



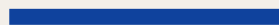
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# 1



## HTTP1.1의 문제점

## Part 1 >> HTTP1.1 문제점



Client-driven  
transmission

Fat message  
headers

Head of Line  
blocking

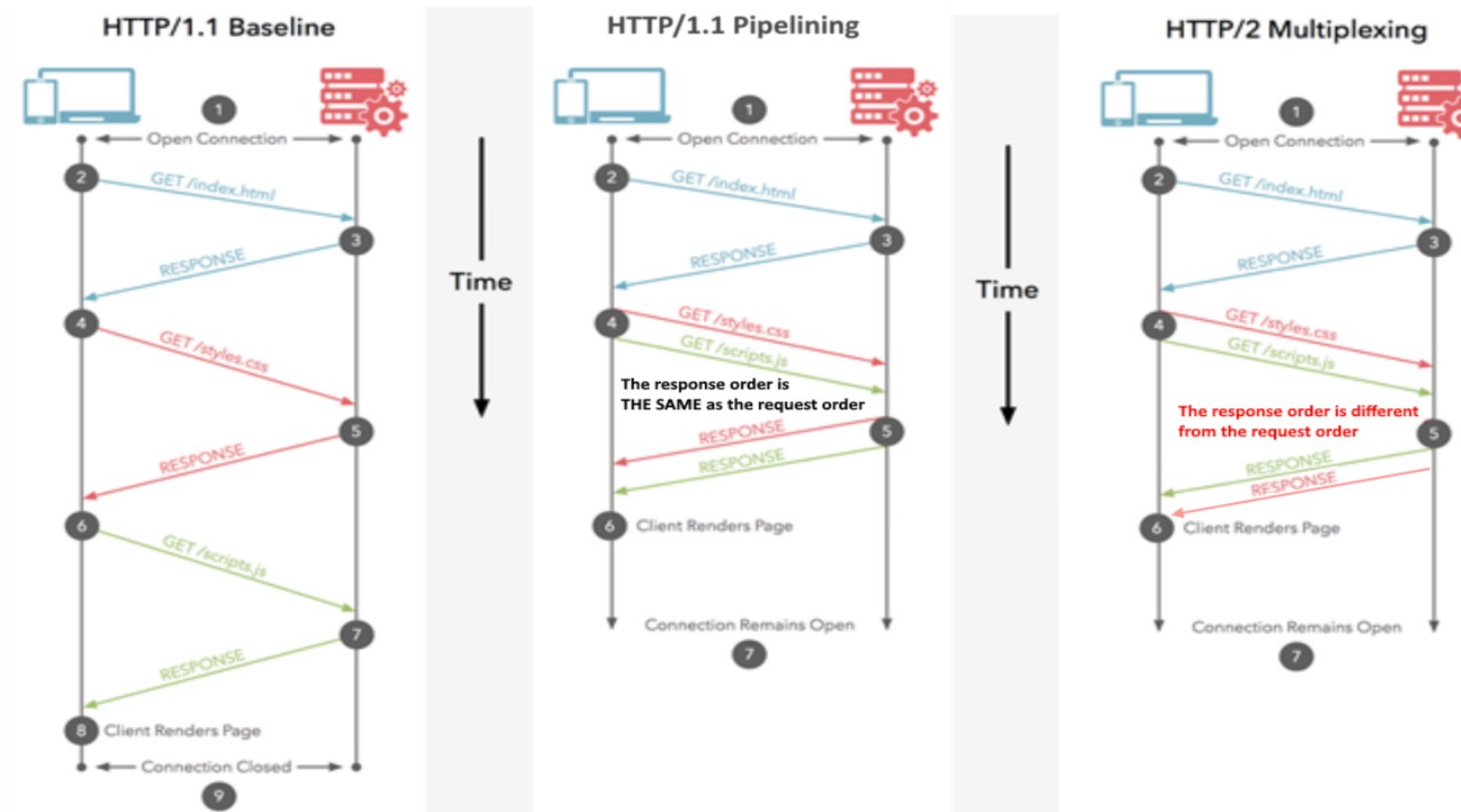
## Part 1 >> Fat Message Headers 문제

```
[host:"localhost:8000", connection:"keep-alive", sec-ch-ua:""Google Chrome";v="105", "Not)A;Brand";v="8", "Chromium";v="105""", sec-ch-ua-mobile:"?0", sec-ch-ua-platform:""macOS""", upgrade-insecure-requests:"1", user-agent:"Mozilla/5.0 (Macintosh; Intel Mac OS X 10_15_7) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/105.0.0.0 Safari/537.36", accept:"text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,image/apng,*/*;q=0.8,application/signed-exchange;v=b3;q=0.9", purpose:"prefetch", sec-fetch-site:"none", sec-fetch-mode:"navigate", sec-fetch-user:"?1", sec-fetch-dest:"document", accept-encoding:"gzip, deflate, br", accept-language:"ko-KR,ko;q=0.9,en-US;q=0.8,en;q=0.7", cookie:"Idea-204dd590=ef972ef0-dc85-49ee-8de1-e290e4651a93; wp-settings-time-1=1660356598; username-localhost-8889="2|1:0|10:1663132530|23:username-localhost-8889|44:NWVhNTk5MDM0ODI0NGE5ZDg0YzlyNWVhNjA5NGEzZWY=|4dba35d84a214b9024dd2a2bc21518064daee4435283ed97abbc51f09e8019ca"; username-localhost-8888="2|1:0|10:1664337852|23:username-localhost-8888|44:ZWVhMDRiMGM5ZThINDI2ZWE2OTU0NWY5NzNINDhhNDQ=|4246b4885a6bb4557b6dbeb8bccdc26261598f7af87cc85dfb8a168108c40b60"; JSESSIONID=FF29CA9346E1FB27B18F0ADCA081C646"]
```

