BITMOVIN

WHITEPAPER

The Cost of Errors

How to reduce churn with granular data in video analytics

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Setting the stage for streaming improvements

Streaming is evolving and improving, but errors are constant

Despite the negative global impact Covid-19 had on many industries, 2020 saw an assortment of new and exciting streaming services emerge, ready to dazzle consumers with a plethora of new content and services in the OTT streaming market. However these new products and services weren't without issues, resulting in countless errors, frustrating end-users and damaging brand reputations on a global scale. Errors in streaming are nothing new, nor will they disappear entirely in the foreseeable future. As with any new product or service, the race to get new OTT video services in market means that there isn't always the time or resources to properly debug and fix errors before release and oftentimes these problems are outside the content provider's control.

Ultimately, every platform has a certain "noise" of errors, and it's absolutely critical to know what exactly is going on so that the streaming service in question can mitigate these errors quickly, and help prevent their occurrence in the future. If not, these errors will become expensive very quickly, thus reducing your error rate and instead of only reacting to errors that occur can bring significant dollar returns both for AVOD and SVOD services.

This whitepaper will show how errors can have an impact on an organization's top-line, how to calculate the cost of an error, as well how to equip technical teams with the right information to help them solve errors faster and decisively.

Audiences that expect better

The gradual adoption of internet-based streaming services by the general population exploded exponentially in 2020. Digital natives (from millennials and early adopters in older generations onwards) are more accustomed to errors throughout their browsing and streaming experiences, as they developed alongside these services and might have a higher "error-threshold" than streaming newcomers (older generations and Gen Z); who may have a lower error-threshold due to their experience with low error applications and/or standard broadcast streaming services, that rarely suffer from things like buffering or connectivity issues.

While the exact value of a consumer "acceptance of error" threshold is something that needs more detailed investigation, the cost of an error (as it applies to consumer churn) can be determined by assuming an error threshold based on other data points.

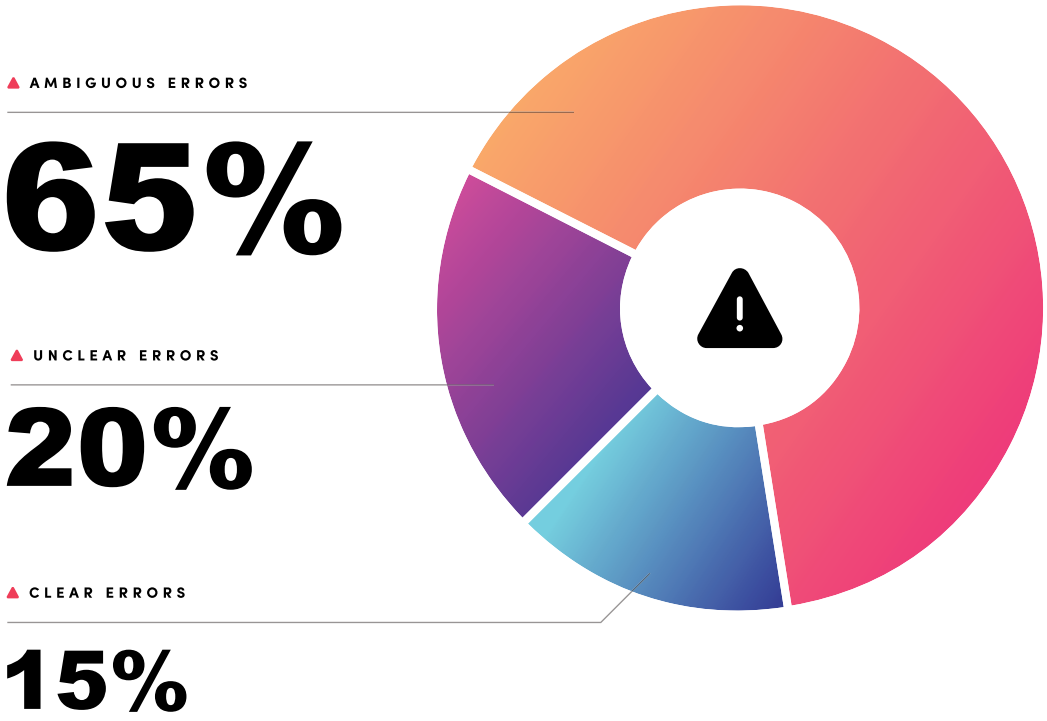
For the purpose of identifying a finite and repeatable calculation, this paper assumes that only errors, such as start or in-stream failures, contribute to the frustration of the user (factors such as content, device reach, or cost of service are not considered). Other issues include repeated buffering (rebuffering), and slow startup times as contributing factors of technical frustration for end-users.

