

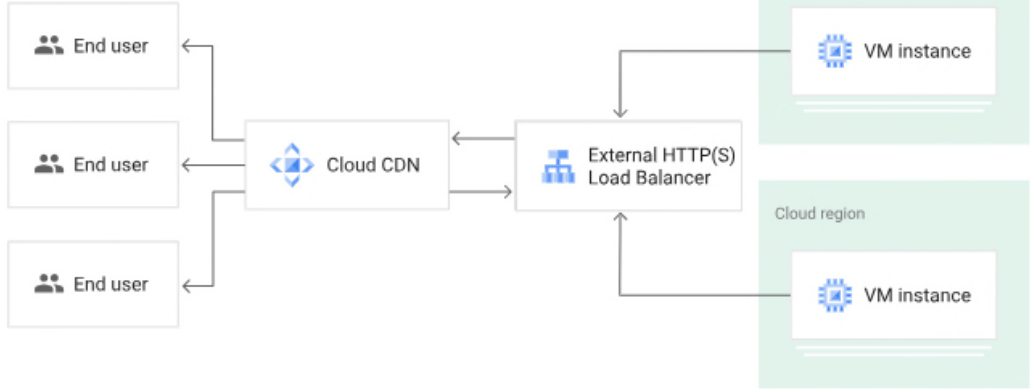
Exhibit E

U.S. Patent No. 10,057,322

Sandpiper CDN

Pat. No. 10,057,322		Google CDN
		Claim 15
15(a)	15. A method comprising: providing, at a content delivery network, an application programming interface (API);	Google provides a method that includes providing, at a content delivery network (CDN), an application programming interface (API). For example, YouTube and Media CDN utilize the same infrastructure and/or certain APIs. Media CDN is Google Cloud's media delivery CDN platform designed for streaming video and large object downloads. Media CDN complements Cloud CDN, Google Cloud's web acceleration CDN platform. With Google Cloud's Media CDN, customers can now leverage the same infrastructure that YouTube uses to serve its global users. Media CDN gives its customers a platform providing massive coverage and presence globally in over 206+ countries/territories and 1300+ cities. In this blog post, we will walk you through the steps of turning up Google Cloud Media CDN. We will cover the following topics: https://cloud.google.com/blog/products/networking/deploy-streaming-service-with-media-cdn Cloud CDN accelerates web applications using Google's global edge network. Media CDN uses YouTube's infrastructure to bring video streams (VoD and live) and large file downloads closer to users for fast and reliable delivery. https://cloud.google.com/cdn

		Google documents various API methods for managing requests through Google Media CDN. In one example, Google documentation describes a configurable method for matching requests to content on the CDN based on factors such as network topology, path parameters, customer policy information, geography information, and the like. Routing Defines how requests are routed, modified, cached, and which origin the content is filled from. JSON representation <pre> { "hostRules": [{ object (HostRule) }], "pathMatchers": [{ object (PathMatcher) }] } </pre> “Excerpt from Google Media CDN documentation explaining configuration parameters for routing requests to the CDN. https://cloud.google.com/media-cdn/docs/reference/rest/v1/projects.locations.edgeCacheServices#routing”
15(b)	at the API, receiving, from an origin system that is	Google provides logic and infrastructure that receives, at the API, from an origin system that is separate from the content delivery network, an embedded resource (such as a request URL) and at least one parameter associated with the embedded resource. For example, Media CDN includes an API receiving, from an origin system, an embedded resource such as an HTTP request with a hostname and/or other parameters such as additional path and/or query parameters associated with the embedded resource.

	separate from the content delivery network, an embedded resource and at least one parameter associated with the embedded resource;	 Figure 1. Responses flow from origin servers through Cloud CDN to clients. https://cloud.google.com/cdn/docs/overview As another example, Google provides API functionality to facilitate communication between an origin system (such as an origin system associated with YouTube’s infrastructure) and the CDN. Google describes how users can utilize the Media CDN service in conjunction with separate established infrastructure. Media CDN lets you easily fetch content from publicly accessible HTTP endpoints. You can use Media CDN with your existing origin infrastructure, whether the content is hosted within Cloud Storage, in another cloud, or within your on-premises infrastructure. “Excerpt from Google Media CDN documentation https://cloud.google.com/media-cdn/docs/overview”
15(c)	generating a modified	Google provides logic and infrastructure that generates a modified embedded resource providing a direct link to a node within the content delivery network for obtaining content associated with the embedded resource.

