). [ Buffering ] → will be explained.

Since TCP is a stateful protocol, Hence each TCP request needs to maintain and reserve some memory in the RAM,

~~Hence~~ Earlier RAM was very less,

So for each Request HTTP 1-0, would open a TCP connection and close a TCP connection.

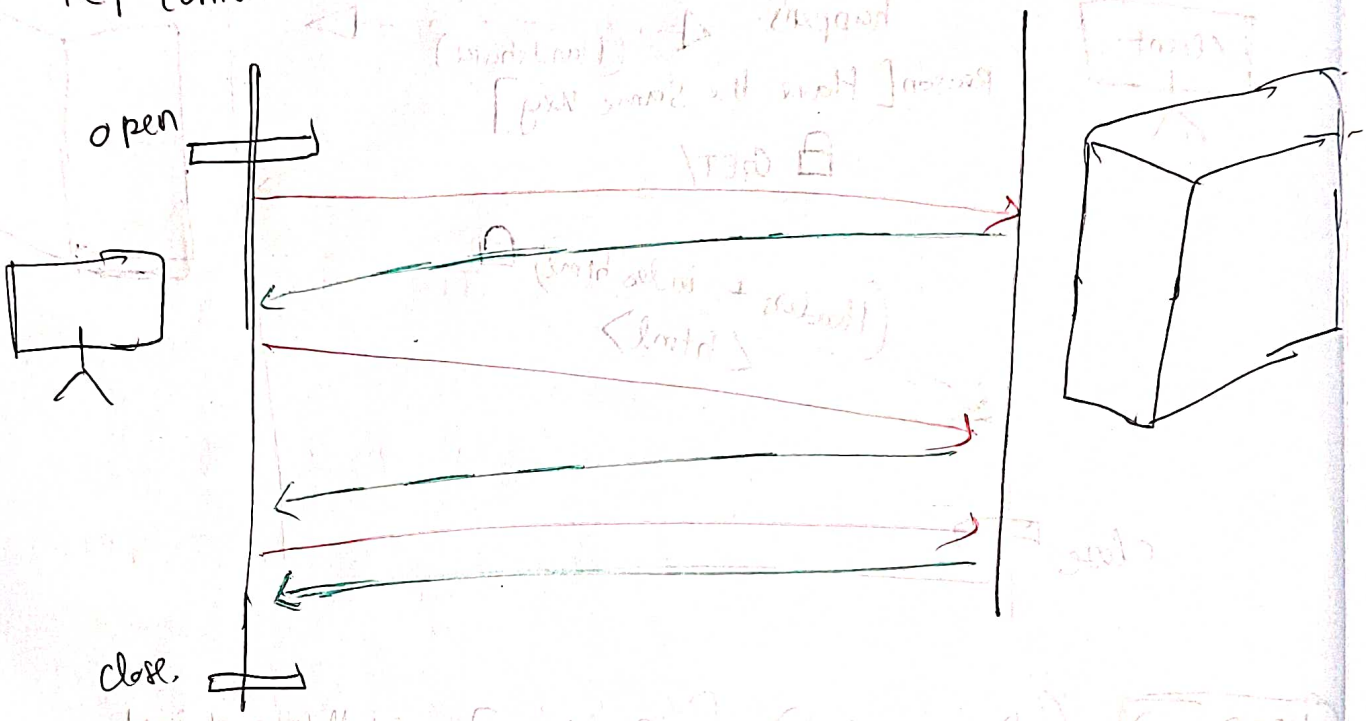



(Since tcp is super slow, So HTTP 1-0 was super slow.)

## (HTTP 1.1) [Streaming with Chunked Transfer]

Keep Alive header: Passed with the request.

TCP connection is kept Alive. till the client/ server want




* persisted tcp connection
* Low Latency

## (HTTP/2)

(will be discussed) → [Will be explained]

Introduced Multiplexing, Compression, Protocol Negotiation during TLS.

