

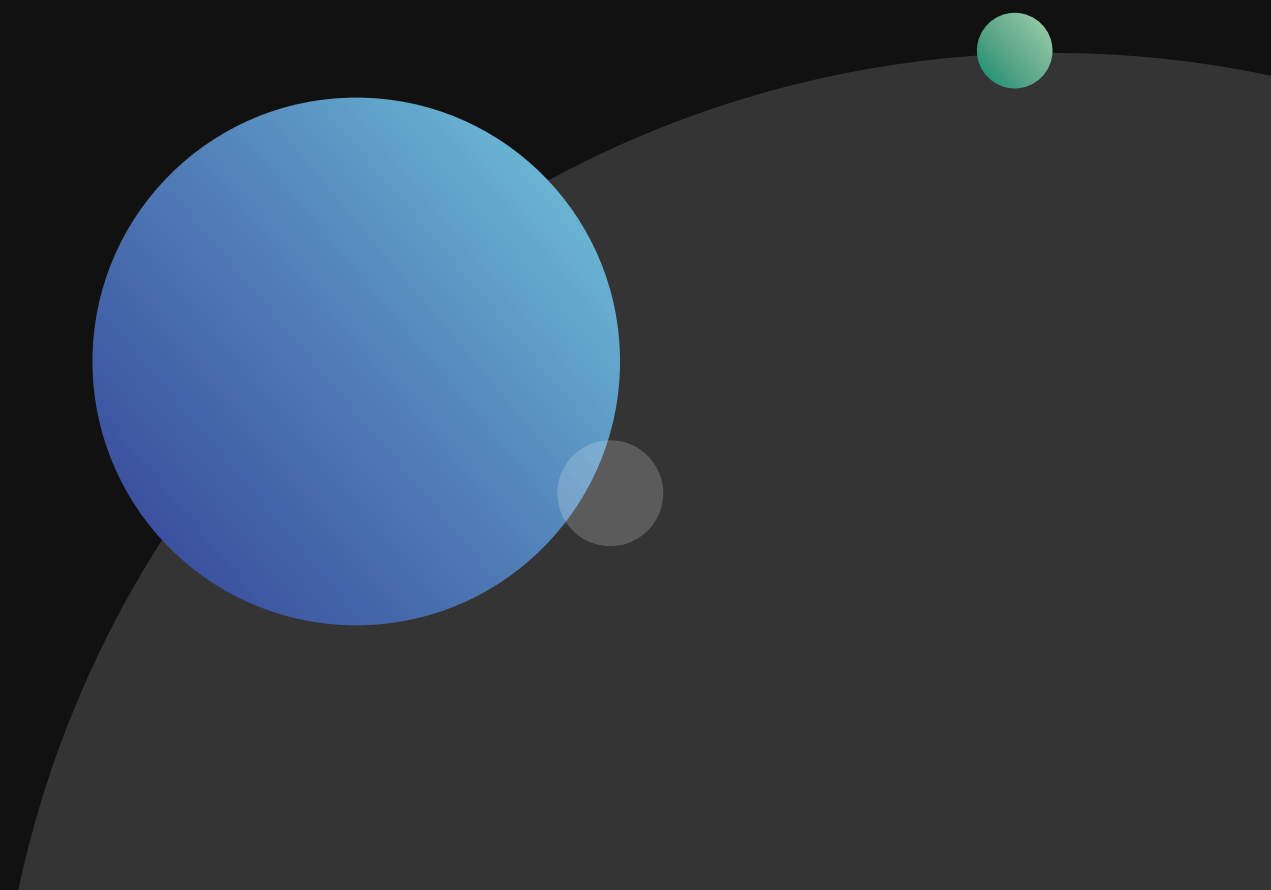
THE 6TH ANNUAL BITMOVIN VIDEO DEVELOPER REPORT

Shaping the future of video 2022/2023

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Welcome

When we created the Bitmovin Video Developer Report six years ago, its primary purpose was to provide a snapshot of the trends shaping the video streaming industry with a complete focus on what they meant for players in this space. However, in the last couple of years, it's become essential to analyze the results in the context of global macroeconomic trends to provide a more cohesive picture of the industry's opportunities and challenges and where it is heading.

The last two Video Developer Reports were conducted, written and published during the height of the pandemic. During these two years, there was a huge boom in video streaming consumption and fast-tracked innovation across the board. Developers felt compelled to innovate at break-neck speed to meet consumers' insatiable appetite for online video content.

And now, in 2022? It's impossible to deny that the supercharged trajectory the video streaming industry experienced during the pandemic has begun to shift due to a challenging economic climate. Consumers and businesses are beginning to tighten their belts, so it's not surprising that video developers cited controlling costs as their biggest challenge this year, replacing live low latency. It indicates that innovations will slow as the industry seeks to minimize operational costs.