보기만 해도 헤더의 정보가 엄청 많다

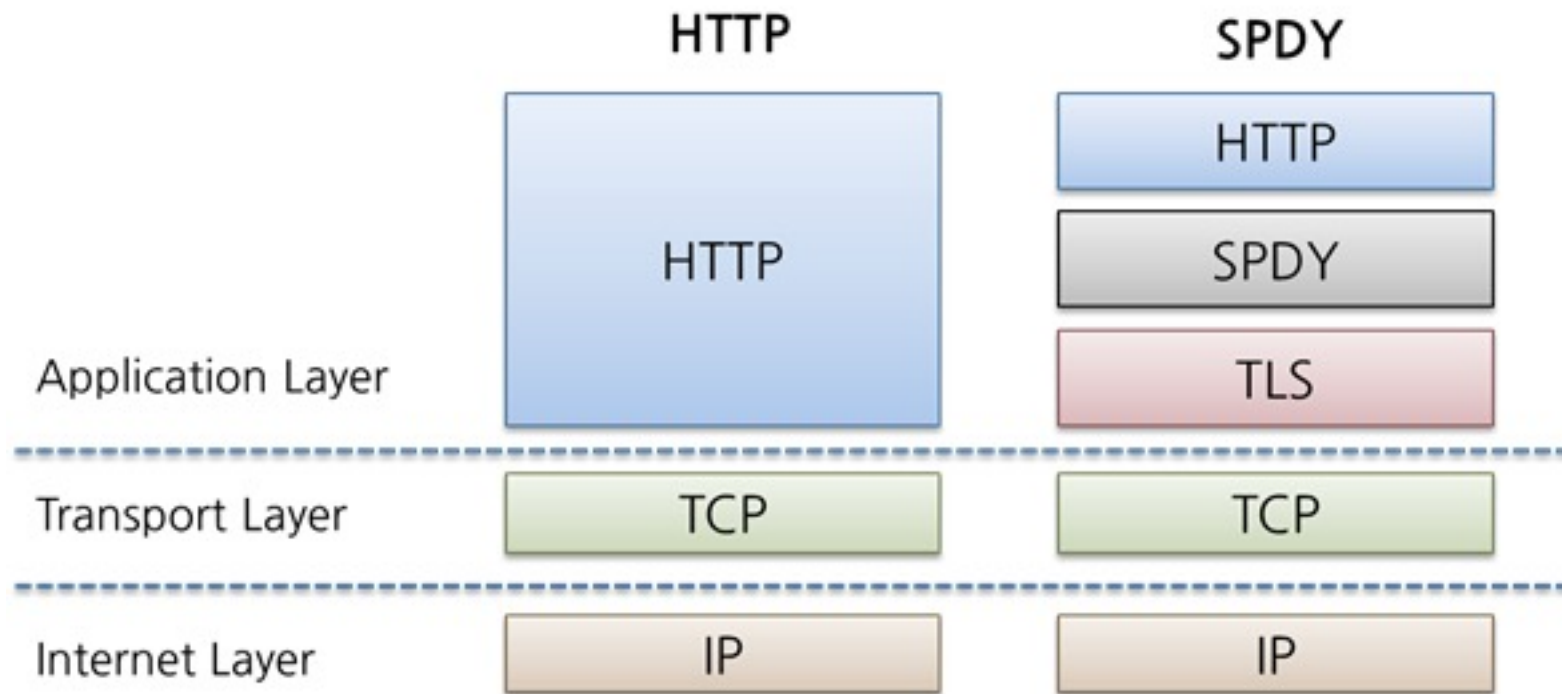
But.. 이걸 매 요청 시마다 전송해야 하는 문제점이 있다(중복된 헤더값 전송)

