

EXHIBIT 44

EXHIBIT 44
UNITED STATES PATENT NO. 8,832,297 (“297 PATENT”)
INFRINGEMENT CLAIM CHART COMPARING CERTAIN AMAZON ACCUSED PRODUCTS¹ TO ASSERTED
INDEPENDENT CLAIM 1

297 Patent	Amazon’s Fire TV Stick
1. A playback device configured to perform multiphase adaptive bitrate streaming by requesting portions of encoded media from a plurality of alternative streams of encoded media that are encoded at different maximum bitrates in response to changes in streaming conditions, the playback device comprising:	An Amazon Fire TV Stick (3rd Gen), Build Model AFTSSS (“Fire Stick”), as exemplary of all Amazon Accused Products, is “[a] playback device configured to perform multiphase adaptive bitrate streaming by requesting portions of encoded media from a plurality of alternative streams of encoded media that are encoded at different maximum bitrates in response to changes in streaming conditions.”

¹ The Accused Products are various generations and screen sizes of Amazon Fire, Fire HD, Fire HD Plus, Fire Kids, Fire Kids Pro, Fire HD Kids, Fire HD Kids Pro tablets, various generations of Amazon Fire TV Stick and Fire Cube devices (collectively, “Amazon Fire TV/Cube devices”); various generations and screen sizes of Amazon Echo Show devices (“Amazon Echo Show devices”); and various screen sizes of Amazon Fire TV 4-Series and Fire TV Omni Series sets (collectively, “Amazon Fire TV sets”).

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	 The image shows the Amazon Fire TV Stick and its Alexa Voice Remote. The Fire TV Stick is a small, black, rectangular device with the Amazon logo on its front. The Alexa Voice Remote is a black, elongated remote with a blue circular button at the top, a large circular touchpad in the center, and various buttons for navigation and streaming services. The remote has buttons for back, home, and app menu, as well as directional arrows, play/pause, stop, and volume controls. It also features dedicated buttons for Prime Video, Netflix, Disney+, and Hulu. The Fire TV logo is visible at the bottom of the remote. Source: <i>Fire TV Stick with Alexa Voice Remote (includes TV controls), HD streaming device</i>, Amazon, https://www.amazon.com/fire-tv-stick-with-3rd-gen-alexa-voice-remote/dp/B08C1W5N87. The Prime Video App receives Media Presentation Description (MPD) container files. The presence of <code>mpeg:dash:schema:mpd</code> indicates that the top-level index and the container files describe therein are used for MPEG-DASH adaptive video streaming.

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	<pre> ▼<MPD xmlns="urn:mpeg:dash:schema:mpd:2011" xmlns:cenc="urn:mpeg:cenc:2013" xmlns:mas="urn:marlin:mas:1-0:services:schemas:mpd" xmlns:xsi="http://www.w3.org instance" majorVersion="1" mediaPresentationDuration="PT53M5.776S" minBufferTime="PT10S" minorVersion="0" profiles="urn:mpeg:dash:profile:isoff-on-demand:2 type="static" xsi:schemaLocation="urn:mpeg:dash:schema:mpd:2011 http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-DASH_schema_files/DASH-MPD.xs ▼<Period duration="PT53M5.776S"> ▼<AdaptationSet contentType="video" group="2" maxBandwidth="9000000" maxHeight="1080" maxWidth="1920" mimeType="video/mp4" minBandwidth="50000" par="16: segmentAlignment="true" startWithSAP="1" subsegmentAlignment="true" subsegmentStartsWithSAP="1"> <ContentProtection cenc:default_KID="E00047A3-0A7C-40A5-BAB8-DFEDD505ECF4" schemeIdUri="urn:mpeg:dash:mp4protection:2011" value="cenc"/> <ContentProtection schemeIdUri="urn:uuid:5E629AF5-38DA-4063-8977-97FFBD9902D4"/> ▼<ContentProtection schemeIdUri="urn:uuid:9A04F079-9840-4286-AB92-E65BE0885F95" value="MSPR 2.0"> <cenc:pssh>bAIAAAEAAQBiAjwAVwBSAE0ASABFAEEARABFAFIAIB4AG0AbABuAHMAPQAIAGGAdAB0AHAA0GAvAC8AcwBjAGgAZQStAGEAcwAuAG0AaQBJAHIAbwBzAG8AZgB0AC4AYwBvAG0AI </cenc:pssh> </ContentProtection> ▼<ContentProtection schemeIdUri="urn:uuid:EDEF88A9-79D6-4ACE-A3C8-27DCD51D21ED"> <cenc:pssh>CAESE0AAR6MKfEclurjf7dUF7PQaBmFtYXpviIIY2lkOjRBQkhvd3A4UUtXNnVOL3QxUVhzOUe9PSxXaW5MVEhZNVROU0RudyTMU1NtW19nPT0qA1NEMgA=</cenc:pssh> </ContentProtection> </AdaptationSet> </Period> </MPD> </pre> Source: MPD file for <i>Galapagos: Real of Giant Sharks</i> downloaded using the Prime Video App on a Fire TV Stick, taken by, or on behalf of, DivX. “DASH provides dynamic switching between different media tracks (e.g. varying by bit-rate, to adapt to network conditions), with the possibility of seamless switching.”, <i>available at</i> https://mpeg.chiariglione.org/standards/mpeg-dash/media-presentation-description-and-segment-formats. MPEG-DASH enables devices to select a stream from a plurality of streams in an Adaptation Set within the MPD file.

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	An Adaptation Set contains a set of Representations (see 5.3.5). A Representation describes a <i>deliverable encoded version</i> of one or several media content components. A Representation includes one or more media streams (one for each media content component in the multiplex). Any single Representation within an Adaptation Set is sufficient to render the contained media content components. By collecting different Representations in <i>one</i> Adaptation Set, the Media Presentation author expresses that the Representations represent perceptually equivalent content. Typically this means, that clients may switch dynamically from Representation to Representation within an Adaptation Set in order to adapt to network conditions or other factors. Switching refers to the presentation of decoded data up to a certain time t, and presentation of decoded data of another Representation from time t onwards. If Representations are included in one Adaptation Set, and the client switches properly, the Media Presentation is expected to be perceived seamless across the switch. Clients may ignore Representations that rely on codecs or other rendering technologies they do not support or that are otherwise unsuitable. Source: Ex. 91 (ISO/IEC 23009-1:2014(E)) at 10. The Prime Video container files define Representations with bandwidths ranging from a minimum of 50000 to a maximum of 9000000. The Prime Video container files list 15 different video files with different bitrates with entries as <BaseURL>2@AgBgAAACAAAKHuAAf9TAEBv5Uw==/135188b2-a258-447b-8ffe-27bcd9c9e8b7_video_N.mp4</BaseURL> where N ranges from 1 to 15. With bandwidth ranging from <Representation aspectRatio="16:9" bandwidth="50000" ... (for video_1) to <Representation aspectRatio="16:9" bandwidth="9000000" ... (for video_15). <pre> 1 <?xml version="1.0" encoding="UTF-8" standalone="no"?> 2 <MPD xmlns="urn:mpeg:dash:schema:mpd:2011" xmlns:cenc="urn:mpeg:cenc:2013" xmlns:mas="urn:marlin:mas:1-0:services:schemas:mpd" xmlns:xsi="http://www.w3 .org/2001/XMLSchema-instance" majorVersion="1" mediaPresentationDuration="PT53M5.776S" minBufferTime="PT10S" minorVersion="0" profiles="urn:mpeg :dash:profile:isoff-on-demand:2011" revision="3" type="static" xsi:schemaLocation="urn:mpeg:dash:schema:mpd:2011 http://standards.iso.org/ittf /PubliclyAvailableStandards/MPEG-DASH_schema_files/DASH-MPD.xsd"> 3 <Period duration="PT53M5.776S"> 4 <AdaptationSet contentType="video" group="2" maxBandwidth="9000000" maxHeight="1080" maxWidth="1920" mimeType="video/mp4" minBandwidth="50000" par ="16:9" segmentAlignment="true" startWithSAP="1" subsegmentAlignment="true" subsegmentStartsWithSAP="1"> 5 <ContentProtection cenc:default_KID="E00047A3-0A7C-40A5-BAB8-DFEDD505ECF4" schemeIdUri="urn:mpeg:dash:mp4protection:2011" value="cenc" /> </pre> ...

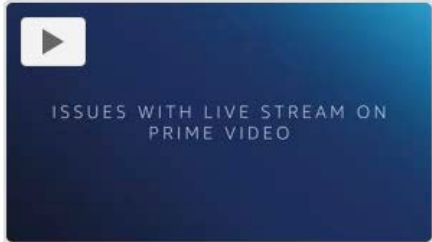
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26	</Representation>
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34	</Representation>
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37	<EncodedSegmentList duration="60" timescale="30">0000000000000000-0000000000000682;00000000000050e3-
38	</Representation>

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	Source: MPD file for <i>Galapagos: Real of Giant Sharks</i> downloaded using the Prime Video App on a Fire TV Stick, taken by, or on behalf of, DivX.

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	As demonstrated by the excerpts of the log file below, the Prime Video App requests video files encoded at different bitrates. 07-08 21:30:02.867 1345 3885 I AmazonVideo: DownloadRequest downloading url: https://s3-iad-2.cf.dash.row.aiv-cdn.net/dm/2\$dhmHxfMusuELmNyJ0Uu3RaaNj90~/1@4e8b31487b9b53cac961fa613053de09/a756/fee8/2a87/4906-a22d-d82f20259a1d/2@AgBgAAACAAAKHIAPX2uB8Bv5Uw==/135188b2-a258-447b-8ffe-27bcd9c9e8b7_video_11.mp4 headers: {Range=bytes=54499567-54832190} expectedSizeKB: 324 timeoutMillis: 9000 07-08 21:30:38.866 1345 3948 I AmazonVideo: DownloadRequest downloading url: https://s3-iad-2.cf.dash.row.aiv-cdn.net/dm/2\$dhmHxfMusuELmNyJ0Uu3RaaNj90~/1@4e8b31487b9b53cac961fa613053de09/a756/fee8/2a87/4906-a22d-d82f20259a1d/2@AgBgAAACAAAKHIASd4TCEBv5Uw==/135188b2-a258-447b-8ffe-27bcd9c9e8b7_video_12.mp4 headers: {Range=bytes=35909872-36055769} expectedSizeKB: 142 timeoutMillis: 9000 Source: Excerpt of log file during playback of <i>Galapagos: Real of Giant Sharks</i> downloaded using the Prime Video App on a Fire TV Stick, taken by, or on behalf of, DivX. As demonstrated by the excerpts of the log file below, the Prime Video App uses the BOLA algorithm to respond to changes in streaming conditions. Ln 3424: 07-08 21:30:04.986 1345 3971 I AmazonVideo: HeuristicAlgorithm - selecting BOLA_V1 for Feature/STREAMING Source: Excerpt of log file during playback of <i>Galapagos: Real of Giant Sharks</i> downloaded using the Prime Video App on a Fire TV Stick, taken by, or on behalf of, DivX. On information and belief, the Prime Video App's implementation of the BOLA algorithm is described in a paper co-authored by a Senior Applied Scientist at Amazon Prime Video. See K. Spiteri, R. Uргаonkar and R. K. Sitaraman, "BOLA: Near-optimal bitrate adaptation for online videos," IEEE INFOCOM 2016 - The 35th Annual IEEE International Conference on Computer

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	Communications, 2016, pp. 1-9, doi: 10.1109/INFOCOM.2016.7524428, <i>available at</i> https://arxiv.org/pdf/1601.06748.pdf. The BOLA algorithm selects among a plurality of alternative streams encoded at different bitrates according to the status of the buffer, i.e. how much video it can store as well as risk of buffer underrun. If the streaming conditions are such that the time to download a segment will take a longer time (i.e. a change in streaming conditions, such as a decrease in available network bandwidth) the amount of video in the buffer will decrease and a lower bitrate will be selected.

