

How to Evaluate the Quality of Experience Associated with Video Streaming



INTRODUCTION

We know that the streaming experience shapes up the video industry. But how can we capture this notion of quality of Experience (QoE) and make the most out of it? This is what we address in this white paper, with the objective of identifying key points of interest that will help us with taking the corrective steps to improve QoE.

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WHAT TO MEASURE

Video QoE can be assessed through the measurement of three different families of metrics:

- **The startup time:** The time it takes for the requested service to be launched, after end-users have selected it from their portal.
- **The number, frequency and duration of freezes:** When this happens, end-users will not be able to see the content.
- **Video layers and changes:** The video layers that are being displayed, the frequency of the switches between them and the average bitrate of the video session.

To assess the impact of these elements on end-user behavior, it is important to correlate it with the completion rate related to the viewing of a program. In other words, to what extent was the experience so bad that it led the user to stop watching the service.

HOW TO MEASURE

To accurately measure these metrics, we need to collect information at the player level. However, each player has its own parameters to catch events happening during the viewing process. It is, therefore, necessary to have a library in the application, specific to each player, that is used to transform those parameters into common metrics.

At Broadpeak, we have developed **Smartlib**, which allows us to gather all the information necessary from the players.



With a few lines of codes, Smartlib can be added within any end-user application. It comes with a built-in mechanism to collect player metrics and sends this information to Broadpeak's analytics solution.

The **startup time** is obtained by computing the elapsed time between the play request and the display of the first video content frame.

The **information about freezes** is obtained by observing the playback position and capturing stall dates.

The **adaptive path among layers** is obtained by listening to the players' events associated with layers switches and bit rate evolution.

The computed metrics are sent to the BkA100 analytics server on a regular basis to be displayed.

The frequency at which the measurements are made has an important impact on the way the information is perceived. But a high accuracy implies an important volume of data that is generated. It is, therefore, important to find a trade-off between the precision about the time when an event occurred and the quantity of information that is stored to capture information.

Aggregation of information is key to reduce the required volume while keeping the details that are useful.

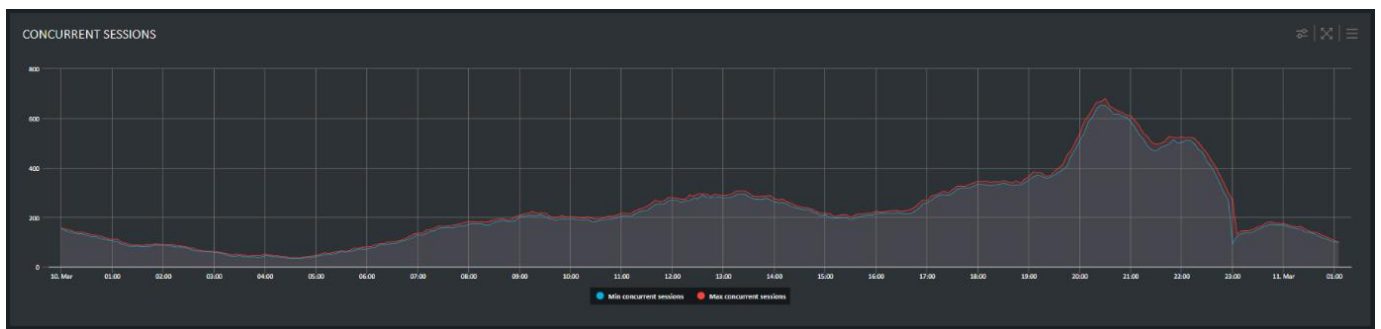
For example, the average startup time per player provides a good indication on the performance of the different players involved in the video delivery solution. A playback will produce a very verbose and spread logs output across the multiple servers involved in the video delivery. An aggregation to present it as a homogenous video session data set allows to assess the QoE of the delivered content and drill-down into details for further analysis.

HOW TO REPRESENT

The way the information is presented in the GUI is crucial if we want to exploit it and trigger some actions. There are many graphical components that exist (i.e., pie charts, histograms, time-based graphics, lists...) and they each serve a different purpose. It is, therefore, key to associate to each piece of information the most adapted way of displaying it, so that the exploitable elements that it conveys immediately draws the attention.