Errors come in all shapes, colors, and values

Much like all web-based services and/or pages, and regardless of the back-end video player(s) that an organization uses to power their service or platform, errors are always displayed using an error code that typically comes with a specific error message (e.g.: 404 - "Page not found"). However, the level of detail that derives from the code and message is very dependent on the documentation that comes with any commercial, native, or open-source player. All video streaming error messages can be sorted into one of three categories:

- **Clear** - The error and message point to a specific and identifiable error behavior.
- **Ambiguous** - Often indicated with a "catch-all" message, these error types can be attributed to many different types of error behavior. Although error origin is provided, there is no specific or identifiable behavior(s) subsumed under that error.
- **Unclear** - As the name suggests, these errors are completely uninformative and often read as "Unknown", "Null", or something similar.

An analysis of the Bitmovin Analytics database indicated that the distribution of error messages and codes were broken down as follows:

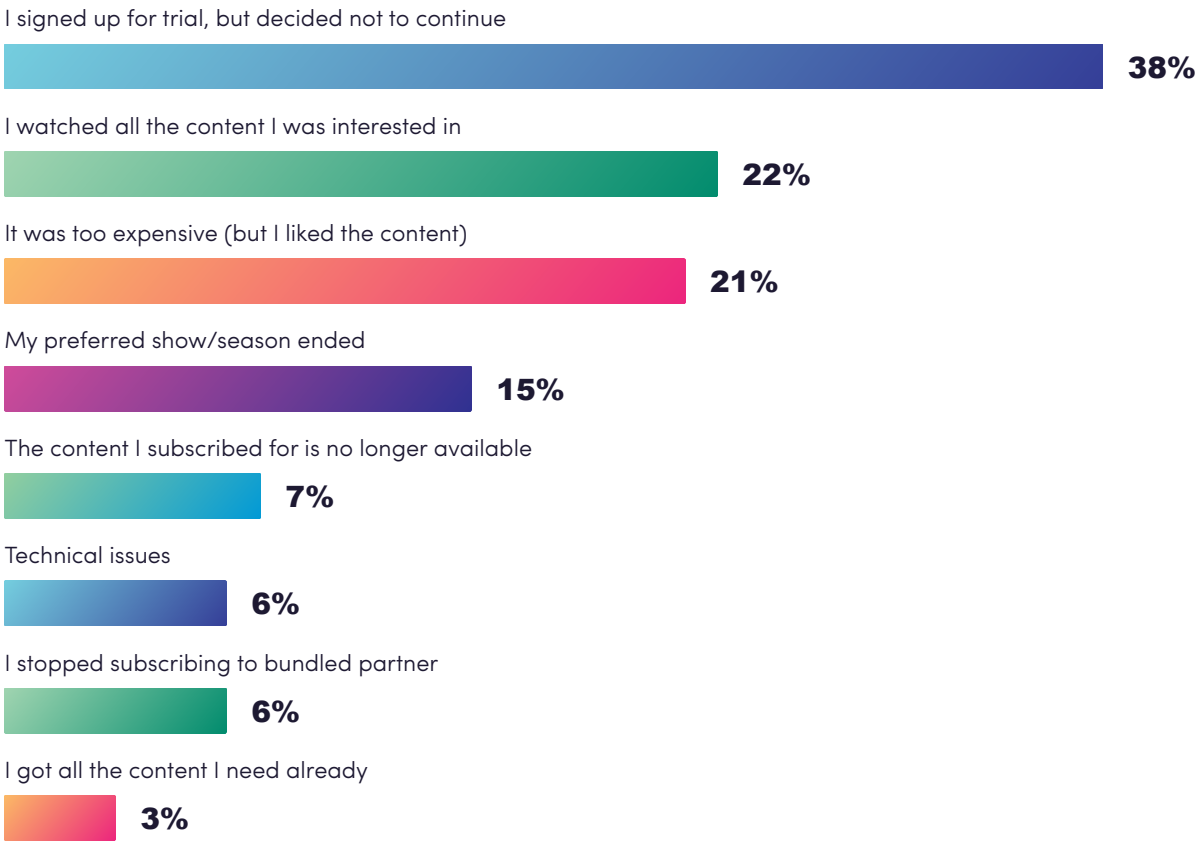


It's important to note that some of the categorizations can be debated based on other contributing factors. Even so, the most striking takeaway is that 20% of errors are identified as "unclear". Unclear errors are often the most costly to resolve as they cannot be debugged by simply looking at the message and code, and will need significant engineering or solutions resources to resolve. Even the best video player documentation will not help. Given the severity and volume of the unclear category, it will be the primary value when calculating the cost of errors and the potential monetary savings that would result from properly identifying unclear errors.

The cost of errors in video streaming

Effects on subscription video streaming (SVOD)

In a recent study and article, streaming service Vimeo released the following numbers that define the various reasons for subscriber churn for SVOD OTT services.



These results are based on a multiple-selection survey, and therefore add up to more than 100%. However, as each statement is treated as an "and" response, selections such as "technical issues" are considered churn rate for the purposes of this paper's calculations. Given that the other reasons are based on cost and/or content, therefore, the assumption is that errors (or technical reasons) attribute towards 6% of churn rate. According to the same report from Vimeo, the average revenue per user (ARPU) across all SVOD service types is approx. $15.

TYPE	LTV	ARPU
Broad Entertainment	**$21**	**$5.98**
Niche Entertainment	**$50**	**$6.30**
