

Francisco A. Villegas (Bar No. 206997)
Damir Cefo (*pro hac vice, to be filed*)
Mark W. Halderman (*pro hac vice, to be filed*)
Evan M. Rosenbaum (Bar No. 310414)
fvillegas@villegascefo.com
dcefo@villegascefo.com
mhalderman@villegascefo.com
erosenbaum@villegascefo.com
VILLEGAS & CEFO, LLP
1350 Avenue of the Americas, Floor 2
New York, NY 10019
Telephone: (646) 844-0679

Mark McDougall
mmcdougall@calfee.com (*pro hac vice, to be filed*)
CALFEE HALTER & GRISWOLD LLP
The Calfee Building
1405 East Sixth Street
Cleveland, OH 44114-1607
Telephone: (216) 622-8200

John V. Picone III (Bar No. 187226)
jpicone@spencerfane.com
SPENCER FANE LLP
225 West Santa Clara Street, Suite 1500
San Jose, CA 95113
Telephone: (408) 286-5100

Attorneys For Plaintiff
WITHROW NETWORKS, INC.

UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF CALIFORNIA

WITHROW NETWORKS, INC.,

Plaintiff,

vs.

GOOGLE, LLC and YOUTUBE, LLC,

Defendants.

Case No. 5:24-CV-3203

COMPLAINT
DEMAND FOR JURY TRIAL

1 Plaintiff Withrow Networks, Inc. (“Withrow”) alleges as follows for its patent infringement
2 Complaint against Defendants Google, LLC (“Google”) and YouTube, LLC (“YouTube”),
3 (Google and YouTube collectively, “Defendants”).

4 **INTRODUCTION**

5 1. Historically, video streaming to mobile devices has not been smooth.

6 2. One problem has been the susceptibility of mobile internet networks to changes in
7 available data capacity (*e.g.*, bandwidth) due in part to congestion, connection quality, or
8 infrastructure limitations.

9 3. Moreover, the many mobile device designs (for example, flip-phones, candy bar
10 devices, and touch screens), each with its own technological needs and capabilities, such as
11 different screen sizes, resolutions, and processor limitations, forced streamed video to target the
12 least common denominator in terms of hardware and bandwidth.

13 4. A further issue was the software that made streaming possible, known as a protocol.
14 In the early days of streaming, such protocols (like Real Time Messaging Protocol, “RTMP”) were
15 simply not:

16 ***designed to ‘adapt’ the size of the encoded and streamed content based on***
17 ***the very specific conditions of a very specific client/player.*** Instead, there
18 was just ‘one version’ of the media . . . [yet], more and more types of devices
19 were ‘connected,’ and more and more environments were being used for
20 playback.

20 Christian Pillsbury, *Gone in a Flash: a brief history of HTTP Adaptive Streaming*, MUX (Oct.
21 10, 2022), <https://www.mux.com/blog/http-adaptive-streaming-history>. (emphases added) (last
22 visited May 19, 2024).

23 5. Behind the scenes, at the server level, at least three other problems further
24 complicated matters. First, the hardware was complex. These systems used expensive dedicated
25 media servers to transmit video to mobile devices (known as “clients”). To transmit video, which
26 is a data intensive task, these “stateful” servers kept track of each client session, maintaining
27 information about client data requests and interactions. This architecture, however, made
28 streaming unnecessarily complex, especially in terms of performance and scalability. Second,

1 these systems were server-focused, meaning that the media servers, instead of the clients,
2 controlled the flow of data, thereby saddling these servers with additional functions. Third, these
3 media servers provided a video stream at a single quality level (*supra* at ¶¶ 3-4) which could not
4 fully account for changing network conditions at the client.

5 6. In summary, the result was sub-optimal playback. “[T]his time [that] predated
6 today’s world of modern smartphones” resulted in video “with less than stellar results” (Pilsbury,
7 *supra*), especially on devices at each extreme: high-end devices failing to exercise their full
8 streaming potential, and the oldest basic phones possibly receiving merely a black screen.

9 7. Plaintiff Withrow, through its prior entities,¹ solved at least these problems using
10 technology it invented and claimed in U.S. Patent No. 10,771,849 (the “’849 Patent”), attached
11 hereto as **Ex. 1**.²

12 8. Withrow’s innovative technology provided smooth streaming video to mobile
13 devices across the Internet using dynamic adaption of different media quality levels. That is,
14 Withrow’s technology, among other things, provided an improved picture even in the presence of
15 fluctuating network conditions. Today, this technology is known as adaptive multi bitrate
16 (“ABR”) streaming.

17 9. More specifically, Withrow realized that to provide a fluid streaming experience,
18 video should be encoded into a ladder of different quality levels with associated metadata to enable
19 mobile devices with diverse capabilities to select the proper rung and efficiently decode a media
20 stream.

21 10. These advances also required a different view of streaming hardware. Withrow
22 took a contrarian position to industry orthodoxy by rejecting expensive stateful media servers.

25 1 Withrow was founded in 2020, but its origin traces to LogoVision Wireless Inc. and its
26 technology commercialization subsidiary, Movidity Inc. Those two latter businesses are now
dissolved.

27 2 ’849 Patent infringement charts (**Exs. 2 and 3**) are introduced in the counts of infringement,
28 *infra* ¶¶ 75-82.

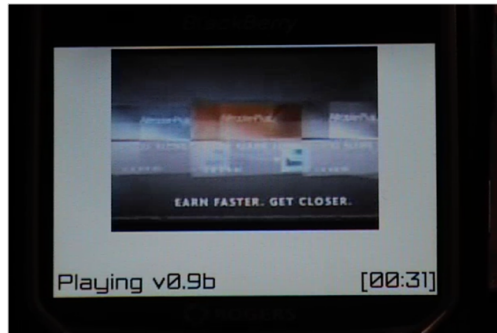
1 11. Instead of streaming basic data packets like stateful media servers, the '849 Patent
2 transmitted multimedia objects. Sending data grouped as multimedia objects made possible the
3 use of Hyper Text Transfer Protocol ("HTTP") which is a *stateless* means of communication. This
4 advancement enabled scalable and efficient streaming through inexpensive web servers (which
5 also made possible communications through firewalls), rather than the costly and technically-
6 complex solutions employing dedicated (stateful) media servers.

7 12. In addition to the problems with stateful architecture, Withrow solved problems
8 caused by diverse client hardware, such as varying processor, screen and resolution capabilities.

9 13. The '849 Patent solved these problems by, at a minimum, creating a streaming data
10 structure that joined multimedia objects with metadata describing the video streams, allowing
11 clients to account for their diverse capabilities. Moreover, with a client-based approach, the client
12 (*i.e.*, mobile device) could tell the server how to send the data. The result was optimized playback
13 of computationally intensive media even on modest mobile device hardware, which otherwise
14 would have been solely possible on wired desktop computers.

15 14. The technology that resulted in the '849 Patent was immediately recognized as
16 groundbreaking. For instance, on information and belief, in December 2005, ARM Ltd., the
17 primary microprocessor manufacturer at the time for mobile phones, believed Withrow's
18 technology provided a highly optimized, true MPEG4 (and for audio true AAC) decoder for mobile
19 clients possessing a "*unique*" adaptive rate media object transmission model. As such, it is
20 unsurprising that ARM Ltd. licensed the Withrow technology to demonstrate high-performance
21 MPEG-4 Part 2 video streaming.

22 15. Below is an example of Withrow's ABR technology on a Blackberry device, which,
23 on information and belief, comes from 2006:

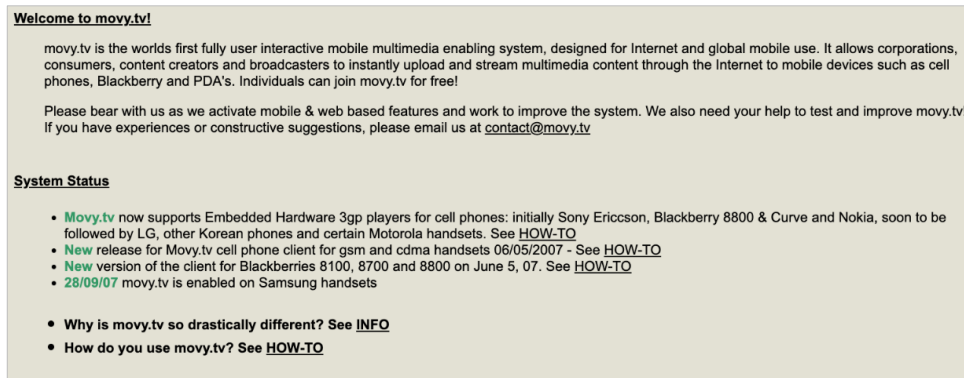


16. By mid-2006, major platforms, such as those of Qualcomm and Sprint, were demonstrating the Withrow mobile ABR technology:

ARM will be demonstrating the Movidity player upon a Qualcomm platform, with Sprint's mobile wireless network. This joint demonstration between ARM, Sprint, Qualcomm and Movidity underscores the significance of each organization in the realm of advanced mobile multimedia. The performance of Movidity's multimedia player will be matched with the capabilities of the ARM enabled Qualcomm mobile device platform and Sprint's advanced wireless network, allowing attendees to experience the next generation in mobile multimedia.

Ex. 4, Press Release, Movidity (May 12, 2006).³

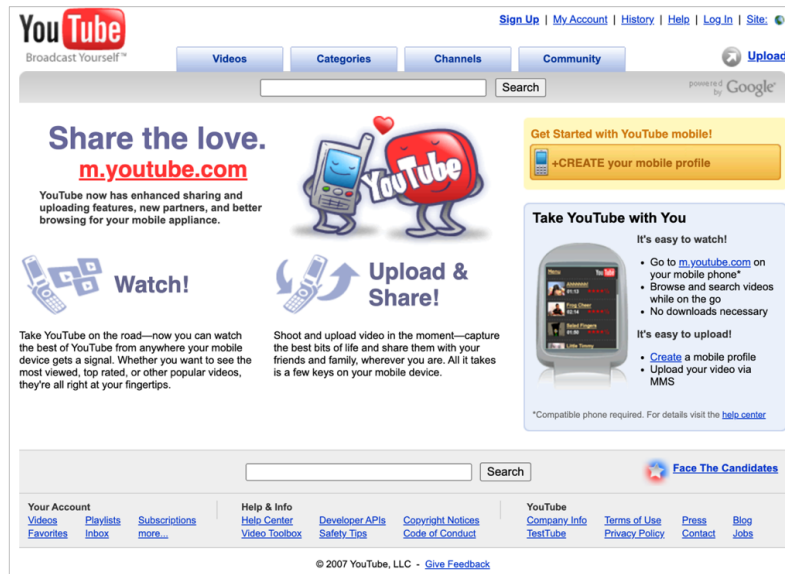
17. In addition to its work with hardware manufacturers, by 2007 Movidity developed Movy.tv—a client-facing mobile ABR media sharing system that provided live and on-demand video streaming.



Movy.tv, www.movy.tv (as of Oct. 17, 2007 on Wayback Machine).

³ Page citations within this Complaint refer to the page of the exhibit, *i.e.*, the PDF, and not the internal pagination, if any, unless otherwise noted.

18. That same year, YouTube launched its own mobile site:

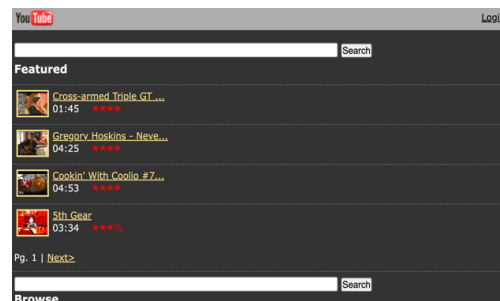
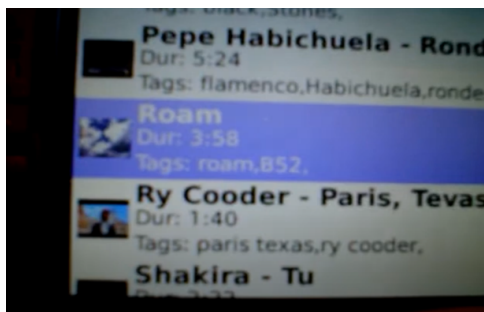


See, e.g., YouTube, <http://youtube.com/mobile> (as of Aug. 28, 2007 on Wayback Machine).

19. On information and belief, YouTube's site at the time streamed to mobile devices using solely the Real Time Streaming Protocol ("RTSP")—a server-driven stateful technology.

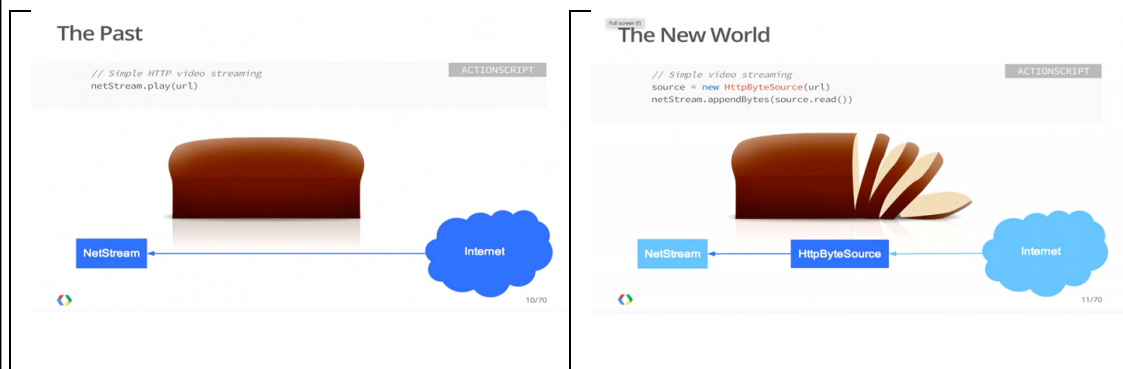
20. Moreover, although both mobile streaming platforms were launched in 2007, Movy.tv used ABR, while YouTube *did not*.

21. Exemplary screen captures from 2008 of Movy.tv and mobile YouTube (as of Apr. 14, 2008 on Wayback Machine) are shown below:



22. In short, Withrow’s HTTP-based mobile streaming technology solved the aforementioned mobile streaming challenges years before its nearest competitor. Indeed, other than Withrow’s patented technology, it is well documented that “there was nothing that even remotely resembled a ‘stream’ in HTTP in 2008, let alone anything that was designed specifically to help with streaming media.” Pillsbury, *supra*.

23. It was not until 2009 that Defendants realized a better and more efficient manner of transmitting videos was necessary. That was the start of Defendants’ aptly named, “Sliced Bread” project with Adobe Inc. (“Adobe”). Google explained that before acquiring ABR technology from Adobe, it was “delivering video in giant loaves of bread” to the end user. After incorporating sliced video into their streaming services, Defendants pronounced this technology as “The New World”:



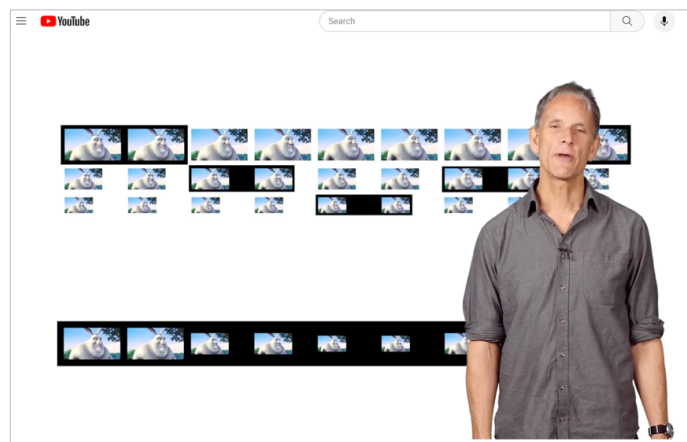
Google I/O 2013 - Adaptive Streaming for You and YouTube, at 2:52 and 3:12, <https://www.youtube.com/watch?v=UkIDSMG9ffU> (last visited May 15, 2024).

24. While this concept may sound easy, it was not. According to YouTube, “One of the core axioms of engineering work at YouTube . . . is [that] playing videos is hard, surprisingly hard.” *Id.*, at 17:30-17:42. To develop a fully functional ABR system (with Adobe’s help), Defendants stated that it “took us . . . 4 years [for this project] from start to finish more or less – we spent months finding bugs and . . . launching experiments and trying to figure out where all the problems” were. *Id.* at 11:54-12:10.

25. Moreover, while slicing data may have addressed bandwidth issues, Defendants also had to address the “hardware . . . limitations that prevented the mobile experience from

keeping up with YouTube on desktop.” **Ex. 5**, Andrey Doronichev, *YouTube Mobile gets a kick start*, YouTube Official Blog (Jul 7, 2010).

26. A comprehensive solution was needed. Eventually, industry developed standards that coopted the ’849 Patent’s technology, including HTTP Live Streaming (“HLS”) (published in 2009) and Dynamic Adaptive Streaming over HTTP (“MPEG-DASH”) (published in 2012)—the streaming standards at issue in this case. As used by Defendants, these standards provide solutions to the problem of fluid video playback on mobile devices—the same problem that Withrow’s technology solved years earlier:



[C]onnectivity can be flaky and changeable, and bandwidth is often limited. To cope with real world connectivity . . . you deliver video in segments over a normal HTTP connection. Each segment is made available at a variety of bit rates, resolutions, and formats. **Depending on the bandwidth and device capabilities, the client chooses the best possible version . . . with all the advantages of HTTP, without the disadvantages of a traditional streaming server.**

Shaka Player: High Performance Video for the Web (Google Developers), at 0:39-1:21 (discussing MPEG-DASH, but equally applicable to HLS), <https://www.youtube.com/watch?v=Fm3Bagcf9Oo> (last visited May 15, 2024) (emphasis added).

27. On information and belief, Defendants place great value on their mobile streaming products and services. Nearly fourteen years ago, they predicted this market to be “huge and growing fast.” **Ex. 5**, Doronichev, *supra*.

1 28. In fact, Defendants found the growth in mobile streaming to be “surprising,” noting
2 that YouTube mobile received “roughly the number of daily playbacks that YouTube.com was
3 streaming when we joined forces with Google in 2006.” *Id.*

4 29. Unfortunately for Defendants, that great value is attributable to their infringement
5 of the '849 Patent, and the Defendants must compensate Withrow for their unauthorized use.

6
7 **NATURE OF THE ACTION**

8 30. This is a civil action for patent infringement arising under 35 U.S.C. § 100, *et seq.*,
9 and in particular, § 271 pertaining to: Google and YouTube’s implementations of the streaming
10 standards MPEG-DASH and HLS on mobile devices.

11 **PARTIES**

12 31. Plaintiff Withrow is a Canadian company with a principal place of business in
13 Toronto, Ontario, Canada M4K 1W6.

14 32. Defendant Google is a Delaware limited liability company with a principal place of
15 business located at 1600 Amphitheatre Parkway, Mountain View, California. Google maintains a
16 regular and established place of business in this District.

17 33. Defendant YouTube is a Delaware limited liability company with a principal place
18 of business located at 901 Cherry Avenue, San Bruno, California. YouTube maintains a regular
19 and established place of business in this District.

20 34. YouTube is wholly owned by Google, and, at all times relevant to the allegations
21 herein, has acted in concert with and/or at the direction of Google.

22 35. YouTube’s Terms of Service under the “Your Service Provider” section state, with
23 respect to YouTube’s services, that “[t]he entity providing the Service is Google LLC.” **Ex. 6**,
24 Terms of Service, YouTube, at 3, <https://www.youtube.com/static?template=terms> (last visited
25 Mar. 13, 2024). Thus, Google exercises direction and control over YouTube’s streaming services.

26 36. YouTube’s Terms of Service also state that many of YouTube’s services can only
27 be used if the customer has a Google account:
28

Google Accounts and YouTube Channels

You can use parts of the Service, such as browsing and searching for Content, without having a Google account. **However, you do need a Google account to use some features.** With a Google account, you may be able to like videos, subscribe to channels, create your own YouTube channel, and more. You can follow these instructions to create a Google account.

Id. at 4-5 (emphasis added). Thus, YouTube is an agent of Google as an account with the latter is required to access the services of the former.

37. YouTube encourages content providers to upload videos to its website for which YouTube will provide royalty payments. YouTube's Terms of Service makes clear that Google, not YouTube, will withhold taxes for such payments by YouTube to its content providers:

Right to Monetize

You grant to YouTube the right to monetize your Content on the Service (and such monetization may include displaying ads on or within Content or charging users a fee for access). . . . [A]ny payments you may be entitled to receive from YouTube . . . will be treated as royalties . . . [and] . . . [i]f required by law, **Google will withhold taxes from such payments.**

Id. at 9 (emphasis added). Again, YouTube is an agent of Google as the latter takes tax responsibility on behalf of YouTube.

38. As the YouTube video service is controlled by Google, the parent company is a real party in interest in terms of enforcing YouTube Community Guidelines ("Guidelines"). For example, if a user's access to YouTube is restricted due to a violation of the Guidelines, "Google reserves the right to terminate [the user's] Google account or [the user's] access to all or part of the Service." *Id.* at 10.

39. Google and YouTube are also financially intertwined. YouTube generates the majority of its revenue through advertisements displayed on its streaming service:

How does YouTube make money?

YouTube's main source of revenue is advertising. Additionally, we earn money from our monthly subscription businesses such as YouTube Premium. We've also developed tools to help eligible Creators earn

1 money in a variety of other ways such as Super Chat, channel
2 memberships, and merchandise. In most cases, Creators and YouTube
share revenue generated from these channels.

3 **Ex. 7**, Revenue Sharing, YouTube, at 1, [https://www.youtube.com/howyoutubeworks/our-](https://www.youtube.com/howyoutubeworks/our-commitments/sharing-revenue/)
4 [commitments/sharing-revenue/](https://www.youtube.com/howyoutubeworks/our-commitments/sharing-revenue/) (last visited Apr. 29, 2024) (emphasis added).

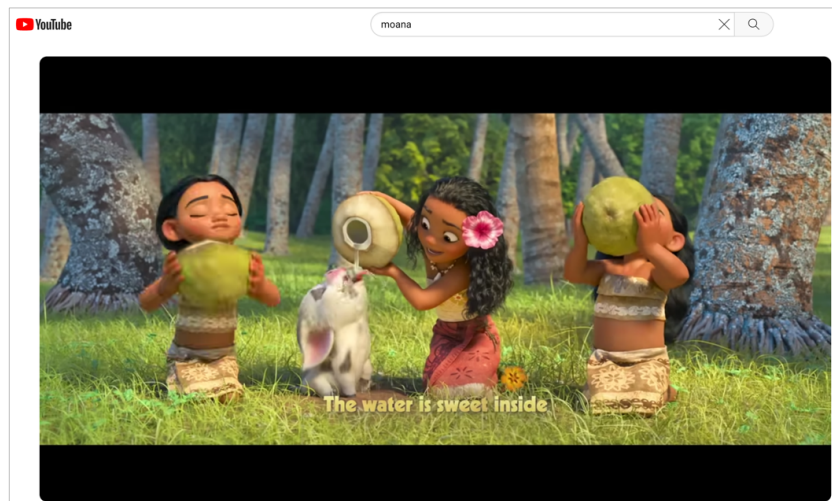
5 40. To generate this majority of its revenue, YouTube must access Google Ads.
6 Indeed, YouTube explicitly states that a content provider must have a Google Ads account:

7 Do I need a Google Ads account to advertise on YouTube?

8 **Yes.** Google Ads helps businesses run ads across the entire Google
9 advertising platform, which includes YouTube. That means you'll set up,
10 run, and manage your YouTube Ads campaign with a Google Ads account.
If you don't have an account yet, you can sign up here.

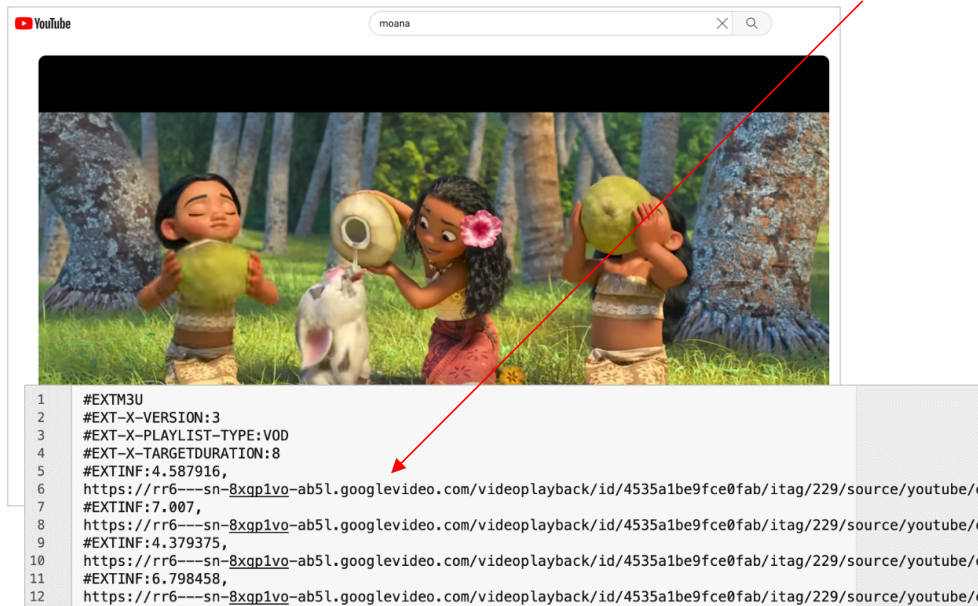
11 **Ex. 8**, Frequently asked questions, YouTube Advertising, www.youtube.com/intl/en_us/ads/faqs/,
12 (last visited Apr. 29, 2024) (emphasis added).