However, there are still opportunities to monetize, and the report suggests that companies are pivoting more towards ad-supported business models. We've already seen major players, such as Netflix and Disney+, commit to introducing ad-supported tiers to their services, and our findings indicate that more companies will follow suit. SVOD remains the dominant monetization model, but AVOD comes in a close second, followed by hybrid, and FAST ranked for the first time.

On the innovation side, the majority of video developers are betting on live streaming as the biggest opportunities for the industry, with live streaming at scale and low latency topping the list of priorities for developers, with low latency also emerging as the second biggest challenge. Enhanced color is cited as the second biggest opportunity for the industry, speaking to consumer demand for high-quality images, and advertising

shot up to fourth place, reflecting the growth of ad-supported business models.

It wouldn't be my executive summary if I didn't mention video codecs! H.264 remains the most popular codec among video developers, which is likely due to its more widespread browser and device support. Yet, when we look at the codecs developers plan to use in the short-term future, H.265/HEVC and AV1 are the two most popular codecs for live and VOD encoding. Personally, I am particularly excited to see the growing popularity of AV1, which has been boosted by more companies introducing support for it.

Before I sign off, I would like to thank the video developer community for taking the time to participate in the survey and share your thoughts and insights with us. Your contributions make the Bitmovin Video Developer Report one of the industry's most anticipated pieces of research. I also extend thanks to everyone who worked tirelessly on this year's report. Last but not least, thank you for reading our report! I am always honored and humbled by the reception it receives.

Here's to a successful 2023 for us all.

Stefan Lederer
CEO, Bitmovin

**Join the conversation by using
#VideoDeveloperReport on social media
and by joining our developer community
at community.bitmovin.com**

KEY FINDINGS

Looking back and looking forward

- Live Streaming at Scale is now at the top of the list when it comes to Innovation Priorities. Last year, Low Latency topped the list. Multiple data points indicate low latency issues can be solved using CMAF-LL (with DASH-LL and LL-HLS) which appears to be in prime position for scalable future adoption.
- The importance and use of H.265/HEVC and AV1 continues to grow with planned adoption in the next 12-24 months having doubled year over year. It appears that the patent pool issues around HEVC have worn off, leading to broad adoption of the codec a decade after it was finalized.
- When it comes to measuring performance, Buffering remains as a key performance metric used. The Ad Ecosystem is becoming less complex, however, Brand Safety Measurement and Targeting provides more challenges for Developers and our industry. Go to page 12 for more detail on what to keep an eye out for.
- Cost matters and continues to be a major challenge faced by our participants. This further highlights the importance of new codecs like HEVC, AV1 and advanced techniques like Per-Title and the impact to reducing overall costs, including lowering CDN costs.
- Content-Aware and Per-Title Encoding is on the rise. Over 1/3 of the survey participants are using it with an additional 1/3 planning to deploy it in the next 12 months with the benefits to increasing quality for the viewer and reducing CDN costs.

Understanding your audience

- It is without doubt that a key success factor is to have the best understanding of the needs of your audience. When it comes to the devices and platforms that video developers are focussing on, go to page 38 for a better understanding of the key devices and platforms that will emerge in the coming 12-24 months.
- When it comes to measuring success and analyzing performance, the growing number of data sources allows for more robust performance measurement than ever before. This year, we see a shift with Buffering Rates now as the most important performance metric in comparison to last year when Delivered Bitrate was at the top of the list.

Methodology

This is our 6th year of running our Bitmovin Video Developer Report. The number of responses, the differing job titles and the regional participants have provided us with a strong representation of the market and reflect the overall growth of this industry and the consumer demand for world-class video experiences.

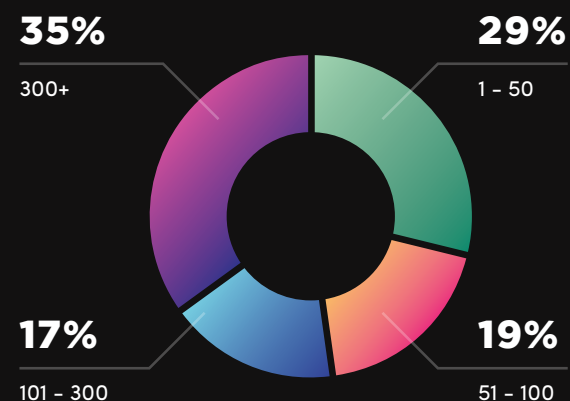
The survey was conducted between June and September 2022. The overall sample size for this report is 424, with responses from video developers and industry experts from over 80 countries. Participation by region was led by EMEA with 43% of our participants, followed by North America at 34%, the Asia Pacific region at 14% and Latin America with 8% of total responses.

As a number of the questions are multiple-choice, you will notice that a number of these multiple-choice/answer questions have an aggregate that will not add up to 100%. Like last year, we have used a ranking option for a number of the questions and have adapted some of the questions to align with the recent advancements in technology development. Please keep in mind that the survey was open for everyone to participate, but the results may be somewhat skewed toward the Bitmovin customer base.