Faith	**$213**	**$17.02**
Fitness	**$212**	**$16.92**
Instructional	**$464**	**$45.91**
Kids	**$78**	**$6.99**
News	**$66**	**$5.48**
Sports	**$78**	**$9.86**

So, with an ARPU of $15, and an assumptive $15 subscription price/service the calculated customer lifetime value (LTV) with a 6% churn rate is $250 or 500 days[1]. The next logical step is to determine how to increase the average customers' LTV. According to the Bitmovin Analytics industry insights benchmarking data, OTT providers are experiencing a 6.6% error rate across their services.

Based on data points from the "best-in-class" SVOD services using the Bitmovin dashboard, an individual subscriber (or household) attempts 150 plays/month, resulting in 0.33 errors per day. Over an average consumer's service lifetime, this adds up to an error acceptance threshold of 165 errors over the period of 500 days[2].

Formula - Possible LTV increase through error % decrease

$$\left(\begin{array}{c}\#\ of\ errors\\ over\ LTV\end{array} - \left(\begin{array}{c}\#\ of\ errors\\ over\ LTV\end{array} \times \left(1 - \begin{array}{c}Target\ error\\ decrease\end{array}\right)\right)\right) \times \frac{errors\ per\ day}{LTV}$$

In a perfect world, if a streaming service could remove 10% of their "unclear" or "ambiguous" errors with more accurate information the customer lifetime would increase by 5 days or 1.1%. In monetary terms: By reducing errors by 10% for an SVOD service with 1M subscribers and a $15/month subscription fee, the 5 days increased in lifetime value for the technical churner segment would result in an estimated revenue increase of $160,000.

[1] LTV Formula: ARPU/Churn Rate/Subscription Price*30 days

[2] For the sake of the calculation we assumed only that errors (start failure, in stream failures) contribute to the frustration of the user. Obviously other issues like repeated buffering (eventually resulting in an error) and slow startup times also contribute heavily to the technical frustration of the user.

Effects on ad-based video streaming (AVOD)

Given that there is a full set of additional elements within an advertising-supported video platform to support ad insertions and content protection - there are different error types that come into play, thus a different error calculation model is necessary. The AVOD cost of error model is based on research from S. Shunmuga Krishnan and Ramesh K. Sitaraman who found that viewers that experienced any interruptions to their streaming service were 2.32% less likely to revisit the video platform than a viewer who did not experience interruptions. This additional data point is especially important for AVOD services that depend on maximizing viewership, and thus the number of ads served, through driving regular consumption of their content.