13 41. Content providers stream their media through the Google and YouTube infringing
14 video services:



24 www.youtube.com/watch?v=RTWhvp_OD6s (last visited Mar. 13, 2024).

42. Such YouTube video streams are served by YouTube's parent company, Google:



Id. (YouTube HLS streaming data).

43. The source domain, googlevideo.com, is owned by Google, LLC:

Registrant:

Organization: Google LLC

Mailing Address: CA, US

Redacted for privacy:

some of the data in this object has been removed.

Ex. 9, ICANN Lookup, at 2, <https://lookup.icann.org/en/lookup> (last visited May 15, 2024).

JURISDICTION AND VENUE

44. The Court has subject matter jurisdiction over this action under 28 U.S.C. §§ 1331 and 1338(a) because it arises under the patent laws of the United States.

45. The Court has personal jurisdiction over Google. Google maintains a regular and established place of business at 1 Market Street, San Francisco, CA 94105. Google has purposefully availed itself of the rights and benefits of the laws of this State and this District. On

1 information and belief, with respect to the allegations outlined in this Complaint, Google also has
2 committed acts of infringement in this District.

3 46. The Court has personal jurisdiction over YouTube. On information and belief,
4 YouTube maintains a regular and established place of business at 901 Cherry Avenue, San Bruno,
5 CA 94066. YouTube has purposefully availed itself of the rights and benefits of the laws of this
6 State and this District. On information and belief, with respect to the allegations outlined in this
7 Complaint, YouTube also has committed acts of infringement in this District.

8 47. On information and belief, Google operates infringing video streaming
9 infrastructure in this District through at least itself, YouTube, or both.

10 48. On information and belief, YouTube operates infringing video streaming
11 infrastructure in this District through at least itself, Google, or both. In fact, YouTube's
12 headquarters are identified as owned by Google, "You can contact YouTube at the address below.
13 Google LLC, D/B/A YouTube, 901 Cherry Ave., San Bruno, CA 94066."
14 https://www.youtube.com/t/contact_us?hl=en_GB (last visited May 15, 2024).

15 49. Venue is proper in this District under 28 U.S.C. §§ 1391 and 1400(b) because,
16 among other things, Google and YouTube have regular and established places of business in this
17 District, engaged in a substantial number of events giving rise to Withrow's claims in this District,
18 and have committed acts of infringement in this District.

19 **FACTUAL BACKGROUND**

20 ***The '849 Patent***

21 50. On September 8, 2020, the United States Patent and Trademark Office issued the
22 '849 Patent, entitled, "MULTIMEDIA SYSTEM FOR MOBILE CLIENT PLATFORMS."

23 51. Withrow is the assignee and owner of all rights, title, and interest in and to the '849
24 Patent, including the right to assert all causes of action arising under the '849 Patent, and the right
25 to all remedies for its infringement.

26 52. Prior to the inventions of the '849 Patent, the delivery of audio and video to mobile
27 devices faced numerous technical problems that negatively affected video quality. Unlike desktop
28 computers, which were generally limited to a few standardized configurations that had ample

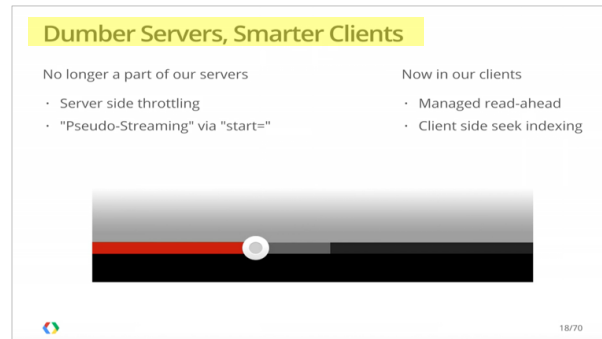
1 processing power to effectively stream video, mobile device streaming at the time of the invention
 2 suffered from a plethora of device design choices, such as variations in screen sizes, and
 3 fragmented technologies coupled with “limited resources” (*e.g.*, processor capabilities), which
 4 were viewed as “bottle necks” to streaming performance. **Ex. 10**, Krešimir Fertalj & Marko
 5 Horvat, *Comparing Architectures of Mobile Applications*, at 1 (2007).

6 53. The ’849 Patent addressed these problems. For example, the invention provides for
 7 object parameters in the video stream to account for the hardware limitations of mobile devices.
 8 *Supra* at ¶¶ 11,13.

9 54. A different problem around the time of the ’849 Patent invention was the system
 10 architecture. Mobile device streaming centered on a server monitoring and controlling the
 11 streaming process. This model, where the server pushed data to the client, required server
 12 management of the selected data stream and, by nature, resulted in a more complex architecture as
 13 the server must store the state of each stream. Pillsbury, *supra* (“[E]xisting standards . . . relied on
 14 highly specialized server . . . and highly specialized clients . . . [and] RTMP and protocols like it
 15 were inherently and deeply session based and stateful between client and server.”).

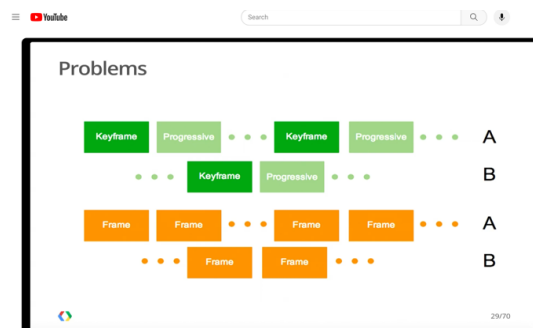
16 55. The ’849 Patent’s client-centric streaming approach (disclosed in its 2005 patent
 17 filing) was an improvement over the stateful, dedicated server model.

18 56. Six years after the filing of the application that resulted in the ’849 Patent, industry
 19 groups arrived at the same conclusion as Withrow: “[A] client-centric approach [has] no session
 20 state in network,” which improves scalability, and importantly, is more effective because the
 21 “client has the best view of network conditions.” **Ex. 11**, Mark Watson, HTTP Adaptive Streaming
 22 in Practice, ACM MMSys 2011, at 8. Industry further realized that by using HTTP to provide
 23 stateless data transmission, a client could benefit from operational metrics because, during the
 24 course of streaming, “only the client knows what really happened anyway.” *Id.* It took, however,
 25 several more years for Defendants to appreciate these benefits:



Google I/O 2013 - Adaptive Streaming for You and YouTube (last visited May 15, 2024) (emphasis added).

57. The '849 Patent provided other solutions in the computational arts. For instance, in 2013, Defendants announced that their new streaming system, which, on information and belief, was not entirely available on mobile devices, solved another key streaming issue. Specifically, YouTube's ABR quality level switching had suffered from a time alignment issue:

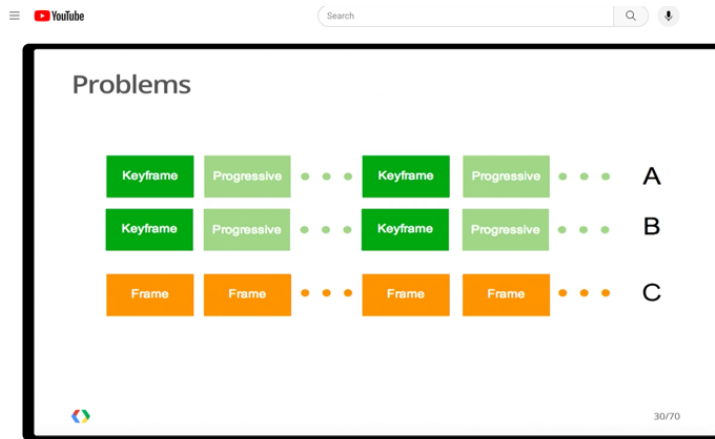


Defendants' Prior ABR Encoding

Id.

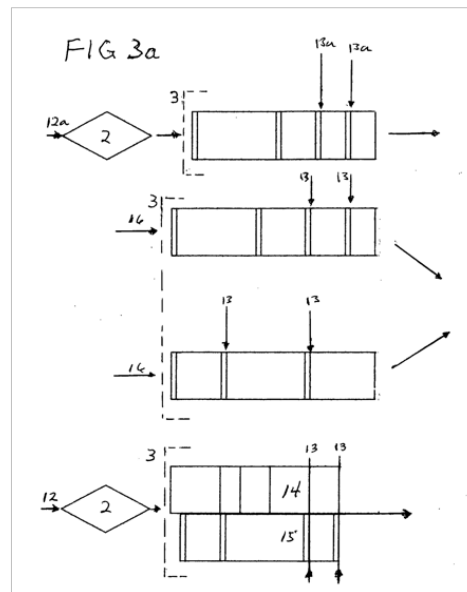
58. The problem was that upshifts or downshifts in quality levels would result in video artifacts ("[Y]ou'd either get black flashes or you'd go back in time." *Id.* at 12:41-45) and audio degradation ("[Y]ou're making pops and glitches in people's ears. This is bad." *Id.* at 12:58-13:05). This happened because a quality level shift meant the client was required to wait until the next frame of the desired quality was ready for playback, during which time the stream exhibited the aforementioned negative characteristics.

59. At the 2013 I/O conference, Defendants announced their solution to the world: first encode all the data to make it time aligned, and then jump the stream at key locations, thereby providing a fluid video broadcast, “to really improve the experience.” *Id.* at 13:29-40.



Defendants' Improved ABR Encoding

60. While this technique was new to Defendants, Withrow had invented that technology at least as of 2005 – nearly eight years earlier:



Ex. 1., '849 Patent.

The HLS Standard

61. The provision of mobile players and systems utilizing the HLS standard to deliver multimedia violates Withrow's rights under the '849 Patent.

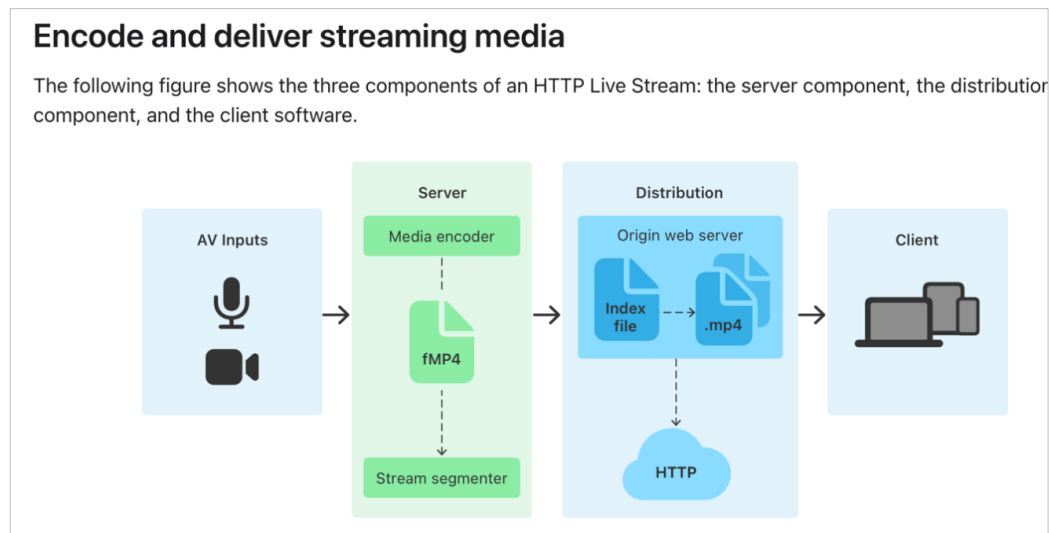
62. Apple Inc., the developer of HLS, describes that standard as follows:

HTTP Live Streaming provides a reliable, cost-effective means of delivering continuous and long-form video over the Internet. It allows a receiver to adapt the bit rate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality.

Ex. 12, Roger Pantos & William May, Jr., *HTTP Live Streaming*, RFC 8216, at 4, <https://datatracker.ietf.org/doc/rfc8216/>.

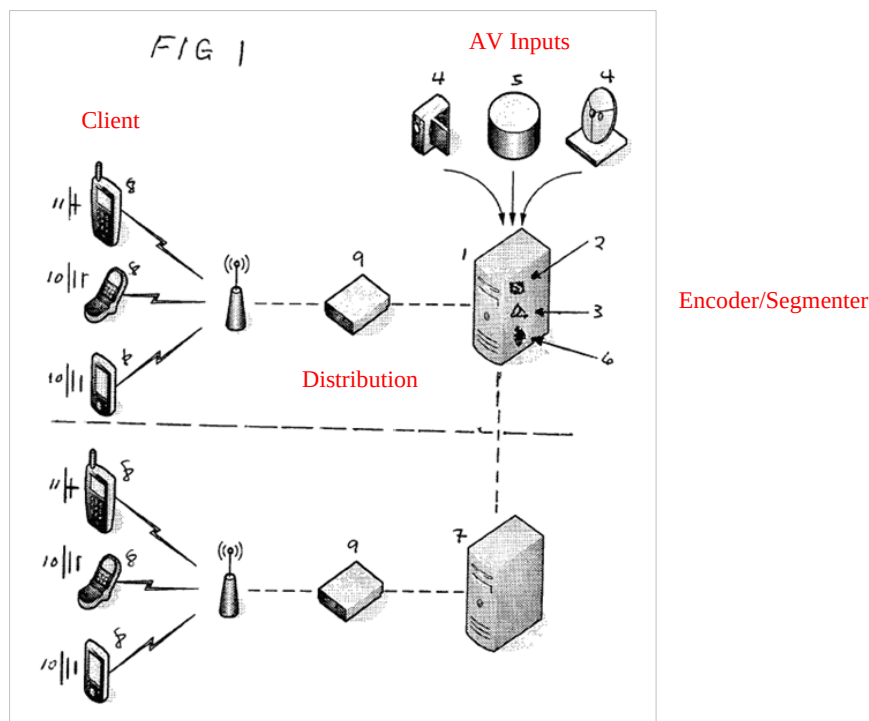
63. As shown below, the '849 Patent and the HLS standard share many structural similarities.

Apple HLS Standard:



Ex. 13 (*HTTP Live Streaming – Overview*, <https://developer.apple.com/documentation/http-live-streaming>, at 1-2 (last visited Mar. 16, 2024).

The '849 Patent:



Ex. 1, the '849 Patent at Fig. 1 (annotated in red).

64. Specifically, infringing streaming systems have at least three parts: encoded data with object parameters, multimedia objects with location identifiers, and fluid decoding and playback of media based on bandwidth conditions. These three streaming elements of the '849 Patent are present in all implementations of HLS.

65. Implementations of the HLS streaming protocol in systems, software, and methods infringe the '849 Patent.

66. For example, HLS processes include: *encoding* data (“a hardware encoder takes audio-video input, encodes it . . . and breaks the stream into a series of short files” (Ex. 13 at 2 (*HTTP Live Streaming – Overview*)) with *object parameters* (“#EXT-X-STREAM-INF: BANDWIDTH = 640000, RESOLUTION = 640x360, CODECS = “avc1.42e00a,mp4a.40.2” (Ex. 13 at 10 (*HTTP Live Streaming – Creating a Multivariant Playlist*)), *host path identifiers* (“http://example.com/movie1/fileSequenceA .ts” (Ex. 13 at 6 (*HTTP Live Streaming – Video on Demand playlist construction*)), and *decoding and sequential playback* (“The URL of the index file

1 is published on the web server . . . then requests the listed media files in order and displays them
2 without any pauses or gaps between segments” (Ex. 13 at 2 (*HTTP Live Streaming – Overview*))
3 such that it is *fluid* (“minimize stalling of playback, to give the user the best possible streaming
4 experience” (Ex. 13 at 9 (*HTTP Live Streaming – Creating a Multivariant Playlist*)).

5 ***The MPEG-DASH Standard***

6 67. The provision of mobile players and systems that utilize the MPEG-DASH standard
7 to deliver multimedia violates Withrow’s rights under the ’849 Patent.

8 68. The MPEG-DASH standard is described as follows:

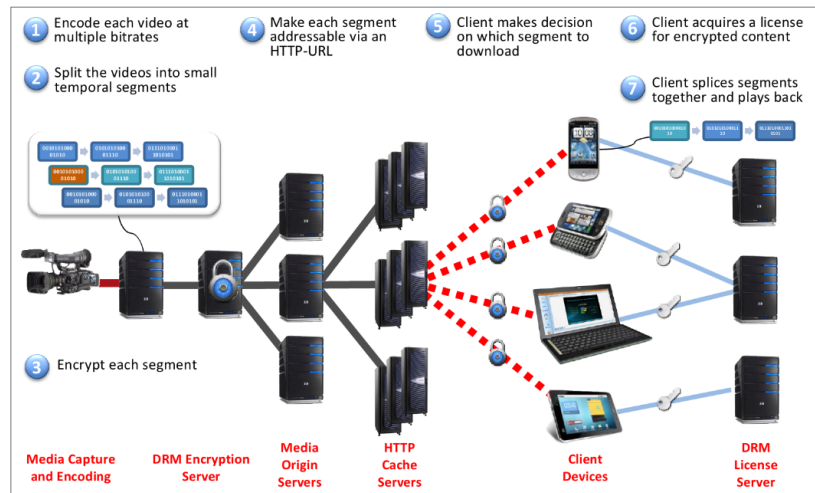
9
10 [MPEG-DASH] specifies . . . formats that enable delivery of media content
from standard HTTP servers to HTTP clients

11 [This format] provides sufficient information for a client to provide a
12 streaming service to the user by accessing the Segments through the
13 protocol specified in the scheme of the defined resources. . . .

14 [This format] provides sufficient information for the DASH Client to
15 provide a streaming service to the user by requesting Segments from an
16 HTTP server and demultiplexing, decoding and rendering the included
media streams.

17 **Ex. 14** *Information technology — Dynamic adaptive streaming over HTTP (DASH)*, ISO/IEC
18 23009-1, at § 4.1 “System Description,” internal p. 8-9 (3d Ed. 2019).

69. As shown below, the '849 Patent and MPEG-DASH standard share many structural similarities:



Ex. 15, Thomas Stockhammer, *Dynamic Adaptive Streaming over HTTP – Design Principles and Standards*, Qualcomm, at 6.

70. Specifically, and as discussed above in reference to the HLS standard, infringing streaming systems have at least three parts: encoded data with object parameters, multimedia objects with location identifiers, and fluid decoding and playback of media based on bandwidth conditions. These three streaming elements of the '849 Patent are present in all implementations of MPEG-DASH.

71. Implementations of the MPEG-DASH streaming protocol in systems, software, and methods infringe the '849 Patent.

72. For example, MPEG-DASH processes include: *encoding* data (Ex. 15, Stockhammer, at 6) with *object parameters* (e.g., @width and @frameRate (Ex. 14, ISO/IEC 23009-1, at Table 13, internal p. 54-57)); *host path identifiers* (e.g., BaseURL (*id.* at § 5.6, internal p. 85)); and *decoding and sequential playback* (“the sequential decoding and presentation of Media Segments . . . results in a correct presentation of all contained media streams” (*id.* at § 4.5.3, internal p. 15)) such that it is *fluid* (“The formats defined in this document are designed for providing good user experience even in case the access bandwidth . . . varies” (*id.* at § 4.5.1, internal p. 14)).

YouTube's Infringement of the '849 Patent

73. On information and belief, YouTube has infringed the '849 Patent at least by providing its streaming services to mobile devices that use YouTube player applications and web-based applets (such as on www.youtube.com and m.youtube.com) through implementations utilizing MPEG-DASH, HLS, or both (the "YouTube Infringing Solutions") (see, **Ex. 2** Infringement Chart with respect to the HLS Standard; and **Ex. 3**, Infringement Chart with respect to the DASH standard).

Google's Infringement of the '849 Patent

74. On information and belief, Google has infringed the '849 Patent (including by at least its control and direction over YouTube) at least by providing its streaming services to mobile devices that use YouTube player applications and web-based applets (such as on www.youtube.com and m.youtube.com) through implementations utilizing MPEG-DASH, HLS, or both (the "Google Infringing Solutions") (see, **Ex. 2** Infringement Chart with respect to the HLS Standard; and **Ex. 3**, Infringement Chart with respect to the DASH standard).

COUNT ONE

Patent Infringement By Google

75. Withrow incorporates by reference each of the preceding paragraphs of this Complaint.

76. Google has directly infringed at least claim 1 of the '849 Patent, pursuant to 35 U.S.C. § 271(a), literally or under the doctrine of equivalents, through its making, using, selling and/or offering for sale of the Google Infringing Solutions. For example, Google's infringement of the '849 Patent is shown in the attached charts hereto. **Ex. 2**, HLS Infringement Chart; **Ex. 3**, MPEG-DASH Infringement Chart.

77. On information and belief, Google, YouTube, and/or third parties provide the Google Infringing Solutions with streaming content, but, regardless of the content provider, Google controls or practices each and every element of at least independent claim 1 of the '849 Patent. Moreover, while particular deployments of each of the Google Infringing Solutions may

1 vary, Google infringes for every deployment that implements HLS, MPEG-DASH or both
2 standards for streaming.

3 78. Google's infringement of the '849 Patent has violated Withrow's intellectual
4 property rights in an amount to be determined at trial.

5 **COUNT TWO**

6 ***Patent Infringement By YouTube***

7 79. Withrow incorporates by reference each of the preceding paragraphs of this
8 Complaint.

9 80. YouTube has directly infringed at least claim 1 of the '849 Patent, pursuant to 35
10 U.S.C. § 271(a), literally or under the doctrine of equivalents, through its making, using, selling
11 and/or offering for sale of the YouTube Infringing Solutions. For example, YouTube's
12 infringement of the '849 Patent is shown in the attached charts hereto. **Ex. 2**, HLS Infringement
13 Chart; **Ex. 3**, MPEG-DASH Infringement Chart.

14 81. On information and belief, Google, YouTube and/or third parties provide the
15 YouTube Infringing Solutions with streaming content, but, regardless of the content provider,
16 YouTube controls or practices each and every element of at least independent claim 1 of the '849
17 Patent. Moreover, while particular deployments of each of the YouTube Infringing Solutions may
18 vary, YouTube infringes for every deployment that implements HLS, MPEG-DASH or both
19 standards for streaming.

20 82. Accordingly, YouTube's infringement of the '849 Patent has violated Withrow's
21 intellectual property rights in an amount to be determined at trial.