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	<i>Abstract</i>—Modern video players employ complex algorithms to adapt the bitrate of the video that is shown to the user. Bitrate adaptation requires a tradeoff between reducing the probability that the video freezes (rebuffers) and enhancing the quality of the video. A bitrate that is too high leads to frequent rebuffering, while a bitrate that is too low leads to poor video quality. Video providers segment videos into short segments and encode each segment at multiple bitrates. The video player adaptively chooses the bitrate of each segment to download, possibly choosing different bitrates for successive segments. We formulate bitrate adaptation as a utility-maximization problem and devise an online control algorithm called BOLA that uses Lyapunov optimization to minimize rebuffering and maximize video quality. We prove that BOLA achieves a time-average utility that is within an additive term $O(1/V)$ of the optimal value, for a control parameter V related to the video buffer size. Further, unlike prior work, BOLA does not require prediction of available network bandwidth. We empirically validate BOLA in a simulated network environment using a collection of network traces. We show that BOLA achieves near-optimal utility and in many cases significantly higher utility than current state-of-the-art algorithms. Our work has immediate impact on real-world video players and for the evolving DASH standard for video transmission. We also implemented an updated version of BOLA that is now part of the standard reference player dash.js and is used in production by several video providers such as Akamai, BBC, CBS, and Orange.

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	Source: K. Spiteri, R. Urgaonkar and R. K. Sitaraman, "BOLA: Near-optimal bitrate adaptation for online videos," IEEE INFOCOM 2016 - The 35th Annual IEEE International Conference on Computer Communications, 2016, pp. 1-9, doi: 10.1109/INFOCOM.2016.7524428, <i>available at</i> https://arxiv.org/pdf/1601.06748.pdf. Documentation for the Prime Video App also discloses that it automatically adjusts streaming quality based on available bandwidth. Digital Services & Content > Prime Video > Troubleshooting > Issues with Live Streams on Prime Video What to do if you're having problems watching live streams or events on Prime Video.  If you're having issues watching live streams or live events on Prime Video, please ensure that you're watching on a supported device, and have a sufficient download speed. Prime Video recommends a minimum download speed of 1MB/s for SD content and 5MB/s for HD content. Prime Video will serve the highest quality streaming experience possible based on the bandwidth speed available. Note: If you're experiencing any issues with the video "juddering" or having excessive motion blur, we recommend turning the Motion setting on your TV to Off. This setting might have a different name depending on your TV manufacturer. Some examples of the Motion setting include Auto Motion Plus, Tru Motion, MotionFlow, Cinemotion, and Motion Picture. Source: Issues with Live Streams on Prime Video, https://www.amazon.com/gp/help/customer/display.html?nodeId=GLF6K9WFVYXMR7BS.

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	Asset requirements Prime Video Direct supports video resolutions up to 1920x1080p. (4K UHD content isn't supported at this time.) Our software automatically adjusts the delivery streams to a resolution appropriate to the customer's device and connection speed. If you submit a 1080p HD video, and a customer streams it in SD, we automatically adjust it for you. For best results, please upload your highest quality video source. After initial publishing, if you submit a revised mezzanine or trailer, it must be at least the same resolution. Note: Prime Video Direct doesn't restrict maximum file size, however, larger files lead to longer uploading, processing, and encoding times. Source: Asset requirements, https://videodirect.amazon.com/home/help?topicId=G201973700. Amazon provides and specifically intends to provide the Amazon Prime Video application through the Amazon Appstore to its customers to use with a consumer electronics device, such as the Fire TV Stick, to create Prime Video playback device, such that Amazon customers will stream video content in the manner charted herein. Amazon encourages customers to stream, and customers do stream, video and audio content on a variety of playback devices in the manner charted herein. The following non-limiting examples are illustrative of ways in which Amazon induces users to practice these claims.  Watch anywhere, anytime Get the Prime Video app to watch on all your favorite devices.  GET IT ON Google Play  Download on the App Store  Available on SAMSUNG Galaxy Store

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	Source: Watch anywhere, anytime, https://www.amazon.com/gp/video/splash/getTheApp. Digital Services & Content › Prime Video › Setting Up › Install Prime Video on Your Devices Using the Prime Video app you will be able to watch Prime Video.  The Prime Video app is available on a range of televisions, Amazon devices, mobile devices, Blu-ray players, games consoles and streaming media devices. 1. Open your device's app store to download and install the Prime Video app. 2. Open the Prime Video app. 3. Register your device by selecting Register on the Amazon website. You will be given a code to enter on a given website. Some devices show the option to Sign in and Start Watching, using your Amazon account information. Source: Install Prime Video on Your Devices, https://www.amazon.com/gp/help/customer/display.html/?nodeId=201422990.

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	Digital Services and Device Support › Fire TV Support › Get Started with Fire TV › Watch Prime Video on Your Fire TV Access Prime Video content from the home screen, through search, or from the Prime Video app. There are several ways to access Prime Video content on your Fire TV: Home Screen Browse Prime Video content from the recommendations on your Fire TV home screen. You can scroll up or down the home screen to see different content categories. Search You can search for content from your Fire TV home screen. Go to Find and then Search to get started. You can also use an Alexa Voice Remote to search by voice. Your search results display content from Prime Video as well as other supported providers, such as: • Prime Video Channels subscriptions. • Streaming services with subscriptions. • Streaming services with free ad-supported content. Videos included with Prime Video have the Watch Now with Prime option. Prime Video App Open the Prime Video app to see videos included with Prime Video. You can browse for content on the home screen or from Search. You can also use an Alexa Voice Remote to search by voice. Source: Watch Prime Video on Your Fire TV, https://www.amazon.com/gp/help/customer/display.html?nodeId=GCWH5UKXJP37KPLP.

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	Digital Services & Content › Prime Video › Setting Up › Watch Prime Video on Chromecast To use Google Chromecast with Prime Video, you need the most recent version of the Prime Video app for either iOS or Android. 1. From the Prime Video app, select the Cast icon. 2. Select the Chromecast device that you wish to use. Your iOS or Android device must be connected to the same Wi-Fi network as your Chromecast. Please ensure that your Chromecast device is up to date. Also ensure that your Prime Video app and iOS or Android device are also up to date. If you're running an Android device, ensure that Google Play Services are also up to date. The Prime Video app on Fire Tablet can't connect to a Chromecast. 3. Select a title you wish to watch. This title will then be shown on the display that the Chromecast is connected to. If you wish to change Subtitle settings on Chromecast, on iOS devices, you must stop Casting to that device. Then select Settings > Accessibility > Subtitles and Captioning > Style and select a style for your Subtitles. On Android devices, while a title is being Casted, tap the three-dot menu on the screen. Select Subtitle styles and toggle on Show captions. You can also select Caption size and style options from that menu. Note: If you have the Chromecast with Google TV device (first released in 2020), you can use the device's remote and use the Prime Video app on that device, in addition to the Casting option. Source: Watch Prime Video on Chromecast, https://www.amazon.com/gp/help/customer/display.html?nodeId=G7U9H58SPSH7ZV4V. Prime Video Apps Smart TVs with the Prime Video App Amazon Devices with the Prime Video App Mobile Devices with the Prime Video App Games Consoles with the Prime Video App Blu-Ray Players with the Prime Video App Set Top Boxes and Media Players with the Prime Video App Prime Video System Requirements for Computers Source: Prime Video, https://www.amazon.com/gp/help/customer/display.html?nodeId=G9SY6AQJV45JFMET.

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	Digital Services & Content › Prime Video › Supported Devices › Amazon Devices with the Prime Video App The following Amazon devices have access to Prime Video. Note: Not all Prime Video titles support all features. Fire TV/Fire TV Stick • Streaming Video Quality - up to Ultra HD • Sound quality - up to 5.1 surround sound, Dolby Atmos • Closed Captions (Subtitles) - Yes • Audio Description - Yes • Live Streaming - Yes (on software version 5.2.6.0 or later) • Live ad support - Yes • Ad-supported channels - Yes • Profiles Supported - Yes, through the Prime Video app Echo Devices with a Screen (Such as Echo Show, Echo Spot) • Streaming Video Quality - Standard Definition • Sound quality - stereo • Closed Captions (Subtitles) - Yes • Audio Description - Yes • Live Streaming - Yes (on software version 594447320, and up) • Live ad support - Yes • Ad-supported channels - Yes for sporting events, No for Prime Video Channels Fire Tablet • Streaming Video Quality - up to HD • Sound quality - up to 5.1 surround sound, where supported • Closed Captions (Subtitles) - Yes • Audio Description - Yes (except for Kindle Fire, 1st Generation) • Live Streaming - Yes, on Generation 7 models and newer • Live ad support - Yes • Ad-supported channels - Yes, on Generation 7 models and newer • Profiles Supported - Yes, through the Prime Video app Fire Phone • Streaming Video Quality - up to HD • Sound quality - up to 5.1 surround sound, where supported • Closed Captions (Subtitles) - Yes • Audio Description - No • Live Streaming - No • Live ad support - No • Ad-supported channels - No

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	Source: Amazon Devices with Prime Video App, https://www.amazon.com/gp/help/customer/display.html?nodeId=GXY5VQJFHE9VYMCK.
1a. a processor configured, via a client application, to request portions of files from a remote server;	The Amazon Fire Stick, as exemplary of all Amazon Accused Products, includes “a processor configured, via a client application”—for example the Prime Video App, which is preinstalled on Amazon Accused products, “to request portions of files from a remote server.” For example, the exemplary Fire TV Stick includes a MediaTek MT8695D Processor (SoC), including a Quad Core 1.7GHz CPU. <i>See</i> Device Specifications: Fire TV Streaming Media Player, https://developer.amazon.com/docs/fire-tv/device-specifications-fire-tv-streaming-media-player.html?v=ftvstickgen3; Aufranc, J., <i>Amazon Fire TV stick 3rd Gen is Powered by MediaTek MT8695D SoC</i> (Sept. 25, 2020), https://www.cnx-software.com/2020/09/25/the-new-amazon-fire-tv-stick-is-powered-by-mediatek-mt8695d-soc/. The Prime Video App requests portions of files, such as but not limited to manifest files and the individual media segments, from remote servers, through HTTP GET requests. 2: What is MPEG-DASH (in a Nutshell)? The basic idea of MPEG-DASH is this: Chop the media file into segments that can be encoded at different bitrates or spatial resolutions. The segments are provided on a web server and can be downloaded through HTTP standard-compliant GET requests (as shown in the figure below) where the HTTP Server serves three different qualities, i.e., Low, Medium, and Best, chopped into segments of equal length. The adaptation to the bitrate or resolution is done on the client-side for each segment, e.g., the client can switch to a higher bitrate – if bandwidth permits – on a per-segment basis. This has several advantages because the client knows its capabilities, received throughput, and the context of the user best. Source: MPEG-DASH (Dynamic Adaptive Streaming over HTTP), https://bitmovin.com/dynamic-adaptive-streaming-http-mpeg-dash/. The Prime Video App receives Media Presentation Description (MPD) container files. The presence of mpeg:dash:schema:mpd indicates that the top-level index and the container files describe therein are used for MPEG-DASH adaptive video streaming.