Demographics of the Bitmovin Annual Video Developer Report

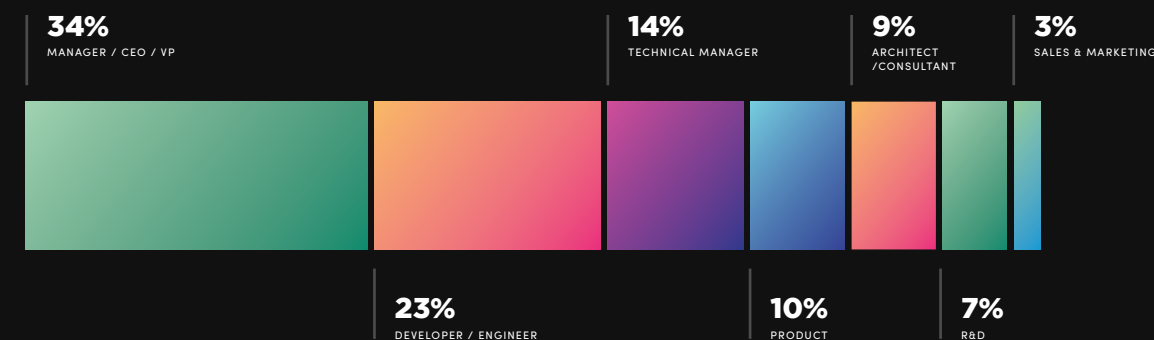
COMPANY SIZE

The majority of the participants this year are in companies with over 300+ employees. In comparison to last year, there has been a slight dip in the number who work at companies under 50 employees, which now sits at just under 30% vs the 40% last year.



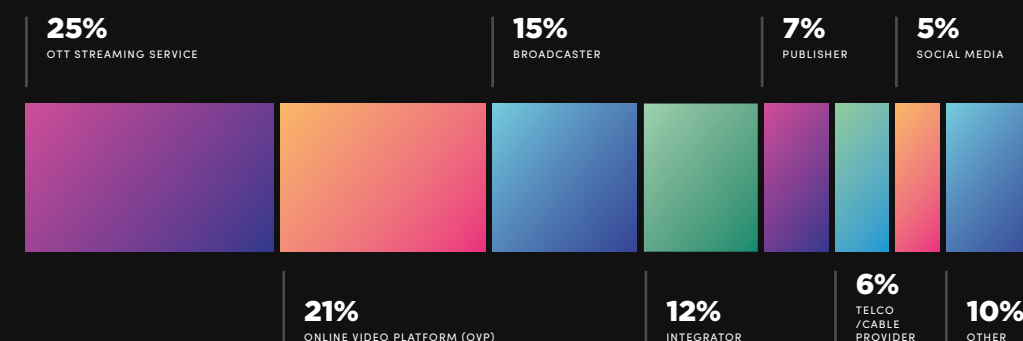
JOB TITLE

Almost two-thirds of the participants are in technical roles, such as Architect, Developer and Engineer. The report has manager-level seniority extending to VP and CEO representation at just over one third of all participants. The senior stakeholder participation has increased by almost double in comparison to last year.



INDUSTRY

Like last year, those in the OTT Streaming Service is the most common industry of the survey participants, with those in the Online Video Platform type of business following closely behind and seeing an increase vs last year.



The State of the Streaming Industry

This report is aimed at providing you with a broad understanding of where the industry is today and highlighting growing trends and opportunities. It is worth mentioning that the effects of the COVID-19 global pandemic are quite clearly still having an impact on the global economy in addition to a variety of other geo-political and global economic situations causing and continuing to cause major impact.

The report is broken into the following three sections. Part 1: an overview of the big challenges, areas of opportunity, how innovation is being prioritized and a picture on how Artificial Intelligence and Machine Learning can and will affect the industry. In Part 2: this report will dive deeper into the detail of Video Workflows. We cover topics from Codecs through to Low Latency needs and advertising functionality. To come to a close, Part 3 outlines additional data into business insights and video analytics.