22 **PRAYER FOR RELIEF**

23 WHEREFORE, Withrow respectfully prays for relief as follows:

- 24 A. Judgment that Defendants have infringed one or more claims of the '849 Patent;
25 B. An award of damages pursuant to 35 U.S.C. § 284 in an amount sufficient to
26 compensate Withrow for the harm caused by Defendants' infringement, not less
27 than a reasonable royalty for the use made of the invention, along with pre- and
28 post-judgment interest;

- 1 C. An order for an accounting of damages from the Defendants' infringement(s);
2 D. Declare this case exceptional and award Withrow its costs, expenses, and attorneys'
3 fees pursuant to 35 U.S.C. § 285; and
4 E. An order awarding to Withrow such other and further relief, whether at law or in
5 equity, that this Court deems just, equitable, and proper.
6

7 **JURY DEMAND**

8 Pursuant to Federal Rule of Civil Procedure 38(b) and Civil Local Rule 3-6(a), WITHROW
9 hereby demands a trial by jury on all issues so triable.
10

11 Dated: May 28, 2024
12

13 By: /s/ John V. Picone III

14 Francisco A. Villegas
15 Damir Cefo (*pro hac vice, to be filed*)
16 Mark W. Halderman (*pro hac vice, to be filed*)
17 Evan M. Rosenbaum
18 VILLEGAS & CEFO LLP

19 Mark McDougall (*pro hac vice, to be filed*)
20 CALFEE HALTER & GRISWOLD LLP

21 John V. Picone III
22 SPENCER FANE LLP

23 Attorneys for Plaintiff
24 WITHROW NETWORKS, INC.
25
26
27
28

EXHIBIT 2

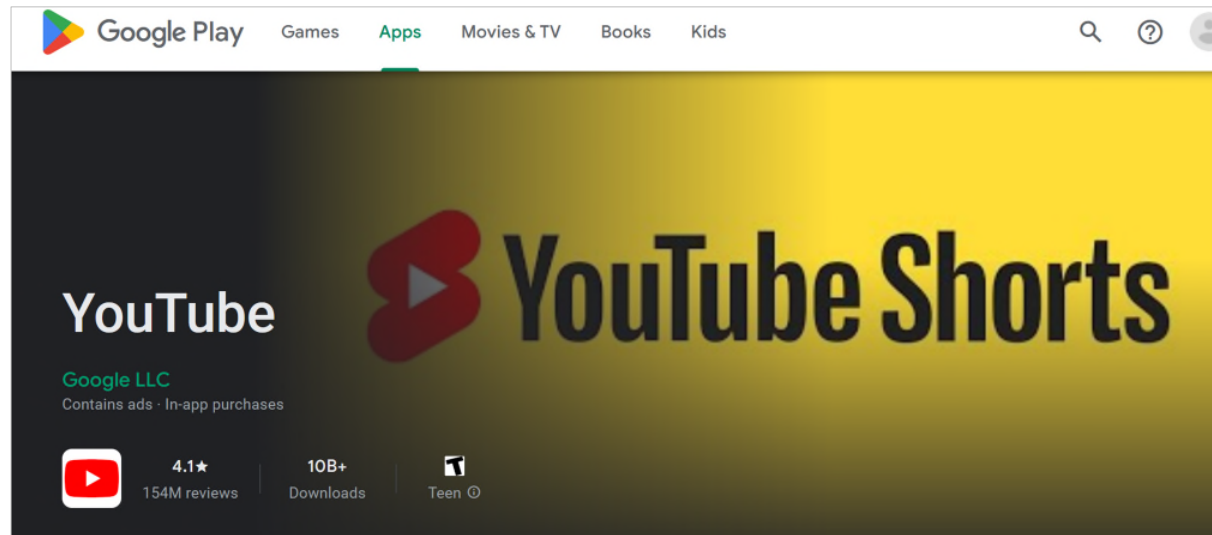
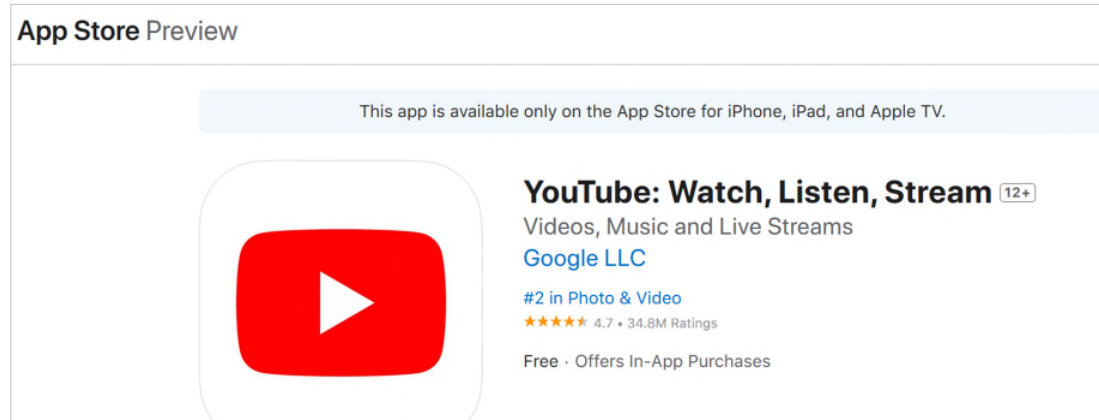
U.S. Patent No. 10,771,849, Claim 1

A method comprising:	
----------------------	--

receiving audio and video segments encoded in a digital encoding format and with an encoding rate;

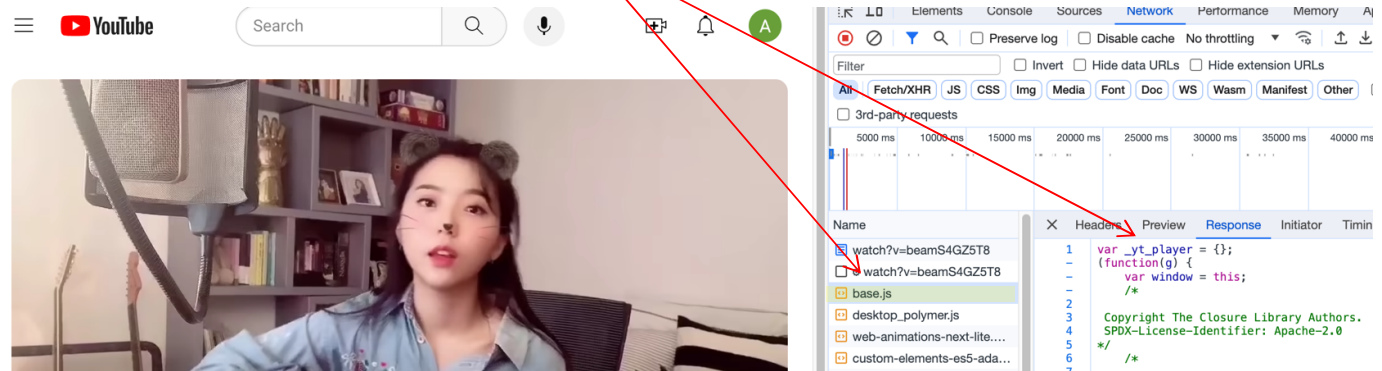
YouTube uses two kinds of Players (“YT Player”) for receiving encoded audio and video segments:

YouTube App Players (e.g., iOS, Smart TVs, streaming devices, Chrome)



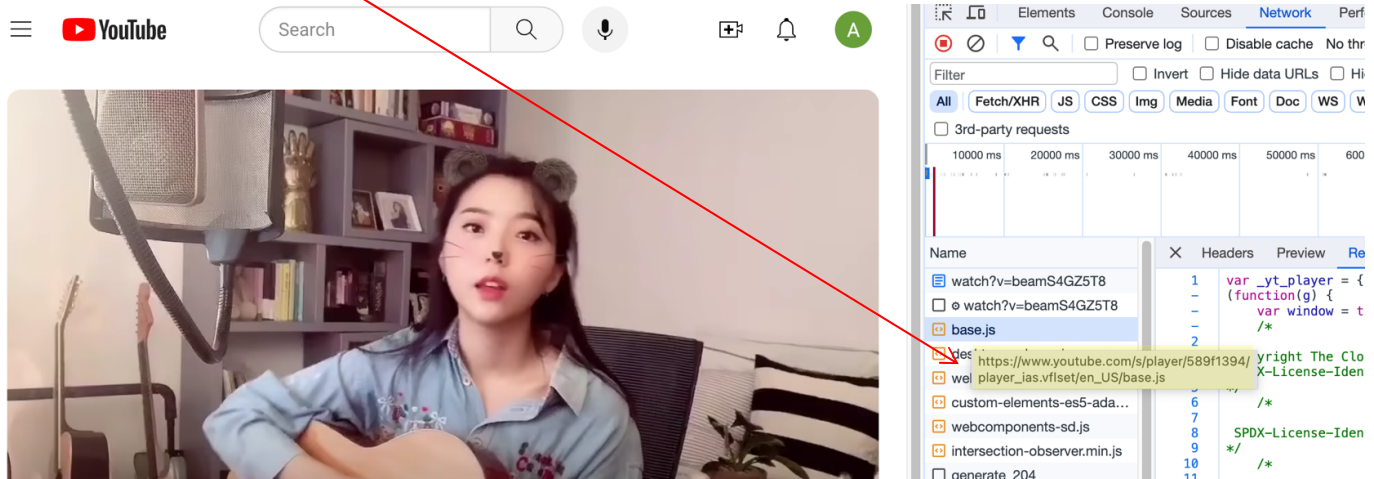
2. Web-based Video Playback

When a video is launched, YouTube uses a Java player. Example below:



YouTube Video, <https://www.youtube.com/watch?v=beamS4GZ5T8> ("Video").

The YT player is served by YouTube to the user:

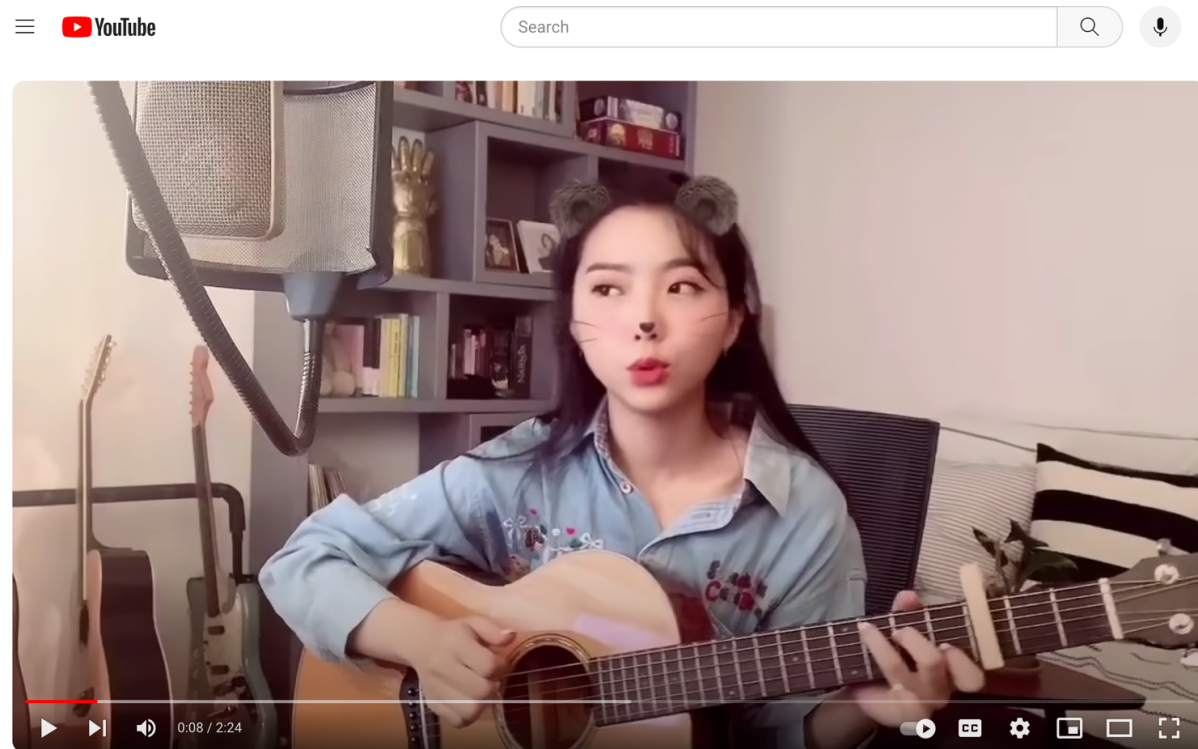


Video.

receiving audio and video segments encoded in a digital encoding format and with an encoding rate;	YouTube stream data identifies the protocol used for receiving encoded audio and video segments as HLS. #EXTM3U #EXT-X-INDEPENDENT-SEGMENTS #EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711083979/ei/... Video.
---	---

receiving audio and video segments encoded in a digital encoding format and with an encoding rate;

Media on YouTube is comprised of video and audio segments:



Video.

receiving audio and video segments encoded in a digital encoding format and with an encoding rate;	The video and audio segments are visible. For example, one stream variant is: #EXT-X-STREAM INF:BANDWIDTH=1314966,CODECS="vp09.00.31.08,mp4a.40.2",RESOLUTION=1280x720,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE Video. For this stream variant, the Video Segment is: https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/.../playlist/index.m3u8/govp/slices%3D0-128117/gosq/0/file/seg.ts Video (excerpt). The Audio Segment for that stream variant is: https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/234/source/youtube/expire/.../begin/0/len/5339/goap/slices%3D0-162690/gosq/0/file/seg.ts Video (excerpt).
--	---

The HLS standard requires segments:

2. Summary

A multimedia presentation is specified by a URI [[RFC3986](#)] to a Playlist file, which is an ordered list of media URIs and informational tags. Each media URI refers to a media file which is a **segment** of a single contiguous stream.

To play the stream, the client first obtains the Playlist file and then obtains and plays each media file in the Playlist. It reloads the Playlist file as described in this document to discover additional **segments**.

Ex. 16, Roger Pantos & William May, Jr., *HTTP Live Streaming*, RFC 8216 Rev. 6 (Draft Mar. 2011), at 5.

receiving audio and video segments encoded in a digital encoding format and with an encoding rate;

As shown below, the YT Player receives data in at least two digital encoding formats: AVC1 and VP9.

```
#EXTM3U
#EXT-X-INDEPENDENT-SEGMENTS
#EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i
#EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i
#EXT-X-STREAM-INF:BANDWIDTH=174202,CODECS="avc1.4D4015,mp4a.40.5",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/you
#EXT-X-STREAM-INF:BANDWIDTH=258776,CODECS="avc1.4D4015,mp4a.40.2",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/you
#EXT-X-STREAM-INF:BANDWIDTH=372190,CODECS="avc1.4D401E,mp4a.40.2",RESOLUTION=640x360,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/230/source/you
#EXT-X-STREAM-INF:BANDWIDTH=491083,CODECS="avc1.4D401E,mp4a.40.2",RESOLUTION=854x480,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/231/source/you
#EXT-X-STREAM-INF:BANDWIDTH=861742,CODECS="avc1.4D401F,mp4a.40.2",RESOLUTION=1280x720,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/232/source/you
#EXT-X-STREAM-INF:BANDWIDTH=150993,CODECS="avc1.4D400C,mp4a.40.5",RESOLUTION=256x144,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/269/source/you
#EXT-X-STREAM-INF:BANDWIDTH=153955,CODECS="vp09.00.11.08,mp4a.40.5",RESOLUTION=256x144,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/603/source/you
#EXT-X-STREAM-INF:BANDWIDTH=247948,CODECS="vp09.00.20.08,mp4a.40.5",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/you
#EXT-X-STREAM-INF:BANDWIDTH=332522,CODECS="vp09.00.20.08,mp4a.40.2",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/you
#EXT-X-STREAM-INF:BANDWIDTH=507720,CODECS="vp09.00.21.08,mp4a.40.2",RESOLUTION=640x360,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/605/source/you
#EXT-X-STREAM-INF:BANDWIDTH=716829,CODECS="vp09.00.30.08,mp4a.40.2",RESOLUTION=854x480,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/606/source/you
#EXT-X-STREAM-INF:BANDWIDTH=1314966,CODECS="vp09.00.31.08,mp4a.40.2",RESOLUTION=1280x720,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/609/source/you
```

Video (excerpt).

AVC1 is a video encoding format.

VP9 is a video encoding format (developed by Google).

receiving audio and video segments encoded in a digital encoding format and with an encoding rate;

The YT Player also receives, for selection, segments with multiple encoding rates tied to bandwidth (yellow):

```
#EXTM3U
#EXT-X-INDEPENDENT-SEGMENTS
#EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i
#EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i
#EXT-X-STREAM-INF:BANDWIDTH=174202, CODECS="avc1.4D4015, mp4a.40.5", RESOLUTION=426x240, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="233", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/you
#EXT-X-STREAM-INF:BANDWIDTH=258776, CODECS="avc1.4D4015, mp4a.40.2", RESOLUTION=426x240, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/you
#EXT-X-STREAM-INF:BANDWIDTH=372190, CODECS="avc1.4D401E, mp4a.40.2", RESOLUTION=640x360, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/230/source/you
#EXT-X-STREAM-INF:BANDWIDTH=491083, CODECS="avc1.4D401E, mp4a.40.2", RESOLUTION=854x480, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/231/source/you
#EXT-X-STREAM-INF:BANDWIDTH=861742, CODECS="avc1.4D401F, mp4a.40.2", RESOLUTION=1280x720, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/232/source/you
#EXT-X-STREAM-INF:BANDWIDTH=150993, CODECS="avc1.4D400C, mp4a.40.5", RESOLUTION=256x144, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="233", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/269/source/you
#EXT-X-STREAM-INF:BANDWIDTH=153955, CODECS="vp09.00.11.08, mp4a.40.5", RESOLUTION=256x144, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="233", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/603/source/you
#EXT-X-STREAM-INF:BANDWIDTH=247948, CODECS="vp09.00.20.08, mp4a.40.5", RESOLUTION=426x240, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="233", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/you
#EXT-X-STREAM-INF:BANDWIDTH=332522, CODECS="vp09.00.20.08, mp4a.40.2", RESOLUTION=426x240, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/you
#EXT-X-STREAM-INF:BANDWIDTH=507720, CODECS="vp09.00.21.08, mp4a.40.2", RESOLUTION=640x360, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/605/source/you
#EXT-X-STREAM-INF:BANDWIDTH=716829, CODECS="vp09.00.30.08, mp4a.40.2", RESOLUTION=854x480, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/606/source/you
#EXT-X-STREAM-INF:BANDWIDTH=1314966, CODECS="vp09.00.31.08, mp4a.40.2", RESOLUTION=1280x720, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/609/source/you
```

Video.

The HLS standard requires encoding rates:

3.3.8. EXT-X-STREAM-INF

The EXT-X-STREAM-INF tag indicates that the next URI in the Playlist file identifies another Playlist file. Its format is:

```
#EXT-X-STREAM-INF:<attribute-list>  
<URI>
```

The following attributes are defined:

BANDWIDTH

The value is a decimal-integer of bits per second. It MUST be an upper bound of the overall bitrate of each media file, calculated to include container overhead, that appears or will appear in the Playlist.

Every EXT-X-STREAM-INF tag MUST include the BANDWIDTH attribute.

Ex. 16, *HTTP Live Streaming* Draft, at 15.

wherein, said audio and video segments are associated with object parameters and supplied host path identification to form multimedia objects;

The media has a YouTube playlist that defines several segment streams associated with object parameters, such as size (height X width), frame rate and encoding rates:

```
#EXTM3U
#EXT-X-INDEPENDENT-SEGMENTS
#EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i
#EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i
#EXT-X-STREAM-INF:BANDWIDTH=174202, CODECS="avc1.4D4015, mp4a.40.5", RESOLUTION=426x240, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="233", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/yo
#EXT-X-STREAM-INF:BANDWIDTH=258776, CODECS="avc1.4D4015, mp4a.40.2", RESOLUTION=426x240, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/yo
#EXT-X-STREAM-INF:BANDWIDTH=372190, CODECS="avc1.4D401E, mp4a.40.2", RESOLUTION=640x360, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/230/source/yo
#EXT-X-STREAM-INF:BANDWIDTH=491083, CODECS="avc1.4D401E, mp4a.40.2", RESOLUTION=854x480, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/231/source/yo
#EXT-X-STREAM-INF:BANDWIDTH=861742, CODECS="avc1.4D401F, mp4a.40.2", RESOLUTION=1280x720, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/232/source/yo
#EXT-X-STREAM-INF:BANDWIDTH=150993, CODECS="avc1.4D400C, mp4a.40.5", RESOLUTION=256x144, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="233", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/269/source/yo
#EXT-X-STREAM-INF:BANDWIDTH=153955, CODECS="vp09.00.11.08, mp4a.40.5", RESOLUTION=256x144, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="233", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/603/source/yo
#EXT-X-STREAM-INF:BANDWIDTH=247948, CODECS="vp09.00.20.08, mp4a.40.5", RESOLUTION=426x240, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="233", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/yo
#EXT-X-STREAM-INF:BANDWIDTH=332522, CODECS="vp09.00.20.08, mp4a.40.2", RESOLUTION=426x240, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/yo
#EXT-X-STREAM-INF:BANDWIDTH=507720, CODECS="vp09.00.21.08, mp4a.40.2", RESOLUTION=640x360, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/605/source/yo
#EXT-X-STREAM-INF:BANDWIDTH=716829, CODECS="vp09.00.30.08, mp4a.40.2", RESOLUTION=854x480, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/606/source/yo
#EXT-X-STREAM-INF:BANDWIDTH=1314966, CODECS="vp09.00.31.08, mp4a.40.2", RESOLUTION=1280x720, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/609/source/yo
```

Video.

The HLS standard requires object parameters:

3.3.8. EXT-X-STREAM-INF

The EXT-X-STREAM-INF tag indicates that the next URI in the Playlist file identifies another Playlist file. Its format is:

```
#EXT-X-STREAM-INF:<attribute-list>
<URI>
```

The following attributes are defined:

BANDWIDTH

The value is a decimal-integer of bits per second. It MUST be an upper bound of the overall bitrate of each media file, calculated to include container overhead, that appears or will appear in the Playlist.

Every EXT-X-STREAM-INF tag MUST include the BANDWIDTH attribute.

PROGRAM-ID

The value is a decimal-integer that uniquely identifies a particular presentation within the scope of the Playlist file.

A Playlist file MAY contain multiple EXT-X-STREAM-INF tags with the same PROGRAM-ID to identify different encodings of the same presentation. These variant playlists MAY contain additional EXT-X-STREAM-INF tags.

CODECS

The value is a quoted-string containing a comma-separated list of formats, where each format specifies a media sample type that is present in a media file in the Playlist file. Valid format identifiers are those in the ISO File Format Name Space defined by [RFC 4281](#) [RFC4281].

Every EXT-X-STREAM-INF tag SHOULD include a CODECS attribute.

RESOLUTION

The value is a decimal-resolution describing the approximate encoded horizontal and vertical resolution of video within the stream.

Ex. 16, *HTTP Live Streaming* Draft, at 15-17.

Some object parameters are identified below:

Multivariant Playlist

9. Multivariant Playlist requirements

- 9.1. Your EXT-X-STREAM-INF tag MUST always provide the CODECS attribute.
- 9.2. Your EXT-X-STREAM-INF tag MUST always provide the RESOLUTION attribute if the rendition includes video.
- 9.3. Your EXT-X-I-FRAME-STREAM-INF tag MUST always provide the CODECS attribute.
- 9.4. Your EXT-X-I-FRAME-STREAM-INF tag MUST always provide the RESOLUTION attribute.
- 9.5. You SHOULD deliver video and audio as separate streams.
- 9.6. If you have multichannel audio, you MUST use separate audio streams.
- 9.7. If you have alternative audio content (languages/commentary/DVS), you MUST use separate audio streams.
- 9.8. If you have different video angles, you MUST use separate audio streams.
- 9.9. You MUST provide multiple bit rates of video (that is, variants).
- 9.10. For HD content, there SHOULD be at least two variants encoded at the highest-available resolution.
- 9.11. If your video segments start with an IDR, you SHOULD use the EXT-X-INDEPENDENT-SEGMENTS tag in the Multivariant Playlist. (See item 7.4.)
- 9.12. If your video segments start with an IDR and the EXT-X-INDEPENDENT-SEGMENTS tag isn't in the Multivariant Playlist, you MUST use the EXT-X-INDEPENDENT-SEGMENTS tag in all video Media Playlists. (See item 7.4.)
- 9.13. The BANDWIDTH attribute MUST be the largest sum of peak segment bit rates that's produced by any playable combination of renditions.
- 9.14. You MUST include the AVERAGE-BANDWIDTH attribute.
- 9.15. Each EXT-X-STREAM-INF tag that includes video content MUST have a FRAME-RATE attribute.
- 9.16. The VIDEO-RANGE attribute MUST be specified unless all variants and renditions are SDR.
- 9.17. Within a group of Renditions (EXT-X-MEDIA tags having the same TYPE and GROUP-ID), those tags having the same LANGUAGE value should be ordered from most general to most specific. (Because CHARACTERISTICS are open-ended, the matching algorithm needs the ordering since it can't interpret all the semantics.)
- 9.18. An EXT-X-CONTENT-STEERING tag SHOULD always have a PATHWAY-ID attribute.
- 9.19. The SCORE attribute (if present) MUST be on every variant. Otherwise, the SCORE attribute will be ignored.

Ex. 17, *HTTP Live Streaming (HLS) authoring specification for Apple devices*, <https://developer.apple.com/documentation/http-live-streaming/hls-authoring-specification-for-apple-devices> (last visited Mar. 31, 2024).

wherein, said audio and video segments are associated with object parameters and supplied host path identification to form multimedia objects;

The multimedia multivariant playlist defines several segment streams that are also associated with host path identifiers, such as URLs:

```
#EXTM3U
#EXT-X-INDEPENDENT-SEGMENTS
#EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i
#EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i
#EXT-X-STREAM-INF:BANDWIDTH=174202,CODECS="avc1.4D4015,mp4a.40.5",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/yo
#EXT-X-STREAM-INF:BANDWIDTH=258776,CODECS="avc1.4D4015,mp4a.40.2",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/yo
#EXT-X-STREAM-INF:BANDWIDTH=372190,CODECS="avc1.4D401E,mp4a.40.2",RESOLUTION=640x360,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/230/source/yo
#EXT-X-STREAM-INF:BANDWIDTH=491083,CODECS="avc1.4D401E,mp4a.40.2",RESOLUTION=854x480,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/231/source/yo
#EXT-X-STREAM-INF:BANDWIDTH=861742,CODECS="avc1.4D401F,mp4a.40.2",RESOLUTION=1280x720,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/232/source/yo
#EXT-X-STREAM-INF:BANDWIDTH=150993,CODECS="avc1.4D400C,mp4a.40.5",RESOLUTION=256x144,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/269/source/yo
#EXT-X-STREAM-INF:BANDWIDTH=153955,CODECS="vp09.00.11.08,mp4a.40.5",RESOLUTION=256x144,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/603/source/yo
#EXT-X-STREAM-INF:BANDWIDTH=247948,CODECS="vp09.00.20.08,mp4a.40.5",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/yo
#EXT-X-STREAM-INF:BANDWIDTH=332522,CODECS="vp09.00.20.08,mp4a.40.2",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/yo
#EXT-X-STREAM-INF:BANDWIDTH=507720,CODECS="vp09.00.21.08,mp4a.40.2",RESOLUTION=640x360,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/605/source/yo
#EXT-X-STREAM-INF:BANDWIDTH=716829,CODECS="vp09.00.30.08,mp4a.40.2",RESOLUTION=854x480,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/606/source/yo
#EXT-X-STREAM-INF:BANDWIDTH=1314966,CODECS="vp09.00.31.08,mp4a.40.2",RESOLUTION=1280x720,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/609/source/yo
```

Video.