## Part 1 >> Head of line blocking 문제



http1.1의 경우 원래 커넥션 하나당 한번의 요청만 가능 -> pipelining을 이용해서 여러 개의 이미지를 요청함  
-> but HOL의 문제인 앞의 요청이 지연되면 뒤의 요청도 전부 다 지연되게 됨

## Part 1 >> SPDY 의 등장



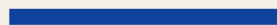
구글에서 웹페이지 전송 지연을 줄이고 웹 보안을 개선하는 목표로 개발한 비표준 네트워크 프로토콜

## Part 2 >> SPDY 의 특징

- TLS 위에서만 작동
- HTTP 헤더 압축
- 바이너리 프로토콜
- Multiplexing
- Full-duplex interleaving과 스트림 우선순위
- Server push

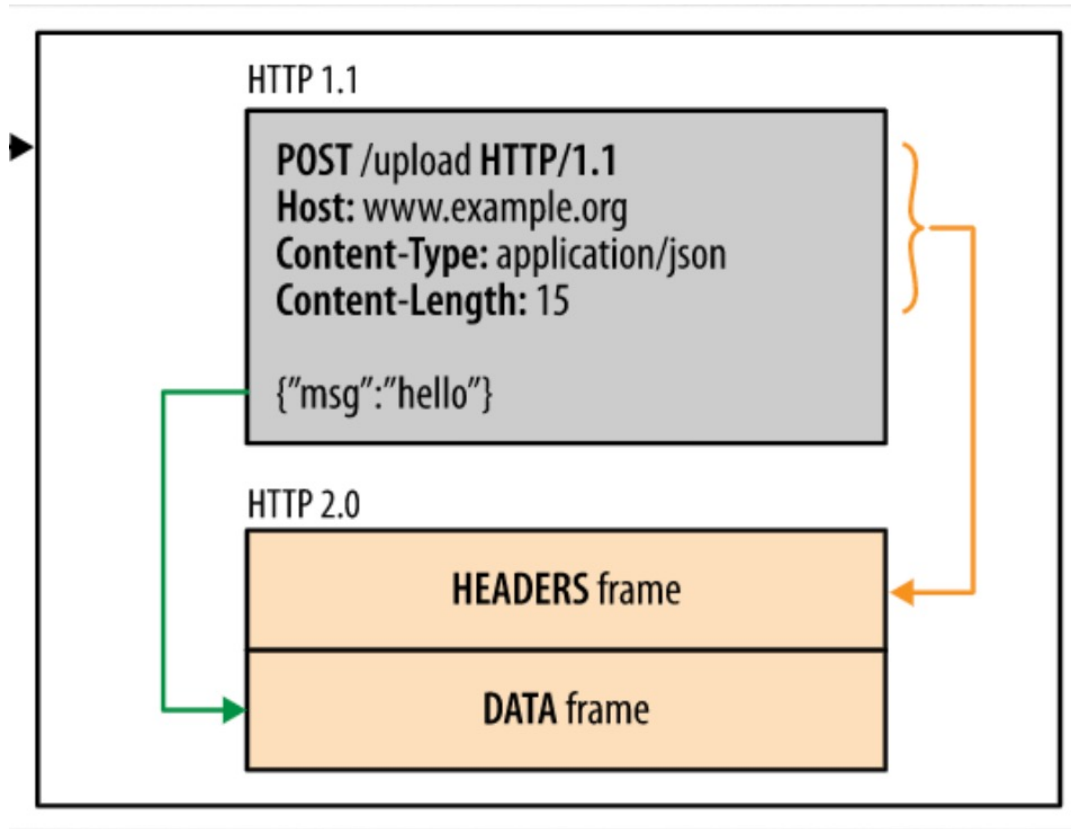


# 2



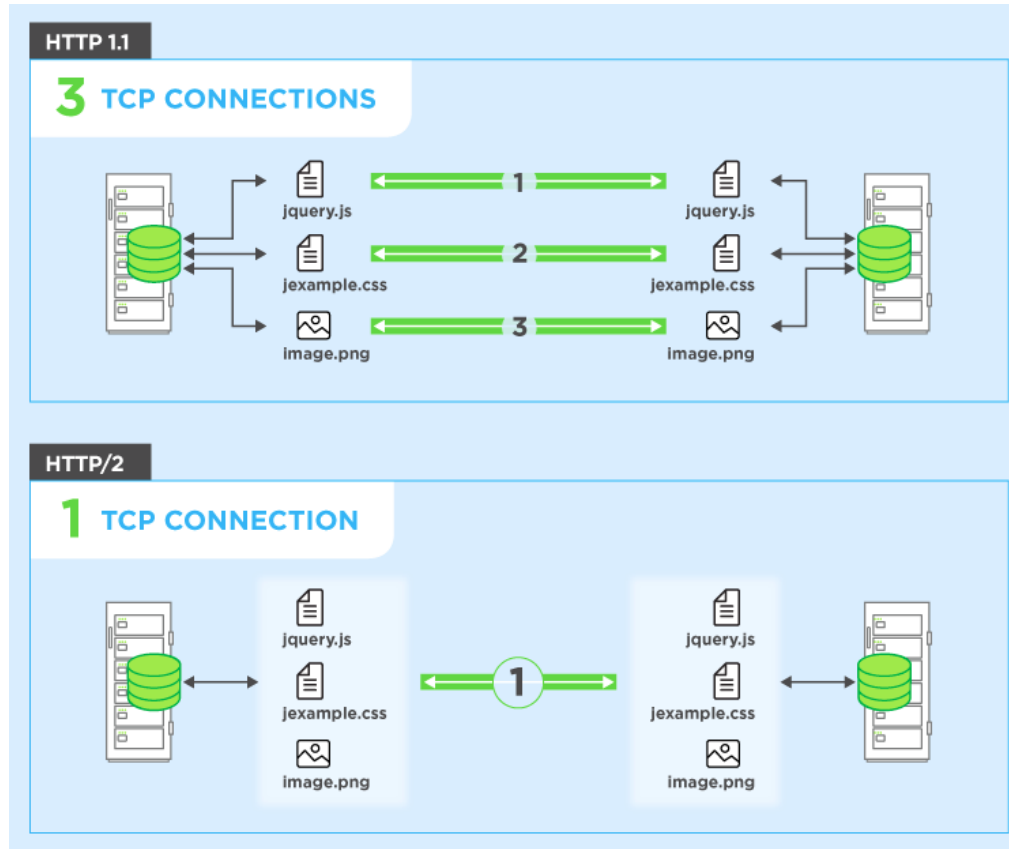
## HTTP2의 등장

## Part 2 >> Binary protocol



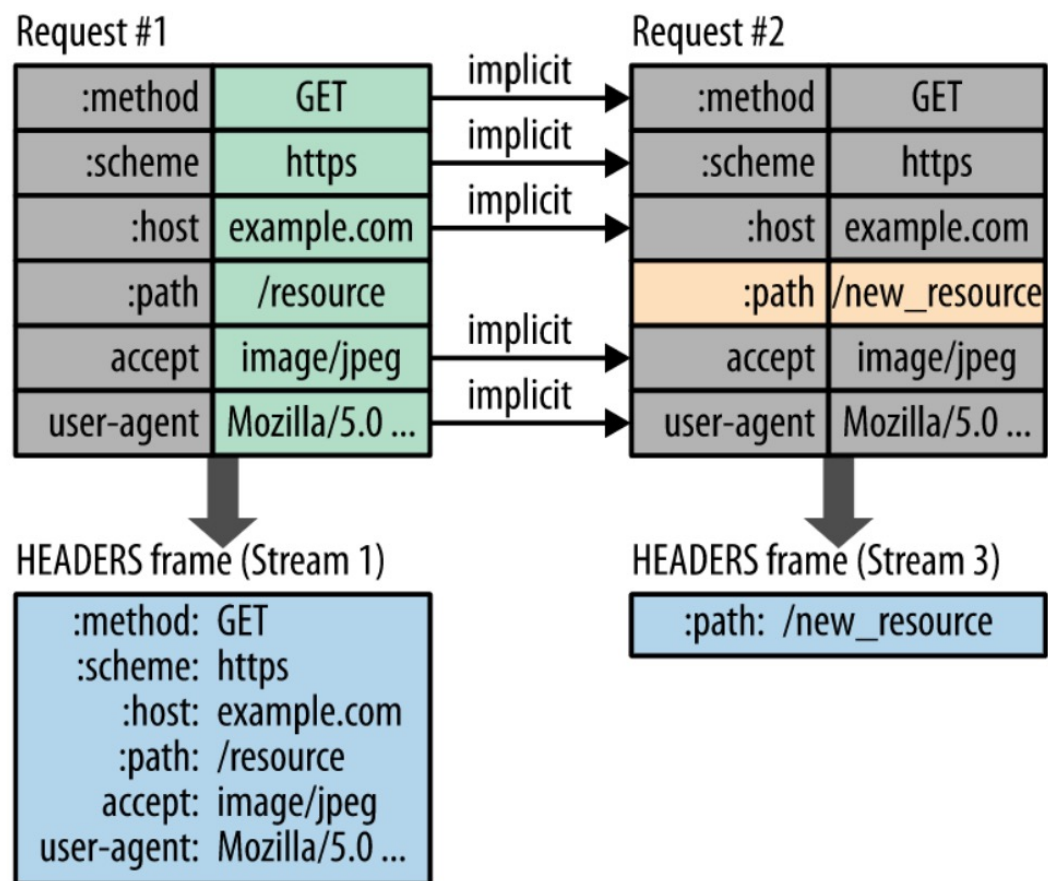