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	<pre> ▼<MPD xmlns="urn:mpeg:dash:schema:mpd:2011" xmlns:cenc="urn:mpeg:cenc:2013" xmlns:mas="urn:marlin:mas:1-0:services:schemas:mpd" xmlns:xsi="http://www.w3.org instance" majorVersion="1" mediaPresentationDuration="PT53M5.776S" minBufferTime="PT10S" minorVersion="0" profiles="urn:mpeg:dash:profile:isoff-on-demand:2 type="static" xsi:schemaLocation="urn:mpeg:dash:schema:mpd:2011 http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-DASH_schema_files/DASH-MPD.xs ▼<Period duration="PT53M5.776S"> ▼<AdaptationSet contentType="video" group="2" maxBandwidth="9000000" maxHeight="1080" maxWidth="1920" mimeType="video/mp4" minBandwidth="50000" par="16: segmentAlignment="true" startWithSAP="1" subsegmentAlignment="true" subsegmentStartsWithSAP="1"> <ContentProtection cenc:default_KID="E00047A3-0A7C-40A5-BAB8-DFE0D505ECF4" schemeIdUri="urn:mpeg:dash:mp4protection:2011" value="cenc"/> <ContentProtection schemeIdUri="urn:uuid:5E629AF5-38DA-4063-8977-97FFBD9902D4"/> ▼<ContentProtection schemeIdUri="urn:uuid:9A04F079-9840-4286-AB92-E65BE0885F95" value="MSPR 2.0"> <cenc:pssh>bAIAAAEAQBiAjwAVwBSAE0ASABFAEEARABFAFIAB4AG0AbABuAHMAPQAiAGgAdAB0AHAA0gAvAC8AcwBjAGgAZQ8tAGEAcwAuAG0AaQBJAHIAbwBzAG8AZgB0AC4AYwBvAG0AI </cenc:pssh> </ContentProtection> ▼<ContentProtection schemeIdUri="urn:uuid:EDEF88A9-79D6-4ACE-A3C8-27DCD51D21ED"> <cenc:pssh>CAESE0AAR6MKfEclurjf7dUF7PQaBmFtYXpviI1Y21kOjRBQkhvd3AAUUtXNnVOL3QxUVhZ0UE9PSxXaW5MVEhZNVRoU0RudytMU1NtW19nPT0qA1NEMgA=</cenc:pssh> </ContentProtection> </pre> Source: MPD file for <i>Galapagos: Real of Giant Sharks</i> downloaded using the Prime Video App on a Fire TV Stick, taken by, or on behalf of, DivX. MPEG-DASH enables devices to stream content in response to network conditions. An Adaptation Set contains a set of Representations (see 5.3.5). A Representation describes a <i>deliverable encoded version</i> of one or several media content components. A Representation includes one or more media streams (one for each media content component in the multiplex). Any single Representation within an Adaptation Set is sufficient to render the contained media content components. By collecting different Representations in <i>one</i> Adaptation Set, the Media Presentation author expresses that the Representations represent perceptually equivalent content. Typically this means, that clients may switch dynamically from Representation to Representation within an Adaptation Set in order to adapt to network conditions or other factors. Switching refers to the presentation of decoded data up to a certain time <i>t</i>, and presentation of decoded data of another Representation from time <i>t</i> onwards. If Representations are included in one Adaptation Set, and the client switches properly, the Media Presentation is expected to be perceived seamless across the switch. Clients may ignore Representations that rely on codecs or other rendering technologies they do not support or that are otherwise unsuitable. Source: Ex. 91 (ISO/IEC 23009-1:2014(E)) at 10. As demonstrated by the excerpts of the log file below, the Prime Video App requests portions of video files encoded at different bitrates. <pre> 07-08 21:30:02.867 1345 3885 I AmazonVideo: DownloadRequest downloading url: https://s3-iad-2.cf.dash.row.aiv- cdn.net/dm/2\$dhmHxfMusuELmNyJ0Uu3RaaNj90~/1@4e8b31487b9b53cac961fa613053de 09/a756/fee8/2a87/4906-a22d- d82f20259a1d/2@AgBgAAACAAAKHIAPX2uB8Bv5Uw==/135188b2-a258-447b-8ffe- </pre>

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	27bcd9c9e8b7_video_11.mp4 headers: {Range=bytes=54499567-54832190} expectedSizeKB: 324 timeoutMillis: 9000 07-08 21:30:38.866 1345 3948 I AmazonVideo: DownloadRequest downloading url: https://s3-iad-2.cf.dash.row.aiv-cdn.net/dm/2\$dhmHxfMusuELmNyJ0Uu3RaaNj90~/1@4e8b31487b9b53cac961fa613053de09/a756/fee8/2a87/4906-a22d-d82f20259a1d/2@AgBgAAACAAAKHIASd4TCEBv5Uw==/135188b2-a258-447b-8ffe-27bcd9c9e8b7_video_12.mp4 headers: {Range=bytes=35909872-36055769} expectedSizeKB: 142 timeoutMillis: 9000 Source: Excerpt of log file during playback of <i>Galapagos: Real of Giant Sharks</i> downloaded using the Prime Video App on a Fire TV Stick, taken by, or on behalf of, DivX.
1b. wherein the client application further configures the processor to: commence streaming of the encoded media in a first operational phase utilizing a first set of stream switching conditions by requesting portions of the encoded media from one of the plurality of alternative streams encoded at a specified maximum bitrate;	The Amazon Fire Stick, as exemplary of all Amazon Accused Products, includes a client application—for example the Prime Video App, which is preinstalled on Amazon Accused Products, “wherein the client application further configures the processor to: commence streaming of the encoded media in a first operational phase utilizing a first set of stream switching conditions by requesting portions of the encoded media from one of the plurality of alternative streams encoded at a specified maximum bitrate.” For example, the Prime Video App directs the Fire TV Stick processor to request portions of the media file from one of the streams encoded with a particular maximum bitrate based on a first set of streaming conditions. The Prime Video App receives Media Presentation Description (MPD) container files. The presence of mpeg:dash:schema:mpd indicates that the top-level index and the container files describe therein are used for MPEG-DASH adaptive video streaming.

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	<pre> ▼<MPD xmlns="urn:mpeg:dash:schema:mpd:2011" xmlns:cenc="urn:mpeg:cenc:2013" xmlns:mas="urn:marlin:mas:1-0:services:schemas:mpd" xmlns:xsi="http://www.w3.org instance" majorVersion="1" mediaPresentationDuration="PT53M5.776S" minBufferTime="PT10S" minorVersion="0" profiles="urn:mpeg:dash:profile:isoff-on-demand:2 type="static" xsi:schemaLocation="urn:mpeg:dash:schema:mpd:2011 http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-DASH_schema_files/DASH-MPD.xs ▼<Period duration="PT53M5.776S"> ▼<AdaptationSet contentType="video" group="2" maxBandwidth="9000000" maxHeight="1080" maxWidth="1920" mimeType="video/mp4" minBandwidth="50000" par="16: segmentAlignment="true" startWithSAP="1" subsegmentAlignment="true" subsegmentStartsWithSAP="1"> <ContentProtection cenc:default_KID="E00047A3-0A7C-40A5-BAB8-DFEDD505ECF4" schemeIdUri="urn:mpeg:dash:mp4protection:2011" value="cenc"/> <ContentProtection schemeIdUri="urn:uuid:5E629AF5-38DA-4063-8977-97FFBD9902D4"/> ▼<ContentProtection schemeIdUri="urn:uuid:9A04F079-9840-4286-AB92-E65BE0885F95" value="MSPR 2.0"> <cenc:pssh>bAIAAAEAQBiAjwAVwBSAE0ASABFAEEARABFAFIAB4AG0AbABuAHMAPQAiAGgAdAB0AHAA0gAvAC8AcwBjAGgAZQ8tAGEAcwAuAG0AaQBJAHIAbwBzAG8AZgB0AC4AYwBvAG0Al </cenc:pssh> </ContentProtection> ▼<ContentProtection schemeIdUri="urn:uuid:EDEF88A9-79D6-4ACE-A3C8-27DCD51D21ED"> <cenc:pssh>CAESE0AAR6MKfEclurjf7dUF7PQaBmftYXpviI1Y21kOjRBQkhvd3AAUUtXNnVOL3QxUVhz0UE9PSxXaW5MVEhZNVRoU0RudytMU1NtW19nPT0qA1NEMgA=</cenc:pssh> </ContentProtection> </pre> Source: MPD file for <i>Galapagos: Real of Giant Sharks</i> downloaded using the Prime Video App on a Fire TV Stick, taken by, or on behalf of, DivX. MPEG-DASH enables devices to stream content in response to network conditions. An Adaptation Set contains a set of Representations (see 5.3.5). A Representation describes a <i>deliverable encoded version</i> of one or several media content components. A Representation includes one or more media streams (one for each media content component in the multiplex). Any single Representation within an Adaptation Set is sufficient to render the contained media content components. By collecting different Representations in <i>one</i> Adaptation Set, the Media Presentation author expresses that the Representations represent perceptually equivalent content. Typically this means, that clients may switch dynamically from Representation to Representation within an Adaptation Set in order to adapt to network conditions or other factors. Switching refers to the presentation of decoded data up to a certain time <i>t</i>, and presentation of decoded data of another Representation from time <i>t</i> onwards. If Representations are included in one Adaptation Set, and the client switches properly, the Media Presentation is expected to be perceived seamless across the switch. Clients may ignore Representations that rely on codecs or other rendering technologies they do not support or that are otherwise unsuitable. Source: Ex. 91 (ISO/IEC 23009-1:2014(E)) at 10. “A key functionality [of DASH] is the ability that the DASH client can seamlessly switch across different Representations of the same media component.” DASH-IF INTEROPERABILITY POINTS (v.4.3) at 29-30, <i>available at</i> https://dashif.org/docs/DASH-IF-IOP-v4.3.pdf. “Dynamic HTTP streaming requires various bitrate alternatives of the multimedia content to be available at the server. In addition, the multimedia content may consist of several media components (e.g. audio, video, text), each of which may have different characteristics. In MPEG-DASH, these characteristics are described by MPD which is an XML document.” Sodagar, MPEG-DASH: THE

STANDARD FOR MULTIMEDIA STREAMING OVER INTERNET (2012), *available at* <https://mpeg.chiariglione.org/standards/mpeg-dash>.