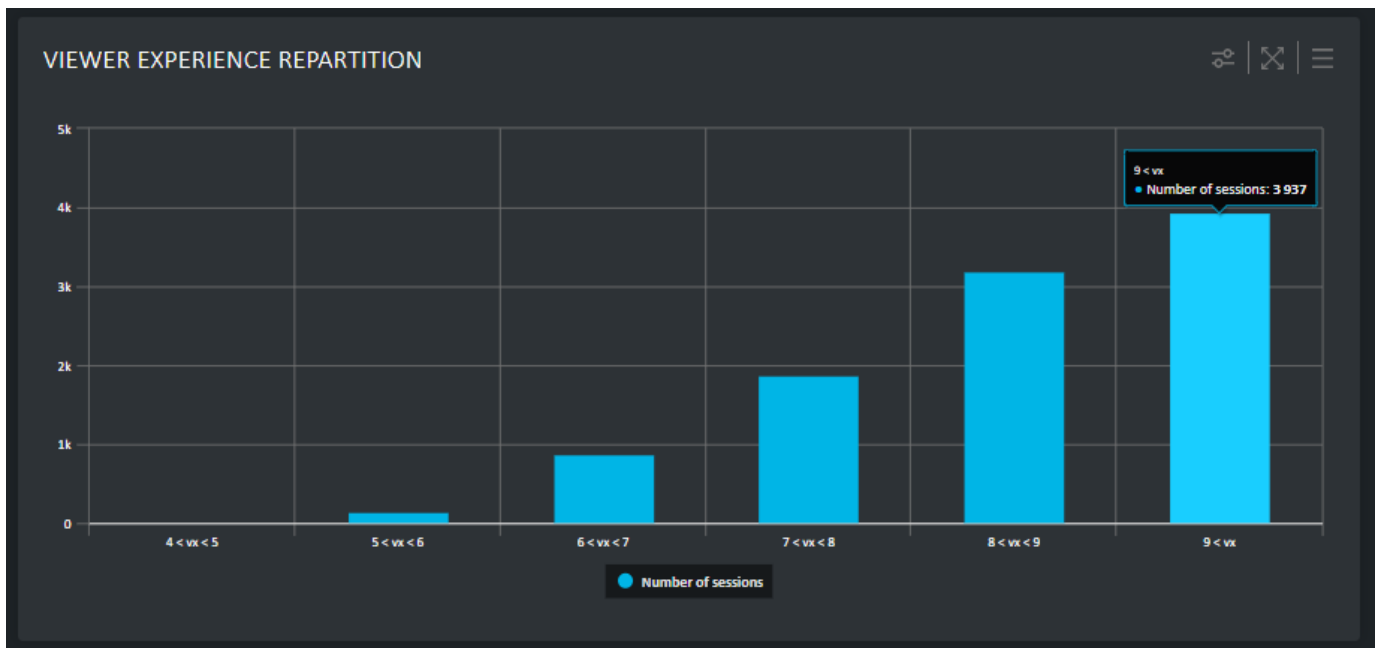
TIMELINE

Timelines are used to visualize the evolution of a metric overtime. For example, they are adapted to see the progress of concurrent video during a given period.



HISTOGRAM

Histograms are efficient to plot the frequency of score occurrences like the QoE Viewer Experience score repartition across the delivered video sessions.



MAP

Maps are used when the data refers to a localization, such as the video session creation per country or region.



RANKING

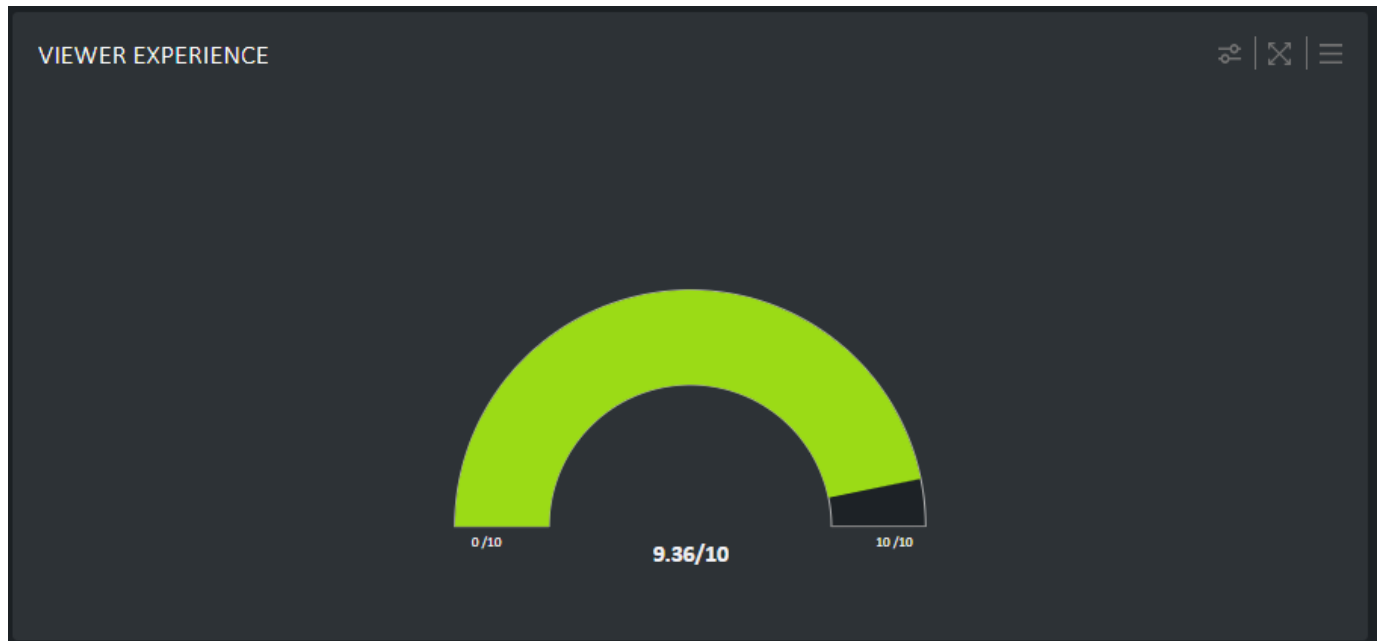
Rankings are used to sort larger data collection by ascending or descending order and to display top/worst lists. Rankings are adapted to rank an amount of video sessions based on http status code, or to rank client IP based on the number of errors to highlight the top viewers impacted by video delivery errors.