	The HLS standard requires a host path identification: 3.3.8. EXT-X-STREAM-INF The EXT-X-STREAM-INF tag indicates that the next URI in the Playlist file identifies another Playlist file. Its format is: <pre>#EXT-X-STREAM-INF:<attribute-list> <URI></pre> Ex. 16, <i>HTTP Live Streaming</i> Draft, at 15. EXT-X-STREAM-INF Indicates that the next URL in the playlist file identifies another playlist file. Ex. 13, (<i>HTTP Live Streaming – Creating a Multivariant Playlist</i>, https://developer.apple.com/documentation/http-live-streaming, at 10 (last visited Mar. 16, 2024).
--	--

wherein, said audio and video segments are associated with object parameters and supplied host path identification to form multimedia objects;

These YouTube segments with associated objects and URLs are multimedia objects (yellow):

```
#EXTM3U
#EXT-X-INDEPENDENT-SEGMENTS
#EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i
#EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i
#EXT-X-STREAM-INF:BANDWIDTH=174202,CODECS="avc1.4D4015,mp4a.40.5",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/you
#EXT-X-STREAM-INF:BANDWIDTH=258776,CODECS="avc1.4D4015,mp4a.40.2",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/you
#EXT-X-STREAM-INF:BANDWIDTH=372190,CODECS="avc1.4D401E,mp4a.40.2",RESOLUTION=640x360,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/230/source/you
#EXT-X-STREAM-INF:BANDWIDTH=491083,CODECS="avc1.4D401E,mp4a.40.2",RESOLUTION=854x480,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/231/source/you
#EXT-X-STREAM-INF:BANDWIDTH=861742,CODECS="avc1.4D401F,mp4a.40.2",RESOLUTION=1280x720,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/232/source/you
#EXT-X-STREAM-INF:BANDWIDTH=150993,CODECS="avc1.4D400C,mp4a.40.5",RESOLUTION=256x144,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/269/source/you
#EXT-X-STREAM-INF:BANDWIDTH=153955,CODECS="vp09.00.11.08,mp4a.40.5",RESOLUTION=256x144,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/603/source/you
#EXT-X-STREAM-INF:BANDWIDTH=247948,CODECS="vp09.00.20.08,mp4a.40.5",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/you
#EXT-X-STREAM-INF:BANDWIDTH=332522,CODECS="vp09.00.20.08,mp4a.40.2",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/you
#EXT-X-STREAM-INF:BANDWIDTH=507720,CODECS="vp09.00.21.08,mp4a.40.2",RESOLUTION=640x360,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/605/source/you
#EXT-X-STREAM-INF:BANDWIDTH=716829,CODECS="vp09.00.30.08,mp4a.40.2",RESOLUTION=854x480,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/606/source/you
#EXT-X-STREAM-INF:BANDWIDTH=1314966,CODECS="vp09.00.31.08,mp4a.40.2",RESOLUTION=1280x720,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/609/source/you
```

Video.

YouTube

Search

Sign in

Cover by [Stella Jang] Ratatouille OST 'Le Festin'

 stellajangtv
593K subscribers

Subscribe

660K

Share

Save

...

18M views · 4 years ago

Another Disney song :)

Hope you'll enjoy! ...more

 Earn Your Best Grades

You work hard.
You want
to succeed.
Join our
Community.

1

[illegible]

wherein said multimedia objects are located using http and received by said multimedia player from servers using a wireless connection;

The YT Player locates the multimedia objects through a URL:

The screenshot displays a YouTube video player interface on the left and a browser's developer tools network tab on the right. The video player shows a woman playing a guitar. The network tab lists various requests, with one highlighted in yellow. A red arrow points from the text 'The YT Player locates the multimedia objects through a URL:' to the highlighted URL in the network tab.

Request URL: https://r2---sn-8xgp1vo-abds.googlevideo.com/videoplayback?expire=1711942403&ei=09-JZrHJZa0_9E...

Request Method: POST

Status Code: 200 OK

Remote Address: 85.206.58.141:443

Referrer Policy: origin-when-cross-origin

Response Headers:

- Access-Control-Allow-Credentials: true
- Access-Control-Allow-Origin: https://www.youtube.com
- Access-Control-Expose-Headers: Client-Protocol, Content-Length, Content-Type, X-Bandwidth-Est, X-Bandwidth-Est2, X-Bit-Est-App-Limited, X-Bandwidth-Est-Comp, X-Bandwidth-Avg, X-Head-Time-Millis, X-Head-Formats-Hint, X-Sequence-Num, X-Segment-Lmt, X-Walltime-Ms
- Alt-Svc: h3="443"; ma=2592000,h3-29="443"; ma=2592000,h3-Q046="443"; ma=2592000,quic="private, max-age=21259"
- Cache-Control: quic
- Client-Protocol: application/vnd.yt-ump
- Content-Type: cross-origin
- Date: Sun, 31 Mar 2024 21:34:04 GMT
- Expires: Sun, 31 Mar 2024 21:34:04 GMT
- Last-Modified: Fri, 01 Nov 2019 09:23:50 GMT
- Server: gws/1.0
- Timing-Allow-Origin: https://www.youtube.com

Video.

wherein said **multimedia objects are** located using http and **received by said multimedia player from servers** using a wireless connection;

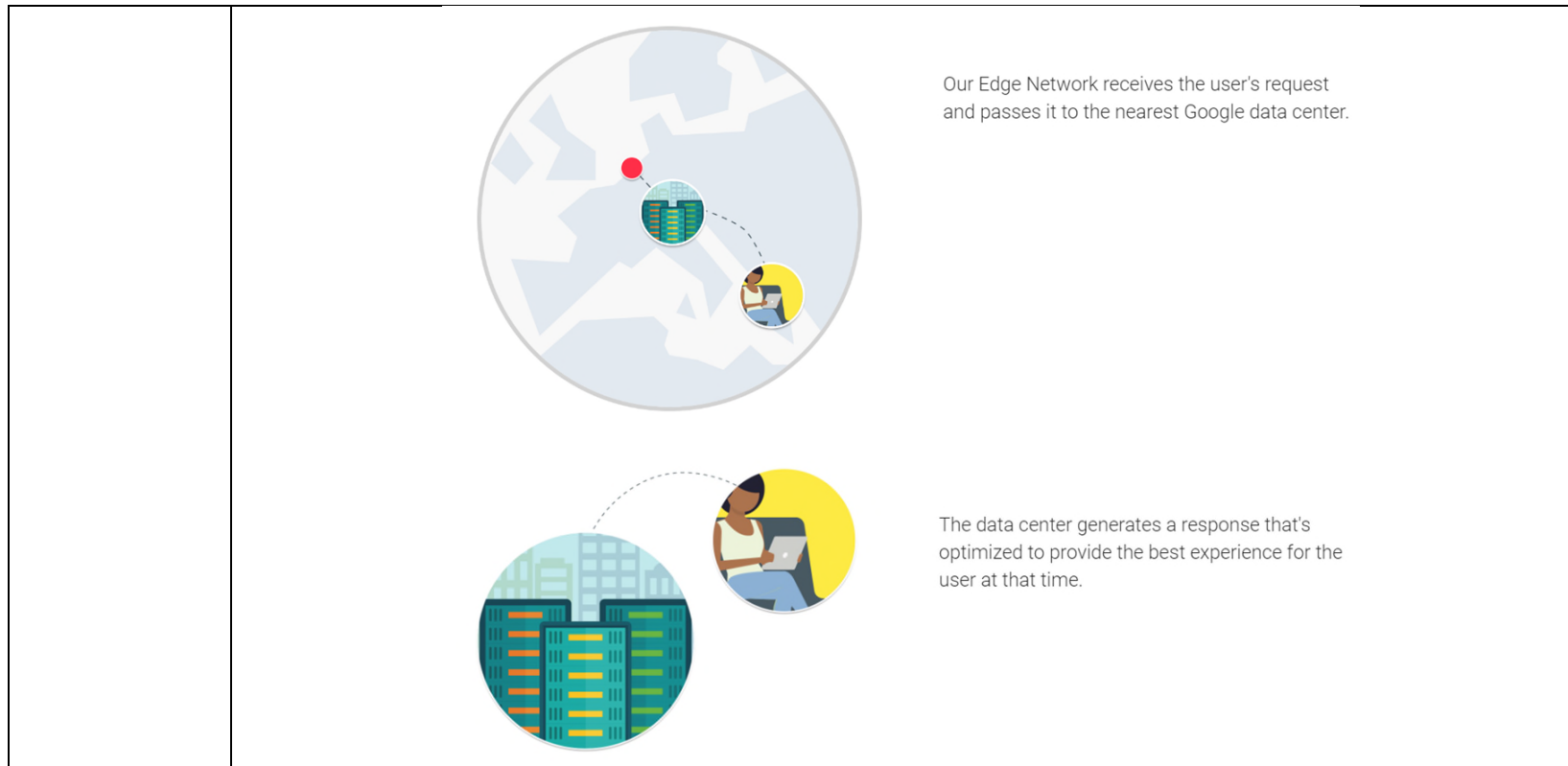
The YT Player receives multimedia objects from Google's content servers:



The journey starts when a user opens a Google app or requests one of our web pages.



Google responds to the user's request from an Edge Network location that will provide the lowest latency.





The app or browser retrieves the requested content. This can come from multiple Google locations, including our data centers, Edge POPs, and Edge Nodes.

<https://peering.google.com/#/> (last visited, Mar. 31, 2024).

For example:

Static content that's very popular with the local host's user base, including YouTube and Google Play, is temporarily cached on edge nodes. Google's traffic management systems direct user requests to an edge node that provides the best experience.

<https://peering.google.com/#/infrastructure> (last visited Mar. 31, 2024).

	See also, <i>Seven Networks, LLC v. Google LLC</i>, 315 F. Supp. 3d 933, 948 (E.D. Tex. 2018) : “Caching and localization are vital for [Google’s] optimization of network resources.” Because “hosting all content everywhere is inefficient, it makes sense to cache popular content and serve it locally.” Doing so brings delivery costs down for Google, network operators, and internet service providers. Storing content locally also allows it to be delivered more quickly, which improves user experience: “Serving content from the edge of the network closer to the user improves performance [and] user happiness.” To achieve these benefits, Google has placed Edge Nodes throughout the United States, including in this District. Google describes these nodes as the “workhorse[s] of video delivery.”
wherein said multimedia objects are located using http and received by said multimedia player from servers using a wireless connection;	Multimedia objects from YouTube can be received using a wireless connection: When you open YouTube in a mobile app or browser, you’ll land on Home 🏠. Here you’ll see videos recommended for you. Your preferences and activity on YouTube will influence your video recommendations. Use YouTube on mobile browsers, https://support.google.com/youtube/answer/3008060?hl=en (last visited Mar. 31, 2024). See also, below: Use YouTube on mobile browsers You can use YouTube for Mobile Web or Desktop mode on your phone. Sign in To get the most out of YouTube, sign in to view your favorite videos, playlists, and more. To sign in: 1. In the upper-right hand corner of the screen, tap the profile picture 🧑. 2. Tap Sign in 📄. 3. Sign in with your Google Account. <i>Id.</i>

In this media example, the currently playing sequence of multimedia objects are the variant segments (green). Notice the playback of segments is sequential.

The HLS standard requires sequential multimedia object playback.

4. Media files

Each media file URI in a Playlist file MUST identify a media file which is a segment of the overall presentation. Each media file MUST be formatted as an MPEG-2 Transport Stream or an MPEG-2 audio elementary stream [ISO 13818].

Transport Stream files MUST contain a single MPEG-2 Program. There SHOULD be a Program Association Table and a Program Map Table at the start of each file. A file that contains video SHOULD have at least one key frame and enough information to completely initialize a video decoder.

A media file in a Playlist MUST be the continuation of the encoded stream at the end of the media file with the previous sequence number unless it was the first media file ever to appear in the Playlist file or it is prefixed by an EXT-X-DISCONTINUITY tag.

Ex. 16, *HTTP Live Streaming* Draft, at 19.

Media Segmentation

7. Media segmentation requirements

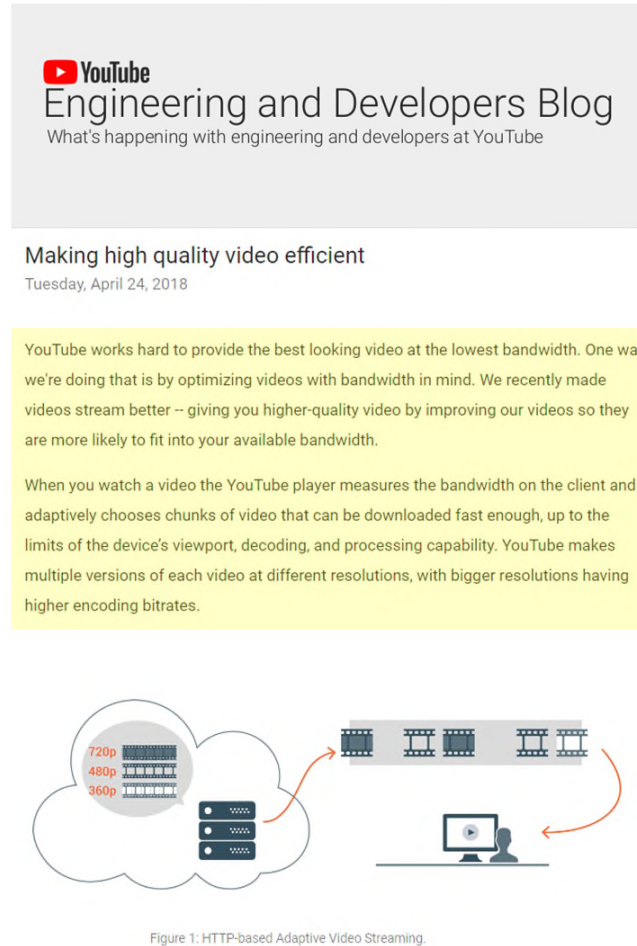
7.1. Your media MUST be continuous across segments, with the exception of transitions for ads and other inserted material.

7.2. If using a transport stream, continuity counters and timestamps MUST be sequential.

Ex. 17, *HTTP Live Streaming (HLS) authoring specification for Apple devices*.

playing back received multimedia objects by the multimedia player, wherein the multimedia player is configured to play multimedia objects in a sequence such that fluidity, video quality and audio quality are maintained by selecting a plurality of said multimedia objects that reflect available network bandwidth, autonomously adjusting said selection and playback according to the multimedia object parameters and supplied host path identification, and by

YouTube playback fluidity, video quality, and audio quality are maintained based on multiple versions of each stream that fit available bandwidth:



Ex. 18, *Making high quality video efficient*, YouTube Engineering and Developers Blog, <https://youtube-eng.googleblog.com/2018/04/making-high-quality-video-efficient.html> (Apr. 24, 2018), at 1.

playing back received multimedia objects by the multimedia player, wherein the multimedia player is configured to play multimedia objects in a sequence such that fluidity, video quality and audio quality are maintained by selecting a plurality of said multimedia objects that reflect available network bandwidth, autonomously adjusting said selection and playback according to the multimedia object parameters and supplied host path identification, and by

YouTube playback fluidity, video quality, and audio quality are maintained based on multiple versions (green) of each video that reflect available bandwidth (yellow):

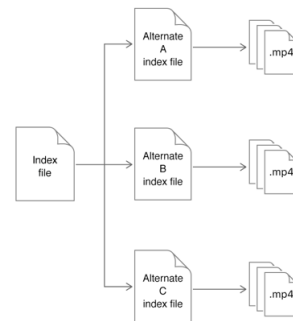
```
#EXTM3U
#EXT-X-INDEPENDENT-SEGMENTS
#EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKI_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i
#EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKI_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i
#EXT-X-STREAM-INF:BANDWIDTH=174202, CODECS="avc1.4D4015, mp4a.40.5", RESOLUTION=426x240, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="233", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKI_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/you
#EXT-X-STREAM-INF:BANDWIDTH=258776, CODECS="avc1.4D4015, mp4a.40.2", RESOLUTION=426x240, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKI_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/you
#EXT-X-STREAM-INF:BANDWIDTH=372190, CODECS="avc1.4D401E, mp4a.40.2", RESOLUTION=640x360, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKI_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/230/source/you
#EXT-X-STREAM-INF:BANDWIDTH=491083, CODECS="avc1.4D401E, mp4a.40.2", RESOLUTION=854x480, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKI_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/231/source/you
#EXT-X-STREAM-INF:BANDWIDTH=861742, CODECS="avc1.4D401F, mp4a.40.2", RESOLUTION=1280x720, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKI_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/232/source/you
#EXT-X-STREAM-INF:BANDWIDTH=150993, CODECS="avc1.4D400C, mp4a.40.5", RESOLUTION=256x144, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="233", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKI_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/269/source/you
#EXT-X-STREAM-INF:BANDWIDTH=153955, CODECS="vp09.00.11.08, mp4a.40.5", RESOLUTION=256x144, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="233", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKI_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/603/source/you
#EXT-X-STREAM-INF:BANDWIDTH=247948, CODECS="vp09.00.20.08, mp4a.40.5", RESOLUTION=426x240, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="233", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKI_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/you
#EXT-X-STREAM-INF:BANDWIDTH=332522, CODECS="vp09.00.20.08, mp4a.40.2", RESOLUTION=426x240, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKI_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/you
#EXT-X-STREAM-INF:BANDWIDTH=507720, CODECS="vp09.00.21.08, mp4a.40.2", RESOLUTION=640x360, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKI_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/605/source/you
#EXT-X-STREAM-INF:BANDWIDTH=716829, CODECS="vp09.00.30.08, mp4a.40.2", RESOLUTION=854x480, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKI_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/606/source/you
#EXT-X-STREAM-INF:BANDWIDTH=1314966, CODECS="vp09.00.31.08, mp4a.40.2", RESOLUTION=1280x720, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKI_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/609/source/you
```

Video.

For adaptive multi-bit-rate playback, HLS requires the player to assess network bandwidth availability to select multimedia objects:

Overview

The Multivariant Playlist describes all of the available variants for your content. Each variant is a version of the stream at a particular bit rate and is contained in a separate playlist. The client switches to the most appropriate variant based on the measured network bit rate. The client's player is tuned to minimize stalling of playback, to give the user the best possible streaming experience.



Ex. 13, *HTTP Live Streaming – Creating a Multivariant Playlist*, at 9.

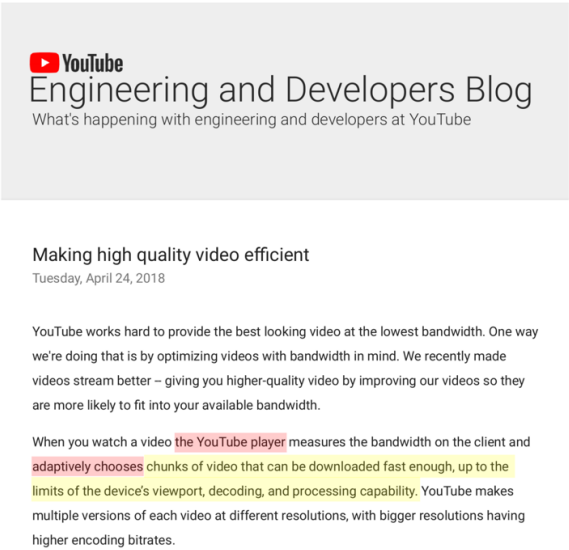
See also,

6.2.4. Providing variant streams

A server MAY offer multiple Playlist files to provide different encodings of the same presentation. If it does so it SHOULD provide a variant Playlist file that lists each variant stream to allow clients to switch between encodings dynamically.

Variant Playlists MUST contain an EXT-X-STREAM-INF tag for each variant stream. Each EXT-X-STREAM-INF tag for the same presentation MUST have the same PROGRAM-ID attribute value. The PROGRAM-ID value for each presentation MUST be unique within the variant Playlist.

Ex. 16, *HTTP Live Streaming Draft*, at 27.

playing back received multimedia objects by the multimedia player, wherein the multimedia player is configured to play multimedia objects in a sequence such that fluidity, video quality and audio quality are maintained by selecting a plurality of said multimedia objects that reflect available network bandwidth, autonomously adjusting said selection and playback according to the multimedia object parameters and supplied host path identification, and by	The YT Player selects a playlist variant based on bandwidth: Using playback statistics, we are able to model the behavior of the player as it switches between resolutions. This allows us in effect to predict when an increased bitrate would be more likely to cause a player to switch to a lower resolution and thereby cancel the effect of bitrate increase in any one resolution. With this model, we are able to find better operating points for each video in the real world.¹ Ex. 18, <i>Making high quality video efficient</i>. YouTube engineering documentation explicitly states that the YouTube player (on the client) autonomously (<i>i.e.</i>, without server-side intervention) adjusts the video playback.  The screenshot shows the header of the YouTube Engineering and Developers Blog. Below the header, the title 'Making high quality video efficient' is displayed with the date 'Tuesday, April 24, 2018'. The main text of the post is visible, discussing how YouTube optimizes video quality based on bandwidth. Key phrases are highlighted in yellow: 'the YouTube player measures the bandwidth on the client and adaptively chooses chunks of video that can be downloaded fast enough, up to the limits of the device's viewport, decoding, and processing capability.' and 'multiple versions of each video at different resolutions, with bigger resolutions having higher encoding bitrates.' <i>Id.</i>
--	---

playing back received multimedia objects by the multimedia player, wherein the multimedia player is configured to play multimedia objects in a sequence such that fluidity, video quality and audio quality are maintained by selecting a plurality of said multimedia objects that reflect available network bandwidth, autonomously adjusting said selection and playback according to the multimedia object parameters and supplied host path identification, and by

The YT Player autonomously adjusts selection and playback of media variants (green) according to the multimedia object parameters (blue):

```
#EXTM3U
#EXT-X-INDEPENDENT-SEGMENTS
#EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i
#EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i
#EXT-X-STREAM-INF: BANDWIDTH=174202, CODECS="avc1.4D4015, mp4a.40.5", RESOLUTION=426x240, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="233", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/yo
#EXT-X-STREAM-INF: BANDWIDTH=258776, CODECS="avc1.4D4015, mp4a.40.2", RESOLUTION=426x240, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/yo
#EXT-X-STREAM-INF: BANDWIDTH=372190, CODECS="avc1.4D401E, mp4a.40.2", RESOLUTION=640x360, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/230/source/yo
#EXT-X-STREAM-INF: BANDWIDTH=491083, CODECS="avc1.4D401E, mp4a.40.2", RESOLUTION=854x480, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/231/source/yo
#EXT-X-STREAM-INF: BANDWIDTH=861742, CODECS="avc1.4D401F, mp4a.40.2", RESOLUTION=1280x720, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/232/source/yo
#EXT-X-STREAM-INF: BANDWIDTH=150993, CODECS="avc1.4D400C, mp4a.40.5", RESOLUTION=256x144, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="233", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/269/source/yo
#EXT-X-STREAM-INF: BANDWIDTH=153955, CODECS="vp09.00.11.08, mp4a.40.5", RESOLUTION=256x144, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="233", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/603/source/yo
#EXT-X-STREAM-INF: BANDWIDTH=247948, CODECS="vp09.00.20.08, mp4a.40.5", RESOLUTION=426x240, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="233", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/yo
#EXT-X-STREAM-INF: BANDWIDTH=332522, CODECS="vp09.00.20.08, mp4a.40.2", RESOLUTION=426x240, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/yo
#EXT-X-STREAM-INF: BANDWIDTH=507720, CODECS="vp09.00.21.08, mp4a.40.2", RESOLUTION=640x360, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/605/source/yo
#EXT-X-STREAM-INF: BANDWIDTH=716829, CODECS="vp09.00.30.08, mp4a.40.2", RESOLUTION=854x480, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/606/source/yo
#EXT-X-STREAM-INF: BANDWIDTH=1314966, CODECS="vp09.00.31.08, mp4a.40.2", RESOLUTION=1280x720, FRAME-RATE=24, VIDEO-RANGE=SDR, AUDIO="234", CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/609/source/yo
```

Video.

Selection and playback of media variants is also based on the host path identification (red).