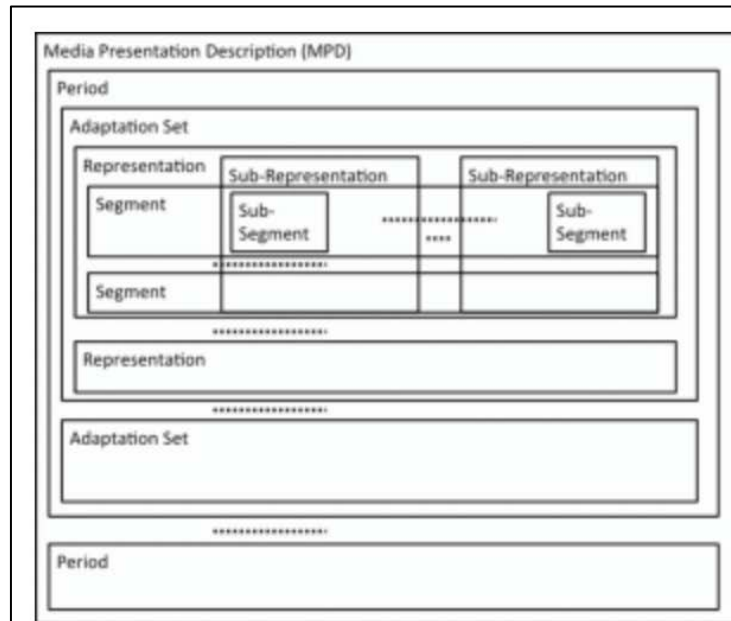
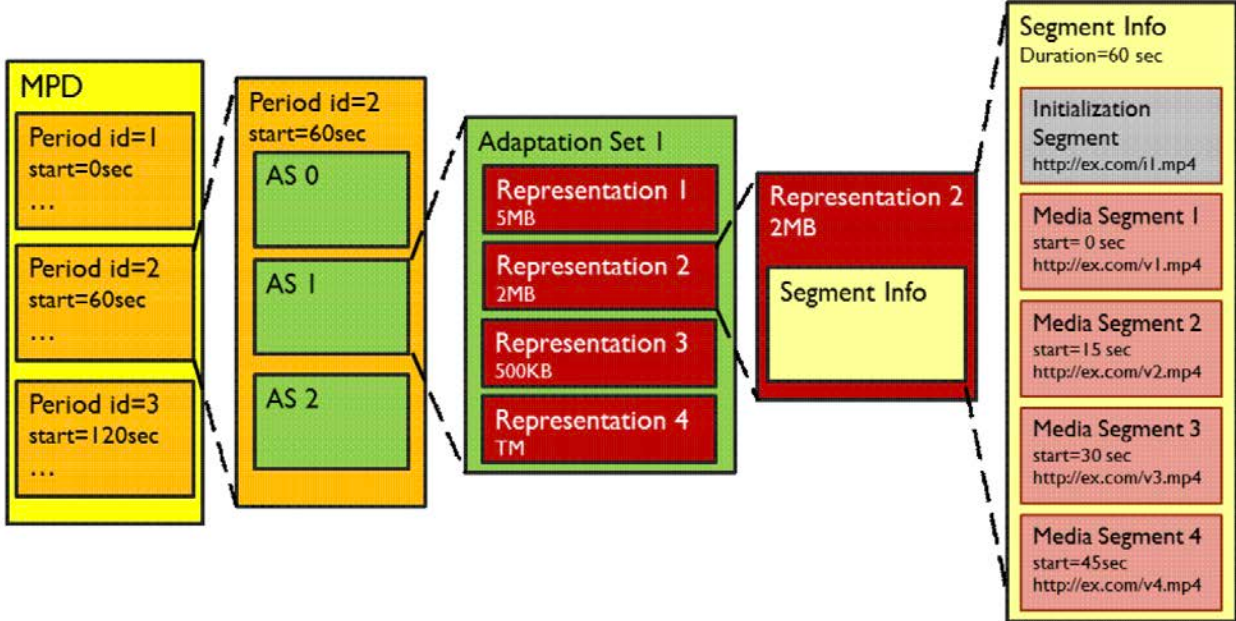


Figure 2 — DASH High-Level Data Model

Source: COPING WITH AN UNPREDICTABLE INTERNET, *available at* <https://ride.chiariglione.org/coping-with-an-unpredictable-internet/>.

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	A DASH Media Presentation [1] is described by a Media Presentation Description [2] (MPD). This describes the sequence of Periods [3] in time that make up the Media Presentation. A Period typically represents a media content period. Within a Period, material is arranged into Adaptation Sets [4]. If there is other material available, for example captions or audio descriptions, then these may each have a separate Adaptation Set. Material may also be provided in multiplexed form, in which case interchangeable versions of the <i>multiplex</i> may be described as a single Adaptation Set, for example an Adaptation Set containing both the main audio and main video for a Period. Each of the multiplexed components may be described individually by a Media Content Component Description. An Adaptation Set contains a set of Representations [5]. A Representation describes a <i>deliverable encoded version</i> of one or several media content components. A Representation includes one or more media streams (one for each media content component in the multiplex). Any single Representation within an Adaptation Set is sufficient to render the contained media content components. Typically, clients may switch from Representation to Representation within an AdaptationSet in order to adapt to network conditions or other factors. Within a Representation, the content may be divided in time into Segments [6]. A URL is provided for each Segment meaning that a Segment is the largest unit of data that can be retrieved with a single HTTP request. DASH defines different timelines. One key feature in DASH is that encoded versions of different Media Content Components [7] share a common timeline. The Presentation Time [8] of Access Unit [9] within the media content is mapped to the global common presentation timeline for synchronization of different media components and to enable seamless switching of different coded versions of the same media components. This timeline is referred as Media Presentation Timeline [10]. The Media Segments themselves contain accurate Media Presentation timing information enabling synchronization of components and seamless switching.

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	[1] Media Presentation: collection of data that establishes a bounded or unbounded presentation of media content [2] Media Presentation Description: formalized description for a Media Presentation for the purpose of providing a streaming service [3] Period: interval of the Media Presentation, during which a consistent set of encoded versions of the media content is available i.e. the set of available bitrates, languages, captions, subtitles etc. does not change during a Period [4] Adaptation Set: a set of interchangeable encoded versions of one or several Media Content Components. For example there may be one Adaptation Set for the main video component and a separate one for the main audio component [5] Representation: collection and encapsulation of one or more media streams in a delivery format and associated with descriptive metadata [6] Segment: unit of data associated with an HTTP-URL and optionally a byte range, meaning that the Segment is contained in the provided byte range of some larger resource [7] Media Content Component: one continuous component of the media content with an assigned media component type that can be encoded individually into a media stream [8] Presentation Time: a time associated to an access unit that maps it to the Media Presentation timeline [9] Access Unit: unit of a media stream with an assigned Media Presentation time [10] Media Presentation Timeline: concatenation of the timeline of all Periods which itself is common to all Representations in the Period Source: COPING WITH AN UNPREDICTABLE INTERNET, <i>available at</i> https://ride.chiariglione.org/coping-with-an-unpredictable-internet/. “Content in one Adaptation Set is constrained to enable and simplify switching across different Representations of the same source content. General Adaptation Set constraints allow sequencing of Media Segments from different Representations (“bitrate switching”) prior to a single audio or video decoder, typically requiring the video decoder to be reset to new decoding parameters at the switch point, such as a different encoded resolution or codec profile and level. Bitstream Switching Adaptation Set constraints allow a switched sequence of Media Segments to be decoded without

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	resetting the decoder at switch points because the resulting Segment stream is a valid track of the source type, so the decoder is not even aware of the switch.” Sodagar, MPEG-DASH: THE STANDARD FOR MULTIMEDIA STREAMING OVER INTERNET (2012), <i>available at</i> https://mpeg.chiariglione.org/standards/mpeg-dash.  Figure 3. The MPD hierarchical data model. Source: Sodagar, MPEG-DASH: THE STANDARD FOR MULTIMEDIA STREAMING OVER INTERNET (2012), <i>available at</i> https://mpeg.chiariglione.org/standards/mpeg-dash.

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	Figure 3 demonstrates the MPD hierarchical data model. The MPD consists of one or multiple periods, where a period is an interval of the program along the temporal axis. Each period has a starting time and duration and consists of one or multiple adaptation sets. An adaptation set provides the information about one or multiple media components and its various encoded alternatives. For instance, an adaptation set may contain the different bitrates of the video component of the same multimedia content. Another adaptation set may contain the different bitrates of the audio component (e.g. lower quality stereo and higher quality surround sound) of the same multimedia content. Each adaptation set usually includes multiple representations. A representation is an encoded alternative of the same media component, varying from other representations by bitrate, resolution, number of channels or other characteristics. Each representation consists of one or multiple segments. Segments are the media stream chunks in temporal sequence. Each segment has a URI, i.e. an addressable location on a server which can be downloaded using HTTP GET or HTTP GET with byte ranges. Source: Sodagar, MPEG-DASH: THE STANDARD FOR MULTIMEDIA STREAMING OVER INTERNET (2012), <i>available at</i> https://mpeg.chiariglione.org/standards/mpeg-dash. Furthermore, “[t]o use this data model the DASH client first parses the MPD XML document. The client then selects the set of representations it will use based on descriptive elements in the MPD the capabilities of the client and choices of its user. The client then builds a timeline and starts playing the multimedia content by requesting appropriate media segments.” To use this data model, the DASH client first parses the MPD XML document. The client then selects the set of representations it will use based on descriptive elements in the MPD, the capabilities of the client and choices of its user. The client then builds a time-line and starts playing the multimedia content by requesting appropriate media segments. Each representation’s description includes information about its segments, which enables requests for each segment to be formulated in terms of HTTP URL and byte range. For live presentations, the MPD also provides segment availability start time and availability end time, approximate media start time, and fixed or variable duration of segments. Source: Sodagar, MPEG-DASH: THE STANDARD FOR MULTIMEDIA STREAMING OVER INTERNET (2012), <i>available at</i> https://mpeg.chiariglione.org/standards/mpeg-dash. As demonstrated by the excerpts of the log file below, the Prime Video App uses the BOLA algorithm to respond to changes in streaming conditions. Ln 3424: 07-08 21:30:04.986 1345 3971 I AmazonVideo: HeuristicAlgorithm - selecting BOLA_V1 for Feature/STREAMING

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	Source: Excerpt of log file during playback of <i>Galapagos: Real of Giant Sharks</i> downloaded using the Prime Video App on a Fire TV Stick, taken by, or on behalf of, DivX. On information and belief, the Prime Video App's implementation of the BOLA algorithm is described in a paper co-authored by a Senior Applied Scientist at Amazon Prime Video. <i>See</i> K. Spiteri, R. Urgaonkar and R. K. Sitaraman, "BOLA: Near-optimal bitrate adaptation for online videos," IEEE INFOCOM 2016 - The 35th Annual IEEE International Conference on Computer Communications, 2016, pp. 1-9, doi: 10.1109/INFOCOM.2016.7524428, <i>available at</i> https://arxiv.org/pdf/1601.06748.pdf. The BOLA algorithm selects among a plurality of alternative streams encoded at different bitrates according to the status of the buffer, i.e. how much video it can store as well as risk of buffer underrun. If the streaming conditions are such that the time to download a segment will take longer time (i.e. a change in streaming conditions, such as a decrease in available network bandwidth) the amount of video in the buffer will decrease and a lower bitrate will be selected.