A table titled "PROCESSED SESSIONS" showing a ranking of sessions by status code. The table includes columns for the status code, total sessions, and percentage. The top 10 sessions are listed, with the first being "200: Session OK" at 95.43%.

Ranking	Total sessions	%
1. 200: Session OK	7 654 815	95.43%
2. 408: Request timeout	264 715	3.3%
3. 203: Non-Authoritative Information	60 800	0.76%
4. 3005: Player unspecified error	18 420	0.23%
5. 3009	18 236	0.23%
6. 3003: Networking error	2 120	0.03%
7. 504: Teardown due to session timeout	663	0.01%
8. 410: Gone	569	0.01%
9. 2004: Content not found	453	0.01%
10. 622: Teardown due to session setup timeout	156	0%

GAUGE

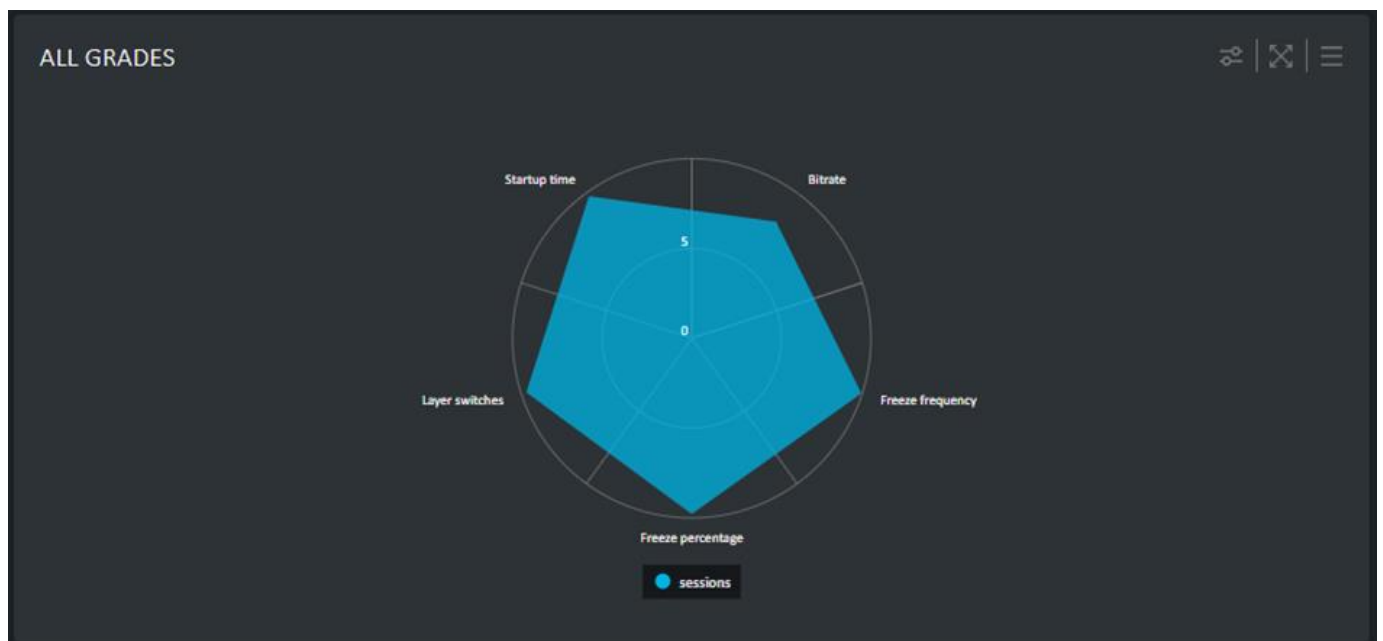
Gauges are used to show a single value within a given scale, for example the QoE Viewer Experience score computed for a user or a group of users.