The HLS standard requires the media stream to possess multimedia object parameters for selection and playback. Some are identified below:

Multivariant Playlist

9. Multivariant Playlist requirements

- 9.1. Your EXT-X-STREAM-INF tag MUST always provide the CODECS attribute.
- 9.2. Your EXT-X-STREAM-INF tag MUST always provide the RESOLUTION attribute if the rendition includes video.
- 9.3. Your EXT-X-I-FRAME-STREAM-INF tag MUST always provide the CODECS attribute.
- 9.4. Your EXT-X-I-FRAME-STREAM-INF tag MUST always provide the RESOLUTION attribute.
- 9.5. You SHOULD deliver video and audio as separate streams.
- 9.6. If you have multichannel audio, you MUST use separate audio streams.
- 9.7. If you have alternative audio content (languages/commentary/DVS), you MUST use separate audio streams.
- 9.8. If you have different video angles, you MUST use separate audio streams.
- 9.9. You MUST provide multiple bit rates of video (that is, variants).
- 9.10. For HD content, there SHOULD be at least two variants encoded at the highest-available resolution.
- 9.11. If your video segments start with an IDR, you SHOULD use the EXT-X-INDEPENDENT-SEGMENTS tag in the Multivariant Playlist. (See item 7.4.)
- 9.12. If your video segments start with an IDR and the EXT-X-INDEPENDENT-SEGMENTS tag isn't in the Multivariant Playlist, you MUST use the EXT-X-INDEPENDENT-SEGMENTS tag in all video Media Playlists. (See item 7.4.)
- 9.13. The BANDWIDTH attribute MUST be the largest sum of peak segment bit rates that's produced by any playable combination of renditions.
- 9.14. You MUST include the AVERAGE-BANDWIDTH attribute.
- 9.15. Each EXT-X-STREAM-INF tag that includes video content MUST have a FRAME-RATE attribute.
- 9.16. The VIDEO-RANGE attribute MUST be specified unless all variants and renditions are SDR.
- 9.17. Within a group of Renditions (EXT-X-MEDIA tags having the same TYPE and GROUP-ID), those tags having the same LANGUAGE value should be ordered from most general to most specific. (Because CHARACTERISTICS are open-ended, the matching algorithm needs the ordering since it can't interpret all the semantics.)
- 9.18. An EXT-X-CONTENT-STEERING tag SHOULD always have a PATHWAY-ID attribute.
- 9.19. The SCORE attribute (if present) MUST be on every variant. Otherwise, the SCORE attribute will be ignored.

Ex. 17, HTTP Live Streaming (HLS) authoring specification for Apple devices.

The HLS standard also requires a host path identification:

3.3.8. EXT-X-STREAM-INF

The EXT-X-STREAM-INF tag indicates that the next **URI** in the Playlist file identifies another Playlist file. Its format is:

```
#EXT-X-STREAM-INF:<attribute-list>
<URI>
```

Ex. 16, *HTTP Live Streaming Draft*, at 15.

EXT-X-STREAM-INF

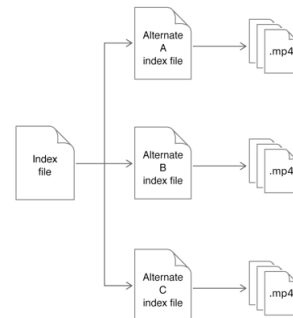
Indicates that the next URL in the playlist file identifies another playlist file.

Ex. 13, *HTTP Live Streaming – Creating a Multivariant Playlist*, at 10.

The HLS standard further requires autonomous selection of multivariant streams:

Overview

The Multivariant Playlist describes all of the available variants for your content. Each variant is a version of the stream at a particular bit rate and is contained in a separate playlist. The client switches to the most appropriate variant based on the measured network bit rate. The client's player is tuned to minimize stalling of playback, to give the user the best possible streaming experience.



Ex. 13, *HTTP Live Streaming Overview, Creating a multivariant playlist* (last visited, Mar. 31, 2023).

utilizing optimized decoding processes to maintain quality playback.

YouTube uses optimized decoding to maintain quality playback.

Defendants use VP9 and AVC1 to decode YouTube video:

```
#EXTM3U
#EXT-X-INDEPENDENT-SEGMENTS
#EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i
#EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i
#EXT-X-STREAM-INF:BANDWIDTH=174202,CODECS="avc1.4D4015,mp4a.40.5",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/you
#EXT-X-STREAM-INF:BANDWIDTH=258776,CODECS="avc1.4D4015,mp4a.40.2",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/you
#EXT-X-STREAM-INF:BANDWIDTH=372190,CODECS="avc1.4D401E,mp4a.40.2",RESOLUTION=640x360,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/230/source/you
#EXT-X-STREAM-INF:BANDWIDTH=491083,CODECS="avc1.4D401E,mp4a.40.2",RESOLUTION=854x480,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/231/source/you
#EXT-X-STREAM-INF:BANDWIDTH=861742,CODECS="avc1.4D401F,mp4a.40.2",RESOLUTION=1280x720,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/232/source/you
#EXT-X-STREAM-INF:BANDWIDTH=150993,CODECS="avc1.4D400C,mp4a.40.5",RESOLUTION=256x144,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/269/source/you
#EXT-X-STREAM-INF:BANDWIDTH=153955,CODECS="vp09.00.11.08,mp4a.40.5",RESOLUTION=256x144,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/603/source/you
#EXT-X-STREAM-INF:BANDWIDTH=247948,CODECS="vp09.00.20.08,mp4a.40.5",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/you
#EXT-X-STREAM-INF:BANDWIDTH=332522,CODECS="vp09.00.20.08,mp4a.40.2",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/you
#EXT-X-STREAM-INF:BANDWIDTH=507720,CODECS="vp09.00.21.08,mp4a.40.2",RESOLUTION=640x360,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/605/source/you
#EXT-X-STREAM-INF:BANDWIDTH=716829,CODECS="vp09.00.30.08,mp4a.40.2",RESOLUTION=854x480,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/606/source/you
#EXT-X-STREAM-INF:BANDWIDTH=1314966,CODECS="vp09.00.31.08,mp4a.40.2",RESOLUTION=1280x720,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE
https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZs0BMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/609/source/you
```

VP9 encoding¹ and decoding optimizations, including DCT, are described by Defendants:

“After this prediction step, you have predicted block contents and you have the actual block that you’re trying to get as close as possible to, and then the difference between these two is the residual signal that you’re going to encode.

So in current generation video codecs, we usually use . . . transforms called DCT²s to encode this residual signal. [I]n VP9 . . . in addition to using the DCT, we’ve also added an asymmetric sine based transform called ADST. And the sine based transform is optimized for a signal that has a near zero value at the edge of the prediction region, whereas the cosine is optimized for a residual signal that has a zero signal in the middle of the predicted signal. So those are optimized for different condition, and together they give good gains when used properly.”

Google I/O 2013 – WebM and the New VP9 Open Video Codec at 24:50 - 25:50
<https://www.youtube.com/watch?v=K6JshvblIcM> (last visited, Apr. 29, 2024).

¹ This paragraph is equally applicable to decoding, which is merely the inverse of encoding.

² DCT means “discreet cosine transform.”

VP9 encoding and decoding optimizations, including DCT, are described by the VP9 Specification:

5.7 Multiple transforms

VP9 specifies a number of different transforms that can be applied to the residual. These differ in size (4x4, 8x8, 16x16, 32x32 are supported) and in the type of transform. The type of transform can be varied independently for rows and columns as being either an integer precision version of a **Discrete Cosine Transform** or an **Asymmetric Discrete Sine Transform**. The choice of transform type is deduced from the intra mode, while the choice of transform size can either be specified at a frame level, or given on a per-block basis.

The idea is that when we are doing intra prediction, normally the samples near the known edges are predicted better than the ones further away so the errors are usually small at one side. The Asymmetric Discrete Sine Transform does a better job of transforming this shape because it has basis vectors that tend to vanish at the known boundary, and maximize energy at the unknown boundary.

Ex. 22 at 22, Adrian Grange, *et al.*, *VP9 Bitstream & Decoding Process Specification*, Ver. 0.7 Google, Inc. (Feb. 22, 2017).

5.8 Inverse DCT structure

The two-dimensional inverse transforms used for processing blocks of coefficients are executed by performing one-dimensional inverse transforms on first the rows of the block followed by the columns of the intermediate result from the row transforms.

Id.

AVC-1 encoding and decoding optimizations, including DCT, are described by the AVC-1 Specification:

8.5.12.2 Transformation process for residual 4x4 blocks

Inputs of this process are:

- the variable bitDepth,
- a 4x4 array of scaled transform coefficients d with elements d_{ij} .

Outputs of this process are residual sample values as 4x4 array r with elements r_{ij} .

* * *

After performing both the one-dimensional horizontal and the one-dimensional vertical inverse transforms to produce an array of transformed samples, the final constructed residual sample values is derived as:

$$r_{ij} = (h_{ij} + 2^5) \gg 6 \quad \text{with } i, j = 0..3 \quad (8-354)$$

Ex. 23, *Information technology — Coding of audio-visual objects*, ISO/IEC 14496-10 (10th Ed., 2022-11), at 223-24.

8.5.13.2 Transformation process for residual 8x8 blocks

Inputs of this process are:

- the variable bitDepth,
- an 8x8 array of scaled transform coefficients d with elements d_{ij} .

Outputs of this process are residual sample values as 8x8 array r with elements r_{ij} .

* * *

After performing both the one-dimensional horizontal and the one-dimensional vertical inverse transforms to produce an array of transformed samples, the final constructed residual sample values are derived as

$$r_{ij} = (m_{ij} + 2^5) \gg 6 \quad \text{with } i, j = 0..7 \quad (8-406)$$

Id. at 225, 228.

EXHIBIT 3

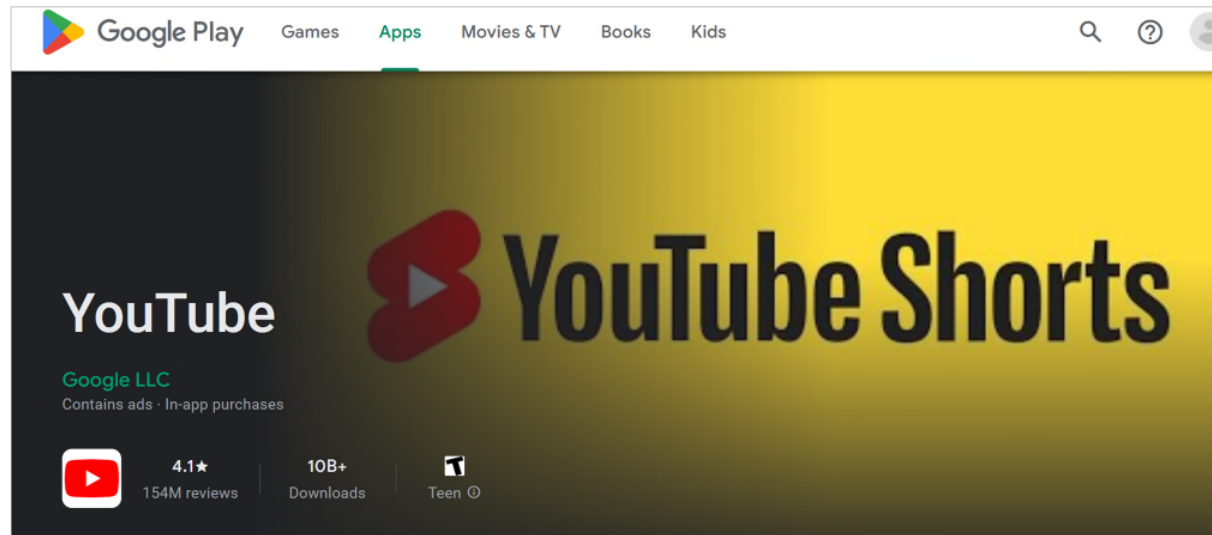
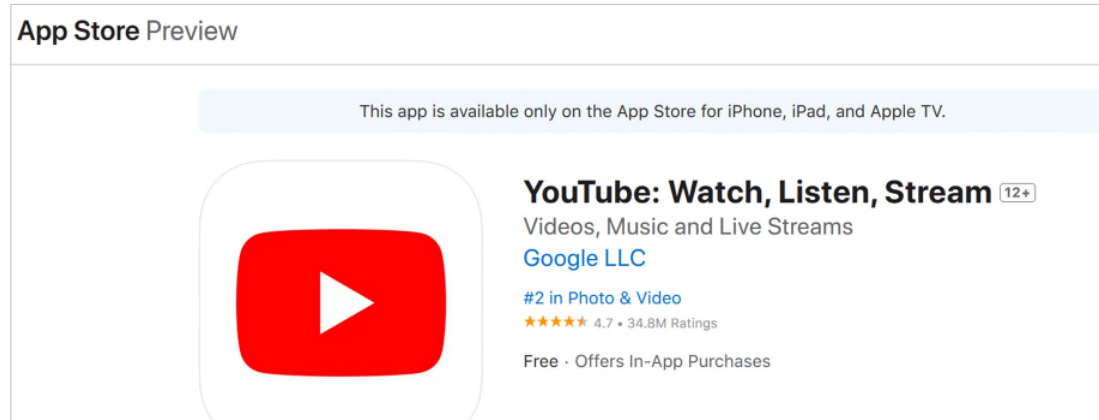
U.S. Patent No. 10,771,849, Claim 1

A method comprising:	
----------------------	--

receiving audio and video segments encoded in a digital encoding format and with an encoding rate;

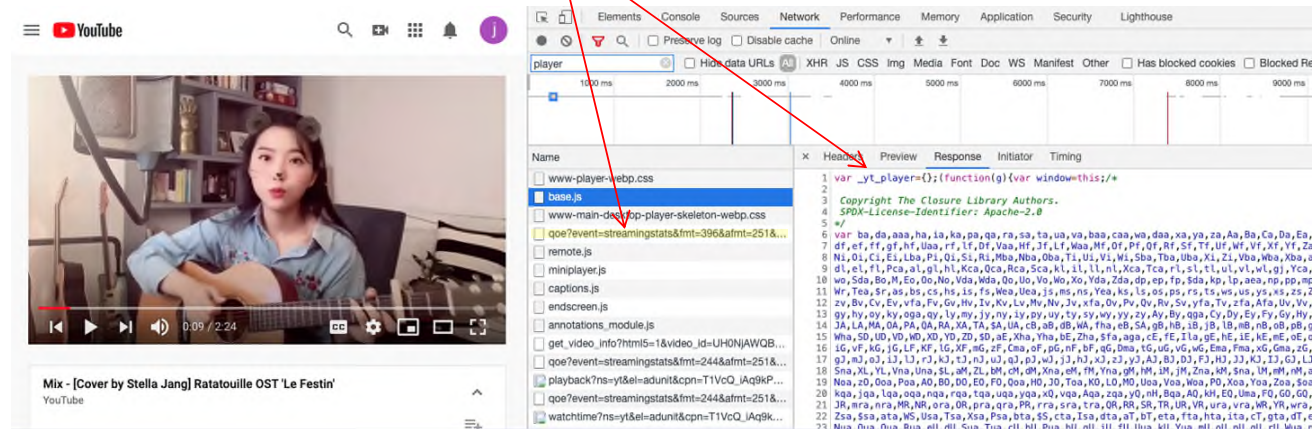
YouTube uses two kinds of Players (“YT Player”) for receiving encoded audio and video segments:

YouTube App Players (e.g., iOS, Smart TVs, streaming devices, Chrome)



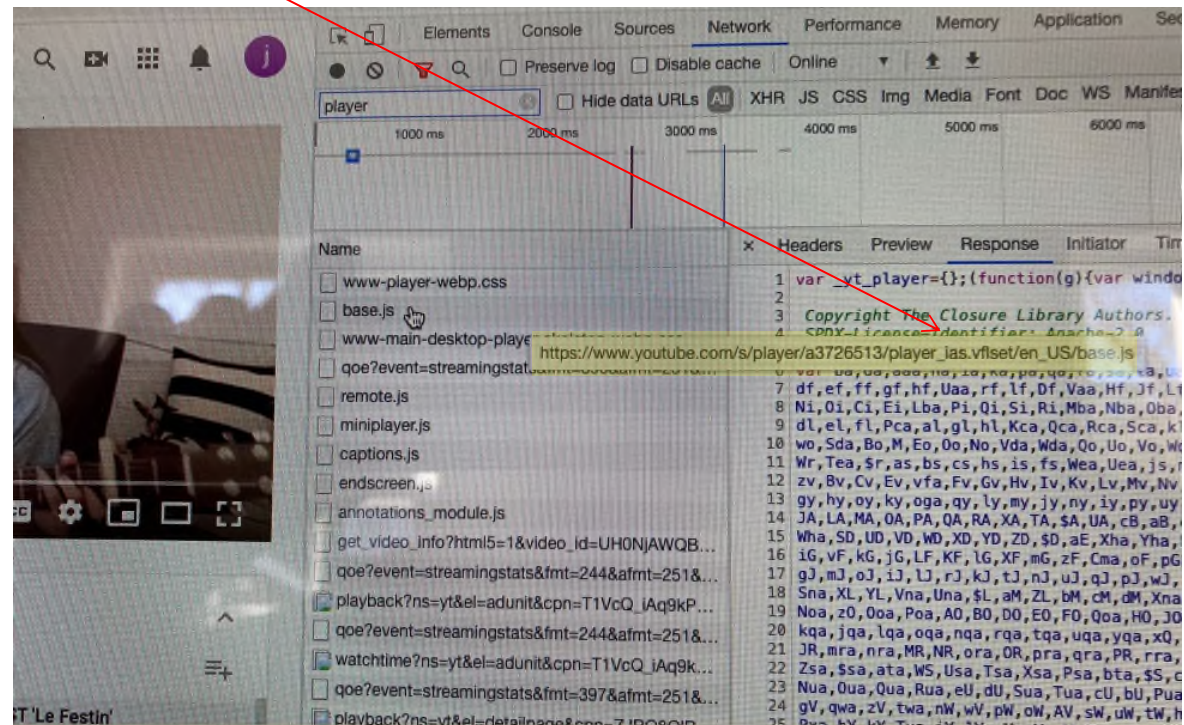
2. Web-based Video Playback

When a video is launched, YouTube uses a Java player. Example below:



YouTube Video, <https://www.youtube.com/watch?v=beamS4GZ5T8> ("Video").

The YT Player player is served by YouTube to the user:



Video.

receiving audio and video segments encoded in a digital encoding format and with an encoding rate;	YouTube stream data identifies the protocol used for receiving encoded audio and video segments as MPEG-DASH. <pre><?xml version="1.0" encoding="UTF-8"?> <MPD xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="urn:mpeg:dash:schema:mpd:2011" xmlns:xlink="http://www.w3.org/1999/xlink" xsi:schemaLocation="urn:mpeg:dash:schema:mpd:2011 http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-DASH_schema_files/DASH-MPD.xsd" minBufferTime="PT1.5S" mediaPresentationDuration="PT144S" type="static" profiles="urn:mpeg:dash:profile:isoff-main:2011"> Video MPD file (XML). Video.</pre>
---	---

receiving audio and video segments
encoded in a digital encoding format and with an encoding rate;

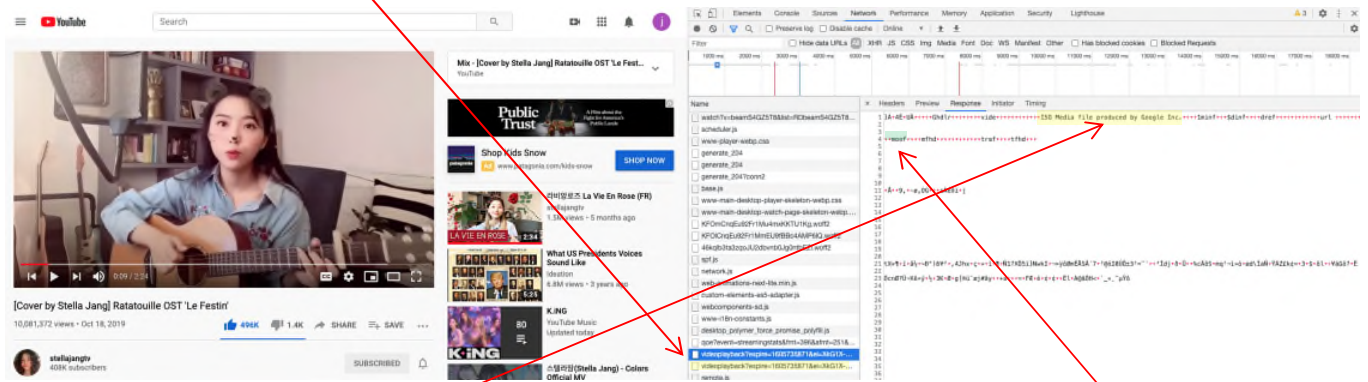
Media on YouTube is comprised of video and audio segments:



Video.

receiving audio and video segments encoded in a digital encoding format and with an encoding rate;

The video and audio segments are visible:



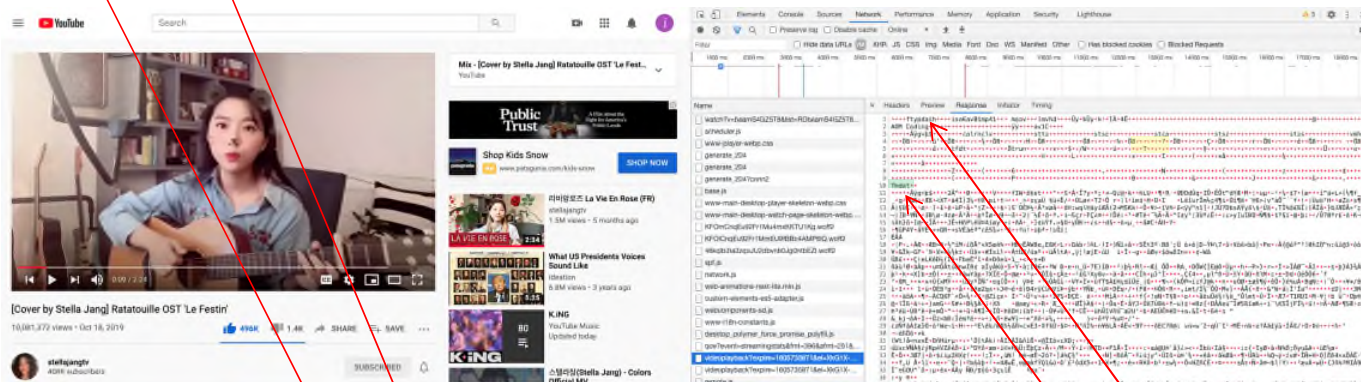
For the highlighted Representation of the media segments, here is the MOOF (green) (infra at 9).

Note Google's signature on the segment creation (base media file format). This format is referenced on page 2.

Video.

receiving audio and video segments encoded in a digital encoding format and with an encoding rate;

The video and audio segments are visible:



Video.

Here is the MDAT (green) (infra at 9).

Note segments are explicitly stamped DASH by Google

<AdaptationSet id="0" mimeType="video/mp4" ...>

...
<Representation id="133" codecs="avc1.4d4015" ...">

<AdaptationSet id="2" mimeType="audio/mp4" ...>

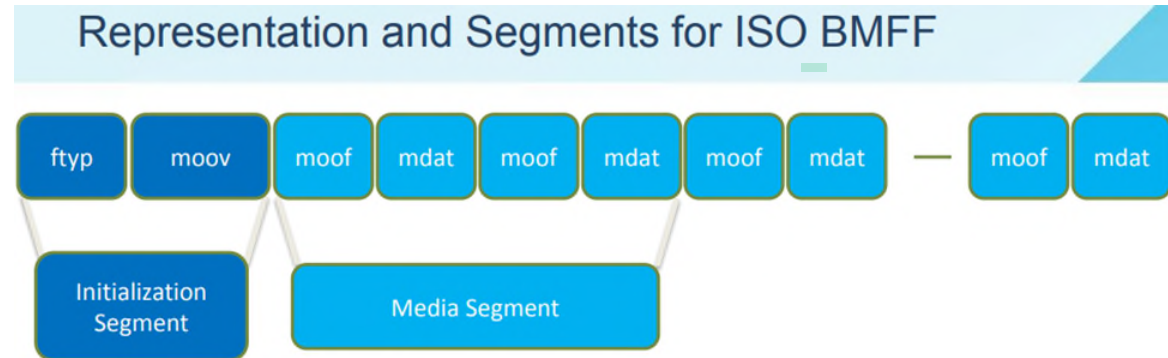
<Representation id="140" codecs="mp4a.40.2" bandwidth="130565">

Video.

receiving audio and video segments encoded in a digital encoding format and with an encoding rate;

The MPEG-DASH standard requires segments:

Segments possess moof and mdat data.



Ex. 19, Ye-Kui Wang & Thomas Stockhammer (slides mostly by Thomas Stockhammer [Dr. Thomas Stockhammer is the Technical Standards Director at Qualcomm and leads the ATSC 3.0 profile for DASH]) *An Introduction to DASH (Dynamic Adaptive Streaming over HTTP)* , at 14 (April 2015).