Based on the Bitmovin Analytics platform for AVOD services, 25-50% of users visit the site or service weekly (recurring users), and each unique user generates around 1.5 plays per week, and AVOD platforms serve around 2 ads/play. At the time of this whitepaper's publication, the price per 1000 ad plays (CPM) for premium content was around $60 and had an upward trend in price in upscale markets such as Germany. In the scenario where a service maintains a 30% recurring viewership and stands to lose ad revenue from 2.32% unique viewers that experience start or in-stream failures, the service would incur a cost of $1.25 per 1000 errors.

Formula - Cost per AVOD Error

$$\textit{plays per Unique} \times \text{CPM} \times \textit{ads per play} \times \textit{recurring viewers} \times \textit{\% less likely to return}$$

LTV increased by

1%

with each 10% error decrease (for subscribers who churn for technical reasons)

Cost per 1000 errors in AVOD

$1 - $3

per 1000 errors

Applied at scale and applying the 6.6% error rate from Bitmovin Analytics industry insights for a service experiencing 25M play attempts per week, this error rate would result in an estimated revenue loss of $3,445/week. Unfortunately, removing all errors is not a likely scenario, however, but in this case, reducing the error percentage by 20% already results in a $35,000 revenue increase.

It's important to note that costs for both SVOD and AVOD errors are highly variable based on the input values (subscription fee, error rate, subscriber count, etc). To find out the potential monetary impact of reducing errors for your specific use case, please visit our calculator at the following link:

https://bitmovin.com/demos/cost-of-errors

How to tackle unknown errors

Now that the cost of unresolved ambiguous and unclear errors has been established, it's time to address how to resolve them efficiently to significantly reduce potential revenue loss. Given that "clear" errors are easily resolved, it stands to reason that more information around each error type will reduce the complexity of finding solutions. To begin, one should check the timeline of the errors - do they correlate with spikes from due events, streams, or regional outages?

The next step is to examine the error percentages that a service experiences, followed by top error codes. Patterns such as recurring error codes can provide much-needed context, like affected device types or regions. This is Bitmovin's methodology of error assessment and reporting known as Top-Down Error reporting, wherein the bigger picture is examined, followed by reviewing more and more granular analytics. In the case of unclear or ambiguous error codes/messages, one can expect to use some of the most granular analytics to fill in the gaps of missing information.
At the bottom of the analysis funnel there are four potential steps one can take (depending on the resolution of unknown information):

1. **Look at the error session**
2. **Assess the error details**
3. **Review app/web stack traces**
4. **Evaluate segment information**

Looking at error sessions

The first step to clearing out any unknowns or ambiguity is to assess a sample set of sessions on a higher level through a basic table that may identify the root cause of an issue.

The Bitmovin Analytics dashboard breaks down the potential root cause by videoTitle, browser, domain, and/or operating systems.

However, if high-level root cause information isn't enough to find a resolution, the next step is to assess the error details at the session-level.

Last Error Impressions

Time	Page	Video	Operating System	Browser	Error Code
04/23/2019, 00:09:53		Video 2	Windows	Chrome	1208
04/22/2019, 23:43:15	test	Video 10	Mac OS X	Firefox	1208
04/22/2019, 22:46:35		Video 1	Mac OS X	Firefox	1208
04/22/2019, 22:43:29	demo	Video 4	iOS	Chrome	1208
04/22/2019, 16:48:29	demo	Video 4	iOS	Chrome	1208
04/22/2019, 16:28:40	demo	Video 1	Windows	Chrome	1208
04/22/2019, 15:53:46	sample	Video 5	Windows	Mobile Safari	1208
04/22/2019, 14:50:28	demo	Video 3	Mac OS X	Chrome	1208
04/22/2019, 14:10:43	demo	Video 5	iOS	Chrome Mobile	1208
04/22/2019, 13:28:50	test	Video 3	Windows	Chrome	1208
04/22/2019, 12:37:38	test	Video 2	Mac OS X	Safari	1208
04/22/2019, 11:04:12		Video 10	iOS	Chrome	1208
04/22/2019, 10:28:46	sample	Video 7	Windows	Edge	1208
04/22/2019, 09:59:09	demo	Video 3	Android	Firefox	1208
04/22/2019, 09:48:12	demo	Video 4	Tizen	Chrome	1208
04/22/2019, 08:54:07		Video 1	Tizen	Firefox	1208
04/22/2019, 08:21:02	demo	Video 8	Windows	Chrome	1208
04/22/2019, 07:38:28	demo	Video 2	iOS	Opera	1208
04/22/2019, 06:51:57	demo	Video 6	iOS	Chrome	1208
04/22/2019, 00:38:21		Video 1	iOS	Chrome	1208