RADAR CHART

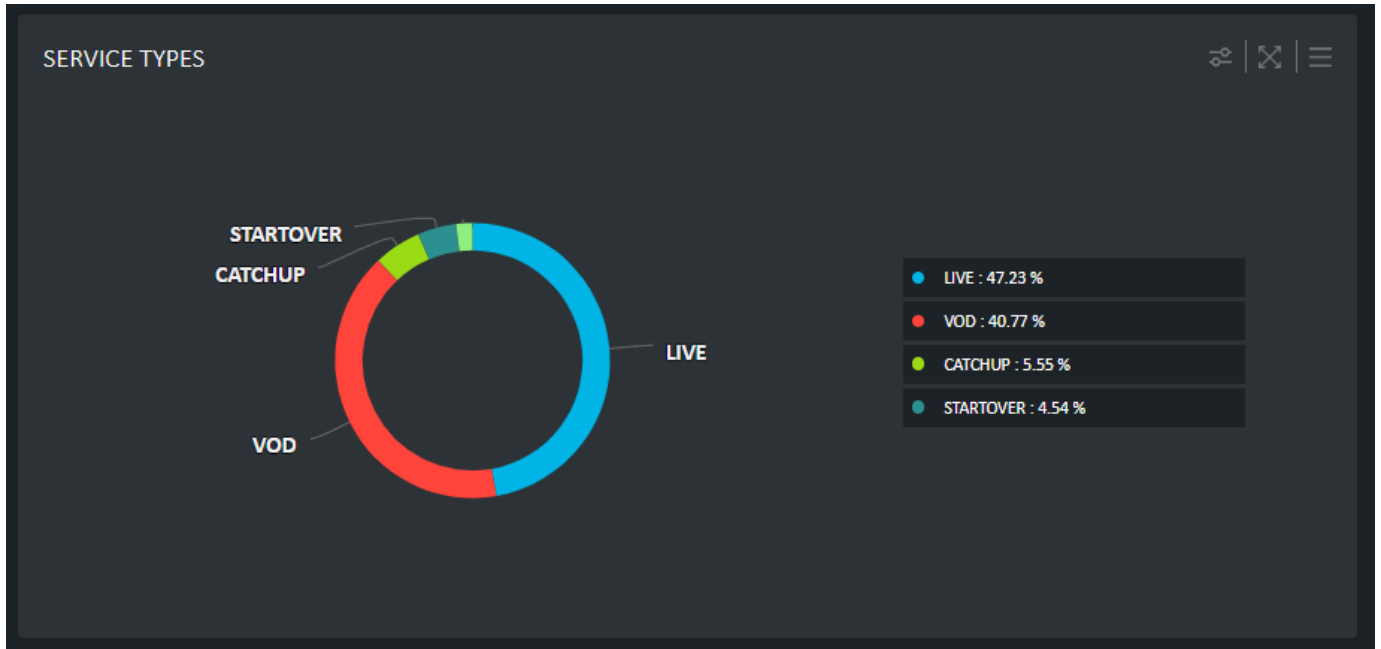
Radar charts can quickly highlight a metric impacting the Viewer Experience score to understand the main reason for a bad QoE.

The Viewer Experience score based on Startup Times, Number of Freezes, Freezes frequency, Average Bitrate and Layer Switches highlight the evolution overtime of the QoE for delivered video sessions. This score must be customizable based on the QoE items that are the most important for each operator.



PIE CHART

Pie charts are used to visualize the data within limited categories such as the percentage of delivered video sessions per service type (i.e., VOD, live, catch-up, start-over) or device type (smartphone, TV, tablet, Set-top box).



SESSION TRACKER

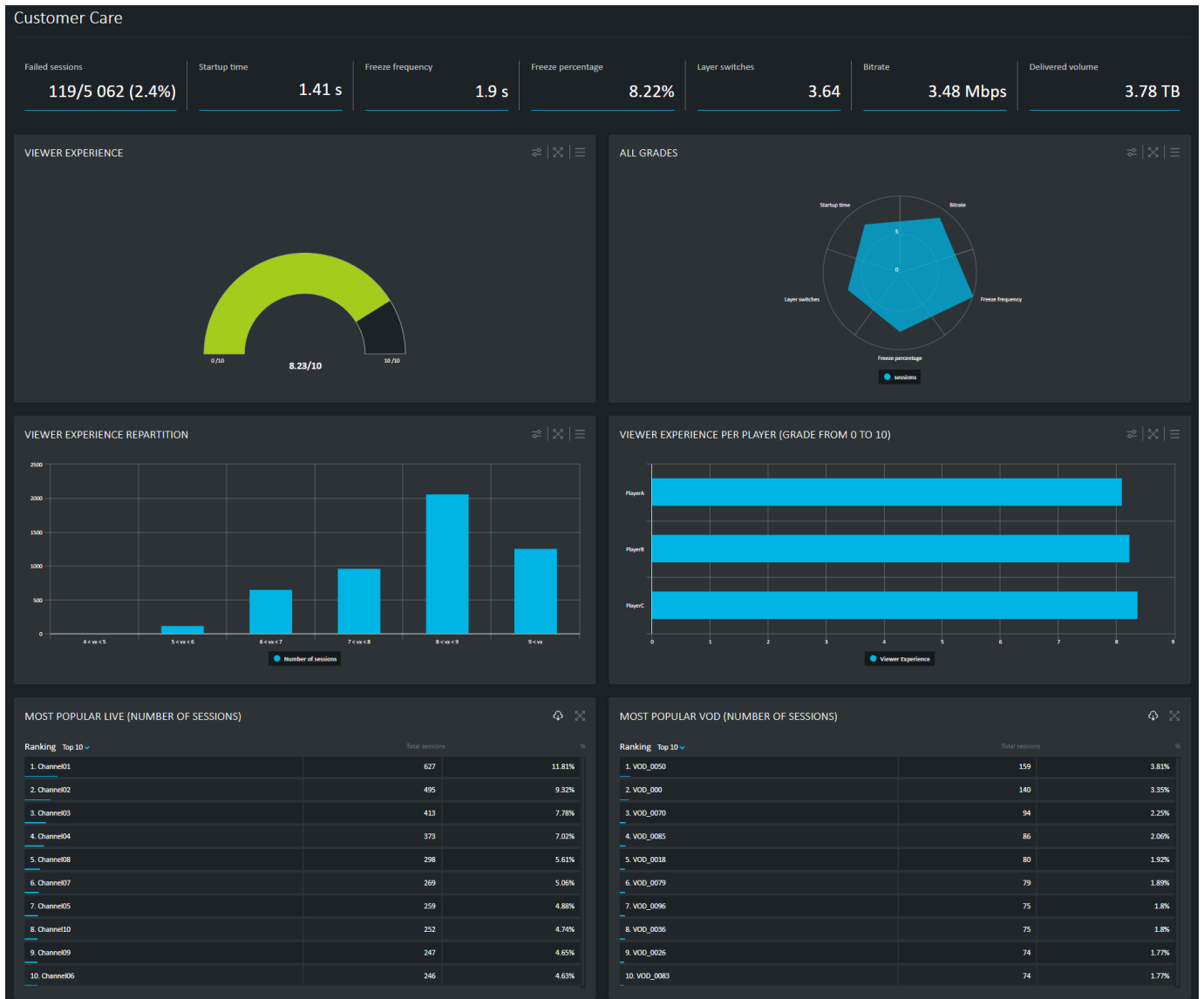
A good analysis also requires that the collected data is represented through different angles.