Protocol Negotiation: Basically client and server negotiate among themselves ~~whether they want~~ which protocol they want to use for Security → TLS → (Transport Layer Security).

Also deciding on the transfer protocol

## HTTP/3

- Replaces TCP with QUIC [UDP with Congestion Control]
- All HTTP/2 features.

Difference between Buffering → [HTTP 1.1] & Streaming with Chunked Data → [HTTP 2.0]

Example.

### Buffering:

Buffering is the process where data is accumulated into a buffer until a certain threshold is reached, after which it is sent in a single transmission.

Example: Buffering a File Download.

### 1. Application Layer

- Client requests a large file from a server.
- Server reads the file into a buffer until it reaches a predetermined size (eg. 1mB)

Then fixed size buffer after going through (L4, L3, L2) is sent.

This buffering you will also see while watching a Youtube video.

By Buffering it fills some part of the bar, then loads again.

## Streaming with Chunked Transfer Encoding:

Chunked Transfer Encoding is used to send data in a series of chunks, particularly useful for streaming data or when total length of content is unknown.

1. Application Layer: : [Streaming Video].

* Client requests a video stream from a server.
* Server starts reading and encoding the video into small chunks (4KB).

| | Buffering. | Chunked Transfer. |
|---|---|---|
| Transmission: | Data accumulated and only sent once message is ready or buffer is full | Data is divided into chunks and sent as soon as chunk is ready. |
| Latency: | Higher latency [Slow] | Lower Latency [Faster] |
| Use Case: | Ensure data integrity: File Transfer, Youtube | Video Streaming |

Lets Explain to you how HTTP/2 uses multiplexing and wins over HTTP/1.1.

## HTTP/1.1 with Keep Alive Header:

* Allows the same tcp connection to be reused for multiple HTTP request and responses
* It reduces the overhead of establishing a new tcp request for each Request.

## Pipelining:

* HTTP/1.1 introduced this concept, which allows multiple requests to be sent out waiting for corresponding responses. (Multiple requests can be send)
* However, the responses must be received in the order the requests were sent - [Head-of-line blocking]

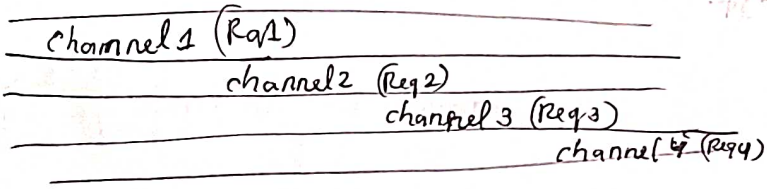
{
* If earlier request takes long time to proces, all request following that will watt.
* this lack of concurrency slows down

}.

## HTTP/2 Multiplexing:

* HTTP/2 allows multiple **streams** within a single TCP connection, enabling multiple requests and responses to be sent and received independently and concurrently.

* Each stream/channel is identified by its own stream/channel id.




No Head-of-Line Blocking

* Since streams are independent, a delay in one stream (request) does not block others.

* Better Performance.

### Multiplexing Concept Innovation

HTTP/2 was designed to address the limitation of HTTP/1.1 particularly to handle the concurrency issue

## (Key Concepts)

(1) Streams

A stream is an independent, bidirectional sequence of frames exchanged between the client and server.

(2) Messages and Frames

→ It corresponds to logical HTTP request and response.

Frames → Are packets. (Smallest Unit).

***

Each HTTP request/response pair is associated with a new stream.

***

Streams/Channels can be assigned higher priorities, for more important messages to be delivered faster.

## (Historical Context & Evolution)

Before HTTP/2, SPDY (a protocol developed by Google) was an experimental protocol that introduced many of the concepts including multiplexing.

SPDY introduced concept of streams and frame-based comms.

Demonstrated the performance benifits of multiplexing

Later adopted by (HTTP/2.)