MOOF is a movie fragment.

MDAT is a box which can hold the actual media data for a presentation.

receiving audio and video segments encoded in a digital encoding format and with an encoding rate;	As shown below, the YT Player receives data in two digital encoding formats: AVC1 and mp4a. The Media Presentation Description ("MPD") file for this MPEG-DASH data shows that the video is in the AVC1 format and the audio is in MP4A format: <MPD xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="urn:mpeg:dash:schema:mpd:2011" xmlns:xlink="http://www.w3.org/1999/xlink" xsi:schemaLocation="urn:mpeg:dash:schema:mpd:2011 http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-DASH_schema_files/DASH-MPD.xsd" minBufferTime="PT1.5S" mediaPresentationDuration="PT144S" type="static" profiles="urn:mpeg:dash:profile:isoff-main:2011"> <Period> <AdaptationSet id="0" mimeType="video/mp4" ...> ... <Representation id="133" codecs="avc1.4d4015" ..."> <AdaptationSet id="2" mimeType="audio/mp4" ...> <Representation id="140" codecs="mp4a.40.2" bandwidth="130565"> Video (excerpt). These two data formats are codecs. AVC1 (green), also known as H264, is a video encoding format, whereas MP4A (green) is used here as an audio encoding format.
---	---

receiving audio and video segments encoded in a digital encoding format and with an encoding rate;	The YT Player also receives, for selection, segments with multiple encoding rates tied to bandwidth (yellow): 144p: <Representation id="160" codecs="avc1.4d400c" startWithSAP="1" bandwidth="93785" width="256" height="144" frameRate="24000/1001"> 240p: <Representation id="133" codecs="avc1.4d4015" startWithSAP="1" bandwidth="115889" width="426" height="240" frameRate="24000/1001"> 480p: <Representation id="135" codecs="avc1.4d401e" startWithSAP="1" bandwidth="337134" width="854" height="480" frameRate="24000/1001"> 360p: <Representation id="134" codecs="avc1.4d401e" startWithSAP="1" bandwidth="223902" width="640" height="360" frameRate="24000/1001"> 720p: <Representation id="136" codecs="avc1.4d401f" startWithSAP="1" bandwidth="690142" width="1280" height="720" frameRate="24000/1001"> Video (exemplary excerpt).		
receiving audio and video segments encoded in a digital encoding format and with an encoding rate;	The MPEG-DASH standard requires encoding rates: <table border="1"> <tr> <td>@bandwidth</td><td> M Consider a hypothetical constant bitrate channel of bandwidth with the value of this attribute in bits per second (bps). Then, if the Representation is continuously delivered at this bitrate, starting at any SAP that is indicated either by @startWithSAP or by any Segment Index box, a client can be assured of having enough data for continuous playout providing playout begins after @minBufferTime * @bandwidth bits have been received (i.e. at time @minBufferTime after the first bit is received). For dependent Representations, this value specifies the bandwidth according to the above definition for the aggregation of this Representation and all complementary Representations. For details, see subclause 5.3.5.4. </td></tr> </table> Ex. 14, <i>Information technology — Dynamic adaptive streaming over HTTP (DASH)</i>, ISO/IEC 23009-1, at Table 9, p. 46 (3rd Ed. 2019).¹	@bandwidth	M Consider a hypothetical constant bitrate channel of bandwidth with the value of this attribute in bits per second (bps). Then, if the Representation is continuously delivered at this bitrate, starting at any SAP that is indicated either by @startWithSAP or by any Segment Index box, a client can be assured of having enough data for continuous playout providing playout begins after @minBufferTime * @bandwidth bits have been received (i.e. at time @minBufferTime after the first bit is received). For dependent Representations, this value specifies the bandwidth according to the above definition for the aggregation of this Representation and all complementary Representations. For details, see subclause 5.3.5.4.
@bandwidth	M Consider a hypothetical constant bitrate channel of bandwidth with the value of this attribute in bits per second (bps). Then, if the Representation is continuously delivered at this bitrate, starting at any SAP that is indicated either by @startWithSAP or by any Segment Index box, a client can be assured of having enough data for continuous playout providing playout begins after @minBufferTime * @bandwidth bits have been received (i.e. at time @minBufferTime after the first bit is received). For dependent Representations, this value specifies the bandwidth according to the above definition for the aggregation of this Representation and all complementary Representations. For details, see subclause 5.3.5.4.		

¹ The second through fifth editions of the MPEG-DASH standard do not possess any changes that impact Google and YouTube in this litigation. Changes made to the third edition from second are described in Exhibit 14 (Third Ed.) at pages 6-7. Changes made to the fourth edition from the third are described in Exhibit 20 (Fourth Ed.) at 7-8. Changes made to the fifth edition from the fourth are described in Exhibit 21 (Fifth Ed.) at 7.

wherein, said audio and video segments are associated with object parameters and supplied host path identification to form multimedia objects;

The media has a YouTube MPD that defines several segment streams associated with object parameters, such as size (height X width), frame rate and encoding rates:

```
<MPD ... mediaPresentationDuration="PT144S" ...>
  <Period>
    <AdaptationSet id="0" mimeType="video/mp4" ...>
      <Role schemeIdUri="urn:mpeg:DASH:role:2011" value="main"/>
      <Representation id="133" codecs="avc1.4d4015" startWithSAP="1" bandwidth="115889" width="426" height="240"
frameRate="24000/1001"><BaseURL>https://r2---sn-8xgp1vo-
ab5l.googlevideo.com/videoplayback?expire=1605735198&ei=vj61X9bkKpfqhwx4pqACg&ip=71.168.227.177&id=o-
AFV1hi0nYBq0Rw9li7YlZQUZAydkyXvkpzQkTYZr_wOK&itag=133&altags=133,134,135,136,160,242,243,244,247,278,394,395,396,397,398&am
p;source=youtube&requiresl=yes&mh=y2&mm=31,29&mn=sn-8xgp1vo-ab5l,sn-
ab5l6ndy&ms=au,rdu&mv=m&mvi=2&pl=17&initcwndbps=2136250&vprv=1&mime=video/mp4&gir=yes&clen=
1731819&dur=144.143&lmt=1572601141606755&mt=1605713472&fvip=2&keepalive=yes&c=WEB&txp=5535432&sp
arams=expire,ei,ip,id,aitags,source,requiresl,vprv,mime,gir,clen,dur,lmt&sig=AOq0QJ8wRQIhAOEA94RUMTgd5OR8ONUKa_ZV8KTMYT-bCba-
N0nE-
WdmAiA3Sk4GMcxhQmu6yLqFhnaLoO8RBnWJGki44FxDeAiQ5Q==&lparams=mh,mm,mn,ms,mv,mvi,pl,initcwndbps&lsig=AG3C_xAwRQIgOL
sAprMcbVKdKqMNzYUo0QnNsNx2r3uepUB7POINSDsCIQCPNe0axLBBKoKYu8yYzrcHQ1ihEcCS49CCZlnZYxoitg==</BaseURL>
...
      </Representation>
      <Representation id="135" codecs="avc1.4d401e" startWithSAP="1" bandwidth="337134" width="854" height="480"
frameRate="24000/1001"><BaseURL>https://r2---sn-8xgp1vo-
ab5l.googlevideo.com/videoplayback?expire=1605735198&ei=vj61X9bkKpfqhwx4pqACg&ip=71.168.227.177&id=o-
AFV1hi0nYBq0Rw9li7YlZQUZAydkyXvkpzQkTYZr_wOK&itag=135&altags=133,134,135,136,160,242,243,244,247,278,394,395,396,397,398&am
p;source=youtube&requiresl=yes&mh=y2&mm=31,29&mn=sn-8xgp1vo-ab5l,sn-
ab5l6ndy&ms=au,rdu&mv=m&mvi=2&pl=17&initcwndbps=2136250&vprv=1&mime=video/mp4&gir=yes&clen=
5086723&dur=144.143&lmt=1572601141608802&mt=1605713472&fvip=2&keepalive=yes&c=WEB&txp=5535432&sp
arams=expire,ei,ip,id,aitags,source,requiresl,vprv,mime,gir,clen,dur,lmt&sig=AOq0QJ8wRQIhAOEh5ZOnTl0qH8HPdUWbfp8fob91gasix8G4dLQ8k-
kSV5tuHfVkJfrSGv3nSowV0AZJfsCIHVhXsUedGbXOOiY_cn9M62H0SiMspFj01OwCCH-
GjDi&lparams=mh,mm,mn,ms,mv,mvi,pl,initcwndbps&lsig=AG3C_xAwRQIgOLsAprMcbVKdKqMNzYUo0QnNsNx2r3uepUB7POINSDsCIQCPNe
0axLBBKoKYu8yYzrcHQ1ihEcCS49CCZlnZYxoitg==</BaseURL>
...
      </Representation>
      <Representation id="134" codecs="avc1.4d401e" startWithSAP="1" bandwidth="223902" width="646" height="360"
frameRate="24000/1001"><BaseURL>https://r2---sn-8xgp1vo-
ab5l.googlevideo.com/videoplayback?expire=1605735198&ei=vj61X9bkKpfqhwx4pqACg&ip=71.168.227.177&id=o-
AFV1hi0nYBq0Rw9li7YlZQUZAydkyXvkpzQkTYZr_wOK&itag=134&altags=133,134,135,136,160,242,243,244,247,278,394,395,396,397,398&am
p;source=youtube&requiresl=yes&mh=y2&mm=31,29&mn=sn-8xgp1vo-ab5l,sn-
ab5l6ndy&ms=au,rdu&mv=m&mvi=2&pl=17&initcwndbps=2136250&vprv=1&mime=video/mp4&gir=yes&clen=
3315031&dur=144.143&lmt=1572601141632693&mt=1605713472&fvip=2&keepalive=yes&c=WEB&txp=5535432&sp
arams=expire,ei,ip,id,aitags,source,requiresl,vprv,mime,gir,clen,dur,lmt&sig=AOq0QJ8wRQIhAOqh5ZOnTl0qH8HPdUWbfp8fob91gasix8G4dLQ8k-
sqAiBXuUmney8sM6S_Kmhka3osUa3-
Gz1PWm01V5ntttN3eg==&lparams=mh,mm,mn,ms,mv,mvi,pl,initcwndbps&lsig=AG3C_xAwRQIgOLsAprMcbVKdKqMNzYUo0QnNsNx2r3uepU
B7POINSDsCIQCPNe0axLBBKoKYu8yYzrcHQ1ihEcCS49CCZlnZYxoitg==</BaseURL>
...
      </Representation>
      <Representation id="160" codecs="avc1.4d400c" startWithSAP="1" bandwidth="93785" width="256" height="144"
frameRate="24000/1001"><BaseURL>https://r2---sn-8xgp1vo-
ab5l.googlevideo.com/videoplayback?expire=1605735198&ei=vj61X9bkKpfqhwx4pqACg&ip=71.168.227.177&id=o-
AFV1hi0nYBq0Rw9li7YlZQUZAydkyXvkpzQkTYZr_wOK&itag=160&altags=133,134,135,136,160,242,243,244,247,278,394,395,396,397,398&am
```

```

p;source=youtube&requiresl=yes&mh=y2&mm=31,29&mn=sn-8xgp1vo-ab5l,sn-
ab5l6ndy&ms=au,rdu&mv=m&mvi=2&pl=17&initcwndbps=2136250&vprv=1&mime=video/mp4&gir=yes&clen=
1207858&dur=144.143&lmt=1572601141607791&mt=1605713472&fvip=2&keepalive=yes&c=WEB&txp=5535432&
sparams=expire,ei,ip,id,aitags,source,requiresl,vprv,mime,gir,clen,dur,lmt&sig=AOq0QJ8wRQlHAndabKIHwuZfZbazvEK0_CkJOXOVf3cgdyLQs05RX
W8WAiBbo2uUuT_3nl-
1ZGvZViu_WuYmAjivw3Tx6RDJdN2E6g==&lparams=mh,mm,mn,ms,mv,mvi,pl,initcwndbps&lsig=AG3C_xAwRQIgOLsAprMcbVKdKqMNzYUo0
QnNsNx2r3uepUB7POINSDsCIQCPNe0axLBBKoKYu8yYzrcHQ1ihEcCS49CCzlnZYxoitg==</BaseURL>
...
</Representation>
<Representation id="136" codecs="avc1.4d401f" startWithSAP="1" bandwidth="690142" width="1280" height="720"
frameRate="24000/1001"><BaseURL>https://r2---sn-8xgp1vo-
ab5l.googlevideo.com/videoplayback?expire=1605735198&ei=vj61X9bkKpfqhwx4pqACg&ip=71.168.227.177&id=o-
AFV1hi0nYBq0Rw9li7YlzQUZAydkyXvkpzQkTYZr_wOK&itag=136&aitags=133,134,135,136,160,242,243,244,247,278,394,395,396,397,398&am
p;source=youtube&requiresl=yes&mh=y2&mm=31,29&mn=sn-8xgp1vo-ab5l,sn-
ab5l6ndy&ms=au,rdu&mv=m&mvi=2&pl=17&initcwndbps=2136250&vprv=1&mime=video/mp4&gir=yes&clen=
10698681&dur=144.143&lmt=1572601141611448&mt=1605713472&fvip=2&keepalive=yes&c=WEB&txp=5535432&
sparams=expire,ei,ip,id,aitags,source,requiresl,vprv,mime,gir,clen,dur,lmt&sig=AOq0QJ8wRAIgYAtlsozwFNXhP9CN63Wb0VXUbm8zHPvOA2PEZn
zGvoCID5bwD-QGfsrnOlgpj0w3-
JY3SjtcozQ5gjregVqObi3&lparams=mh,mm,mn,ms,mv,mvi,pl,initcwndbps&lsig=AG3C_xAwRQIgOLsAprMcbVKdKqMNzYUo0QnNsNx2r3uepUB
7POINSDsCIQCPNe0axLBBKoKYu8yYzrcHQ1ihEcCS49CCzlnZYxoitg==</BaseURL>
...
</Representation>
</AdaptationSet>
...
</Period>
</MPD>

Video.

```

wherein, said audio and video segments are associated with object parameters and supplied host path identification to form multimedia objects;

The MPEG-DASH standard discloses object parameters, and some object parameters are identified below:

@width	0	specifies the horizontal visual presentation size of the video media type on a grid determined by the @sar attribute. In the absence of @sar width and height are specified as if the value of @sar were "1:1" NOTE The visual presentation size of the video is equal to the number of horizontal and vertical samples used for presentation after encoded samples are cropped in response to encoded cropping parameters, "overscan" signaling, or "pan/scan" display parameters, e.g. SEI messages. If not present on any level, the value is unknown.
@height	0	specifies the vertical visual presentation size of the video media type, on a grid determined by the @sar attribute. If not present on any level, the value is unknown.

Ex. 14, ISO/IEC 23009-1, at Table 13, internal p. 54.

@frameRate	0	specifies the output frame rate (or in the case of interlaced, half the output field rate) of the video media type in the Representation. If the frame or field rate is varying, the value is the average frame or half the average field rate field rate over the entire duration of the Representation. The value is coded as a string, either containing two integers separated by a "/", ("F/D"), or a single integer "F". The frame rate is the division F/D, or F, respectively, per second (i.e. the default value of D is "1"). If not present on any level, the value is unknown.
------------	---	---

Id. at internal p. 55.

wherein, said audio and video segments are associated with object parameters and supplied host path identification to form multimedia objects;

The MPD defines several segment streams that are also associated with host path identifiers, such as URLs:

```
<MPD ... mediaPresentationDuration="PT144S" ...>
  <Period>
    <AdaptationSet id="0" mimeType="video/mp4" ...>
      <Role schemeIdUri="urn:mpeg-DASH:role:2011" value="main"/>
      <Representation id="133" codecs="avc1.4d4015" startWithSAP="1" bandwidth="115889" width="426" height="240"
frameRate="24000/1001"><BaseURL>https://r2--sn-8xgp1vo-
ab5l.googlevideo.com/videoplayback?expire=1605735198&ei=vj61X9bkKpfqhwx4pqACg&ip=71.168.227.177&id=o-
AFV1hi0nYBq0Rw9li7YlZQUZAydkyXvkpzQkTYZr_wOK&itag=133&aiags=133,134,135,136,160,242,243,244,247,278,394,395,396,397,398&am
p;source=youtube&requiressl=yes&mh=y2&mm=31,29&mn=sn-8xgp1vo-ab5l,sn-
ab5l6ndy&ms=au,rdu&mv=m&mvi=2&pl=17&initcwndbps=2136250&vprv=1&mime=video/mp4&gir=yes&clen=
1731819&dur=144.143&lmt=1572601141606755&mt=1605713472&fvip=2&keepalive=yes&c=WEB&txp=5535432&sp
sparams=expire,ei,ip,id,aitags,source,requiressl,vprv,mime,gir,clen,dur,lmt&sig=AOq0QJ8wRQlhAOEA94RUMTqd5OR8ONUKa_ZV8KMTYT-bCba-
N0nE-
WdmAiA3Sk4GMcxhQmu6yLqFhnaLoO8RBNWJGki44FxDeAiQ5Q==&lparams=mm,mn,ms,mv,mvi,pl,initcwndbps&lsig=AG3C_xAwRQlgOL
sAprMcbVKdKqMNzYUo0QnNsNx2r3uepUB7POINSDsCIQCPNe0axLBBKoKYu8yYzrcHQ1ihEcCS49CCZlnZYxoigt==</BaseURL>
...
      </Representation>
      <Representation id="135" codecs="avc1.4d401e" startWithSAP="1" bandwidth="337134" width="854" height="480"
frameRate="24000/1001"><BaseURL>https://r2--sn-8xgp1vo-
ab5l.googlevideo.com/videoplayback?expire=1605735198&ei=vj61X9bkKpfqhwx4pqACg&ip=71.168.227.177&id=o-
AFV1hi0nYBq0Rw9li7YlZQUZAydkyXvkpzQkTYZr_wOK&itag=135&aiags=133,134,135,136,160,242,243,244,247,278,394,395,396,397,398&am
p;source=youtube&requiressl=yes&mh=y2&mm=31,29&mn=sn-8xgp1vo-ab5l,sn-
ab5l6ndy&ms=au,rdu&mv=m&mvi=2&pl=17&initcwndbps=2136250&vprv=1&mime=video/mp4&gir=yes&clen=
5086723&dur=144.143&lmt=1572601141608802&mt=1605713472&fvip=2&keepalive=yes&c=WEB&txp=5535432&sp
sparams=expire,ei,ip,id,aitags,source,requiressl,vprv,mime,gir,clen,dur,lmt&sig=AOq0QJ8wRQlhAEVcwUiupOlb979-
kSV5tuHFvkJfrSGv3nSowV0AzJfsCiHvHxSUEdGbXOOiY_cn9M62H0siMspFj01OwCCCH-
GjDi&lparams=mm,mn,ms,mv,mvi,pl,initcwndbps&lsig=AG3C_xAwRQlgOLsAprMcbVKdKqMNzYUo0QnNsNx2r3uepUB7POINSDsCIQCPNe
0axLBBKoKYu8yYzrcHQ1ihEcCS49CCZlnZYxoigt==</BaseURL>
...
      </Representation>
      <Representation id="134" codecs="avc1.4d401e" startWithSAP="1" bandwidth="223902" width="640" height="360"
frameRate="24000/1001"><BaseURL>https://r2--sn-8xgp1vo-
ab5l.googlevideo.com/videoplayback?expire=1605735198&ei=vj61X9bkKpfqhwx4pqACg&ip=71.168.227.177&id=o-
AFV1hi0nYBq0Rw9li7YlZQUZAydkyXvkpzQkTYZr_wOK&itag=134&aiags=133,134,135,136,160,242,243,244,247,278,394,395,396,397,398&am
p;source=youtube&requiressl=yes&mh=y2&mm=31,29&mn=sn-8xgp1vo-ab5l,sn-
ab5l6ndy&ms=au,rdu&mv=m&mvi=2&pl=17&initcwndbps=2136250&vprv=1&mime=video/mp4&gir=yes&clen=
3315031&dur=144.143&lmt=1572601141632693&mt=1605713472&fvip=2&keepalive=yes&c=WEB&txp=5535432&sp
sparams=expire,ei,ip,id,aitags,source,requiressl,vprv,mime,gir,clen,dur,lmt&sig=AOq0QJ8wRQlhAOqh5ZOnTl0qH8HPdUWBfp8fob91gasix8G4dlQ8k
sqAiBXuUmney8sM6S_Kmhka3osUa3-
Gz1PWm01V5ntttN3eg==&lparams=mm,mn,ms,mv,mvi,pl,initcwndbps&lsig=AG3C_xAwRQlgOLsAprMcbVKdKqMNzYUo0QnNsNx2r3uepU
B7POINSDsCIQCPNe0axLBBKoKYu8yYzrcHQ1ihEcCS49CCZlnZYxoigt==</BaseURL>
...
      </Representation>
      <Representation id="160" codecs="avc1.4d400c" startWithSAP="1" bandwidth="93785" width="256" height="144"
frameRate="24000/1001"><BaseURL>https://r2--sn-8xgp1vo-
ab5l.googlevideo.com/videoplayback?expire=1605735198&ei=vj61X9bkKpfqhwx4pqACg&ip=71.168.227.177&id=o-
AFV1hi0nYBq0Rw9li7YlZQUZAydkyXvkpzQkTYZr_wOK&itag=160&aiags=133,134,135,136,160,242,243,244,247,278,394,395,396,397,398&am
p;source=youtube&requiressl=yes&mh=y2&mm=31,29&mn=sn-8xgp1vo-ab5l,sn-
```

	<pre> ab5l6ndy&ms=au,rdu&mv=m&mvi=2&pl=17&initcwndbps=2136250&vprv=1&mime=video/mp4&gir=yes&clen= 1207858&dur=144.143&mt=1572601141607791&mt=1605713472&fvip=2&keepalive=yes&c=WEB&txp=5535432& sparams=expire,ei,ip,id,aitags,source,requiressl,vprv,mime,gir,clen,dur,mt&sig=AOq0QJ8wRQIhANdabKIHwuZfZbazvEK0_CkJOXOVf3cgdyLQs05RX W8WAIbBo2uUuT_3nl- 1ZGvZViu_WuYmAjivw3Tx6RDJdN2E6g==&lsparams=mh,mm,mn,ms,mv,mvi,pl,initcwndbps&lsig=AG3C_xAwRQIgOLsAprMcbVKdKqMNzYUo0 QnNsNx2r3uepUB7POINSDsCIQCPNe0axLBBKoKYu8yYzrcHQ1ihEcCS49CCzlnZYxoitg==</BaseURL> ... </Representation> <Representation id="136" codecs="avc1.4d401f" startWithSAP="1" bandwidth="690142" width="1280" height="720" frameRate="24000/1001"><BaseURL>https://r2---sn-8xgp1vo- ab5l.googlevideo.com/videoplayback?expire=1605735198&ei=vj61X9bkKpfqhwx4pqACg&ip=71.168.227.177&id=o- AFV1hi0nYBq0Rw9li7YlzQUZAydkyXvkpzQkTYZr_wOK&itag=136&aitags=133,134,135,136,160,242,243,244,247,278,394,395,396,397,398&am p;source=youtube&requiressl=yes&mh=y2&mm=31,29&mn=sn-8xgp1vo-ab5l,sn- ab5l6ndy&ms=au,rdu&mv=m&mvi=2&pl=17&initcwndbps=2136250&vprv=1&mime=video/mp4&gir=yes&clen= 10698681&dur=144.143&mt=1572601141611448&mt=1605713472&fvip=2&keepalive=yes&c=WEB&txp=5535432& sparams=expire,ei,ip,id,aitags,source,requiressl,vprv,mime,gir,clen,dur,mt&sig=AOq0QJ8wRAIgYAtlsozwFNXhP9CN63Wb0VXUbm8zHPvOA2PEZn zGvoCID5bwD-QGfsrnOlqpi0w3- JY3SjtcozQ5gJregVqObi3&lsparams=mh,mm,mn,ms,mv,mvi,pl,initcwndbps&lsig=AG3C_xAwRQIgOLsAprMcbVKdKqMNzYUo0QnNsNx2r3uepUB 7POINSDsCIQCPNe0axLBBKoKYu8yYzrcHQ1ihEcCS49CCzlnZYxoitg==</BaseURL> ... </Representation> </AdaptationSet> ... </Period> </MPD> Video. </pre>
	The MPEG-DASH standard discloses a host path identification: 5.6 Base URL Processing 5.6.1 Overview The BaseURL element may be used to specify one or more common locations for Segments and other resources. Reference resolution as defined in subclause 5.6.4 shall be applied to each URL in the MPD. Handling of multiple alternative base URLs is addressed in subclause 5.6.5. The semantics of the attributes and elements for the Base URL are provided in 5.6.2, Table 26. The XML syntax of the Base URL is provided in subclause 5.6.3. Ex. 14, ISO/IEC 23009-1, at internal p. 85.

wherein, said audio and video segments are associated with object parameters and supplied host path identification to form multimedia objects;