Information related to a specific customer or session are relevant in case a support request is made. A session tracker view fulfils this objective by displaying all the relevant events that happened on a timeline.



CUSTOMIZABLE DASHBOARD

All this information can be combined in dedicated dashboards that must be customizable based on the QoE items that are the most important for each operator.



But this is not enough. The possibility of grouping the indicators relative to different parameters is key to undergo investigations about root cause of errors. This is where the list of filters that can be applied on the graphics is most useful.

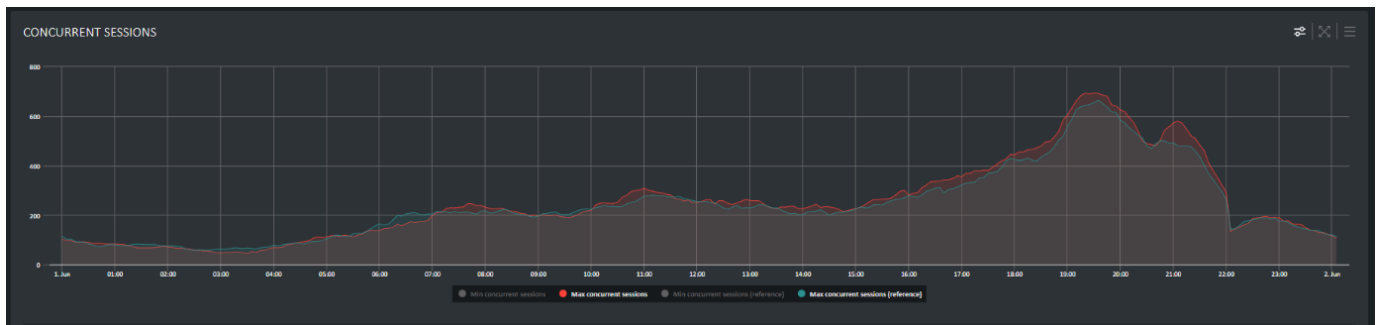
HOW TO EXPLOIT

THRESHOLDS

The analytics information is useless if it does not trigger any action. It is, therefore, important to be able to set thresholds on different QoE parameters, in particular, those that will trigger an alert. The information will come as a notification in the GUI, an SMS or an e-mail.

OVERLAID GRAPHS

Abnormalities can also be identified by superimposing two identical graphics taken at different times.