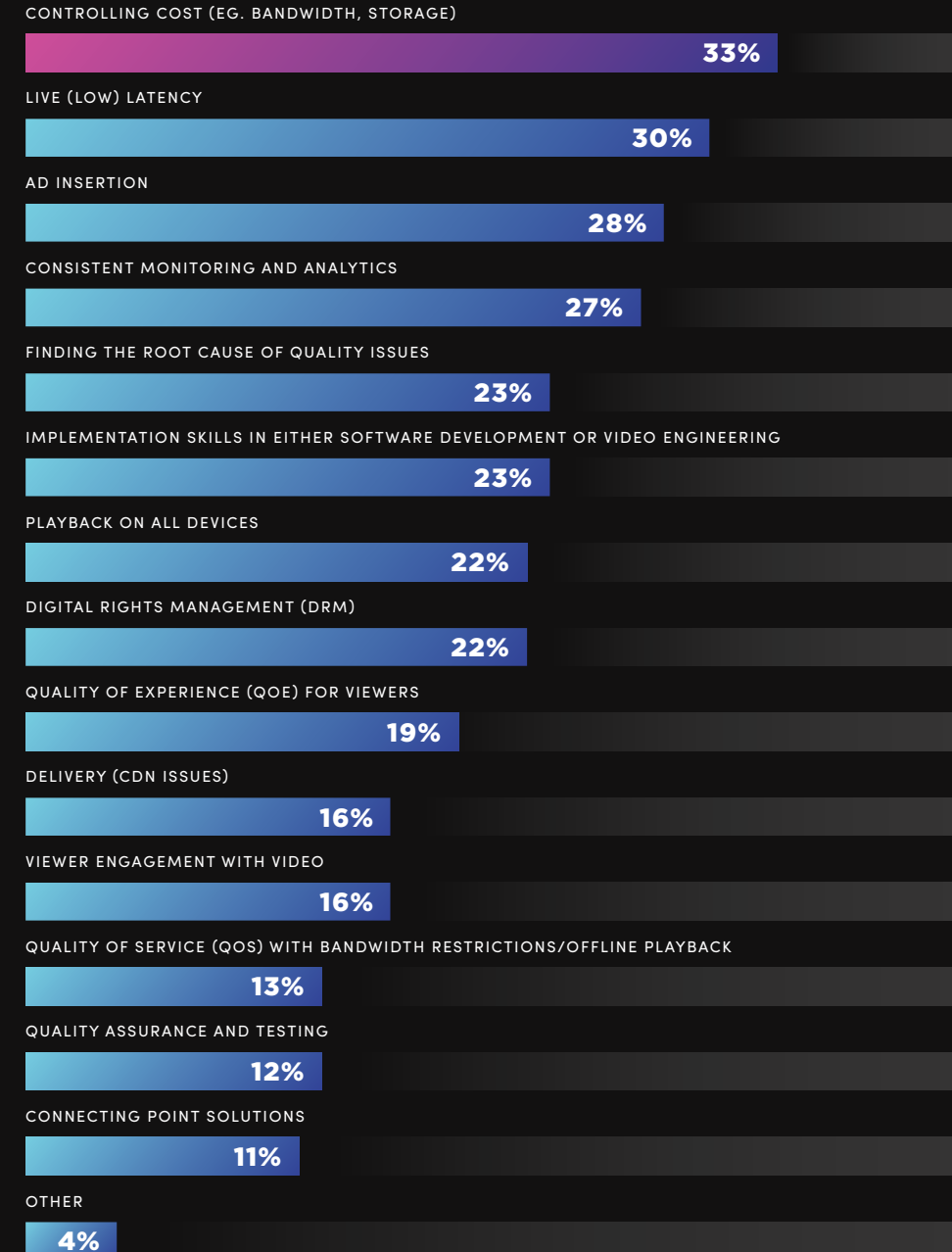
What are the top three biggest challenges you are experiencing with video technology today?

This is our traditional warm-up question and helps us get a good understanding of what's top of mind from all of our survey participants. This time around Controlling Cost sits at the top of the list with Live Low Latency moving down to the number two top challenge. You can find more detail on both of these topics further in the report.

In addition to the topic of Controlling Cost taking the number one spot, the topic of Ad

Insertion has climbed up the list and now sits as top challenge number three. This is no surprise with the increase in CTV/OTT Viewing and Ad-supported services scaling rapidly.

In comparison to last year, the topic of Playback on All Devices moved from third place down to seventh and this year, the following two new topics feature in the Top 10 - Finding the Root Cause of Quality Issues and Implementation Skills in Development or Video Engineering.



Where do you see the most opportunity for innovation in your service?

Taking the top spot this year is Live Streaming at Scale. The growth in live streaming is seeing little slowdown in terms of numbers and the same goes for its level of importance. It is without question that the COVID-19 pandemic played a significant part in the continued growth. With this in mind, we see the topic of low latency having slipped to the number two spot. It is a safe assumption to say that these two topics are closely linked to each other.

Scale and quality, to no surprise, are at top of mind with strong numbers of participants also looking at the topic of enhanced color as another key area for innovation. Similar to the previous question, this year's report puts advertising as a key challenge and innovation opportunity. Advertising has climbed up three spots year over year and in line with the developments with the broader industry increases of more ad-supported offerings.