Fig.1 Analytics Dashboard

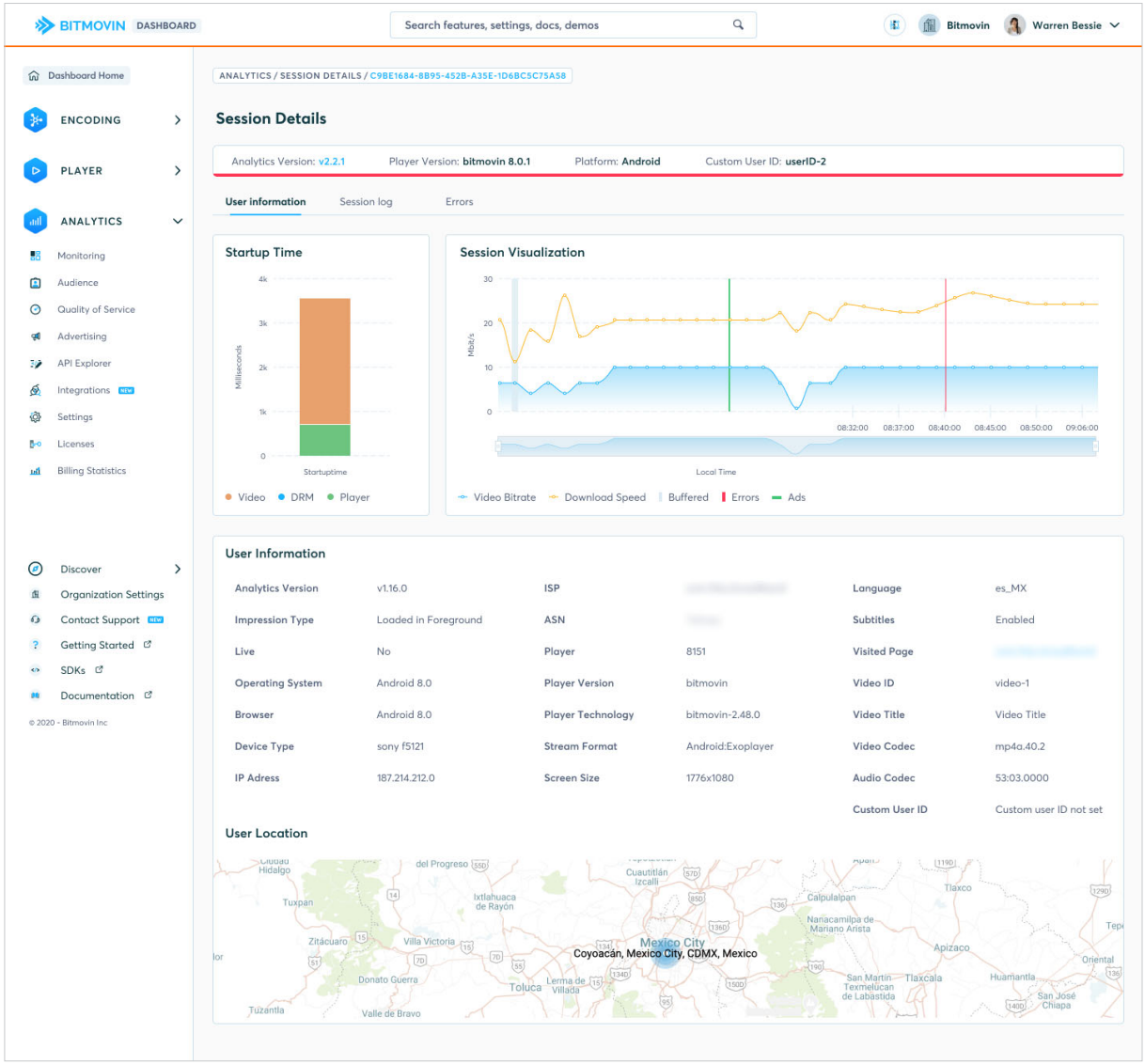


Fig 2. Bitmovin Analytics - Session Visualization

Assessing error details

Individual session assessments for errors will provide more clarity, especially for in-stream errors. A sample of the issues that session-level details provide include: available user bandwidth, video quality consistency, and/or frequency and severity of buffering penultimate error session. Knowing this information will help determine if the issues are ongoing or based on spikes or if the issue is sourced from the service vs external factors. The combination of these factors will provide a clearer understanding of why, how, and where each error occurred. However, there is always a chance that the error remains unclear, so what are the other factors that need to be considered?

Stack traces

The next level of analysis includes a deep dive into the stack traces of a web or app, this is especially applicable in scenarios that fit multiple potential issues within a singular error code/ message. The added information of stack traces through Bitmovin's Analytics defines the origins of many unknown codes/errors, thus taking the anonymity out of the source error and mapping it to an actual cause.