embedded resource providing a direct link to a node within the content delivery network for obtaining content associated with the embedded resource;	In a first example, a modified embedded resource (e.g., the “https://rr4---sn-q4flrnsk.googlevideo.com/videoplayback?expire=...” URL highlighted on the screenshot below) is generated and provides a direct link to a node with the content delivery network. As shown, a request made to the YouTube hostname (e.g., the origin system) results in a response that includes embedded resources (e.g., URLs) corresponding to a local host on which the requested content is stored. Therefore, a modified embedded resource (e.g., a modified URL) is returned by the Google Media CDN to the YouTube origin server so that YouTube can deliver information to the client, thereby enabling the client to directly receive the embedded object, for example, from a local server within the Google Media CDN. <pre>"streamingData": { "expiresInSeconds": "21540", "formats": [{ "itag": 18, "url": "https://rr4---sn-q4flrnsk.googlevideo.com/videoplayback?expire=1732247818\u0026ei=qqw_Z-2hA", "mimeType": "video/mp4; codecs=\"avc1.42001E, mp4a.40.2\"", "bitrate": 342693, "width": 640, "height": 360, "lastModified": "1697929619917530", "quality": "medium", "fps": 30, "qualityLabel": "360p", "projectionType": "RECTANGULAR", "audioQuality": "AUDIO_QUALITY_LOW", "approxDurationMs": "1575195", "audioSampleRate": "44100", "audioChannels": 2 }], }</pre> Excerpt from HTML code containing reference to the CDN node on which the video is stored. This code is returned as a response when requesting the following YouTube URL; https://www.youtube.com/watch?v=Tx69m9Jb0EY
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In a second example, a request was made for the same video resource using a different network from the network used in the first example. In this second example, the embedded resource (e.g., URL) pointing to the CDN is modified prior to serving the client device. As shown in the highlighted portion of the second example below, the embedded resource (e.g., URL) is modified differently as compared to the embedded resource (e.g., URL) from the first example above.

```
"streamingData": {  
  "expiresInSeconds": "21540",  
  "formats": [{  
    "itag": 18,  
    "url": "https://rr3---sn-qxo7rn7y.googlevideo.com/videoplayback?expire=1732325796\u0026",  
    "mimeType": "video/mp4; codecs=\\"avc1.42001E, mp4a.40.2\\"",  
    "bitrate": 342693,  
    "width": 640,  
    "height": 360,  
    "lastModified": "1697929619917530",  
    "quality": "medium",  
    "fps": 30,  
    "qualityLabel": "360p",  
    "projectionType": "RECTANGULAR",  
    "audioQuality": "AUDIO_QUALITY_LOW",  
    "approxDurationMs": "1575195",  
    "audioSampleRate": "44100",  
    "audioChannels": 2  
  }],  
}
```

Excerpt from HTML code containing reference to the CDN node on which the video is stored.

Based on request from network separate from the previous example.

<https://www.youtube.com/watch?v=Tx69m9Jb0EY>

In further support, Google provides webpages with embedded videos. In doing so, Google further generates a modified embedded resource providing a direct link (e.g., a link pointing to specific cache server), as indicated below.