LIVE STREAMING AT SCALE

33%

LOW LATENCY

30%

ENHANCED COLOR SUCH AS HDR OR DOLBY VISION

29%

ADVERTISING

25%

MEDIA DELIVERY AND DISTRIBUTION

25%

CONTENT RECOMMENDATIONS

25%

VOD-TO-LIVE CHANNELS WITH PERSONALIZED CONTENT

24%

CONTENT PREPARATION AND PRODUCTION

20%

VIRTUAL REALITY APPLICATIONS

19%

IMMERSIVE AUDIO (E.G. DOLBY ATMOS)

16%

CONTENT PROTECTION AND SECURITY

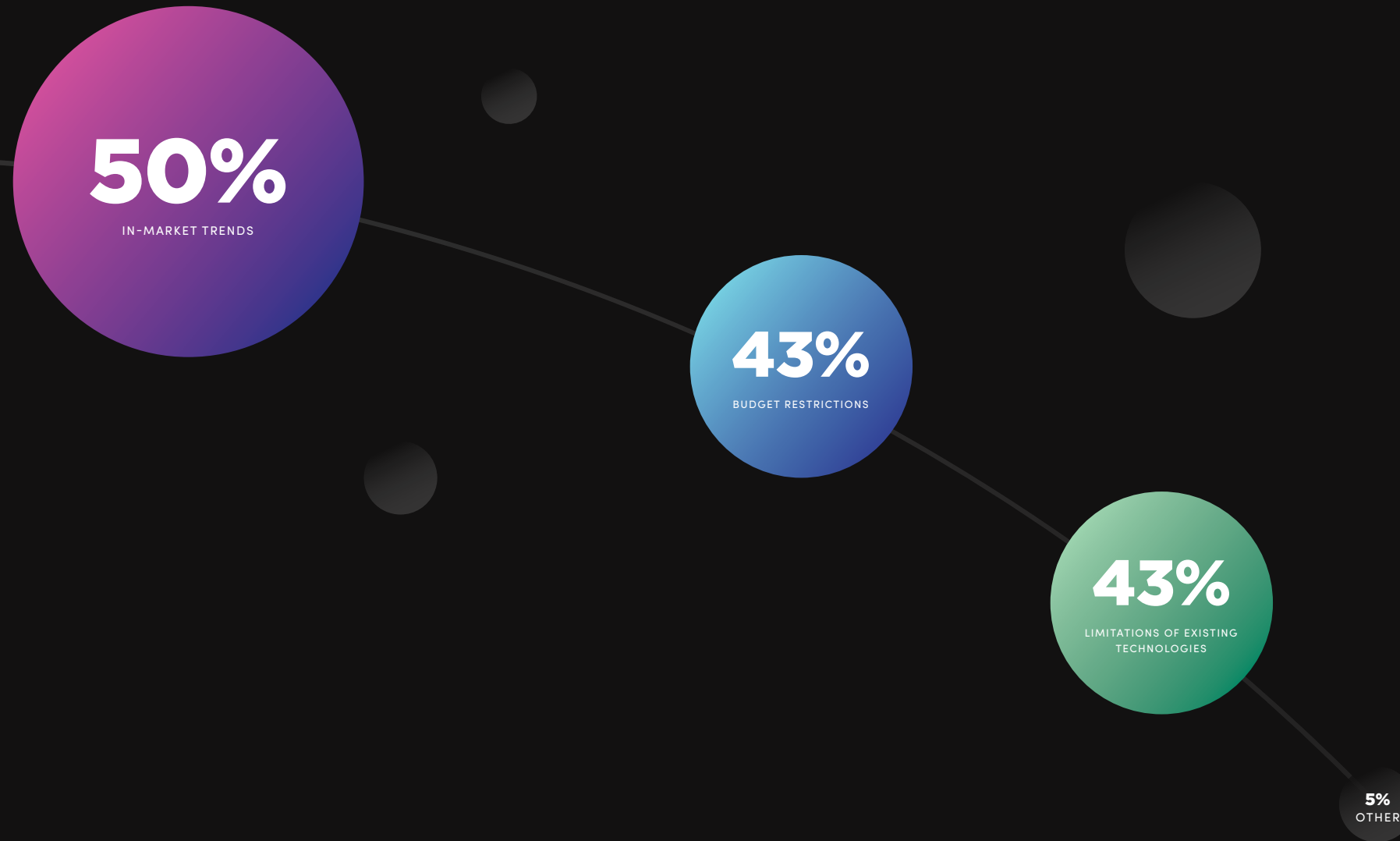
16%

OTHER

2%

What dictates the prioritization of innovation?

This year, we looked to get a better understanding of the driving forces behind the innovation that our industry is seeing. Whilst there is roughly an even split on what participants believe dictates prioritization of innovation, in-market trends seems to be the key factor determining the innovation agenda.



For which of the following video use cases do you expect to use machine learning (ML) or artificial intelligence (AI) to improve the video experience for your viewers?