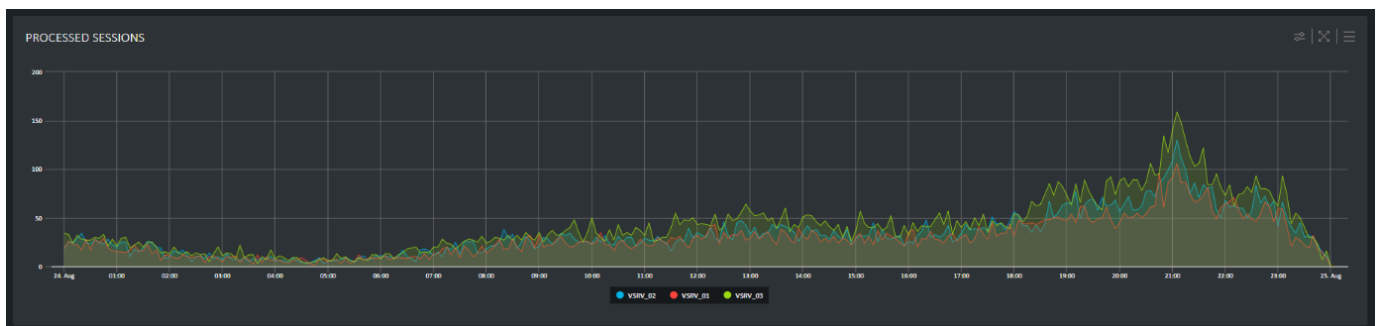
FILTERS

Eventually, the combination of filters can help with identifying the root cause of an error, such as in the scenario described below:

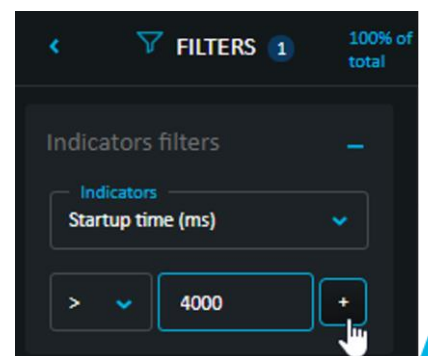
An Operator received multiple calls from a frustrated customer complaining about Start-up times, and we want to understand the root cause of these issues.

1. We can first look at the repartition of the created sessions per video server overtime.

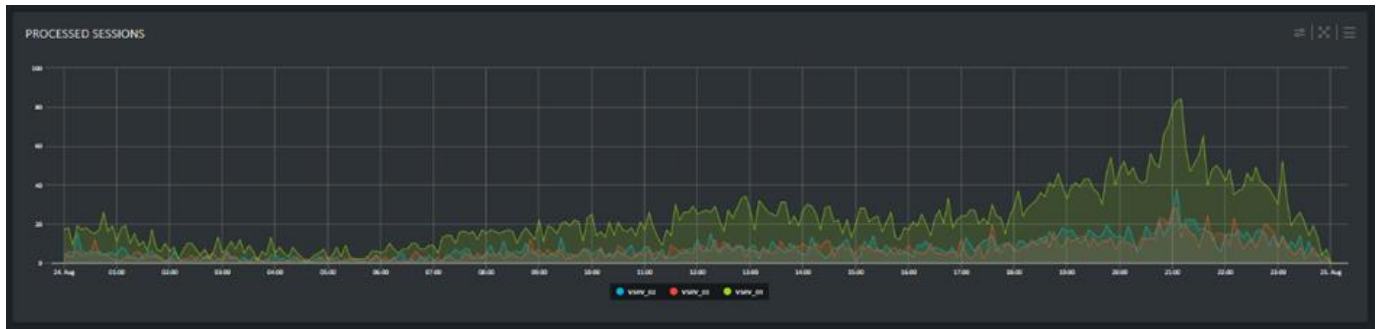
We can see a fairly even repartition across 3 streaming servers.



2. As we are looking for startup time issues, we will apply a filter to isolate the number of sessions with a Start-up time above 4 seconds.



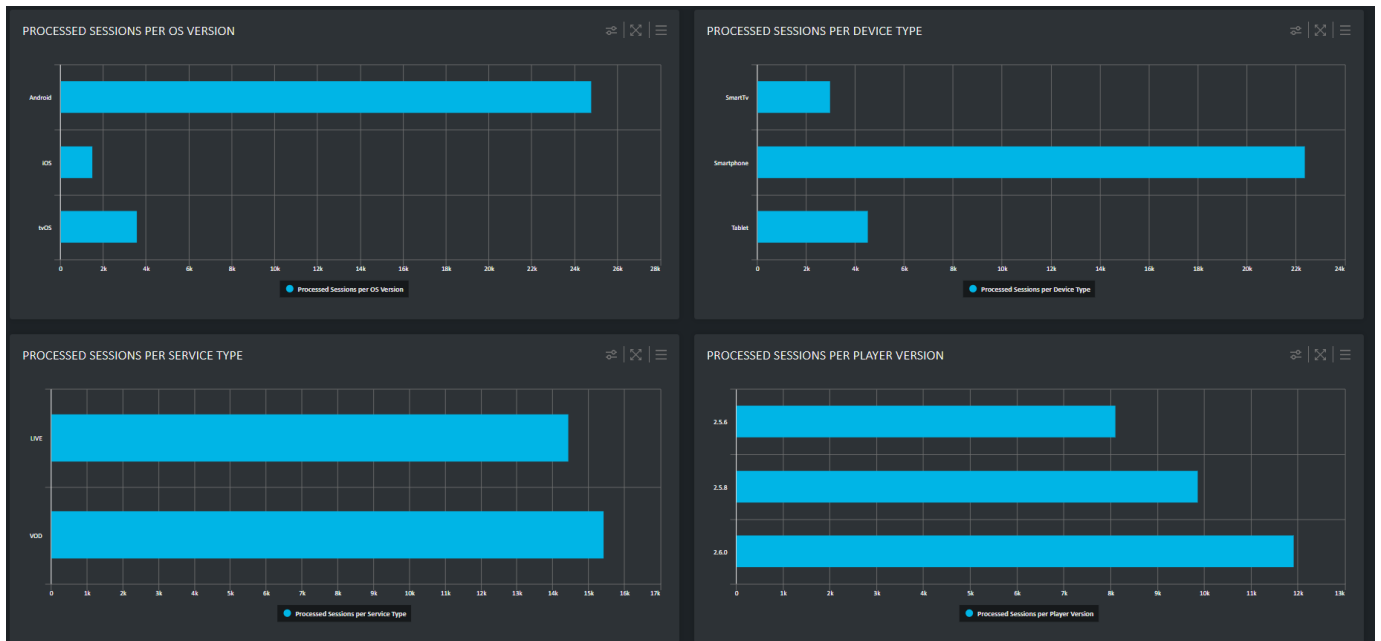
As a result, we see that the 3rd video server is the one mostly involved with these problematic sessions. However, no monitoring tool has shown any system or streaming capacity issues on this server.