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	<i>Abstract</i>—Modern video players employ complex algorithms to adapt the bitrate of the video that is shown to the user. Bitrate adaptation requires a tradeoff between reducing the probability that the video freezes (rebuffers) and enhancing the quality of the video. A bitrate that is too high leads to frequent rebuffering, while a bitrate that is too low leads to poor video quality. Video providers segment videos into short segments and encode each segment at multiple bitrates. The video player adaptively chooses the bitrate of each segment to download, possibly choosing different bitrates for successive segments. We formulate bitrate adaptation as a utility-maximization problem and devise an online control algorithm called BOLA that uses Lyapunov optimization to minimize rebuffering and maximize video quality. We prove that BOLA achieves a time-average utility that is within an additive term $O(1/V)$ of the optimal value, for a control parameter V related to the video buffer size. Further, unlike prior work, BOLA does not require prediction of available network bandwidth. We empirically validate BOLA in a simulated network environment using a collection of network traces. We show that BOLA achieves near-optimal utility and in many cases significantly higher utility than current state-of-the-art algorithms. Our work has immediate impact on real-world video players and for the evolving DASH standard for video transmission. We also implemented an updated version of BOLA that is now part of the standard reference player dash.js and is used in production by several video providers such as Akamai, BBC, CBS, and Orange.

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	Source: K. Spiteri, R. Urgaonkar and R. K. Sitaraman, "BOLA: Near-optimal bitrate adaptation for online videos," IEEE INFOCOM 2016 - The 35th Annual IEEE International Conference on Computer Communications, 2016, pp. 1-9, doi: 10.1109/INFOCOM.2016.7524428, <i>available at</i> https://arxiv.org/pdf/1601.06748.pdf. On information and belief, the Prime Video App's implementation of the BOLA algorithm is based on BOLA-FINITE, which is an adaptation of the BOLA algorithm applied to the finite-sized videos used in streaming services and described in a paper co-authored by a Senior Applied Scientist at Amazon Prime Video. <i>See</i> K. Spiteri, R. Urgaonkar and R. K. Sitaraman, "BOLA: Near-optimal bitrate adaptation for online videos," IEEE INFOCOM 2016 - The 35th Annual IEEE International Conference on Computer Communications, 2016, pp. 1-9, doi: 10.1109/INFOCOM.2016.7524428, <i>available at</i> https://arxiv.org/pdf/1601.06748.pdf. The Prime Video App's implementation of the BOLA algorithm transitions from a startup operational phase (LOW_TRANSIENT and/or TRANSIENT) where "[l]ower bitrate segments are preferred until the buffer level reaches [a] steady state" operational phase (STEADY). <i>See</i> K. Spiteri, R. Urgaonkar and R. K. Sitaraman, "BOLA: Near-optimal bitrate adaptation for online videos," IEEE INFOCOM 2016 – The 35th Annual IEEE International Conference on Computer Communications, 2016, pp. 1-9, doi: 10.1109/INFOCOM.2016.7524428, <i>available at</i> https://arxiv.org/pdf/1601.06748.pdf. "The benefit of the adjustments is also evident as the buffer grows larger, as there is no significant decrease in utility caused by filling the buffer with low-bitrate segments in the earlier stages of the video." K. Spiteri, R. Urgaonkar and R. K. Sitaraman, "BOLA: Near-optimal bitrate adaptation for online videos," IEEE INFOCOM 2016 - The 35th Annual IEEE International Conference on Computer Communications, 2016, pp. 1-9, doi: 10.1109/INFOCOM.2016.7524428, <i>available at</i> https://arxiv.org/pdf/1601.06748.pdf. The Prime Video App commences streaming of the encoded media in its first operational phase (switching State from "UNINITIALIZED" to "LOW_TRANSIENT") utilizing a first set of stream switching conditions and requests portions of the encoded media from one of the plurality of alternative streams encoded at a specified maximum bitrate.

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	Ln 3377: 07-08 21:30:04.825 1345 3971 I AmazonVideo: Starting ContentSession for VideoSpecification ... c9e8b7_corrected.mpd ... Ln 3382: 07-08 21:30:04.838 1345 3934 I AmazonVideo: DownloadRequest downloading url: ... c9e8b7_corrected.mpd ... Ln 3424: 07-08 21:30:04.986 1345 3971 I AmazonVideo: HeuristicAlgorithm - selecting BOLA_V1 for Feature/STREAMING Ln 3445: 07-08 21:30:04.998 1345 3971 I platform-utils: processState(): BolaTransient UNINITIALIZED --> LOW_TRANSIENT Ln 3449: 07-08 21:30:04.999 1345 3971 I platform-utils: calculateTransientBufferDuration(): BOLA calculateTransientBufferDuration desiredStartupBitrate 2700000 MIndex 12 MBitrate 3500000 NIndex 11 NBitrate 2250000 Ln 3450: 07-08 21:30:04.999 1345 3971 I platform-utils: calculateTransientBufferDuration(): BOLA calculateTransientBufferDuration transientBufferNumMComponent 102976662.742569 transientBufferNumNComponent 67689503.062802, transientBufferNum 35287159.679767 transientBufferDen 312500.000000 transientBuffer 113.018911 Ln 3451: 07-08 21:30:04.999 1345 3971 I platform-utils: initializeTransientBufferDuration(): BolaTransient init LOW_TRANSIENT TransientBufferSeconds 113.02 Line 3453: 07-08 21:30:05.012 1345 3971 I platform-utils: submitDownloadRequests(): BOLA Video requested download FragmentIndex 0, bitrateMbps 2.25, timeoutMillis 9000, State LOW_TRANSIENT, ... Line 3455: 07-08 21:30:05.016 1345 3945 I AmazonVideo: DownloadRequest downloading url: c9e8b7_video_11.mp4 headers: {Range=bytes=20708-157155} expectedSizeKB: 133 timeoutMillis: 9000 Ln 3455: 07-08 21:30:05.016 1345 3945 I AmazonVideo: DownloadRequest downloading url: ... c9e8b7_video_11.mp4 ... Ln 3460: 07-08 21:30:05.019 1345 3971 I platform-utils: calculateTransientBufferDuration(): ... Ln 3462: 07-08 21:30:05.019 1345 3971 I platform-utils: initializeTransientBufferDuration(): ...

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	Ln 3543: 07-08 21:30:05.267 1345 3980 I platform-utils: onDownloadComplete(): BolaTransient OnDownloadComplete transientBufferSeconds 113.751, realBufferSeconds 2.000 Ln 3544: 07-08 21:30:05.268 1345 3980 I platform-utils: reportDownloadProgress(): BOLA Video completed request FragmentInfo{fragmentIndex: 0, timeAllowedMillis: 9000, sizeInBytes: 136448, bytesDownloaded: 136448} Reason: DOWNLOAD_STATUS_SUCCESS, BufferSeconds 2.00, elapsedMillis 255, StallMillis 0.00 Source: Excerpt of log file during playback of <i>Galapagos: Real of Giant Sharks</i> downloaded using the Prime Video App on a Fire TV Stick, taken by, or on behalf of, DivX.
1bii. measure streaming conditions for receiving the requested portions of the encoded media from a current one of the plurality of alternate streams having a current maximum bitrate;	The Amazon Fire Stick, as exemplary of all Amazon Accused Products, “measure[s] streaming conditions for receiving the requested portions of the encoded media from a current one of the plurality of alternate streams having a current maximum bitrate.” The log file shows the use of getBolaBitRate to measure streaming conditions and determine when the first set of streaming conditions are satisfied while in the first operational phase (State LOW_TRANSIENT or TRANSIENT), after which submitDownloadRequests requests the corresponding portions of the encoded media. In the first operational phase (State LOW_TRANSIENT or TRANSIENT), the Prime Video App evaluates the onDownloadComplete function which is used to determine when a phase transition criterion is satisfied by the measured streaming conditions. The Prime Video App uses getBolaBitRate which uses values for BufferDurationSec, ParamV/Gamma, BitRate/GoodnessValue to measure streaming conditions and determine when the first set of stream switching conditions are satisfied based on the requirements of the first operational phase (State LOW_TRANSIENT or TRANSIENT). 07-08 21:30:09.402 1345 4026 I platform-utils: onDownloadComplete(): BolaTransient OnDownloadComplete transientBufferSeconds 117.464, realBufferSeconds 41.756 07-08 21:30:09.402 1345 4026 I platform-utils: reportDownloadProgress(): BOLA Video completed request FragmentInfo{fragmentIndex: 20, timeAllowedMillis: 7600, sizeInBytes: 267783, bytesDownloaded: 267783} Reason: DOWNLOAD_STATUS_SUCCESS, BufferSeconds 41.76, elapsedMillis 136, StallMillis 0.00

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	07-08 21:30:09.403 1345 4026 I platform-utils: getBolaBitRate(): getBolaBitRate FragmentIndex 21 SelectedBitrate 5.00 mbps Note: BufferDurationSec 117.464 ParamV/Gamma 5.996/15.821 BitRate/GoodnessValue 0.05MB/-0.001808130 0.08MB/- 0.001075755 0.12MB/-0.000578407 0.20MB/-0.000285785 0.30MB/-0.000158107 0.45MB/- 0.000083794 0.65MB/-0.000044442 1.00MB/-0.000018555 1.30MB/-0.000009433 1.90MB/- 0.000001664 1.95MB/-0.000001302 2.25MB/0.000000397 3.50MB/0.000003283 5.00MB/0.000004009 9.00MB/0.000003794 optimalValue 0.000004009 idealGoodnessValue 0.000003969 ... 07-08 21:30:09.425 1345 4026 I platform-utils: submitDownloadRequests(): BOLA Video requested download FragmentIndex 21, bitrateMbps 5.00, timeoutMillis 7600, State LOW_TRANSIENT, BufferSec:(Compensated 117.46, Effective 117.46, Real 41.76, Stall 0.02), maxBufferSec 126.00 07-08 21:30:09.426 1345 3935 I AmazonVideo: DownloadRequest downloading url: https://s3-iad-2.cf.dash.row.aiv- cdn.net/dm/2\$dhmHxfMusuELmNyJ0Uu3RaaNj90~/1@4e8b31487b9b53cac961fa613053de 09/a756/fee8/2a87/4906-a22d- d82f20259a1d/2@AgBgAAACAAKHGAiWoOCUBv5Uw==/135188b2-a258-447b-8ffe- 27bcd9c9e8b7_video_14.mp4 headers: {Range=bytes=23748104-24083049} expectedSizeKB: 327 timeoutMillis: 7600 ... 07-08 21:30:09.559 1345 4040 I platform-utils: onDownloadComplete(): BolaTransient OnDownloadComplete transientBufferSeconds 118.308, realBufferSeconds 43.612 07-08 21:30:09.559 1345 4040 I platform-utils: reportDownloadProgress(): BOLA Video completed request FragmentInfo{fragmentIndex: 21, timeAllowedMillis: 7600, sizeInBytes: 334946, bytesDownloaded: 334946} Reason: DOWNLOAD_STATUS_SUCCESS, BufferSeconds 43.61, elapsedMillis 134, StallMillis 0.00 07-08 21:30:09.560 1345 4040 I platform-utils: getBolaBitRate(): getBolaBitRate FragmentIndex 22 SelectedBitrate 9.00 mbps Note: BufferDurationSec 118.307 ParamV/Gamma 5.996/15.821 BitRate/GoodnessValue 0.05MB/-0.001875604 0.08MB/- 0.001120738 0.12MB/-0.000606522 0.20MB/-0.000302654 0.30MB/-0.000169353 0.45MB/- 0.000091291 0.65MB/-0.000049633 1.00MB/-0.000021929 1.30MB/-0.000012028 1.90MB/-