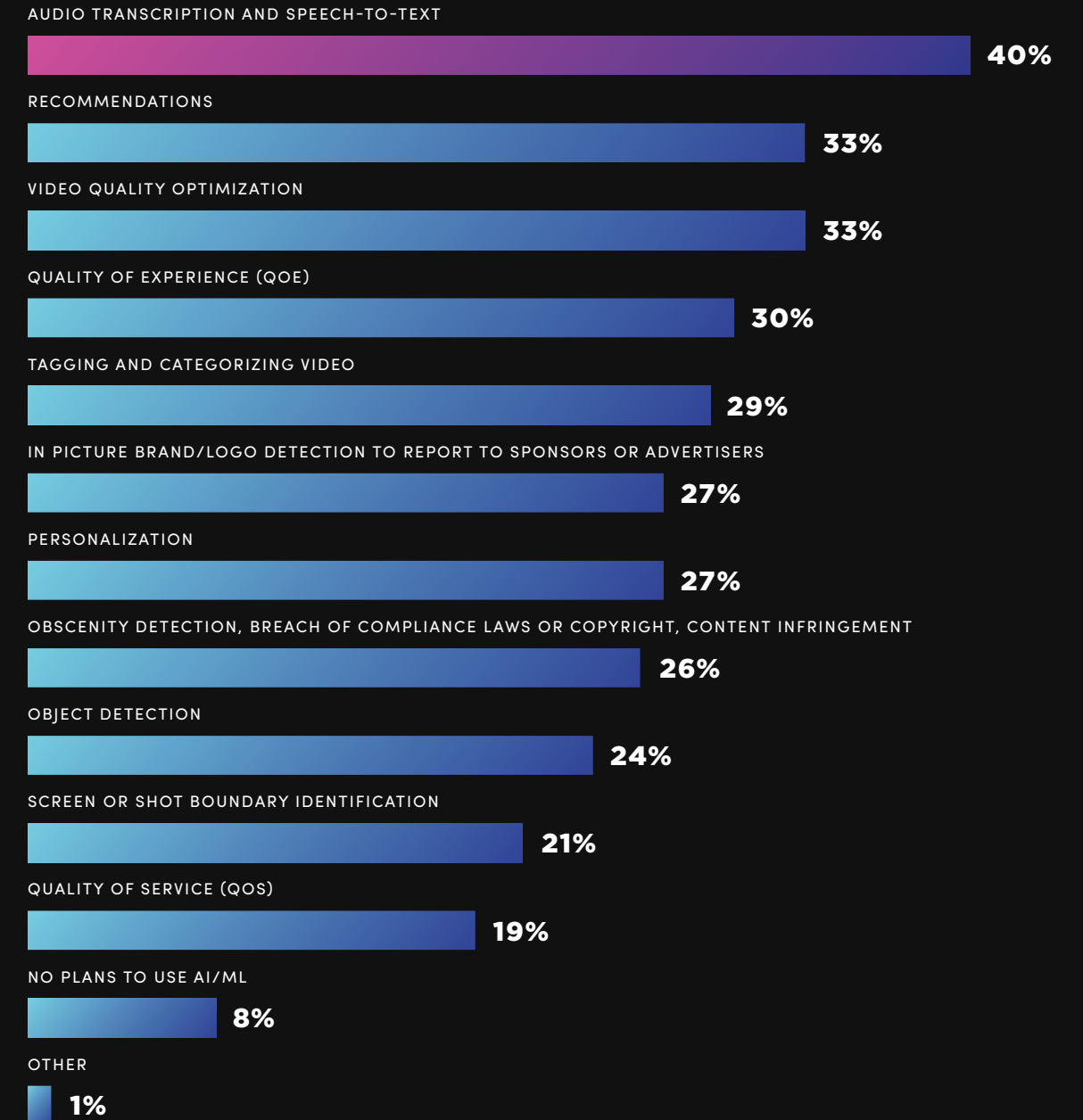
Audio Transcription and Speech-to-Text is once again the top Use Case for AI and ML usage, confirming to us for another year in a row the value, importance and multiple uses of speech-to-text.

As we learned from previous years, the importance and key benefit of video transcription is to provide closed captions. The secondary key benefit is in aiding the discoverability of video content with well-categorized asset and content libraries.

Recommendations has seen a significant jump from seventh place to the second most important use case and the following additional use cases saw a critical mass year over year:

In picture/brand logo detection to report to sponsors or advertisers.

Obscenity detection, breach of compliance laws or copyright, content infringement.