		First, we need to know how the basic setup of YouTube’s video and load distribution works. When a client requests a video from YouTube’s website youtube.com, the web frontend returns a rendered HTML webpage which contains a link pointing to a specific cache server (e.g. r4---sn-4g5e6nsd.googlevideo.com). YouTube does not disclose how and based Another interesting observation we made while uploading videos through YouTube’s web interface was that the video server cache URLs differ between the video uploader and other users or viewers. The uploader gets a URL of the form https://r1---sn-bg07dnsr.c.youtube.com, whereas others get URL likes https://r1---sn-5hne6nsd.googlevideo.com. There seem https://blog.cubieserver.de/2020/investigations-into-video-streaming/report1-analysis-of-youtube-cdn.pdf
15(d)	delivering, by the content delivery network, the modified embedded resource to the origin system;	Google provides logic and infrastructure that delivers, by the content delivery network, the modified embedded resource to the origin system. For example, YouTube provides videos requested by users with the link to a specific cache server within Google’s CDN. In one example, the modified embedded resource includes the direct link (e.g., a link pointing) to specific cache server. The following image shows how a modified embedded resource (e.g., the “https://rr4---sn-q4flrnsk.googlevideo.com/videoplayback?expire= . . .” URL highlighted on the screenshot below) is generated and delivered. In the two example images below, the modified embedded resource differs when made from different networks. Additionally, the following two images show the response body generated from an API request to YouTube for a video. In particular, the response includes code for displaying the webpage, logic required to make additional requests and accompanying CDN node URL (e.g., “the modified embedded resource”) which reference the node(s) on which the requested video was cached and the functionality to make requests utilizing the node(s).

```
"streamingData": {  
  "expiresInSeconds": "21540",  
  "formats": [{  
    "itag": 18,  
    "url": "https://rr4---sn-q4flrnsk.googlevideo.com/videoplayback?expire=1732247818\u0026ei=qqw_Z-2hA",  
    "mimeType": "video/mp4; codecs=\"avc1.42001E, mp4a.40.2\"",  
    "bitrate": 342693,  
    "width": 640,  
    "height": 360,  
    "lastModified": "1697929619917530",  
    "quality": "medium",  
    "fps": 30,  
    "qualityLabel": "360p",  
    "projectionType": "RECTANGULAR",  
    "audioQuality": "AUDIO_QUALITY_LOW",  
    "approxDurationMs": "1575195",  
    "audioSampleRate": "44100",  
    "audioChannels": 2  
  }],  
}
```

Excerpt from HTML code containing reference to the CDN node on which the video is stored.

This code is returned as a response when requesting the following YouTube URL;

<https://www.youtube.com/watch?v=Tx69m9Jb0EY>

In a second example, a request was made for the same video resource from the client device connected to a network different from the network used in the first example. In this case, the URL is pointing to the CDN is modified prior to being served to the client device.

```
"streamingData": {  
  "expiresInSeconds": "21540",  
  "formats": [{  
    "itag": 18,  
    "url": "https://rr3---sn-qxo7rn7y.googlevideo.com/videoplayback?expire=1732325796\u0026",  
    "mimeType": "video/mp4; codecs=\\\"avc1.42001E, mp4a.40.2\\\"",  
    "bitrate": 342693,  
    "width": 640,  
    "height": 360,  
    "lastModified": "1697929619917530",  
    "quality": "medium",  
    "fps": 30,  
    "qualityLabel": "360p",  
    "projectionType": "RECTANGULAR",  
    "audioQuality": "AUDIO_QUALITY_LOW",  
    "approxDurationMs": "1575195",  
    "audioSampleRate": "44100",  
    "audioChannels": 2  
  }],  
}
```

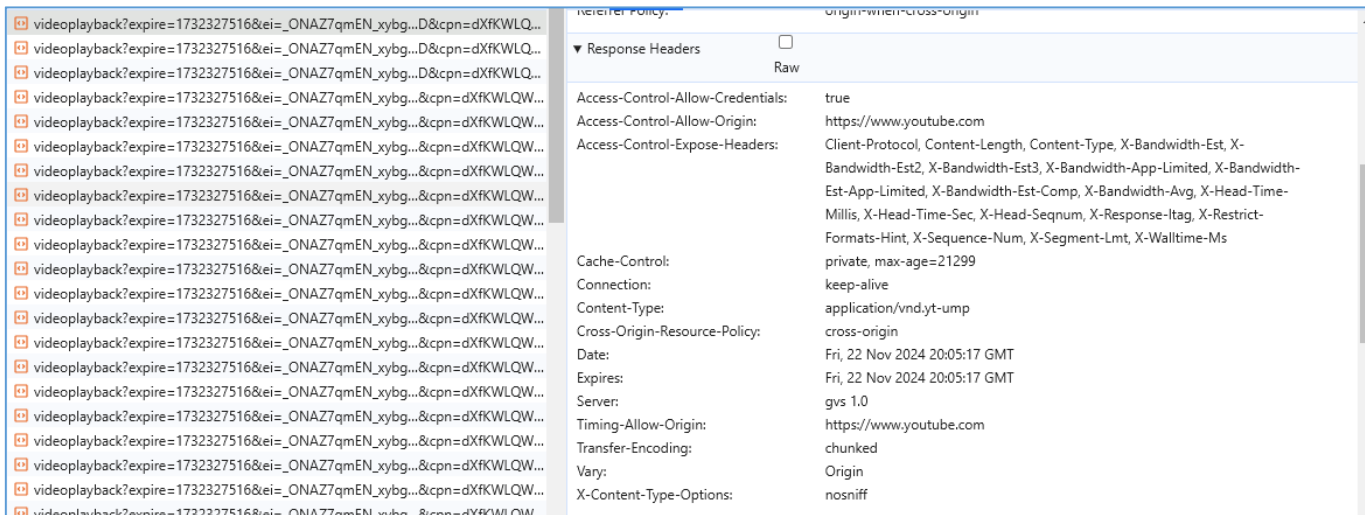
Excerpt from HTML code containing reference to the CDN node on which the video is stored.
Based on request from network separate from the previous example.