These YouTube segments with associated objects and URLs are multimedia objects (green):

```
<MPD ... mediaPresentationDuration="PT144S" ...>
  <Period>
    <AdaptationSet id="0" mimeType="video/mp4" ...>
      <Role schemeIdUri="urn:mpeg:DASH:role:2011" value="main"/>
      <Representation id="133" codecs="avc1.4d4015" startWithSAP="1" bandwidth="115889" width="426" height="240"
frameRate="24000/1001"><BaseURL>https://r2---sn-8xgp1vo-
ab5l.googlevideo.com/videoplayback?expire=1605735198&ei=vj61X9bkKpfqhwx4pqACg&ip=71.168.227.177&id=o-
AFV1hi0nYBq0Rw9li7YlZQUZAydkyXvkpzQkTYZr_wOK&itag=133&aitags=133,134,135,136,160,242,243,244,247,278,394,395,396,397,398&
amp;source=youtube&requiressl=yes&mh=y2&mm=31,29&mn=sn-8xgp1vo-ab5l,sn-
ab5l6ndy&ms=au,rdu&mv=m&mvi=2&pl=17&initcwndbps=2136250&vprv=1&mime=video/mp4&gir=yes&cle
n=1731819&dur=144.143&imt=1572601141606755&mt=1605713472&fvip=2&keepalive=yes&c=WEB&txp=5535432
&sparams=expire,ei,ip,id,aitags,source,requiressl,vprv,mime,gir,clen,dur,imt&sig=AOq0QJ8wRQlhAOEA94RUMTgd5OR8ONUKa_ZV8KTYMT
-bCba-N0nE-
WdmAiA3Sk4GMcxhQmu6yLqFhnaLoO8RBnWJGki44FxDeAiQ5Q==&lparams=mm,mn,ms,mv,mvi,pl,initcwndbps&lsig=AG3C_xAwRQlg
OLsAprMcbVKdKqMNZYUo0QnNsNx2r3uepUB7POINSDsCIQCPNe0axLBBKokYu8yYzrcHQ1ihEcCS49CCZlnZYxoigt==</BaseURL>
...
      </Representation>
      <Representation id="135" codecs="avc1.4d401e" startWithSAP="1" bandwidth="337134" width="854" height="480"
frameRate="24000/1001"><BaseURL>https://r2---sn-8xgp1vo-
ab5l.googlevideo.com/videoplayback?expire=1605735198&ei=vj61X9bkKpfqhwx4pqACg&ip=71.168.227.177&id=o-
AFV1hi0nYBq0Rw9li7YlZQUZAydkyXvkpzQkTYZr_wOK&itag=135&aitags=133,134,135,136,160,242,243,244,247,278,394,395,396,397,398&
amp;source=youtube&requiressl=yes&mh=y2&mm=31,29&mn=sn-8xgp1vo-ab5l,sn-
ab5l6ndy&ms=au,rdu&mv=m&mvi=2&pl=17&initcwndbps=2136250&vprv=1&mime=video/mp4&gir=yes&cle
n=5086723&dur=144.143&imt=1572601141608802&mt=1605713472&fvip=2&keepalive=yes&c=WEB&txp=5535432
&sparams=expire,ei,ip,id,aitags,source,requiressl,vprv,mime,gir,clen,dur,imt&sig=AOq0QJ8wRAIgEVcwUiupOlB979-
kSV5tuHfVkJfrSGv3nSowV0AzJfsCIHVhxSUedGbXOOiY_cn9M62H0siMspFj01OwCCCH-
GjDi&lparams=mm,mn,ms,mv,mvi,pl,initcwndbps&lsig=AG3C_xAwRQlgOLsAprMcbVKdKqMNZYUo0QnNsNx2r3uepUB7POINSDsCIQCP
Ne0axLBBKokYu8yYzrcHQ1ihEcCS49CCZlnZYxoigt==</BaseURL>
...
      </Representation>
      <Representation id="134" codecs="avc1.4d401e" startWithSAP="1" bandwidth="223902" width="640" height="360"
frameRate="24000/1001"><BaseURL>https://r2---sn-8xgp1vo-
ab5l.googlevideo.com/videoplayback?expire=1605735198&ei=vj61X9bkKpfqhwx4pqACg&ip=71.168.227.177&id=o-
AFV1hi0nYBq0Rw9li7YlZQUZAydkyXvkpzQkTYZr_wOK&itag=134&aitags=133,134,135,136,160,242,243,244,247,278,394,395,396,397,398&
amp;source=youtube&requiressl=yes&mh=y2&mm=31,29&mn=sn-8xgp1vo-ab5l,sn-
ab5l6ndy&ms=au,rdu&mv=m&mvi=2&pl=17&initcwndbps=2136250&vprv=1&mime=video/mp4&gir=yes&cle
n=3315031&dur=144.143&imt=1572601141632693&mt=1605713472&fvip=2&keepalive=yes&c=WEB&txp=5535432
&sparams=expire,ei,ip,id,aitags,source,requiressl,vprv,mime,gir,clen,dur,imt&sig=AOq0QJ8wRQlhAOqh5ZOnTl0qH8HPdUWBfp8fob91gasix8
G4dLQ8k_sqAiBXuUmney8sM6S_Kmhka3osUa3-
Gz1PWm01V5ntttN3eg==&lparams=mm,mn,ms,mv,mvi,pl,initcwndbps&lsig=AG3C_xAwRQlgOLsAprMcbVKdKqMNZYUo0QnNsNx2r3ue
pUB7POINSDsCIQCPNe0axLBBKokYu8yYzrcHQ1ihEcCS49CCZlnZYxoigt==</BaseURL>
...
      </Representation>
```

	<pre> <Representation id="160" codecs="avc1.4d400c" startWithSAP="1" bandwidth="93785" width="256" height="144" frameRate="24000/1001"><BaseURL>https://r2---sn-8xgp1vo- ab5l.googlevideo.com/videoplayback?expire=1605735198&ei=vj61X9bkKpfqhwx4pqACg&ip=71.168.227.177&id=o- AFV1hiOnYBq0Rw9li7YlZQUZAydkyXvkpzQkTYZr_wOK&itag=160&aitags=133,134,135,136,160,242,243,244,247,278,394,395,396,397,398& amp;source=youtube&requiressl=yes&mh=y2&mm=31,29&mn=sn-8xgp1vo-ab5l,sn- ab5l6ndy&ms=au,rdu&mv=m&mvi=2&pl=17&initcwndbps=2136250&vprv=1&mime=video/mp4&gir=yes&clen= n=1207858&dur=144.143&ltmt=1572601141607791&mt=1605713472&fvip=2&keepalive=yes&c=WEB&txp=5535432 &spams=expire,ei,ip,id,aitags,source,requiressl,vprv,mime,gir,clen,dur,ltmt&sig=AOqQJ8wRQlhANDabKIHWuZfZbavEK0_CkjOXOvF3cgdy LQs05RXW8WAiBbo2uUuT_3nl- 1ZGvZViu_WuYmAjivw3Tx6RDJdN2E6g==&lsparams=mh,mm,mn,ms,mv,mvi,pl,initcwndbps&lsig=AG3C_xAwRQIgOLsAprMcbVKdKqMNzY Uo0QnNsNx2r3uepUB7POINSDsCIQCPNe0axLBBKoKYu8yYzrcHQ1ihEcCS49CCzlnZYxoigt==</BaseURL> ... </Representation> <Representation id="136" codecs="avc1.4d401f" startWithSAP="1" bandwidth="690142" width="1280" height="720" frameRate="24000/1001"><BaseURL>https://r2---sn-8xgp1vo- ab5l.googlevideo.com/videoplayback?expire=1605735198&ei=vj61X9bkKpfqhwx4pqACg&ip=71.168.227.177&id=o- AFV1hiOnYBq0Rw9li7YlZQUZAydkyXvkpzQkTYZr_wOK&itag=136&aitags=133,134,135,136,160,242,243,244,247,278,394,395,396,397,398& amp;source=youtube&requiressl=yes&mh=y2&mm=31,29&mn=sn-8xgp1vo-ab5l,sn- ab5l6ndy&ms=au,rdu&mv=m&mvi=2&pl=17&initcwndbps=2136250&vprv=1&mime=video/mp4&gir=yes&clen= n=10698681&dur=144.143&ltmt=1572601141611448&mt=1605713472&fvip=2&keepalive=yes&c=WEB&txp=5535432 &spams=expire,ei,ip,id,aitags,source,requiressl,vprv,mime,gir,clen,dur,ltmt&sig=AOqQJ8wRAIgYAtlsozwFNXhP9CN63Wb0VXUbm8zHPv OA2PEZnzGvoCiD5bwD-QGfsmOlGpj0w3- JY3SjtcozQ5gjregVqObi3&lsparams=mh,mm,mn,ms,mv,mvi,pl,initcwndbps&lsig=AG3C_xAwRQIgOLsAprMcbVKdKqMNzYUo0QnNsNx2r3uep UB7POINSDsCIQCPNe0axLBBKoKYu8yYzrcHQ1ihEcCS49CCzlnZYxoigt==</BaseURL> ... </Representation> </AdaptationSet> ... </Period> </MPD> Video. </pre>
--	---

requesting by a multimedia player, **transmission of** said multimedia objects;

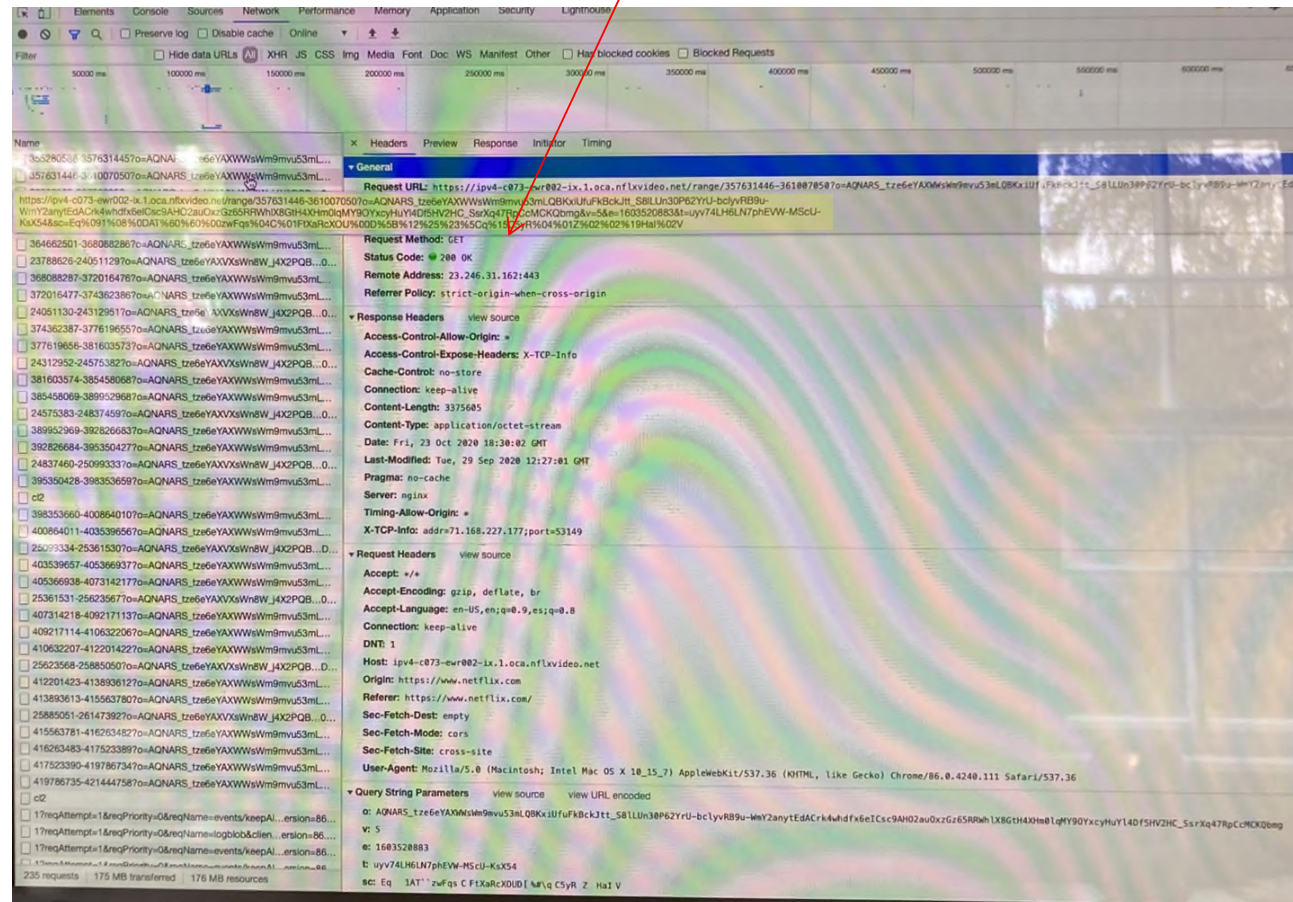
The YT Player requests transmission of multimedia objects:

The image shows a video player on the left with a woman playing guitar. On the right, a network analysis tool is open, displaying a list of network requests. The tool shows various details such as the request name, URL, status, and headers. A red arrow points from the video player to the network tool, indicating the source of the captured traffic.

Video.

wherein said multimedia objects are located using http and received by said multimedia player from servers using a wireless connection;

The YT Players locates the multimedia objects through a URL:



Video.

wherein said **multimedia objects are** located using http and **received by said multimedia player from servers** using a wireless connection;

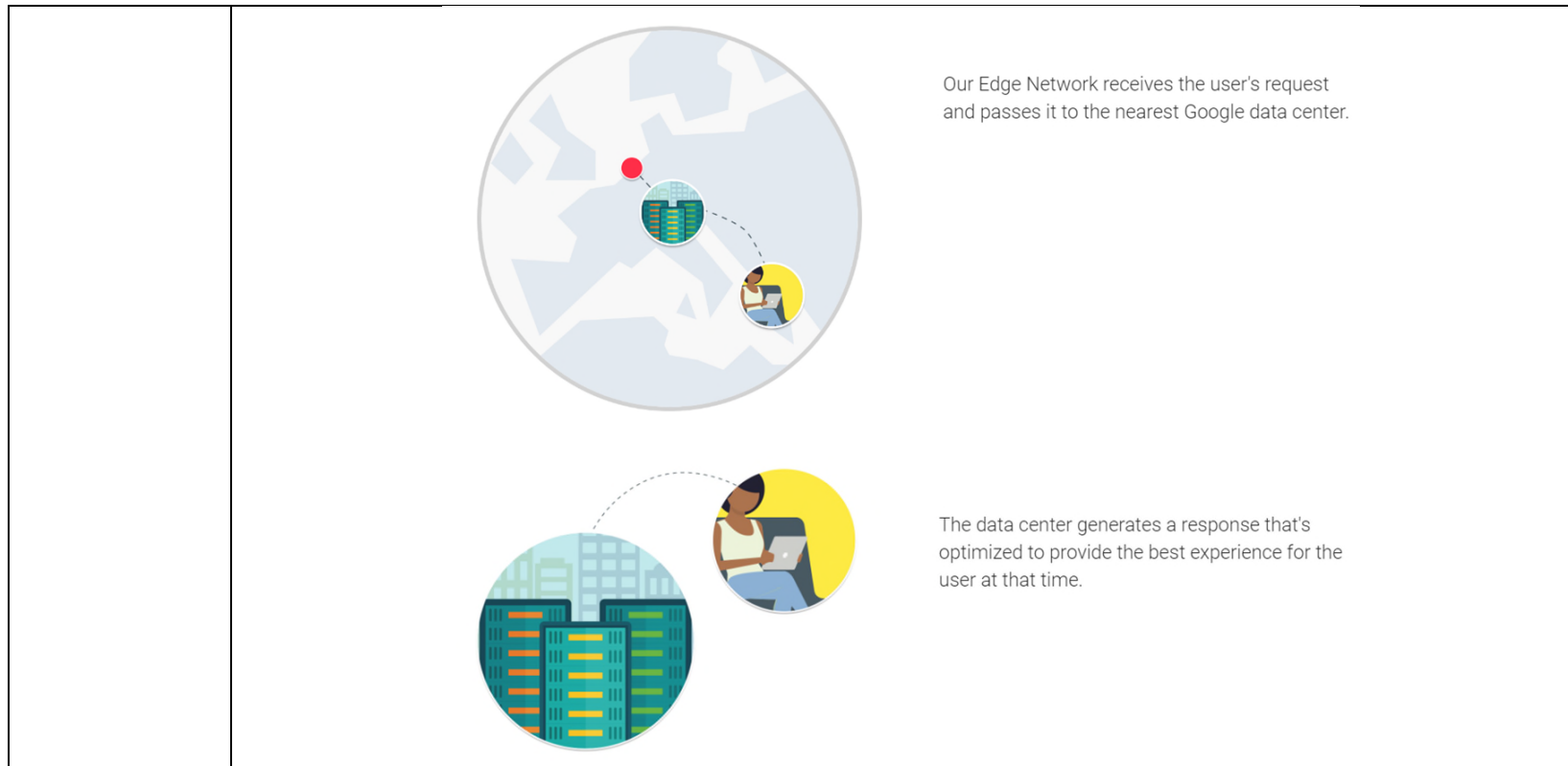
The YT Player receives multimedia objects from Google's content servers:



The journey starts when a user opens a Google app or requests one of our web pages.



Google responds to the user's request from an Edge Network location that will provide the lowest latency.





The app or browser retrieves the requested content. This can come from multiple Google locations, including our data centers, Edge POPs, and Edge Nodes.

<https://peering.google.com/#/> (last accessed, Mar. 31, 2024).

For example:

Static content that's very popular with the local host's user base, including YouTube and Google Play, is temporarily cached on edge nodes. Google's traffic management systems direct user requests to an edge node that provides the best experience.

<https://peering.google.com/#/infrastructure> (last visited Mar. 31, 2024).

	See also, <i>Seven Networks, LLC v. Google LLC</i>, 315 F. Supp. 3d 933, 948 (E.D. Tex. 2018): “Caching and localization are vital for [Google’s] optimization of network resources.” Because “hosting all content everywhere is inefficient, it makes sense to cache popular content and serve it locally.” Doing so brings delivery costs down for Google, network operators, and internet service providers. Storing content locally also allows it to be delivered more quickly, which improves user experience: “Serving content from the edge of the network closer to the user improves performance [and] user happiness.” To achieve these benefits, Google has placed Edge Nodes throughout the United States, including in this District. Google describes these nodes as the “workhorse[s] of video delivery.”
wherein said multimedia objects are located using http and received by said multimedia player from servers using a wireless connection;	Multimedia objects from YouTube can be received using a wireless connection: When you open YouTube in a mobile app or browser, you'll land on Home 🏠. Here you'll see videos recommended for you. Your preferences and activity on YouTube will influence your video recommendations. Use <i>YouTube on mobile browsers</i>, https://support.google.com/youtube/answer/3008060?hl=en (last visited Mar. 31, 2024) See also, below: Use YouTube on mobile browsers You can use YouTube for Mobile Web or Desktop mode on your phone. Sign In To get the most out of YouTube, sign in to view your favorite videos, playlists, and more. To sign in: 1. In the upper-right hand corner of the screen, tap the profile picture 🧑. 2. Tap Sign in. 3. Enter your email address and password. 4. Tap Sign in. <i>Id.</i>

playing back received multimedia objects by the multimedia player, wherein the multimedia player is configured to play multimedia objects in a sequence such that fluidity, video quality and audio quality are maintained by selecting a plurality of said multimedia objects that reflect available network bandwidth, autonomously adjusting said selection and playback according to the multimedia object parameters and supplied host path identification, and by

The YouTube playback of multimedia objects is sequential:

The screenshot displays a YouTube video player for the video "[Cover by Stella Jang] Ratatouille OST 'Le Festin'" by the channel "stellajangtv". The video player shows a woman playing an acoustic guitar. To the right, the browser's developer tools are open to the Network tab, showing a list of video segments. A red arrow points from the text "In this media example, the currently playing sequence of multimedia objects are the Representation segments (green)." to the green-highlighted segments in the network tab. The segments are listed with their respective URLs and durations.

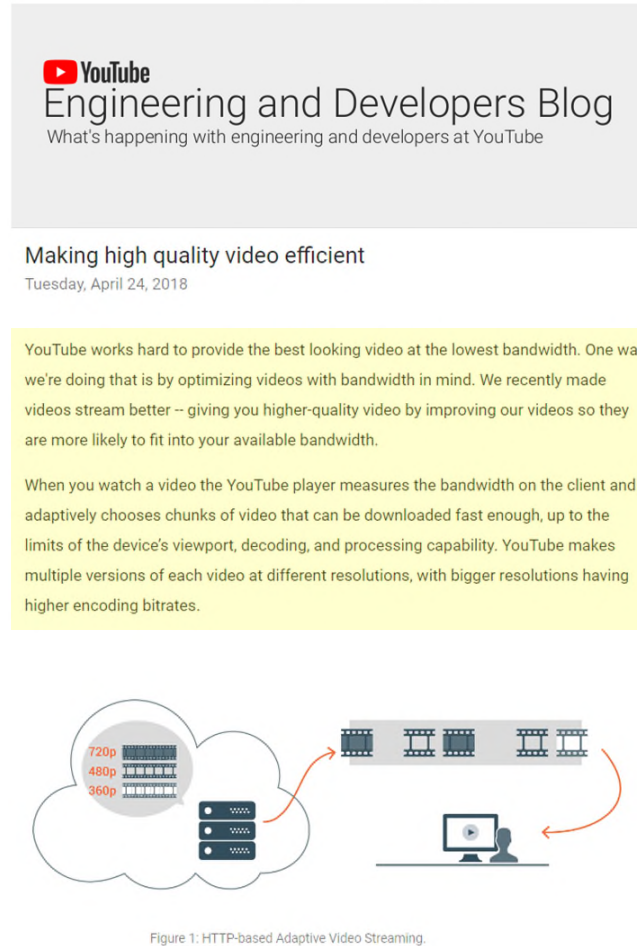
Name	Duration
videoplayback?expire=1605755433&ei=Y21X6uYKY-Ihwb...&in=1&m=12&range=150749-475499&m=14&buf=5666	3:16
videoplayback?expire=1605755433&ei=Y21X6uYKY-Ihwb...&in=1&m=12&range=475500-1210519&m=18&buf=10010	2:34
videoplayback?expire=1605755433&ei=Y21X6uYKY-Ihwb...&in=1&m=12&range=1210520-2313784&m=20&buf=15133	
videoplayback?expire=1605755433&ei=Y21X6uYKY-Ihwb...&in=1&m=12&range=2313785-3774199&m=22&buf=22145	
videoplayback?expire=1605755433&ei=Y21X6uYKY-Ihwb...&in=1&m=12&range=3774200-5601655&m=24&buf=32666	
videoplayback?expire=1605755433&ei=Y21X6uYKY-Ihwb...&in=1&m=12&range=5601656-7429985&m=26&buf=44945	
videoplayback?expire=1605755433&ei=Y21X6uYKY-Ihwb...&in=1&m=12&range=7429986-9241350&m=27&buf=57470	
videoplayback?expire=1605755433&ei=Y21X6uYKY-Ihwb...&in=1&m=12&range=9241351-10084970&m=29&buf=69746	
videoplayback?expire=1605755433&ei=Y21X6uYKY-Ihwb...&cover=2.2020117.01.00&range=0-1079&m=31&buf=0	
videoplayback?expire=1605755433&ei=Y21X6uYKY-Ihwb...201117.01.00&in=1&m=12&range=0-1079&m=32&buf=0	

In this media example, the currently playing sequence of multimedia objects are the Representation segments (green). Notice the playback of segments is sequential.