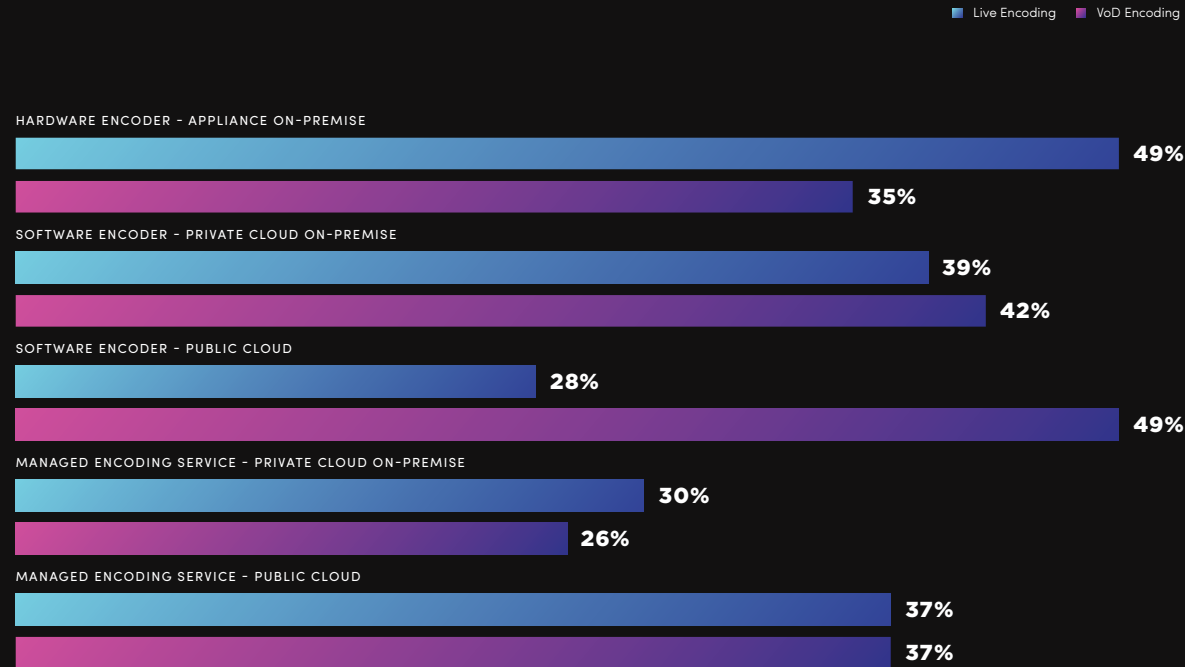


Video Workflows



How is the multi-codec world developing and what moves are being made in driving the adoption of some codecs over others? What we do know is that market forces such as cost, low latency requirements and the ability to live stream at scale are key factors that are driving decisions across the board. The changes year over year are both interesting and encouraging. Keep reading to learn more about the trends observed from our 6th Annual Video Developer Report and what this means for our industry in the coming years.

Don't forget, you can join the conversation on social media using this hashtag [#VideoDeveloperReport](#)



Where do you encode video?

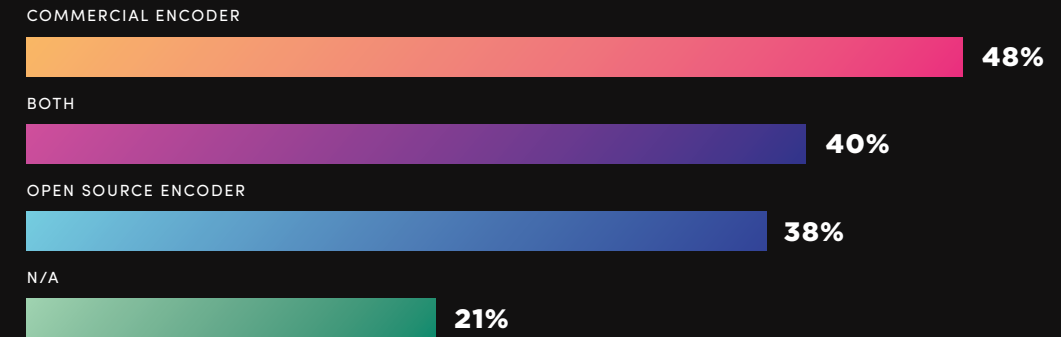
We have broken down the analysis like we did last year between Video-on-Demand (VOD) and Live Encoding to understand the impact of content types on encoding location.

An interesting trend in hardware encoding, last year when Live and VOD were fairly even (40% to 38% respectively), and this year this is a definitive split.

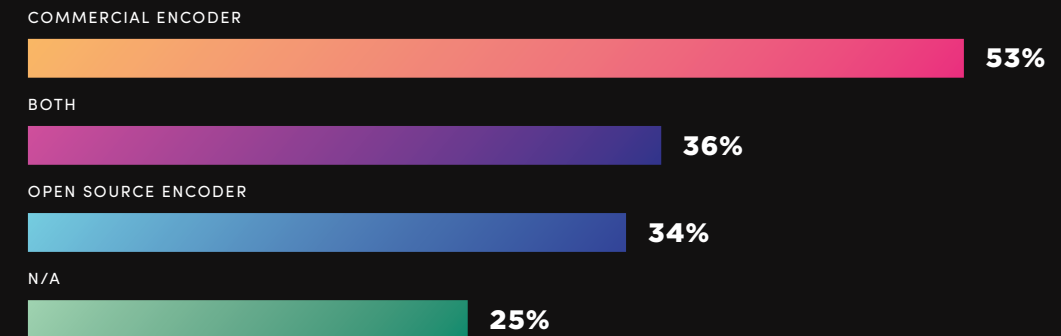
Hardware based encoding for Live has increased, with a downward trend in on premise and cloud software. However there is an uptick in people reporting to use managed encoding services for Live in both public and private clouds.

For VOD the drop in usage of hardware encoders to 35%, seems to show a shift towards using the public cloud (up from 38% to 49% this year).