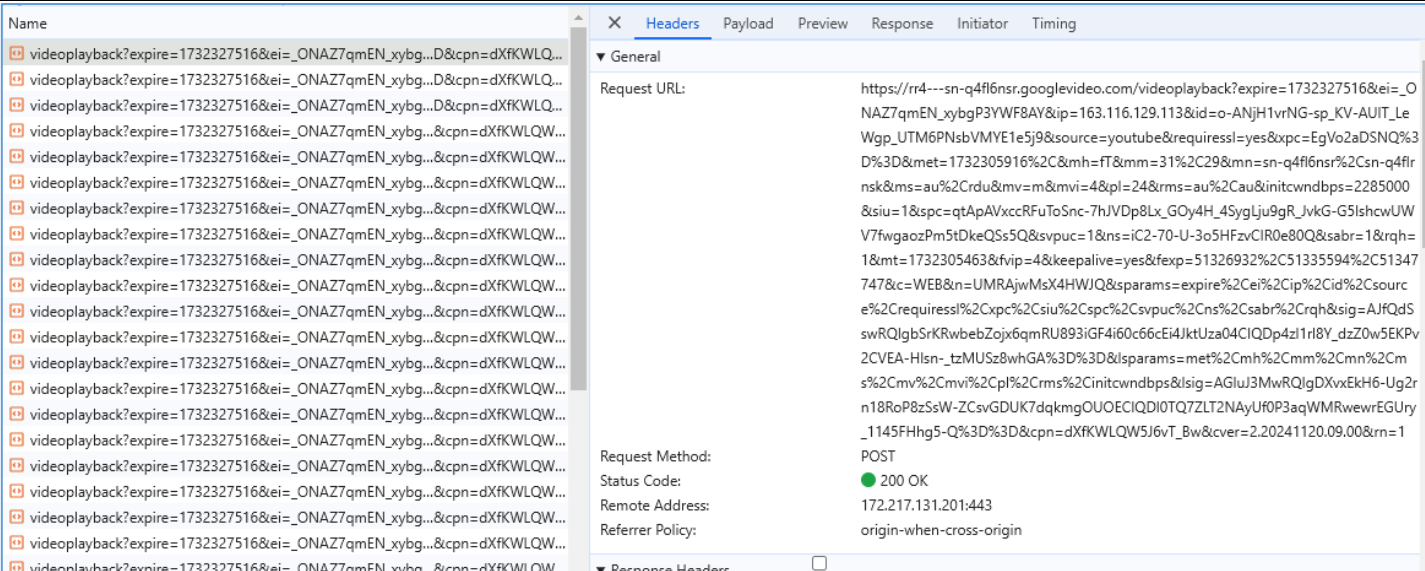
<https://www.youtube.com/watch?v=Tx69m9Jb0EY>