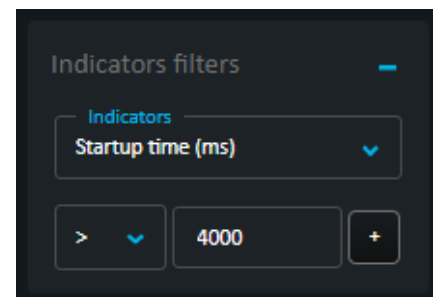
Another factor might be involved, and it could be correlated with an issue between the streaming server and another parameter such as the end-users' device type, the Operating System of the device, the player version, or with the type of video service delivered.

3. We can look at the typical repartition of created sessions over the day.

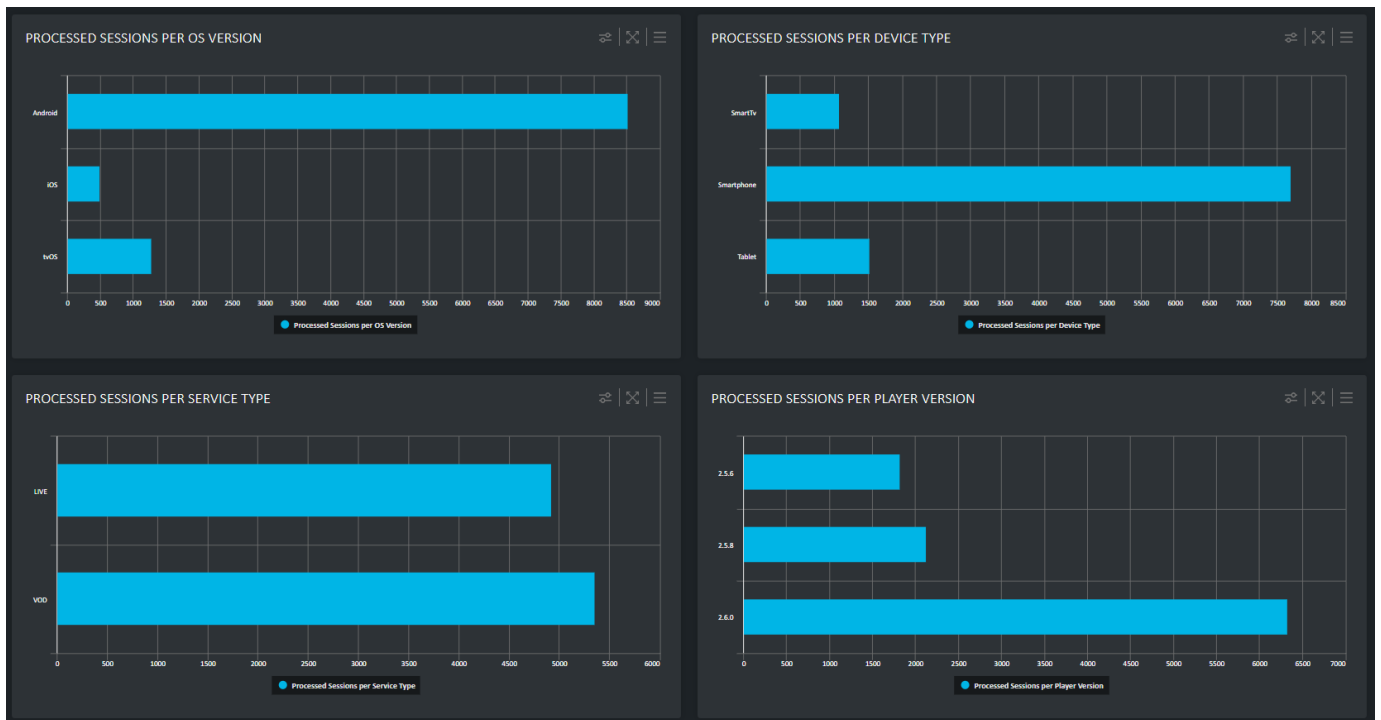
Most of the sessions here are consumed by Android smartphones. The rest being shared between tablets and SmartTVs on TvOS, iOS and Android devices. We see a 52% of the sessions for Live vs 48% for VOD. Finally, 27%, 33% and 40% repartition across 3 video player versions.