-> 데이터의 파싱이 더 빠르고,  
오류 발생 가능성이 적음

## Part 2 >> multiplexed streams



-> connection 한 개로 동시에 여러 개의 메시지를 주고 받을 수 있음(stream 방식으로)

## Part 2 >> Header compression



-> Header Table과 Huffman  
Encoding을 사용하는 HPACK  
압축방식을 이용

달라진  
:path 정보만  
전송함

## Part 2 >> 이외의 특징



**Server push**



**Stream prioritization**

# 3



## HTTP2 테스트

## Part 3 >>

```
keytool -genkey -alias spring -storetype PKCS12 -keyalg RSA -keysize 2048 -keystore keystore.p12 -validity 4000
```

```
server:  
  ssl:  
    key-store: keystore.p12  
    key-alias: spring  
    key-store-password: 123456  
    key-store-type: PKCS12  
  http2:  
    enabled: true  
  port: 8000  
spring:
```

```
[(base) ksm@suminui-MacBookPro ~ % curl -I -k https://localhost:8000/  
HTTP/2 200  
content-type: text/plain;charset=UTF-8  
content-length: 40  
date: Sat, 08 Oct 2022 08:53:10 GMT  
  
(base) ksm@suminui-MacBookPro ~ %
```

-I : http header만 보여주는 옵션  
-k: https 사이트를 SSL 검증 없이 연결

## Part 3 >>

The screenshot shows a web browser with the Naver homepage on the left and the Chrome DevTools Network tab on the right.