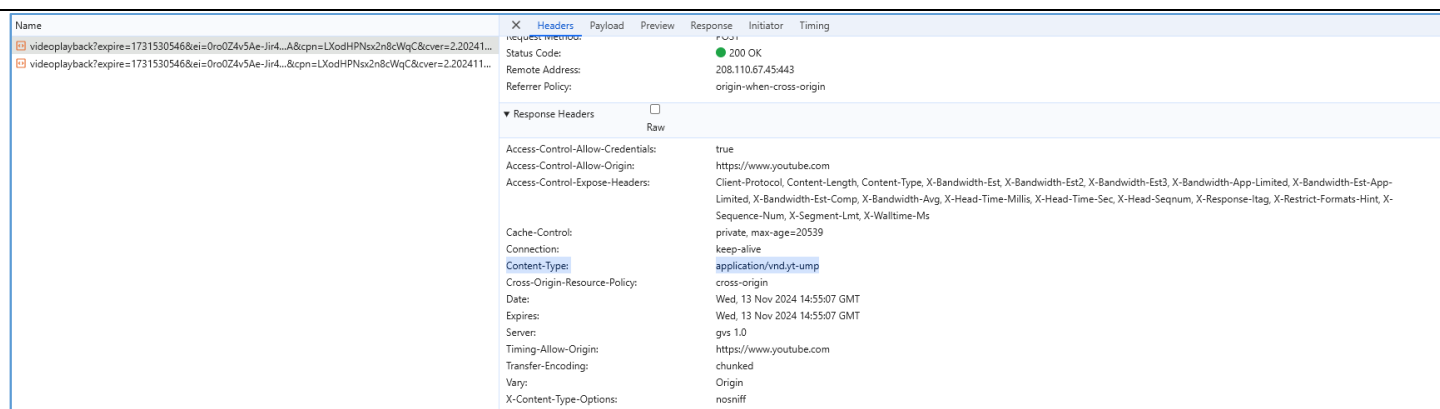
In further support, YouTube provides videos embedded in webpages requested by users, for example using a link to a specific cache server, as indicated above.

<https://blog.cubieserver.de/2020/investigations-into-video-streaming/report1-analysis-of-youtube-cdn.pdf>

Upon information and belief, based on the processes described in the above sections and examples provided herein, the modified embedded resource is provided to the origin system by the content delivery network, for example, through the request URL modification.

15(e)	receiving, at the node, a request from a client device to obtain the content; and	Google provides logic and infrastructure for receiving, at the node, a request from a client device to obtain the content. In one example, client devices request YouTube videos. After the origin system exposes the modified embedded resource mentioned in the prior section to the client device, the client device sends additional requests to obtain data associated with the content such as video and audio files. The following two images show requests to Google’s CDN for audio and video playback from the node that is specified in the modified embedded resource.  The screenshot displays a list of 20 video playback requests in the Chrome DevTools network panel. The selected request shows the following response headers: <table><tr><th>Header</th><th>Value</th></tr><tr><td>Access-Control-Allow-Credentials:</td><td>true</td></tr><tr><td>Access-Control-Allow-Origin:</td><td>https://www.youtube.com</td></tr><tr><td>Access-Control-Expose-Headers:</td><td>Client-Protocol, Content-Length, Content-Type, X-Bandwidth-Est, X-Bandwidth-Est2, X-Bandwidth-Est3, X-Bandwidth-App-Limited, X-Bandwidth-Est-App-Limited, X-Bandwidth-Est-Comp, X-Bandwidth-Avg, X-Head-Time-Millis, X-Head-Time-Sec, X-Head-Seqnum, X-Response-Itag, X-Restrict-Formats-Hint, X-Sequence-Num, X-Segment-Lmt, X-Walltime-Ms</td></tr><tr><td>Cache-Control:</td><td>private, max-age=21299</td></tr><tr><td>Connection:</td><td>keep-alive</td></tr><tr><td>Content-Type:</td><td>application/vnd.yt-ump</td></tr><tr><td>Cross-Origin-Resource-Policy:</td><td>cross-origin</td></tr><tr><td>Date:</td><td>Fri, 22 Nov 2024 20:05:17 GMT</td></tr><tr><td>Expires:</td><td>Fri, 22 Nov 2024 20:05:17 GMT</td></tr><tr><td>Server:</td><td>gvs 1.0</td></tr><tr><td>Timing-Allow-Origin:</td><td>https://www.youtube.com</td></tr><tr><td>Transfer-Encoding:</td><td>chunked</td></tr><tr><td>Vary:</td><td>Origin</td></tr><tr><td>X-Content-Type-Options:</td><td>nosniff</td></tr></table> “Excerpt of HTTP requests made to Google CDN when playing content title ‘Pressure Canning 4 Recipes to Fill the Pantry with 16 Convenience Meals’ On chrome browser session on a Windows PC as displayed by chrome browser tools.” https://www.youtube.com/watch?v=Tx69m9Jb0EY	Header	Value	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-Bandwidth-Est3, X-Bandwidth-App-Limited, X-Bandwidth-Est-App-Limited, X-Bandwidth-Est-Comp, X-Bandwidth-Avg, X-Head-Time-Millis, X-Head-Time-Sec, X-Head-Seqnum, X-Response-Itag, X-Restrict-Formats-Hint, X-Sequence-Num, X-Segment-Lmt, X-Walltime-Ms	Cache-Control:	private, max-age=21299	Connection:	keep-alive	Content-Type:	application/vnd.yt-ump	Cross-Origin-Resource-Policy:	cross-origin	Date:	Fri, 22 Nov 2024 20:05:17 GMT	Expires:	Fri, 22 Nov 2024 20:05:17 GMT	Server:	gvs 1.0	Timing-Allow-Origin:	https://www.youtube.com	Transfer-Encoding:	chunked	Vary:	Origin	X-Content-Type-Options:	nosniff
Header	Value																															
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-Bandwidth-Est3, X-Bandwidth-App-Limited, X-Bandwidth-Est-App-Limited, X-Bandwidth-Est-Comp, X-Bandwidth-Avg, X-Head-Time-Millis, X-Head-Time-Sec, X-Head-Seqnum, X-Response-Itag, X-Restrict-Formats-Hint, X-Sequence-Num, X-Segment-Lmt, X-Walltime-Ms																															
Cache-Control:	private, max-age=21299																															
Connection:	keep-alive																															
Content-Type:	application/vnd.yt-ump																															
Cross-Origin-Resource-Policy:	cross-origin																															
Date:	Fri, 22 Nov 2024 20:05:17 GMT																															
Expires:	Fri, 22 Nov 2024 20:05:17 GMT																															
Server:	gvs 1.0																															
Timing-Allow-Origin:	https://www.youtube.com																															
Transfer-Encoding:	chunked																															
Vary:	Origin																															
X-Content-Type-Options:	nosniff																															