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	0.000003439 1.95MB/-0.000003032 2.25MB/-0.000001102 3.50MB/0.000002319 5.00MB/0.000003334 9.00MB/0.000003419 optimalValue 0.000003419 idealGoodnessValue 0.000003385 07-08 21:30:09.560 349 608 V installed: DexInv: --- BEGIN '/system/priv- app/WhisperlinkSdk/WhisperlinkSdk.apk' --- 07-08 21:30:09.563 294 471 I MTK_GRALLOC: Successfully ref secure 4307 07-08 21:30:09.564 1345 4040 I platform-utils: submitDownloadRequests(): BOLA Video requested download FragmentIndex 22, bitrateMbps 9.00, timeoutMillis 7600, State LOW_TRANSIENT, BufferSec:(Compensated 118.31, Effective 118.31, Real 43.61, Stall 0.00), maxBufferSec 126.00 07-08 21:30:09.566 1345 3948 I AmazonVideo: DownloadRequest downloading url: https://s3-iad-2.cf.dash.row.aiv- cdn.net/dm/2\$dhmHxfMusuELmNyJ0Uu3RaaNj90~/1@4e8b31487b9b53cac961fa613053de 09/a756/fee8/2a87/4906-a22d- d82f20259a1d/2@AgBgAAACAAKHGBBqj7CcBv5Uw==/135188b2-a258-447b-8ffe- 27bcd9c9e8b7_video_15.mp4 headers: {Range=bytes=42717038-43333570} expectedSizeKB: 602 timeoutMillis: 7600 Source: Excerpt of log file during playback of <i>Galapagos: Real of Giant Sharks</i> downloaded using the Prime Video App on a Fire TV Stick, taken by, or on behalf of, DivX.
1biii. determine when a first set of stream switching conditions is satisfied in a first operational phase by the measured streaming conditions;	The Amazon Fire Stick, as exemplary of all Amazon Accused Products, , “determine[s] when a first set of stream switching conditions is satisfied in a first operational phase by the measured streaming conditions.” As discussed in claim element [1bii], the exemplary Fire Stick running the preinstalled Prime Video App, measures streaming conditions and determine when the first set of stream switching conditions is satisfied in a first operational phase.
1biv. request portions of the encoded media from another one of the plurality	The Amazon Fire Stick, as exemplary of all Amazon Accused Products, , “request[s] portions of the encoded media from another one of the plurality of alternative streams encoded at a maximum bitrate

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of alternative streams encoded at a maximum bitrate that is different than the current maximum bitrate in response to the determination that the first set of stream switching conditions are satisfied;	that is different than the current maximum bitrate in response to the determination that the first set of stream switching conditions are satisfied.” As discussed in claim element [1bii] and [1biii], the exemplary Fire Stick running the preinstalled Prime Video App, measures streaming conditions and determine when the first set of stream switching conditions is satisfied in a first operational phase. Network traffic monitoring from log file shows, for example, requesting “_video_15” corresponding to a SelectedBitrate of 9.00 mbps for FragmentIndex 22 after previously requesting “_video_14” corresponding to a SelectedBitrate of 5.00 mbps for FragmentIndex 21 based on a determination that the first set of stream switching conditions are satisfied during playback of <i>Galapagos: Real of Giant Sharks</i> downloaded using the Prime Video App on a Fire TV Stick. <pre> 07-08 21:30:09.402 1345 4026 I platform-utils: onDownloadComplete(): BolaTransient OnDownloadComplete transientBufferSeconds 117.464, realBufferSeconds 41.756 07-08 21:30:09.402 1345 4026 I platform-utils: reportDownloadProgress(): BOLA Video completed request FragmentInfo{fragmentIndex: 20, timeAllowedMillis: 7600, sizeInBytes: 267783, bytesDownloaded: 267783} Reason: DOWNLOAD_STATUS_SUCCESS, BufferSeconds 41.76, elapsedMillis 136, StallMillis 0.00 07-08 21:30:09.403 1345 4026 I platform-utils: getBolaBitRate(): getBolaBitRate FragmentIndex 21 SelectedBitrate 5.00 mbps Note: BufferDurationSec 117.464 ParamV/Gamma 5.996/15.821 BitRate/GoodnessValue 0.05MB/-0.001808130 0.08MB/- 0.001075755 0.12MB/-0.000578407 0.20MB/-0.000285785 0.30MB/-0.000158107 0.45MB/- 0.000083794 0.65MB/-0.000044442 1.00MB/-0.000018555 1.30MB/-0.000009433 1.90MB/- 0.000001664 1.95MB/-0.000001302 2.25MB/0.000000397 3.50MB/0.000003283 5.00MB/0.000004009 9.00MB/0.000003794 optimalValue 0.000004009 idealGoodnessValue 0.000003969 ... 07-08 21:30:09.425 1345 4026 I platform-utils: submitDownloadRequests(): BOLA Video requested download FragmentIndex 21, bitrateMbps 5.00, timeoutMillis 7600, State LOW_TRANSIENT, BufferSec:(Compensated 117.46, Effective 117.46, Real 41.76, Stall 0.02), maxBufferSec 126.00 </pre>

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	07-08 21:30:09.426 1345 3935 I AmazonVideo: DownloadRequest downloading url: https://s3-iad-2.cf.dash.row.aiv-cdn.net/dm/2\$dhmHxfMusuELmNyJ0Uu3RaaNj90~/1@4e8b31487b9b53cac961fa613053de09/a756/fee8/2a87/4906-a22d-d82f20259a1d/2@AgBgAAACAAAKHGAIWoOCUBv5Uw==/135188b2-a258-447b-8ffe-27bcd9c9e8b7_video_14.mp4 headers: {Range=bytes=23748104-24083049} expectedSizeKB: 327 timeoutMillis: 7600 ... 07-08 21:30:09.559 1345 4040 I platform-utils: onDownloadComplete(): BolaTransient OnDownloadComplete transientBufferSeconds 118.308, realBufferSeconds 43.612 07-08 21:30:09.559 1345 4040 I platform-utils: reportDownloadProgress(): BOLA Video completed request FragmentInfo{fragmentIndex: 21, timeAllowedMillis: 7600, sizeInBytes: 334946, bytesDownloaded: 334946} Reason: DOWNLOAD_STATUS_SUCCESS, BufferSeconds 43.61, elapsedMillis 134, StallMillis 0.00 07-08 21:30:09.560 1345 4040 I platform-utils: getBolaBitRate(): getBolaBitRate FragmentIndex 22 SelectedBitrate 9.00 mbps Note: BufferDurationSec 118.307 ParamV/Gamma 5.996/15.821 BitRate/GoodnessValue 0.05MB/-0.001875604 0.08MB/-0.001120738 0.12MB/-0.000606522 0.20MB/-0.000302654 0.30MB/-0.000169353 0.45MB/-0.000091291 0.65MB/-0.000049633 1.00MB/-0.000021929 1.30MB/-0.000012028 1.90MB/-0.000003439 1.95MB/-0.000003032 2.25MB/-0.000001102 3.50MB/0.000002319 5.00MB/0.000003334 9.00MB/0.000003419 optimalValue 0.000003419 idealGoodnessValue 0.000003385 07-08 21:30:09.560 349 608 V installed: DexInv: --- BEGIN '/system/priv-app/WhisperlinkSdk/WhisperlinkSdk.apk' --- 07-08 21:30:09.563 294 471 I MTK_GRALLOC: Successfully ref secure 4307 07-08 21:30:09.564 1345 4040 I platform-utils: submitDownloadRequests(): BOLA Video requested download FragmentIndex 22, bitrateMbps 9.00, timeoutMillis 7600, State LOW_TRANSIENT, BufferSec:(Compensated 118.31, Effective 118.31, Real 43.61, Stall 0.00), maxBufferSec 126.00 07-08 21:30:09.566 1345 3948 I AmazonVideo: DownloadRequest downloading url: https://s3-iad-2.cf.dash.row.aiv-cdn.net/dm/2\$dhmHxfMusuELmNyJ0Uu3RaaNj90~/1@4e8b31487b9b53cac961fa613053de

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	09/a756/fee8/2a87/4906-a22d-d82f20259a1d/2@AgBgAAACAAKHGBBqj7CcBv5Uw==/135188b2-a258-447b-8ffe-27bcd9c9e8b7_video_15.mp4 headers: {Range=bytes=42717038-43333570} expectedSizeKB: 602 timeoutMillis: 7600 Source: Excerpt of log file during playback of <i>Galapagos: Real of Giant Sharks</i> downloaded using the Prime Video App on a Fire TV Stick, taken by, or on behalf of, DivX.
1bv. determine when at least one phase transition criterion of the first operational phase is satisfied by the measured streaming conditions;	The Amazon Fire Stick, as exemplary of all Amazon Accused Products, , “determine[s] when at least one phase transition criterion of the first operational phase is satisfied by the measured streaming conditions.” On information and belief, the Prime Video App’s implementation of the BOLA algorithm is based on BOLA-FINITE, which is an adaptation of the BOLA algorithm applied to the finite-sized videos used in streaming services and described in a paper co-authored by a Senior Applied Scientist at Amazon Prime Video. <i>See</i> K. Spiteri, R. Urgaonkar and R. K. Sitaraman, “BOLA: Near-optimal bitrate adaptation for online videos,” IEEE INFOCOM 2016 - The 35th Annual IEEE International Conference on Computer Communications, 2016, pp. 1-9, doi: 10.1109/INFOCOM.2016.7524428, <i>available at</i> https://arxiv.org/pdf/1601.06748.pdf. The Prime Video App’s implementation of the BOLA algorithm transitions from a startup operational phase (LOW_TRANSIENT and/or TRANSIENT) where “[l]ower bitrate segments are preferred until the buffer level reaches [a] steady state” operational phase (STEADY). <i>See</i> K. Spiteri, R. Urgaonkar and R. K. Sitaraman, “BOLA: Near-optimal bitrate adaptation for online videos,” IEEE INFOCOM 2016 - The 35th Annual IEEE International Conference on Computer Communications, 2016, pp. 1-9, doi: 10.1109/INFOCOM.2016.7524428, <i>available at</i> https://arxiv.org/pdf/1601.06748.pdf. The benefit of the adjustments is also evident as the buffer grows larger, as there is no significant decrease in utility caused by filling the buffer with low-bitrate segments in the earlier stages of the video.” K. Spiteri, R. Urgaonkar and R. K. Sitaraman, “BOLA: Near-optimal bitrate adaptation for online videos,” IEEE INFOCOM 2016 - The 35th Annual IEEE International Conference on