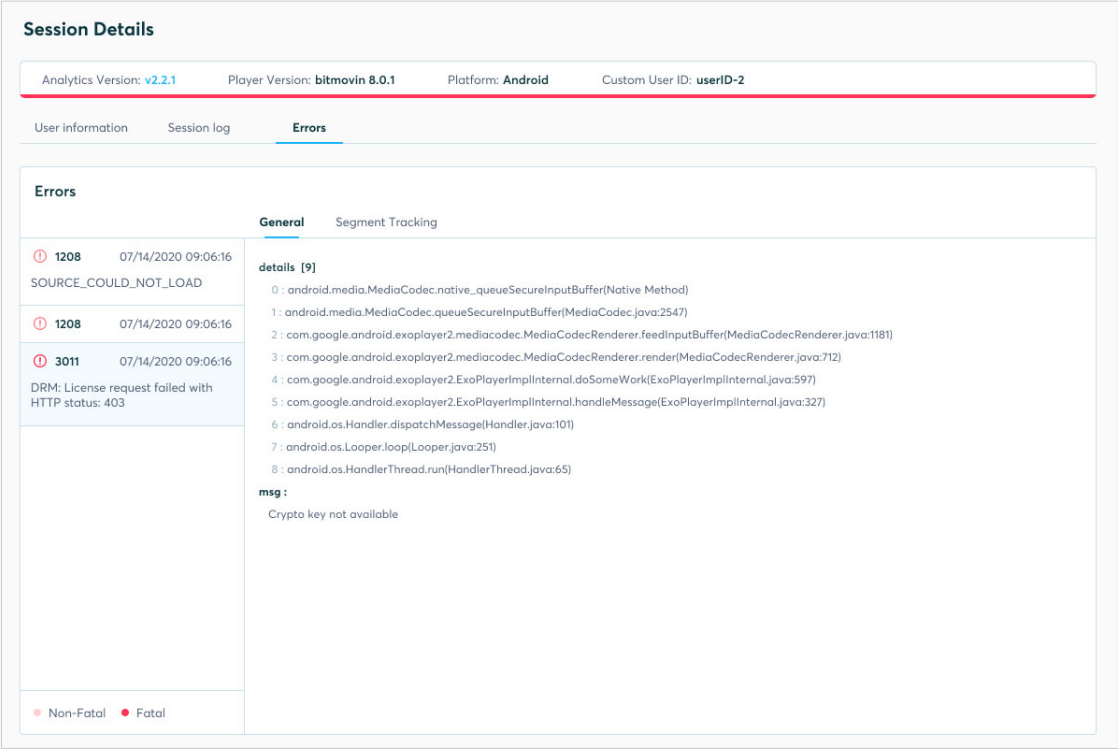
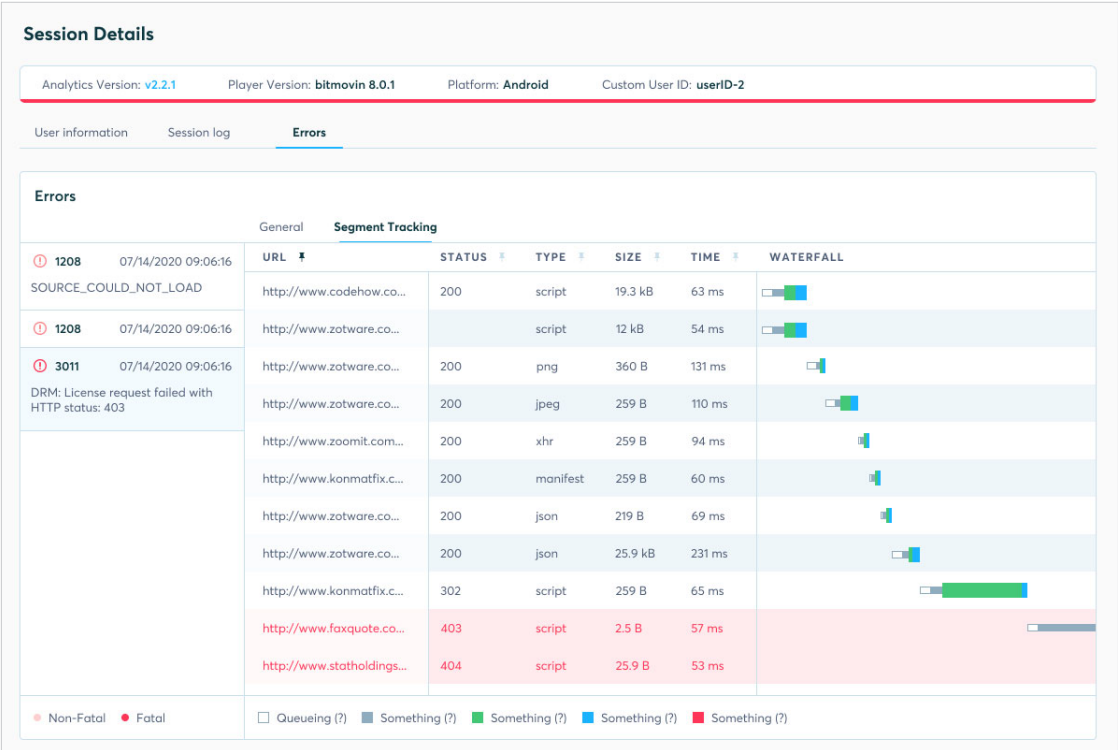


Fig 3. Example of stack traces for Android.

Segment information

The final granular piece of information that one can evaluate to determine the root cause of issues is to review where the error occurred within the video, especially which segments produced the error – this can be especially helpful with source errors. This can be displayed with additional information one could surmise the root cause from.



If an error is identified within a specific range of segments additional data such as “HTTP status”, “type” “download speed”, “time to first byte”, and/or “size” for each segment around the error is visualized. Some use cases include:

- **504 HTTP status code** - There was a problem with the CDN origin server
- **Time to the first byte is very high** - there may be a problem with the general network

With all compiled information and identified patterns, it becomes much easier to identify, resolve, and prevent the costly ambiguous and/or unclear errors.

The critical importance of data granularity

Technical errors within a streaming platform account for a fairly sizable portion of consumer churn with nearly 6% of viewers dropping a service due to a variety of issues that they might experience. Unfortunately, only about 15% of these issues are objectively easy to resolve, while the remaining 85% require additional investigation. In some cases, regional or event-based issues are the root cause and are completely unavoidable, but other “unknown” or “ambiguous” errors can be resolved or avoided entirely with a little bit more information. If the additional granular data such as browser-type or operating systems, bandwidth, web codes, or segment stability reduce errors by as much as 10% service-wide, one can reduce the cost of errors their system is accountable for by tens to thousands of dollars per month.

Want to learn more?

Check out our resources page: www.bitmovin.com/resources

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