		 The screenshot shows a network tool interface. On the left, a list of requests is displayed, all with the same URL: <code>videoplayback?expire=1732327516&ei=_ONAZ7qmEN_xybg...D&cpn=dXfKWLQW...</code>. The right pane shows the 'General' tab for one of these requests. The 'Request URL' is <code>https://rr4---sn-q4fl6nsr.googlevideo.com/videoplayback?expire=1732327516&ei=_ONAZ7qmEN_xybgP3YWF8AY&ip=163.116.129.113&id=o-ANjH1vrNG-sp_KV-AUIIT_LeWgp_UTM6PNsbVMYE1e5j9&source=youtube&requiressl=yes&xpc=EgVo2aDSNQ%3D%3D&met=1732305916%2C&mh=ft&mm=31%2C29&mn=sn-q4fl6nsr%2Csn-q4flrnsk&rms=au%2Crd&mv=m&mv=4&pl=24&rms=au%2Cau&initcwndbps=2285000&siu=1&spc=qtApAVxcRfuToSnc-7hJVDp8Lx_GOy4H_4SylgJlu9gR_JvkG-G5lshcwUWV7fwgaozPm5tDkeQs5Q&svpuc=1&ns=iC2-70-U-3o5HFzvCIR0e80Q&tsabr=1&trqh=1&mt=1732305463&fvip=4&keepalive=yes&fexp=51326932%2C51335594%2C51347747&c=WEB&n=UMRAjwMsX4HWJQ&sparams=expire%2Ce%2Cip%2Cid%2Csource%2Crequiressl%2Cxp%2Csiu%2Cspc%2Csvpuc%2Cns%2Csabr%2Crqh&sig=AjFQdSswRQlgbSrKRwebZojx6qmRU893iGF4i60c66cEi4JktUza04CIQDp4z1rl8Y_dzZ0w5EKpv2CvEA-Hlsn-tzMUSz8whGA%3D%3D&isparams=met%2Cmh%2Cmm%2Cmn%2Cms%2Cmv%2Cmvi%2Cpl%2Crm%2Cinitcwndbps&lsig=AGluJ3MwRQlgDXvxEkH6-Ug2rn18RoP8zSsW-ZCsvGDUK7dqkmgOUOEIQDI0TQ7ZLT2NayUf0P3aqWMrwewrEGUry_1145FHhg5-Q%3D%3D&cpn=dXfKWLQW5j6vT_Bw&icver=2.20241120.09.00&rm=1</code>. The 'Request Method' is POST, 'Status Code' is 200 OK, 'Remote Address' is 172.217.131.201:443, and 'Referrer Policy' is origin-when-cross-origin. “Excerpt of an individual HTTP request generated by YouTube streaming service detailing request headers including the specific CDN node utilized for the aforementioned content title” https://www.youtube.com/watch?v=Tx69m9Jb0EY
15(f)	providing the content to the client device.	Google provides the content to the client device.