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	Computer Communications, 2016, pp. 1-9, doi: 10.1109/INFOCOM.2016.7524428, <i>available at</i> https://arxiv.org/pdf/1601.06748.pdf. The Prime Video App commences streaming of the encoded media in its first operational phase (switching State from “UNINITIALIZED” to “LOW_TRANSIENT”) utilizing a first set of stream switching conditions and requests portions of the encoded media from one of the plurality of alternative streams encoded at a specified maximum bitrate. <pre> Ln 3377: 07-08 21:30:04.825 1345 3971 I AmazonVideo: Starting ContentSession for VideoSpecification ... c9e8b7_corrected.mpd ... Ln 3382: 07-08 21:30:04.838 1345 3934 I AmazonVideo: DownloadRequest downloading url: ... c9e8b7_corrected.mpd ... Ln 3424: 07-08 21:30:04.986 1345 3971 I AmazonVideo: HeuristicAlgorithm - selecting BOLA_V1 for Feature/STREAMING Ln 3445: 07-08 21:30:04.998 1345 3971 I platform-utils: processState(): BolaTransient UNINITIALIZED --> LOW_TRANSIENT Ln 3449: 07-08 21:30:04.999 1345 3971 I platform-utils: calculateTransientBufferDuration(): BOLA calculateTransientBufferDuration desiredStartupBitrate 2700000 MIndex 12 MBitrate 3500000 NIndex 11 NBitrate 2250000 Ln 3450: 07-08 21:30:04.999 1345 3971 I platform-utils: calculateTransientBufferDuration(): BOLA calculateTransientBufferDuration transientBufferNumMComponent 102976662.742569 transientBufferNumNComponent 67689503.062802, transientBufferNum 35287159.679767 transientBufferDen 312500.000000 transientBuffer 113.018911 Ln 3451: 07-08 21:30:04.999 1345 3971 I platform-utils: initializeTransientBufferDuration(): BolaTransient init LOW_TRANSIENT TransientBufferSeconds 113.02 Line 3453: 07-08 21:30:05.012 1345 3971 I platform-utils: submitDownloadRequests(): BOLA Video requested download FragmentIndex 0, bitrateMbps 2.25, timeoutMillis 9000, State LOW_TRANSIENT, ... </pre>

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	<pre> Line 3455: 07-08 21:30:05.016 1345 3945 I AmazonVideo: DownloadRequest downloading url: c9e8b7_video_11.mp4 headers: {Range=bytes=20708-157155} expectedSizeKB: 133 timeoutMillis: 9000 Ln 3455: 07-08 21:30:05.016 1345 3945 I AmazonVideo: DownloadRequest downloading url: ... c9e8b7_video_11.mp4 ... Ln 3460: 07-08 21:30:05.019 1345 3971 I platform-utils: calculateTransientBufferDuration(): ... Ln 3462: 07-08 21:30:05.019 1345 3971 I platform-utils: initializeTransientBufferDuration(): ... Ln 3543: 07-08 21:30:05.267 1345 3980 I platform-utils: onDownloadComplete(): BolaTransient OnDownloadComplete transientBufferSeconds 113.751, realBufferSeconds 2.000 Ln 3544: 07-08 21:30:05.268 1345 3980 I platform-utils: reportDownloadProgress(): BOLA Video completed request FragmentInfo{fragmentIndex: 0, timeAllowedMillis: 9000, sizeInBytes: 136448, bytesDownloaded: 136448} Reason: DOWNLOAD_STATUS_SUCCESS, BufferSeconds 2.00, elapsedMillis 255, StallMillis 0.00 </pre> Source: Excerpt of log file during playback of <i>Galapagos: Real of Giant Sharks</i> downloaded using the Prime Video App on a Fire TV Stick, taken by, or on behalf of, DivX. After each portion of encoded media is downloaded while in the first operational phase, the Prime Video App calls onDownloadComplete to determine when the phase transition criterion is satisfied by the measured streaming conditions. That function calls calculateEffectiveBufferDurationSeconds to determine whether the BolaTransient real buffer exceeds the threshold. If the BolaTransient real buffer exceeds the threshold, then processState is called to change the State. As shown in the log file below, when the BolaTransient real buffer exceeds the threshold in LOW_TRANSIENT, processState transitions from LOW_TRANSIENT to TRANSIENT. And when the BolaTransient real buffer exceeds the threshold in TRANSIENT, processState transitions from TRANSIENT to STEADY. <pre> 07-08 21:30:14.293 1345 4040 I platform-utils: onDownloadComplete(): BolaTransient OnDownloadComplete transientBufferSeconds 119.700, realBufferSeconds 60.889 </pre>

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	07-08 21:30:14.293 1345 4040 I platform-utils: reportDownloadProgress(): BOLA Video completed request FragmentInfo {fragmentIndex: 32, timeAllowedMillis: 7600, sizeInBytes: 2325626, bytesDownloaded: 2325626} Reason: DOWNLOAD_STATUS_SUCCESS, BufferSeconds 60.89, elapsedMillis 520, StallMillis 0.00 07-08 21:30:14.294 1345 4040 I platform-utils: calculateEffectiveBufferDurationSeconds(): BolaTransient real buffer 60.888744 sec >= threshold 60.000000 sec 07-08 21:30:14.294 1345 4040 I platform-utils: processState(): BolaTransient LOW_TRANSIENT --> TRANSIENT ... Line 8582: 07-08 21:30:30.591 1345 3987 I platform-utils: calculateEffectiveBufferDurationSeconds(): BolaTransient real buffer 118.585501 sec > transient buffer 116.916494 sec Line 8583: 07-08 21:30:30.591 1345 3987 I platform-utils: processState(): BolaTransient TRANSIENT --> STEADY Source: Excerpt of log file during playback of <i>Galapagos: Real of Giant Sharks</i> downloaded using the Prime Video App on a Fire TV Stick, taken by, or on behalf of, DivX.
1bvi. transition to a second operational phase utilizing a second set of stream switching conditions in response to the determination that the at least one transition criterion is satisfied;	The Amazon Fire Stick, as exemplary of all Amazon Accused Products, , “transition[s] to a second operational phase utilizing a second set of stream switching conditions in response to the determination that the at least one transition criterion is satisfied.” As discussed in claim element [1bv], the exemplary Fire Stick running the preinstalled Prime Video App, determines when a transition criteria is satisfied. The Prime Video App’s implementation of the BOLA algorithm transitions from a startup operational phase (LOW_TRANSIENT and/or TRANSIENT) where “[l]ower bitrate segments are preferred until the buffer level reaches [a] steady state” operational phase (STEADY). <i>See</i> K. Spiteri, R. Urgaonkar and R. K. Sitaraman, “BOLA: Near-optimal bitrate adaptation for online videos,” IEEE INFOCOM 2016 - The 35th Annual IEEE International Conference on Computer Communications, 2016, pp. 1-9, doi: 10.1109/INFOCOM.2016.7524428, available at https://arxiv.org/pdf/1601.06748.pdf.

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	After each portion of encoded media is downloaded while in the first operational phase, the Prime Video App call onDownloadComplete to determine when the phase transition criterion is satisfied by the measured streaming conditions. That function calls calculateEffectiveBufferDurationSeconds to determine whether the BolaTransient real buffer exceeds the threshold. If the BolaTransient real buffer exceeds the threshold, then processState is called to change the State. As shown in the log file below, when the BolaTransient real buffer exceeds the threshold in LOW_TRANSIENT, processState transitions from LOW_TRANSIENT to TRANSIENT. And when the BolaTransient real buffer exceeds the threshold in TRANSIENT, processState transitions from TRANSIENT to STEADY. <pre> 07-08 21:30:14.293 1345 4040 I platform-utils: onDownloadComplete(): BolaTransient OnDownloadComplete transientBufferSeconds 119.700, realBufferSeconds 60.889 07-08 21:30:14.293 1345 4040 I platform-utils: reportDownloadProgress(): BOLA Video completed request FragmentInfo{fragmentIndex: 32, timeAllowedMillis: 7600, sizeInBytes: 2325626, bytesDownloaded: 2325626} Reason: DOWNLOAD_STATUS_SUCCESS, BufferSeconds 60.89, elapsedMillis 520, StallMillis 0.00 07-08 21:30:14.294 1345 4040 I platform-utils: calculateEffectiveBufferDurationSeconds(): BolaTransient real buffer 60.888744 sec >= threshold 60.000000 sec 07-08 21:30:14.294 1345 4040 I platform-utils: processState(): BolaTransient LOW_TRANSIENT --> TRANSIENT ... Line 8582: 07-08 21:30:30.591 1345 3987 I platform-utils: calculateEffectiveBufferDurationSeconds(): BolaTransient real buffer 118.585501 sec > transient buffer 116.916494 sec Line 8583: 07-08 21:30:30.591 1345 3987 I platform-utils: processState(): BolaTransient TRANSIENT --> STEADY </pre> Source: Excerpt of log file during playback of <i>Galapagos: Real of Giant Sharks</i> downloaded using the Prime Video App on a Fire TV Stick, taken by, or on behalf of, DivX.
1bvii. determine when the second set of stream switching conditions is	The Amazon Fire Stick, as exemplary of all Amazon Accused Products, , “determine[s] when the second set of stream switching conditions is satisfied in the second operational phase by the measured streaming conditions.”

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satisfied in the second operational phase by the measured streaming conditions; and	The log file shows the use of getBolaBitRate to measure streaming conditions and determine when the second set of stream switching conditions are satisfied while in the second operational phase (State STEADY), after which submitDownloadRequests requests the corresponding portions of the encoded media. In the second operational phase (State STEADY), the Prime Video App no longer evaluates the onDownloadComplete function which is used to determine when a phase transition criterion is satisfied by the measured streaming conditions. The Prime Video App uses getBolaBitRate which uses values for BufferDurationSec, ParamV/Gamma, BitRate/GoodnessValue to determine when the second set of stream switching conditions are satisfied in the second operational phase based on the requirements of the second operational phase (State STEADY). <pre> 07-08 21:30:38.945 1345 4039 I platform-utils: reportDownloadProgress(): BOLA Video completed request FragmentInfo{fragmentIndex: 71, timeAllowedMillis: 9000, sizeInBytes: 145898, bytesDownloaded: 145898} Reason: DOWNLOAD_STATUS_SUCCESS, BufferSeconds 114.23, elapsedMillis 88, StallMillis 0.00 07-08 21:30:38.945 1345 4039 I platform-utils: getBolaBitRate(): getBolaBitRate FragmentIndex 72 SelectedBitrate 3.50 mbps Note: BufferDurationSec 114.226 ParamV/Gamma 5.996/15.821 BitRate/GoodnessValue 0.05MB/-0.001549110 0.08MB/- 0.000903075 0.12MB/-0.000470482 0.20MB/-0.000221030 0.30MB/-0.000114937 0.45MB/- 0.000055014 0.65MB/-0.000024518 1.00MB/-0.000005605 1.30MB/0.000000529 1.90MB/0.000005153 1.95MB/0.000005340 2.25MB/0.000006153 3.50MB/0.000006984 5.00MB/0.000006599 9.00MB/0.000005233 optimalValue 0.000006984 idealGoodnessValue 0.000006914 07-08 21:30:38.946 1345 4039 I platform-utils: submitDownloadRequests(): BOLA Video requested download FragmentIndex 72, bitrateMbps 3.50, timeoutMillis 9000, State STEADY, BufferSec:(Compensated 114.23, Effective 114.23, Real 114.23, Stall 0.00), maxBufferSec 126.00 07-08 21:30:38.947 1345 3936 I AmazonVideo: DownloadRequest downloading url: https://s3-iad-2.cf.dash.row.aiv- cdn.net/dm/2\$dhmHxfMusuELmNyJ0Uu3RaaNj90~/1@4e8b31487b9b53cac961fa613053de 09/a756/fee8/2a87/4906-a22d- d82f20259a1d/2@AgBgAAACAAAKHIAbECpCMBv5Uw==/135188b2-a258-447b-8ffe- </pre>