4. Now, we apply the filter to isolate the number of sessions with a Start-up time above 4 seconds.



The count of created sessions expectedly decrease on all charts. And most importantly, we can see a significant change in the repartition of session per player versions.

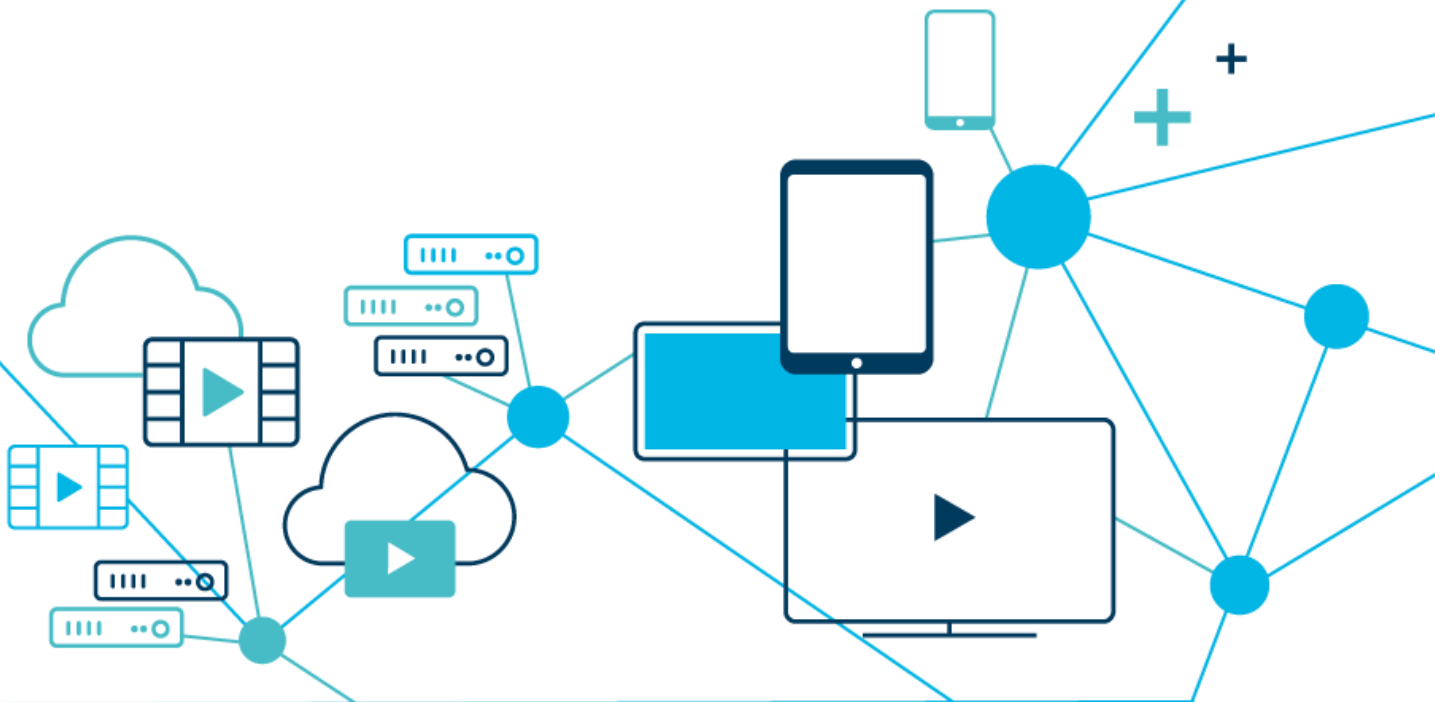


This leads us to a multi-factor cause. The drop in quality is resulting from a degraded behavior when VSRV_03 streaming server is sending its content to a 2.6.0 version of the player. Looking at the configuration of both server and player version will allow to take the corrective steps to improve the QoE.

STREAMING VIDEO ALLIANCE

Broadpeak is an active member of the Streaming Video Alliance where it contributes to the QoE group which aim is to identify streaming video metrics to gather, establish guidelines on how to calculate those metrics and create best practices on implementing a system to capture QoE and other measurement data.





Broadpeak® designs and manufactures video delivery components for content providers and network service providers deploying IPTV, cable, OTT, and mobile services. Its portfolio of solutions and technologies powers the delivery of movies, television programming, and other video content over managed networks and the Internet for viewing on any type of device. The company's systems and services help operators increase market share and improve subscriber loyalty with superior quality of experience.

Broadpeak supports all of its customers worldwide, from simple installations to large delivery systems reaching capacities of several million of simultaneous streams. The company is headquartered in Cesson-Sevigne, France.

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