Excerpt of the same HTTP request, showing the content type returned in the Universal MIDI Packet format.

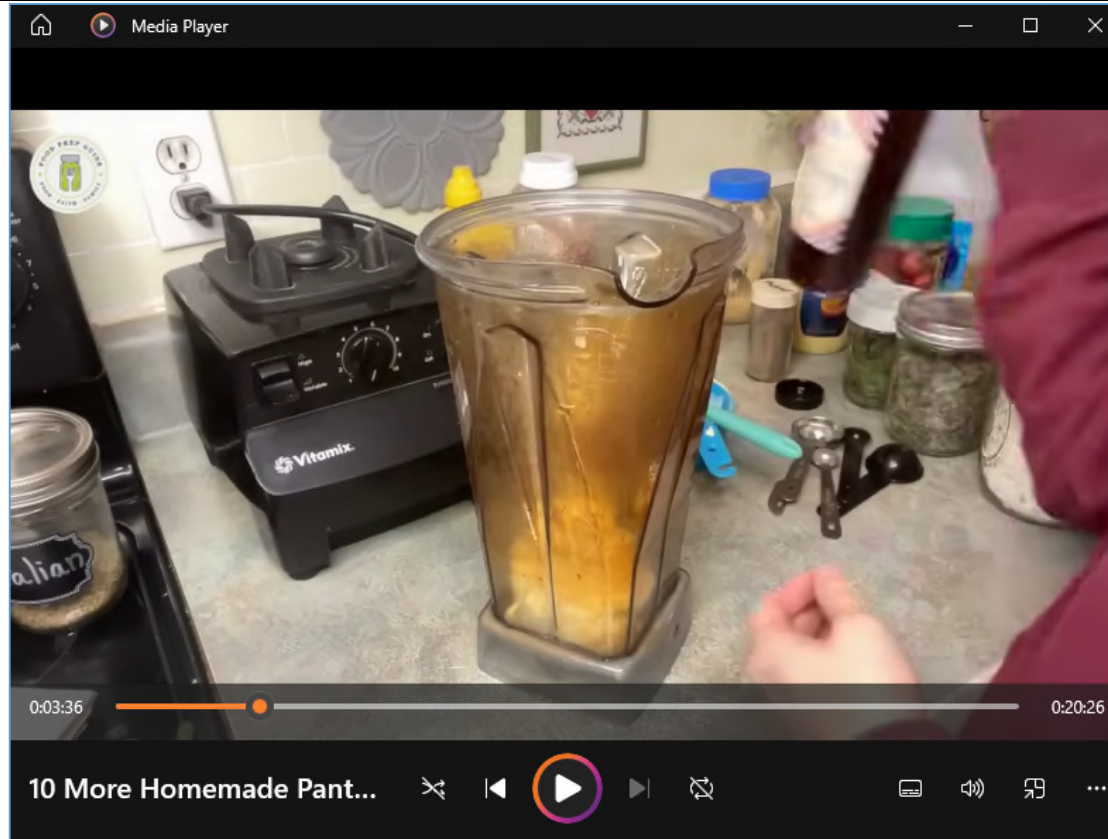
In the example above, Google CDN provides content, including video data to the client device in a specialized Universal MIDI Packet (e.g., UMP) format.