	The MPEG-DASH standard discloses sequential multimedia object playback. Segments and Subsegments represent units for which the client has an exact map on how to access and download the unit using HTTP GET or HTTP partial GET methods. Segments (respectively Subsegments) are typically generated by segmenting encoded media streams into appropriate units. If the generation of Segments (respectively Subsegments) adheres to certain rules, then the sequential decoding and presentation of Media Segments (respectively Subsegments) results in a correct presentation of all contained media streams. To define such rules the notion of “non-overlapping” segments (respectively Subsegments) is defined as follows. Ex. 14, ISO/IEC 23009-1, at § 4.5.3, internal p. 15.
--	---

playing back received multimedia objects by the multimedia player, wherein the multimedia player is configured to play multimedia objects in a sequence such that fluidity, video quality and audio quality are maintained by selecting a plurality of said multimedia objects that reflect available network bandwidth, autonomously adjusting said selection and playback according to the multimedia object parameters and supplied host path identification, and by

YouTube playback fluidity, video quality, and audio quality are maintained based on multiple versions of each stream that fit available bandwidth:



Ex. 18, *Making high quality video efficient*, YouTube Engineering and Developers Blog, <https://youtube-eng.googleblog.com/2018/04/making-high-quality-video-efficient.html> (Apr. 24, 2018), at 1.

playing back received multimedia objects by the multimedia player, wherein the multimedia player is configured to play multimedia objects in a sequence such that fluidity, video quality and audio quality are maintained by selecting a plurality of said multimedia objects that reflect available network bandwidth, autonomously adjusting said selection and playback according to the multimedia object parameters and supplied host path identification, and by

YouTube playback fluidity, video quality, and audio quality are maintained based on multiple versions (yellow) of each video that reflect available bandwidth (green):

```
<MPD ... mediaPresentationDuration="PT144S" ...>
  <Period>
    <AdaptationSet id="0" mimeType="video/mp4" ...>
      <Role schemeIdUri="urn:mpeg:DASH:role:2011" value="main"/>
      ...
      <Representation id="160" codecs="avc1.4d400c" startWithSAP="1" bandwidth="93785" width="256" height="144"
frameRate="24000/1001"><BaseURL>https://r2---sn-8xgp1vo-
ab5l.googlevideo.com/videoplayback?expire=1605735198&ei=vj61X9bkKpfqhwx4pqACg&ip=71.168.227.177&id=o-
AFV1hi0nYBq0Rw9li7YlZQUZAydkyXvkpzQkTYZr_wOK&itag=160&itag=133,134,135,136,160,242,243,244,247,278,394,395,396,397,398&am
p;source=youtube&requiressl=yes&mh=y2&mm=31,29&mn=sn-8xgp1vo-ab5l,sn-
ab5l6ndy&ms=au,rdu&mv=m&mvi=2&pl=17&initcwndbps=2136250&vprv=1&mime=video/mp4&gir=yes&clen=
1207858&dur=144.143&lmt=15726011416067791&mt=1605713472&fvip=2&keepalive=yes&c=WEB&txp=5535432&sp
sparams=expire,ei,ip,id,aitags,source,requiressl,vprv,mime,gir,clen,dur,lmt&sig=AOq0QJ8wRQlhANdabKIHwuZFzbazvEK0_CkjOXOvF3cgdyLQs05RX
W8WAiBbo2uUuT_3nl-
1ZGvZViu_WuYmAjIvw3Tx6RDJdN2E6g==&lparams=mh,mm,mn,ms,mv,mvi,pl,initcwndbps&lsig=AG3C_xAwRQIgOLsAprMcbVKdKqMNzYUo0
QnNsNx2r3uepUB7POINSDsCIQCPNe0axLBBKoKYu8yYzrcHQ1ihEcCS49CCzlnZYxoitg==</BaseURL>
      ...
      <Representation id="133" codecs="avc1.4d4015" startWithSAP="1" bandwidth="115889" width="426" height="240"
frameRate="24000/1001"><BaseURL>https://r2---sn-8xgp1vo-
ab5l.googlevideo.com/videoplayback?expire=1605735198&ei=vj61X9bkKpfqhwx4pqACg&ip=71.168.227.177&id=o-
AFV1hi0nYBq0Rw9li7YlZQUZAydkyXvkpzQkTYZr_wOK&itag=133&itag=133,134,135,136,160,242,243,244,247,278,394,395,396,397,398&am
p;source=youtube&requiressl=yes&mh=y2&mm=31,29&mn=sn-8xgp1vo-ab5l,sn-
ab5l6ndy&ms=au,rdu&mv=m&mvi=2&pl=17&initcwndbps=2136250&vprv=1&mime=video/mp4&gir=yes&clen=
1731819&dur=144.143&lmt=1572601141606755&mt=1605713472&fvip=2&keepalive=yes&c=WEB&txp=5535432&sp
sparams=expire,ei,ip,id,aitags,source,requiressl,vprv,mime,gir,clen,dur,lmt&sig=AOq0QJ8wRQlhAOEA94UMTgd5OR8ONUKa_ZV8KTMYT-bCba-
N0nE-
WdmAiA3Sk4GMcxhQmu6yLqFhnaLo0R8BnWJGki44FxDeAiQ5Q==&lparams=mh,mm,mn,ms,mv,mvi,pl,initcwndbps&lsig=AG3C_xAwRQIgOL
sAprMcbVKdKqMNzYUo0QnNsNx2r3uepUB7POINSDsCIQCPNe0axLBBKoKYu8yYzrcHQ1ihEcCS49CCzlnZYxoitg==</BaseURL>
      ...
      </Representation>
      <Representation id="135" codecs="avc1.4d401e" startWithSAP="1" bandwidth="937134" width="854" height="480"
frameRate="24000/1001"><BaseURL>https://r2---sn-8xgp1vo-
ab5l.googlevideo.com/videoplayback?expire=1605735198&ei=vj61X9bkKpfqhwx4pqACg&ip=71.168.227.177&id=o-
AFV1hi0nYBq0Rw9li7YlZQUZAydkyXvkpzQkTYZr_wOK&itag=135&itag=133,134,135,136,160,242,243,244,247,278,394,395,396,397,398&am
p;source=youtube&requiressl=yes&mh=y2&mm=31,29&mn=sn-8xgp1vo-ab5l,sn-
ab5l6ndy&ms=au,rdu&mv=m&mvi=2&pl=17&initcwndbps=2136250&vprv=1&mime=video/mp4&gir=yes&clen=
5086723&dur=144.143&lmt=1572601141608802&mt=1605713472&fvip=2&keepalive=yes&c=WEB&txp=5535432&sp
sparams=expire,ei,ip,id,aitags,source,requiressl,vprv,mime,gir,clen,dur,lmt&sig=AOq0QJ8wRAIgEVcwUiupOlb979-
kSV5tuHfVkJfrSGv3nSowV0AzJfscIHVhxSuedGbXOOiY_cn9M62H0siMspFJ01OwCCH-
GjDi&lparams=mh,mm,mn,ms,mv,mvi,pl,initcwndbps&lsig=AG3C_xAwRQIgOLsAprMcbVKdKqMNzYUo0QnNsNx2r3uepUB7POINSDsCIQCPNe
0axLBBKoKYu8yYzrcHQ1ihEcCS49CCzlnZYxoitg==</BaseURL>
      ...
      </Representation>
```

	<pre> <Representation id="134" codecs="avc1.4d401e" startWithSAP="1" bandwidth="223902" width="640" height="360" frameRate="24000/1001"><BaseURL>https://r2---sn-8xgp1vo- ab5l.googlevideo.com/videoplayback?expire=1605735198&ei=vj61X9bkKpfqhwax4pqACg&ip=71.168.227.177&id=o- AFV1hi0nYBq0Rw9li7YlzQUZAydkyXvkpzQkTYZr_wOK&itag=134&aitags=133,134,135,136,160,242,243,244,247,278,394,395,396,397,398&am p;source=youtube&requiresl=yes&mh=y2&mm=31,29&mn=sn-8xgp1vo-ab5l,sn- ab5l6ndy&ms=au,rd&mv=m&mvi=2&pl=17&initcwndbps=2136250&vprv=1&mime=video/mp4&gir=yes&clen= 3315031&dur=144.143&lmt=1572601141632693&mt=1605713472&fvip=2&keepalive=yes&c=WEB&txp=5535432& sparams=expire,ei,ip,id,aitags,source,requiresl,vprv,mime,gir,clen,dur,lmt&sig=AOq0QJ8wRQlhAOqh5ZOnTl0qH8HPdUWBfp8fob91gasix8G4dLQ8k_ sqAiBXuUmney8sM6S_Kmhka3osUa3- Gz1PWm01V5ntttN3eg==&lparams=mm,mn,ms,mv,mvi,pl,initcwndbps&lsig=AG3C_xAwRQIgOLsAprMcbVKdKqMNzYUo0QnNsNx2r3uepU B7POINSDsCiQCPNe0axLBBKoKYu8yYzrcHQ1ihEcCS49CCzInZYxoigt==</BaseURL> ... </Representation> <Representation id="136" codecs="avc1.4d401f" startWithSAP="1" bandwidth="690142" width="1280" height="720" frameRate="24000/1001"><BaseURL>https://r2---sn-8xgp1vo- ab5l.googlevideo.com/videoplayback?expire=1605735198&ei=vj61X9bkKpfqhwax4pqACg&ip=71.168.227.177&id=o- AFV1hi0nYBq0Rw9li7YlzQUZAydkyXvkpzQkTYZr_wOK&itag=136&aitags=133,134,135,136,160,242,243,244,247,278,394,395,396,397,398&am p;source=youtube&requiresl=yes&mh=y2&mm=31,29&mn=sn-8xgp1vo-ab5l,sn- ab5l6ndy&ms=au,rd&mv=m&mvi=2&pl=17&initcwndbps=2136250&vprv=1&mime=video/mp4&gir=yes&clen= 10698681&dur=144.143&lmt=1572601141611448&mt=1605713472&fvip=2&keepalive=yes&c=WEB&txp=5535432& sparams=expire,ei,ip,id,aitags,source,requiresl,vprv,mime,gir,clen,dur,lmt&sig=AOq0QJ8wRAIgYAtIsozwFNXhP9CN63Wb0VXUbm8zHPvOA2PEZn zGvoCID5bwD-QGfsmOlgpj0w3- JY3SjtcozQ5gjregVqObi3&lparams=mm,mn,ms,mv,mvi,pl,initcwndbps&lsig=AG3C_xAwRQIgOLsAprMcbVKdKqMNzYUo0QnNsNx2r3uepUB 7POINSDsCiQCPNe0axLBBKoKYu8yYzrcHQ1ihEcCS49CCzInZYxoigt==</BaseURL> ... </Representation> </AdaptationSet> ... </Period> </MPD> Video. </pre>
--	---

	For adaptive multi-bit-rate playback, MPEG-DASH discloses that the player assesses network bandwidth availability to select multimedia objects: 4.5 Media stream and Representation properties 4.5.1 Switching and Random Access Support The formats defined in this document are designed for providing good user experience even in case the access bandwidth between the DASH segment delivery function or the cache varies. A key functionality is the ability of the DASH Client to seamlessly switch across different Representations of the same media component without severely impacting the user experience. Ex. 14, ISO/IEC 23009-1, at internal p. 24.
--	--

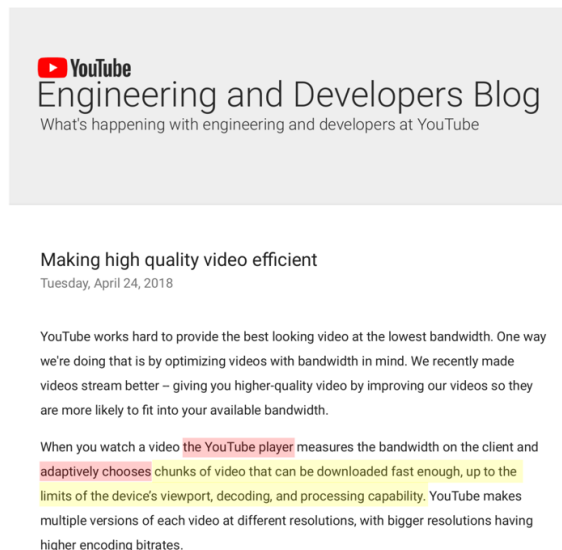
playing back received multimedia objects by the multimedia player, wherein the multimedia player is configured to play multimedia objects in a sequence such that fluidity, video quality and audio quality are maintained by selecting a plurality of said multimedia objects that reflect available network bandwidth, autonomously adjusting said selection and playback according to the multimedia object parameters and supplied host path identification, and by

The YT Player selects the Representation based on bandwidth:

Using playback statistics, we are able to model the behavior of the player as it switches between resolutions. This allows us in effect to predict when an increased bitrate would be more likely to cause a player to switch to a lower resolution and thereby cancel the effect of bitrate increase in any one resolution. With this model, we are able to find better operating points for each video in the real world.¹

Ex. 18, *Making high quality video efficient*, YouTube Engineering and Developers Blog, <https://youtube-eng.googleblog.com/2018/04/making-high-quality-video-efficient.html> (Apr. 24, 2018).

YouTube engineering documentation explicitly states that the YouTube player (on the client) autonomously (i.e., without server-side intervention) adjusts the video playback.



Id.

playing back received multimedia objects by the multimedia player, wherein the multimedia player is configured to play multimedia objects in a sequence such that fluidity, video quality and audio quality are maintained by selecting a plurality of said multimedia objects that reflect available network bandwidth, autonomously adjusting said selection and playback according to the multimedia object parameters and supplied host path identification, and by

The YT Player autonomously adjusts selection and playback of media variants (green) according to the multimedia object parameters (blue):

```
<MPD ... mediaPresentationDuration="PT144S" ...>
  <Period>
    <AdaptationSet id="0" mimeType="video/mp4" ...>
      <Role schemeIdUri="urn:mpeg:DASH:role:2011" value="main"/>
      ...
      <Representation id="160" codecs="avc1.4d400c" startWithSAP="1" bandwidth="93785" width="256" height="144"
frameRate="24000/1001"><BaseURL>https://r2---sn-8xgp1vo-
ab5l.googlevideo.com/videoplayback?expire=1605735198&ei=vj61X9bkKpfqhwx4pqACg&ip=71.168.227.177&id=o-
AFV1hi0nYBq0Rw9li7YlZQUZAydkyXvkpzQkTYZr_wOK&itag=160&itag=133,134,135,136,160,242,243,244,247,278,394,395,396,397,398&am
p;source=youtube&requiressl=yes&mh=y2&mm=31,29&mn=sn-8xgp1vo-ab5l,sn-
ab5l6ndy&ms=au,rdu&mv=m&mvi=2&pl=17&initcwndbps=2136250&vprv=1&mime=video/mp4&gir=yes&clen=
1207858&dur=144.143&lmt=15726011416067791&mt=1605713472&fvip=2&keepalive=yes&c=WEB&txp=5535432&sp
sparams=expire,ei,ip,id,aitags,source,requiressl,vprv,mime,gir,clen,dur,lmt&sig=AOq0QJ8wRQIhANdabKIHwuZfZbazvEK0_CkjOXOVf3cgdyLQs05RX
W8WAiBbo2uUuT_3nl-
1ZGvZViu_WuYmAjIvw3Tx6RDJdN2E6g==&lparams=mh,mm,mn,ms,mv,mvi,pl,initcwndbps&lsig=AG3C_xAwRQIgOLsAprMcbVKdKqMNzYUo0
QnNsNx2r3uepUB7POINSDsCIQCPNe0axLBBKoKYu8yYzrcHQ1ihEcCS49CCZlnZYxoitg==</BaseURL>
      ...
      <Representation id="133" codecs="avc1.4d4015" startWithSAP="1" bandwidth="115889" width="426" height="240"
frameRate="24000/1001"><BaseURL>https://r2---sn-8xgp1vo-
ab5l.googlevideo.com/videoplayback?expire=1605735198&ei=vj61X9bkKpfqhwx4pqACg&ip=71.168.227.177&id=o-
AFV1hi0nYBq0Rw9li7YlZQUZAydkyXvkpzQkTYZr_wOK&itag=133&itag=133,134,135,136,160,242,243,244,247,278,394,395,396,397,398&am
p;source=youtube&requiressl=yes&mh=y2&mm=31,29&mn=sn-8xgp1vo-ab5l,sn-
ab5l6ndy&ms=au,rdu&mv=m&mvi=2&pl=17&initcwndbps=2136250&vprv=1&mime=video/mp4&gir=yes&clen=
1731819&dur=144.143&lmt=1572601141606755&mt=1605713472&fvip=2&keepalive=yes&c=WEB&txp=5535432&sp
sparams=expire,ei,ip,id,aitags,source,requiressl,vprv,mime,gir,clen,dur,lmt&sig=AOq0QJ8wRQIhAOEA94RUMTgd5OR8ONUKa_ZV8KTMYT-bCba-
N0nE-
WdmAiA3Sk4GMcxhQmu6yLqFhnaLo0R8BnWJGki44FxDeAiQ5Q==&lparams=mh,mm,mn,ms,mv,mvi,pl,initcwndbps&lsig=AG3C_xAwRQIgOL
sAprMcbVKdKqMNzYUo0QnNsNx2r3uepUB7POINSDsCIQCPNe0axLBBKoKYu8yYzrcHQ1ihEcCS49CCZlnZYxoitg==</BaseURL>
      ...
      </Representation>
      <Representation id="135" codecs="avc1.4d401e" startWithSAP="1" bandwidth="337134" width="854" height="480"
frameRate="24000/1001"><BaseURL>https://r2---sn-8xgp1vo-
ab5l.googlevideo.com/videoplayback?expire=1605735198&ei=vj61X9bkKpfqhwx4pqACg&ip=71.168.227.177&id=o-
AFV1hi0nYBq0Rw9li7YlZQUZAydkyXvkpzQkTYZr_wOK&itag=135&itag=133,134,135,136,160,242,243,244,247,278,394,395,396,397,398&am
p;source=youtube&requiressl=yes&mh=y2&mm=31,29&mn=sn-8xgp1vo-ab5l,sn-
ab5l6ndy&ms=au,rdu&mv=m&mvi=2&pl=17&initcwndbps=2136250&vprv=1&mime=video/mp4&gir=yes&clen=
5086723&dur=144.143&lmt=1572601141608802&mt=1605713472&fvip=2&keepalive=yes&c=WEB&txp=5535432&sp
sparams=expire,ei,ip,id,aitags,source,requiressl,vprv,mime,gir,clen,dur,lmt&sig=AOq0QJ8wRAIgEVcwUiupOlb979-
kSV5tuHfVkJfrSGv3nSowV0AzJfscIHVhXsUedGbXOOiY_cn9M62H0sIMspFj01OwCCH-
GjDi&lparams=mh,mm,mn,ms,mv,mvi,pl,initcwndbps&lsig=AG3C_xAwRQIgOLsAprMcbVKdKqMNzYUo0QnNsNx2r3uepUB7POINSDsCIQCPNe
0axLBBKoKYu8yYzrcHQ1ihEcCS49CCZlnZYxoitg==</BaseURL>
      ...
      </Representation>
```

```

<Representation id="134" codecs="avc1.4d401e" startWithSAP="1" bandwidth="223902" width="640" height="360"
frameRate="24000/1001"><BaseURL>https://r2---sn-8xgp1vo-
ab5l.googlevideo.com/videoplayback?expire=1605735198&ei=vj61X9bkKpfqhwax4pqACg&ip=71.168.227.177&id=o-
AFV1hi0nYBq0Rw9li7YlZQUZAydkyXvkpzQkTYZr_wOK&itag=134&aitags=133,134,135,136,160,242,243,244,247,278,394,395,396,397,398&am
p;source=youtube&requiresl=yes&mh=y2&mm=31,29&mn=sn-8xgp1vo-ab5l,sn-
ab5l6ndy&ms=au,rd&mv=m&mvi=2&pl=17&initcwndbps=2136250&vprv=1&mime=video/mp4&gir=yes&clen=
3315031&dur=144.143&lmt=1572601141632693&mt=1605713472&fvip=2&keepalive=yes&c=WEB&txp=5535432&
sparams=expire,ei,ip,id,aitags,source,requiresl,vprv,mime,gir,clen,dur,lmt&sig=AOq0QJ8wRQlHqAOqh5ZOnTl0qH8HPdUWBfp8fob91gasix8G4dLQ8k_
sqAiBXuUmney8sM6S_Kmhka3osUa3-
Gz1PWm01V5ntttN3eg==&lparams=mh,mm,mn,ms,mv,mvi,pl,initcwndbps&lsig=AG3C_xAwRQIgOLsAprMcbVKdKqMNzYUo0QnNsNx2r3uepU
B7POINSDsCIQCPNe0axLBBKoKYu8yYzrcHQ1ihEcCS49CCZlnZYxoigt==</BaseURL>
...
</Representation>

<Representation id="136" codecs="avc1.4d401f" startWithSAP="1" bandwidth="690142" width="1280" height="720"
frameRate="24000/1001"><BaseURL>https://r2---sn-8xgp1vo-
ab5l.googlevideo.com/videoplayback?expire=1605735198&ei=vj61X9bkKpfqhwax4pqACg&ip=71.168.227.177&id=o-
AFV1hi0nYBq0Rw9li7YlZQUZAydkyXvkpzQkTYZr_wOK&itag=136&aitags=133,134,135,136,160,242,243,244,247,278,394,395,396,397,398&am
p;source=youtube&requiresl=yes&mh=y2&mm=31,29&mn=sn-8xgp1vo-ab5l,sn-
ab5l6ndy&ms=au,rd&mv=m&mvi=2&pl=17&initcwndbps=2136250&vprv=1&mime=video/mp4&gir=yes&clen=
10698681&dur=144.143&lmt=1572601141611448&mt=1605713472&fvip=2&keepalive=yes&c=WEB&txp=5535432&
sparams=expire,ei,ip,id,aitags,source,requiresl,vprv,mime,gir,clen,dur,lmt&sig=AOq0QJ8wRAIgYAtlsozwFNXhP9CN63Wb0VXUbm8zHPvOA2PEZn
zGvoCID5bwD-QGfsmOlGpj0w3-
JY3SjtcozQ5gjregVqObi3&lparams=mh,mm,mn,ms,mv,mvi,pl,initcwndbps&lsig=AG3C_xAwRQIgOLsAprMcbVKdKqMNzYUo0QnNsNx2r3uepUB
7POINSDsCIQCPNe0axLBBKoKYu8yYzrcHQ1ihEcCS49CCZlnZYxoigt==</BaseURL>
...
</Representation>
</AdaptationSet>
...
</Period>
</MPD>

Video.

```

Selection and playback of media variants is also based on the host path identification (yellow).

The MPEG-DASH standard requires the media stream to possess multimedia object parameters for selection and playback.

4.3 DASH data model overview

* * *

Each media content component may have several encoded versions, referred to as **media streams**. Each media stream inherits the properties of the media content, the media content period, the media content component from which it was encoded and, in addition, it gets assigned the properties of the encoding process such as sub-sampling, codec parameters, encoding bitrate, etc. This describing metadata is relevant for static and dynamic selection of media content components and media streams.

Ex. 14, ISO/IEC 23009-1, at internal p. 10.

The MPEG-DASH standard also discloses a host path identification.

Within a Representation, the content may be divided in time into **Segments** (see subclause 5.3.9 and Clause 6) for proper accessibility and delivery. In order to access a Segment, a URL is provided for each Segment. Consequently, a Segment is the largest unit of data that can be retrieved with a single HTTP request. For segmented Representations, two types of Segments are differentiated: **Initialization Segments** contain static metadata for the Representation, **Media Segments** contain media samples and advanced the timeline. Media may also be organized by a single self-initialitizing Segment which contains then both initialization information as well as media data.

NOTE This is not strictly true, since the MPD can also include a byte range with the URL, meaning that the Segment is contained in the provided byte range of some larger resource. An intelligent client can in principle construct a single request for multiple Segments, but this is not the typical case.

Id. at internal p. 12.

utilizing optimized decoding processes to maintain quality playback.

YouTube uses optimized decoding to maintain quality playback.

Defendants use at least AVC1 to decode YouTube video:

```
<MPD xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="urn:mpeg:dash:schema:mpd:2011"
xmlns:xlink="http://www.w3.org/1999/xlink" xsi:schemaLocation="urn:mpeg:dash:schema:mpd:2011
http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-DASH_schema_files/DASH-MPD.xsd"
minBufferTime="PT1.5S" mediaPresentationDuration="PT144S" type="static" profiles="urn:mpeg:dash:profile:isoff-
main:2011">
```

```
<Period>
```

```
    <AdaptationSet id="0" mimeType="video/mp4" ...>
```

```
        ...
```

```
        <Representation id="133" codecs="avc1.4d4015" ...">
```

```
    <AdaptationSet id="2" mimeType="audio/mp4" ...>
```

```
        <Representation id="140" codecs="mp4a.40.2" bandwidth="130565">
```

Video (excerpt).

AVC-1 encoding and decoding optimizations, including DCT, are described by the AVC-1 Specification:

8.5.12.2 Transformation process for residual 4x4 blocks

Inputs of this process are:

- the variable bitDepth,
- a 4x4 array of scaled transform coefficients d with elements d_{ij} .

Outputs of this process are residual sample values as 4x4 array r with elements r_{ij} .

* * *

After performing both the one-dimensional horizontal and the one-dimensional vertical inverse transforms to produce an array of transformed samples, the final constructed residual sample values is derived as:

$$r_{ij} = (h_{ij} + 2^5) \gg 6 \quad \text{with } i, j = 0..3 \quad (8-354)$$

Ex. 23, *Information technology — Coding of audio-visual objects*, ISO/IEC 14496-10 (10th Ed., 2022-11) at 223-24.

	8.5.13.2 Transformation process for residual 8x8 blocks Inputs of this process are: – the variable bitDepth, – an 8x8 array of scaled transform coefficients d with elements d_{ij}. Outputs of this process are residual sample values as 8x8 array r with elements r_{ij}. * * * After performing both the one-dimensional horizontal and the one-dimensional vertical inverse transforms to produce an array of transformed samples, the final constructed residual sample values are derived as $r_{ij} = (m_{ij} + 2^5) \gg 6 \text{ with } i, j = 0..7 \quad (8-406)$ <i>Id.</i> at 225-28.
--	--