**Browser Tab:** The address bar shows `naver.com`. The browser has multiple tabs open, including "HTTP/2", "[네트워크]", "Introducti...", "spring bo...", "[Spring B...", "블로그관리", "HTTP2", "진행중공고", and "NAVER".

**NAVER Homepage:** The page displays a search bar, a navigation menu with links like "블로그", "지식IN", "쇼핑", "소핑 LIVE", "Pay", "TV", "사전", "뉴스", "증권", "부동산", "지도", "VIBE", "도서", and "웹툰". Below the menu, there are several news articles, including one about the "2022.10.08. 22:09" article titled "셴간 문화일보" and another about "켈렌스키도 '러시아 핵전쟁 준비 시작'... 바이든 '아마겟돈' ...".

**Chrome DevTools Network Tab:** The Network tab is active, showing a list of network requests. The first request is highlighted, showing a status of 200, protocol of h2, and type of jpeg. The table below shows the details of the requests:

Name	Status	Protocol	Type	Initiator	Size	Time	Waterfall
rsrc=%22https%3A%2F%2Fpmst... s.pstatic.net/dthumb.phinf	200	h2	jpeg	(index) Parser	45.4 KB 45.0 KB	120... 102...	
?src=%22https%3A%2F%2Fmusi... s.pstatic.net/dthumb.phinf	200	h2	jpeg	(index) Parser	22.3 KB 22.0 KB	106... 100...	
?src=%22https%3A%2F%2Fmusi... s.pstatic.net/dthumb.phinf	200	h2	jpeg	(index) Parser	12.9 KB 12.6 KB	106... 106...	
?src=%22https%3A%2F%2Fmusi... s.pstatic.net/dthumb.phinf	200	h2	jpeg	(index) Parser	18.5 KB 18.2 KB	110... 106...	
?src=%22https%3A%2F%2Fmusi... s.pstatic.net/dthumb.phinf	200	h2	jpeg	(index) Parser	25.5 KB 25.1 KB	110... 109...	
?src=%22https%3A%2F%2Fmusi... s.pstatic.net/dthumb.phinf	200	h2	jpeg	(index) Parser	34.0 KB 33.7 KB	135... 113...	
?src=%22https%3A%2F%2Fmusi... s.pstatic.net/dthumb.phinf	200	h2	jpeg	(index) Parser	24.8 KB 24.5 KB	124... 114...	
?src=%22https%3A%2F%2Fmusi... s.pstatic.net/dthumb.phinf	200	h2	jpeg	(index) Parser	42.4 KB 42.0 KB	135... 120...	
?src=%22https%3A%2F%2Fmusi... s.pstatic.net/dthumb.phinf	200	h2	jpeg	(index) Parser	19.9 KB 19.6 KB	124... 118...	

The bottom of the DevTools panel shows the Console tab with several error messages:

```

HTTP error: status code 404, net::ERR_HTTP_RESPONSE_CODE_FAILURE
DevTools failed to load source map: Could not load content for https://pm.pstatic.net/dist/js/vendors~more~nmain~sidebar~notice.7aad5e27.js.map: HTTP error: status code 404, net::ERR_HTTP_RESPONSE_CODE_FAILURE
DevTools failed to load source map: Could not load content for https://pm.pstatic.net/dist/js/nmain.e31af4db.js.map: HTTP error: status code 404, net::ERR_HTTP_RESPONSE_CODE_FAILURE
DevTools failed to load source map: Could not load content for https://pm.pstatic.net/dist/js/vendors~more~nmain~notice~search~sidebar~notice.40da85e0.js.map: HTTP error: status code 404, net::ERR_HTTP_RESPONSE_CODE_FAILURE
  
```



## Part 3 >>

The image shows the YouTube KR homepage with the DevTools Network tab open. The network tab displays a list of requests, with the first request highlighted by a red circle around the 'h3' protocol.