In another example, a client device was used to download a YouTube video without using a web browser. The following image shows how YouTube provides URLs pointing to the CDN nodes that contain the video information that is then sent to the client device. The following two URLs represent the video and audio components (highlighted below) of a YouTube video respectively, and are used to locally download videos from YouTube.

```
PS C:\Users\lvanfossan\Downloads\YTDDownloads> yt-dlp --no-check-certificate -g 'https://www.youtube.com/watch?v=cOcEmOgwc18'
https://rr4---sn-q4fl6nsk.googlevideo.com/videoplayback?expire=1732327240&ei=60JAZ5SIIoC1qvAPgLPUiQo&ip=108.233.53.103&id=o-AJ9hL3_JlQsq-Y5K16hfbn9N5clpzVqguRJuTVkVi5EP&itag=397&source=youtube&requiressl=yes&xpc=EgVo2aDSNQ%3D%3D&met=1732305640%2C&mh=ha&mm=31%2C29&mn=sn-q4fl6nsk%2Csn-q4flrnes&ms=au%2Crdu&mv=m&mvi=4&pl=20&rms=au%2Cau&in itcwndbps=608750&bui=AQn3pFT6T0FdCdqaSH_b388col742pAwJSITc2CLQHIIaP3_Bh7kt1fhW_fhBcMGJGG_5Vlq6VBFjWuy&spc=qtApAf e4yn1tAcmedIY1h86N4B7f1zLizQM5e4nthr-vkEA&vprv=1&svpuc=1&mime=video%2Fmp4&rqh=1&gir=yes&cflen=67217109&dur=1442.0 33&lm=1731034029756494&mt=1732305213&fvip=3&keepalive=yes&fexp=51326932%2C51335594&c=IOS&txp=543G434&sparams=ex pire%2Ceip%2Cip%2Cid%2Citag%2Csource%2Crequiressl%2Cxpc%2Cbui%2Cspc%2Cvprv%2Csvpuc%2Cmime%2Crqh%2Cgir%2Cflen%2Cdu r%2Clt&sig=AJfQdSswRAIgIJ_OXTzirYqHfRoEeo7nMleMLqer6mJdfa-Vfpn5rYCIHOjFMKgxFTbLXfTRoeSQUtGQqYPVh8XIZFYnIuRza- &lparams=met%2Cmh%2Cmm%2Cmn%2Cms%2Cmv%2Cmvi%2Cpl%2Crms%2Cinitcwndbps&lsg=AGluJ3MwRQIhAJu0-i6wr3KBa4_HCZzIj20To H5GH2xgirkDySfEMHTvAiBI1NqTBJ87WGStGzmtLrFLZ4Kt5aNB6LNkr97-fkJTg%3D%3D
https://rr4---sn-q4fl6nsk.googlevideo.com/videoplayback?expire=1732327240&ei=60JAZ5SIIoC1qvAPgLPUiQo&ip=108.233.53.103&id=o-AJ9hL3_JlQsq-Y5K16hfbn9N5clpzVqguRJuTVkVi5EP&itag=251&source=youtube&requiressl=yes&xpc=EgVo2aDSNQ%3 D%3D&met=1732305640%2C&mh=ha&mm=31%2C29&mn=sn-q4fl6nsk%2Csn-q4flrnes&ms=au%2Crdu&mv=m&mvi=4&pl=20&rms=au%2Cau&in itcwndbps=608750&bui=AQn3pFT6T0FdCdqaSH_b388col742pAwJSITc2CLQHIIaP3_Bh7kt1fhW_fhBcMGJGG_5Vlq6VBFjWuy&spc=qtApAf e4yn1tAcmedIY1h86N4B7f1zLizQM5e4nthr-vkEA&vprv=1&svpuc=1&mime=audio%2Fwebm&rqh=1&gir=yes&cflen=20588227&dur=1442. 061&lm=1731028138841268&mt=1732305213&fvip=3&keepalive=yes&fexp=51326932%2C51335594&c=IOS&txp=5432434&sparams=e xpire%2Ceip%2Cip%2Cid%2Citag%2Csource%2Crequiressl%2Cxpc%2Cbui%2Cspc%2Cvprv%2Csvpuc%2Cmime%2Crqh%2Cgir%2Cflen%2Cd ur%2Clt&sig=AJfQdSswRgIhAIRr4qADHvB81-Q-V8l5an1BjBZdAYeJ-8LxZA0Hc1w0AiEA-aP9zI1cJf8N4dTxxzCNSRcCTrMZQ-8_fmovaUMP jKsg%3D&lparams=met%2Cmh%2Cmm%2Cmn%2Cms%2Cmv%2Cmvi%2Cpl%2Crms%2Cinitcwndbps&lsg=AGluJ3MwRQIhAJu0-i6wr3KBa4_HCZ zIj20ToH5GH2xgirkDySfEMHTvAiBI1NqTBJ87WGStGzmtLrFLZ4Kt5aNB6LNkr97-fkJTg%3D%3D
PS C:\Users\lvanfossan\Downloads\YTDDownloads>
```

Excerpt of download information extracted from the YouTube video, the above represents the CDN nodes through which video/audio data for the video can be retrieved.

Further, the following image shows the result of downloading this video and audio data and causing client playback on a local media player.



Still image of YouTube video retrieved from the URL '<https://www.youtube.com/watch?v=cOcEmQgwcl8>' showing the video played at the 0:03:36 mark.