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	27bcd9c9e8b7_video_13.mp4 headers: {Range=bytes=52083431-52242393} expectedSizeKB: 155 timeoutMillis: 9000 07-08 21:30:38.965 4306 4435 I WhisperLink: JmdnsManager - Creating or resetting service for Description: Description(sid:amzn.dmgr, friendlyName:null, accessLevel:0, security:0, flags:0, version:2, minSupportedVersion:2); 07-08 21:30:38.993 318 506 D AudioFlinger: mixer(0xa5d83480) throttle end: throttle time(24) 07-08 21:30:39.003 4306 4435 I WhisperLink: AndroidMdnsUtil - Secure port compiled from device :43924; 07-08 21:30:39.005 1333 1351 I .client.metric: Background concurrent copying GC freed 5028(406KB) AllocSpace objects, 2(104KB) LOS objects, 18% free, 2MB/2MB, paused 168us total 592.334ms 07-08 21:30:39.034 1345 3936 I : T3936: AIVDashFragmentJNI::Java_com_amazon_avod_smoothstream_dash_Mp4FragmentJni_parse: Parsing fragment (size 158963) 07-08 21:30:39.042 1345 4040 I platform-utils: reportDownloadProgress(): BOLA Video completed request FragmentInfo{fragmentIndex: 72, timeAllowedMillis: 9000, sizeInBytes: 158963, bytesDownloaded: 158963} Reason: DOWNLOAD_STATUS_SUCCESS, BufferSeconds 116.13, elapsedMillis 95, StallMillis 0.00 07-08 21:30:39.042 1345 4040 I platform-utils: getBolaBitRate(): getBolaBitRate FragmentIndex 73 SelectedBitrate 5.00 mbps Note: BufferDurationSec 116.128 ParamV/Gamma 5.996/15.821 BitRate/GoodnessValue 0.05MB/-0.001701264 0.08MB/-0.001004511 0.12MB/-0.000533880 0.20MB/-0.000259068 0.30MB/-0.000140296 0.45MB/-0.000071920 0.65MB/-0.000036222 1.00MB/-0.000013212 1.30MB/-0.000005323 1.90MB/0.000001149 1.95MB/0.000001439 2.25MB/0.000002772 3.50MB/0.000004810 5.00MB/0.000005078 9.00MB/0.000004387 optimalValue 0.000005078 idealGoodnessValue 0.000005027 07-08 21:30:39.052 1345 4040 I platform-utils: submitDownloadRequests(): BOLA Video requested download FragmentIndex 73, bitrateMbps 5.00, timeoutMillis 9000, State STEADY, BufferSec:(Compensated 116.13, Effective 116.13, Real 116.13, Stall 0.01), maxBufferSec 126.00

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	07-08 21:30:39.052 1345 3950 I AmazonVideo: DownloadRequest downloading url: https://s3-iad-2.cf.dash.row.aiv-cdn.net/dm/2\$dhmHxfMusuELmNyJ0Uu3RaaNj90~/1@4e8b31487b9b53cac961fa613053de09/a756/fee8/2a87/4906-a22d-d82f20259a1d/2@AgBgAAACAAAKHGAIWoOCUBv5Uw==/135188b2-a258-447b-8ffe-27bcd9c9e8b7_video_14.mp4 headers: {Range=bytes=70326085-70526901} expectedSizeKB: 196 timeoutMillis: 9000 Source: Excerpt of log file during playback of <i>Galapagos: Real of Giant Sharks</i> downloaded using the Prime Video App on a Fire TV Stick, taken by, or on behalf of, DivX.
1bviii. request portions of the encoded media from another one of the plurality of alternative streams encoded at a maximum bitrate that is different from the current maximum bitrate in response to the determination that the second set of stream switching conditions are satisfied.	The Amazon Fire Stick, as exemplary of all Amazon Accused Products, “request[s] portions of the encoded media from another one of the plurality of alternative streams encoded at a maximum bitrate that is different from the current maximum bitrate in response to the determination that the second set of stream switching conditions are satisfied.” As discussed in claim element [1bvii], the exemplary Fire Stick running the preinstalled Prime Video App, determines when a second set of streaming conditions are satisfied. The log file shows the use of getBolaBitRate to determine when the second set of stream switching conditions are satisfied, after which submitDownloadRequests requests the corresponding portions of the encoded media. Network traffic monitoring from log file shows, for example, requesting “_video_14” corresponding to a SelectedBitrate of 5.00 mbps for FragmentIndex 73 after previously requesting “_video_14” corresponding to a SelectedBitrate of 3.50 mbps for FragmentIndex 72 based on a determination that the second set of stream switching conditions are satisfied during playback of <i>Galapagos: Real of Giant Sharks</i> downloaded using the Prime Video App on a Fire TV Stick. 07-08 21:30:38.945 1345 4039 I platform-utils: reportDownloadProgress(): BOLA Video completed request FragmentInfo{fragmentIndex: 71, timeAllowedMillis: 9000, sizeInBytes: 145898, bytesDownloaded: 145898} Reason: DOWNLOAD_STATUS_SUCCESS, BufferSeconds 114.23, elapsedMillis 88, StallMillis 0.00 07-08 21:30:38.945 1345 4039 I platform-utils: getBolaBitRate(): getBolaBitRate FragmentIndex 72 SelectedBitrate 3.50 mbps Note: BufferDurationSec 114.226

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	ParamV/Gamma 5.996/15.821 BitRate/GoodnessValue 0.05MB/-0.001549110 0.08MB/-0.000903075 0.12MB/-0.000470482 0.20MB/-0.000221030 0.30MB/-0.000114937 0.45MB/-0.000055014 0.65MB/-0.000024518 1.00MB/-0.000005605 1.30MB/0.000000529 1.90MB/0.000005153 1.95MB/0.000005340 2.25MB/0.000006153 3.50MB/0.000006984 5.00MB/0.000006599 9.00MB/0.000005233 optimalValue 0.000006984 idealGoodnessValue 0.000006914 07-08 21:30:38.946 1345 4039 I platform-utils: submitDownloadRequests(): BOLA Video requested download FragmentIndex 72, bitrateMbps 3.50, timeoutMillis 9000, State STEADY, BufferSec:(Compensated 114.23, Effective 114.23, Real 114.23, Stall 0.00), maxBufferSec 126.00 07-08 21:30:38.947 1345 3936 I AmazonVideo: DownloadRequest downloading url: https://s3-iad-2.cf.dash.row.aiv-cdn.net/dm/2\$dhmHxfMusuELmNyJ0Uu3RaaNj90~/1@4e8b31487b9b53cac961fa613053de09/a756/fee8/2a87/4906-a22d-d82f20259a1d/2@AgBgAAACAAAKHIAbECpCMBv5Uw==/135188b2-a258-447b-8ffe-27bcd9c9e8b7_video_13.mp4 headers: {Range=bytes=52083431-52242393} expectedSizeKB: 155 timeoutMillis: 9000 07-08 21:30:38.965 4306 4435 I WhisperLink: JmdnsManager - Creating or resetting service for Description: Description(sid:amzn.dmgr, friendlyName:null, accessLevel:0, security:0, flags:0, version:2, minSupportedVersion:2); 07-08 21:30:38.993 318 506 D AudioFlinger: mixer(0xa5d83480) throttle end: throttle time(24) 07-08 21:30:39.003 4306 4435 I WhisperLink: AndroidMdnsUtil - Secure port compiled from device :43924; 07-08 21:30:39.005 1333 1351 I .client.metric: Background concurrent copying GC freed 5028(406KB) AllocSpace objects, 2(104KB) LOS objects, 18% free, 2MB/2MB, paused 168us total 592.334ms 07-08 21:30:39.034 1345 3936 I : T3936: AIVDashFragmentJNI::Java_com_amazon_avod_smoothstream_dash_Mp4FragmentJni_parse: Parsing fragment (size 158963) 07-08 21:30:39.042 1345 4040 I platform-utils: reportDownloadProgress(): BOLA Video completed request FragmentInfo{fragmentIndex: 72, timeAllowedMillis: 9000, sizeInBytes:

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	158963, bytesDownloaded: 158963} Reason: DOWNLOAD_STATUS_SUCCESS, BufferSeconds 116.13, elapsedMillis 95, StallMillis 0.00 07-08 21:30:39.042 1345 4040 I platform-utils: getBolaBitRate(): getBolaBitRate FragmentIndex 73 SelectedBitrate 5.00 mbps Note: BufferDurationSec 116.128 ParamV/Gamma 5.996/15.821 BitRate/GoodnessValue 0.05MB/-0.001701264 0.08MB/-0.001004511 0.12MB/-0.000533880 0.20MB/-0.000259068 0.30MB/-0.000140296 0.45MB/-0.000071920 0.65MB/-0.000036222 1.00MB/-0.000013212 1.30MB/-0.000005323 1.90MB/0.000001149 1.95MB/0.000001439 2.25MB/0.000002772 3.50MB/0.000004810 5.00MB/0.000005078 9.00MB/0.000004387 optimalValue 0.000005078 idealGoodnessValue 0.000005027 07-08 21:30:39.052 1345 4040 I platform-utils: submitDownloadRequests(): BOLA Video requested download FragmentIndex 73, bitrateMbps 5.00, timeoutMillis 9000, State STEADY, BufferSec:(Compensated 116.13, Effective 116.13, Real 116.13, Stall 0.01), maxBufferSec 126.00 07-08 21:30:39.052 1345 3950 I AmazonVideo: DownloadRequest downloading url: https://s3-iad-2.cf.dash.row.aiv-cdn.net/dm/2\$dhmHxfMusuELmNyJ0Uu3RaaNj90~/1@4e8b31487b9b53cac961fa613053de09/a756/fee8/2a87/4906-a22d-d82f20259a1d/2@AgBgAAACAAAKHGAIWoOCUBv5Uw==/135188b2-a258-447b-8ffe-27bcd9c9e8b7_video_14.mp4 headers: {Range=bytes=70326085-70526901} expectedSizeKB: 196 timeoutMillis: 9000 Source: Excerpt of log file during playback of <i>Galapagos: Real of Giant Sharks</i> downloaded using the Prime Video App on a Fire TV Stick, taken by, or on behalf of, DivX.