Name	Status	Protocol	Type	Initiator	Size	Time	Waterfall
sp.js	200	h3	script	explore:21	(mem...)	0 ms	
/s/desktop/1fa3f652/jsbin/spf.vflset	200	h3	script	explore:21	39.9 kB	0 ms	
network.js	200	h3	script	explore:21	14.0 kB	0 ms	
/s/desktop/1fa3f652/jsbin/network...	200	h3	script	explore:21	14.0 kB	0 ms	
css2?family=Roboto:wght@300;40...	200	h3	stylesheet	explore:21	10.9 kB	0 ms	
fonts.googleapis.com	200	h3	stylesheet	explore:21	10.9 kB	0 ms	
KFOmCnqEu92Fr1Mu4mxKKTU1K...	200	h3	font	css2?family=Robo...	(mem...)	0 ms	
fonts.gstatic.com/s/roboto/v30	200	h3	font	css2?family=Robo...	(mem...)	0 ms	
KFOlCnqEu92Fr1MmEU9fBBc4AM...	200	h3	font	css2?family=Robo...	(mem...)	0 ms	
fonts.gstatic.com/s/roboto/v30	200	h3	font	css2?family=Robo...	(mem...)	0 ms	
KFOlCnqEu92Fr1MmWUlfBBc4AM...	200	h3	font	css2?family=Robo...	(mem...)	0 ms	
fonts.gstatic.com/s/roboto/v30	200	h3	font	css2?family=Robo...	(mem...)	0 ms	
www-main-desktop-home-page-sk...	200	h3	stylesheet	explore:21	(mem...)	0 ms	
/s/desktop/1fa3f652/cssbin	200	h3	stylesheet	explore:21	4.1 kB	0 ms	
www-onepick-2x.css	200	h3	stylesheet	explore:21	(mem...)	0 ms	
/s/desktop/1fa3f652/cssbin	200	h3	stylesheet	explore:21	841 B	0 ms	
rs=AGKMywEdUybyoPiSGddzAW...	200	h3	stylesheet	explore:21	(mem...)	0 ms	
/s/_ytmainappweb/_/ss/k=ytmaina...	200	h3	stylesheet	explore:21	39.1 kB	0 ms	

Summary: 59 requests | 141 kB transferred | 14.5 MB resources | Finish: 2.64 s | DOMContentLoaded: 736 ms | Load: 745 ms

## Part 3 >>

The screenshot shows a Google search for the word 'test'. The search results page is in Korean, displaying the definition of 'test' from Oxford Languages. The DevTools Network tab is open, showing a list of network requests. The first request, 'search?q=test&rlz=1C5CHFA\_enK...', is highlighted with a red circle around the 'h3' protocol. The table below lists the requests:

Name	Status	Protocol	Type	Initiator	Size	Time	Waterfall
search?q=test&rlz=1C5CHFA_enK...	200	h3	document	Other	119 kB	654...	
googlelogo_light_color_92x30dp.png	200	h3	png	/search?q=test&rlz=...	451 kB	137...	
tia.png	200	h3	png	/search?q=test&rlz=...	2.1 kB	2 ms	
tia.png	200	h3	png	/search?q=test&rlz=...	258 B	1 ms	
www.gstatic.com/inputtools/images	200	h3	png	/search?q=test&rlz=...	151 B	1 ms	
desktop_searchbox_sprites318_hr...	200	h3	webp	/search?q=test&rlz=...	660 B	1 ms	
data:image/svg+xml;...	200 OK	data	svg+xml	/search?q=test&rlz=...	192 B	0 ms	
data:image/svg+xml;...	200 OK	data	svg+xml	/search?q=test&rlz=...	270 B	0 ms	
data:image/svg+xml;...	200 OK	data	svg+xml	/search?q=test&rlz=...	427 B	0 ms	
arrow_drop_down_grey600_18dp...	200	h3	png	/search?q=test&rlz=...	90 B	1 ms	

At the bottom of the Network tab, the summary shows: 92 requests, 836 kB transferred, 5.3 MB resources, Finish: 11.82 s, DOMContentLoaded: 663 ms, Load: 1.75 s.

## Part 3 >>

The screenshot shows the Netflix homepage in a Chrome browser. The Chrome DevTools Network tab is open, displaying a list of network requests. The 'browse' request is highlighted, and its details are shown in the right pane. The 'Protocol' column for the 'browse' request is circled in red, showing 'h2'.

Name	Status	Protocol	Type	Initiator	Size	Time	Waterfall
browse	200	h2	document	Other	92.1 kB	1.61 s	
otSDKStub.js	200	h2	script	Parser	446 kB	1.58 s	
cdn.cookiecutter.org/scripttemplates	200	h2	script	Parser	21.7 kB	0 ms	
AAAABWD4emUUNG9-oyPmLtx5...	200	http/1.1	png	Parser	(mem...)	0 ms	
occ-0-395-988.1.nflxso.net/dnm/a...	OK	http/1.1	webp	Parser	2.2 kB	0 ms	
AAAABURzEONyhbY-FqvTc...	200	http/1.1	webp	Parser	(mem...)	0 ms	
occ-0-395-988.1.nflxso.net/dnm/a...	OK	http/1.1	webp	Parser	56.5 kB	0 ms	
AAAABREtAutODCUNxgR4V-P_fk...	200	http/1.1	webp	Parser	(mem...)	0 ms	
occ-0-395-988.1.nflxso.net/dnm/a...	OK	http/1.1	webp	Parser	16.2 kB	0 ms	
AAAABR7INSjYyVJEALoB_rfczRB...	200	http/1.1	webp	Parser	(mem...)	0 ms	
occ-0-395-988.1.nflxso.net/dnm/a...	OK	http/1.1	webp	Parser	22.6 kB	0 ms	
AAAABTdsIKijCPikbNp-4LsS3rt4...	200	http/1.1	jpeg	Parser	(mem...)	0 ms	
occ-0-395-988.1.nflxso.net/dnm/a...	OK	http/1.1	jpeg	Parser	39.9 kB	0 ms	
AAAABVQ4BOP57RyJ42HZnk0bdy...	200	http/1.1	webp	Parser	(mem...)	0 ms	
occ-0-395-988.1.nflxso.net/dnm/a...	OK	http/1.1	webp	Parser	42.9 kB	0 ms	
AAAABTcaOBtkncGVx7d4TroAsRH...	200	http/1.1	webp	Parser	(mem...)	0 ms	
occ-0-395-988.1.nflxso.net/dnm/a...	OK	http/1.1	webp	Parser	22.6 kB	0 ms	

Summary statistics at the bottom of the Network tab:

- 152 requests
- 9.8 MB transferred
- 22.1 MB resources
- Finish: 25.56 s
- DOMContentLoaded: 1.96 s
- Load: 2.02 s

The Console tab shows a notification: "Notifications permission has been blocked as the user has ignored the permission prompt several times. This can be reset in Page Info which can be accessed by clicking the lock icon next to the URL. See <https://www.chromestatus.com/feature/6443143280984064> for more information."

<https://quicwg.org/>



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HTTP3는 UDP를 기반으로 하는 QUIC을 사용  
<https://quicwg.org/>

## 참고 링크

---

<https://web.dev/performance-http2/>

-> http2 설명 사이트 (이성원 교수님 수업자료랑 내용이 똑같아요..소오름..)

<https://http2.github.io/>

-> http2 공식 사이트

<https://gngsn.tistory.com/99>

-> http0.9부터 – 2.0까지 잘 설명해주는 글

<https://velog.io/@dsunni/Spring-Boot-스프링부트-원리-내장-서버-HTTPS와-HTTP2-1vcfg132>

-> 스프링부트로 http2 해보는 방법

<https://d2.naver.com/helloworld/140351>

-> 구글의 SPDY에 대해 잘 설명되어있는 글