VOD ENCODING



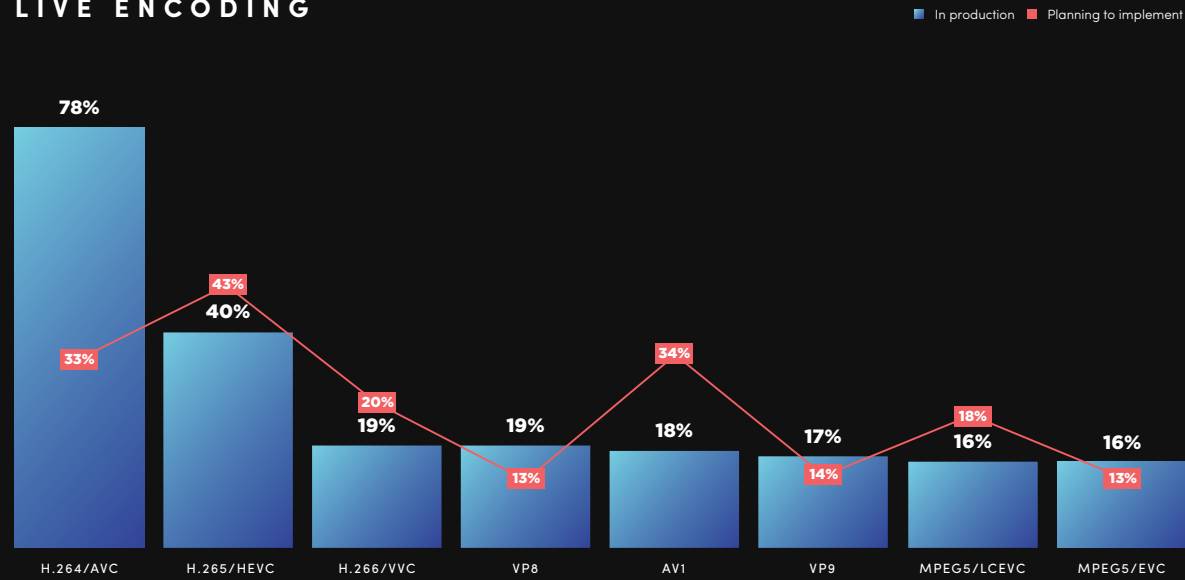
LIVE ENCODING



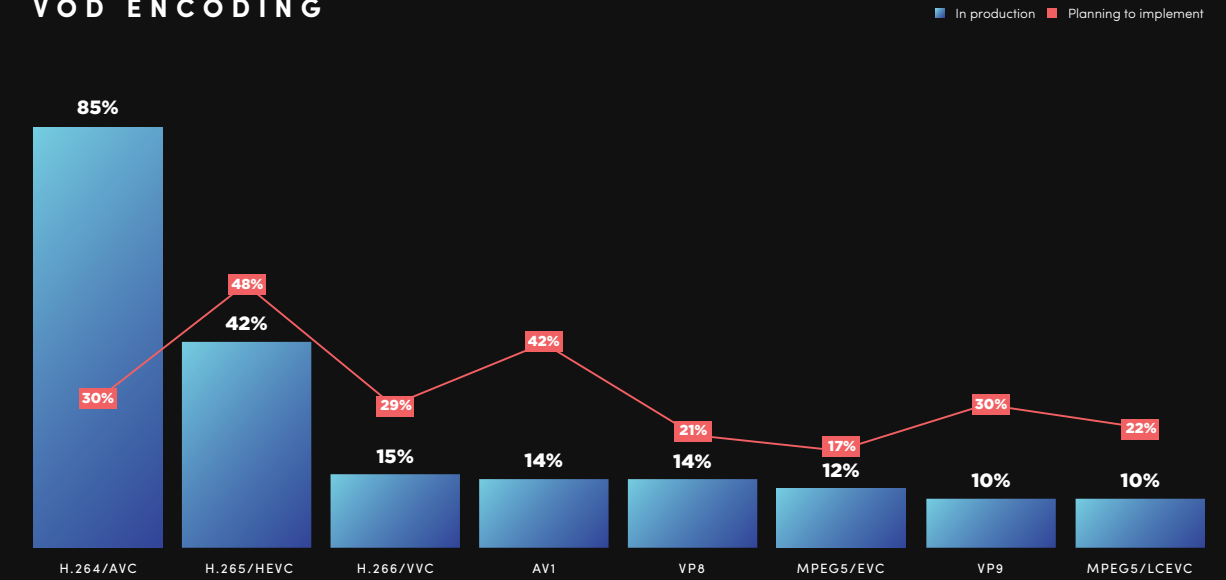
Do you use a commercial encoder or an open-source-based encoder?

This year we split responses between VOD and Live, and the interesting, and perhaps surprising note is that the spread across Commercial and Open-source solutions remains the same for both.

LIVE ENCODING



VOD ENCODING



Which video codecs are you using in production and which codecs are you planning to implement within the next 12-24 months?

Another split between Live and VOD this year, making trends slightly trickier to spot, H.264 remains consistently the most utilized codec, its gradual decline is in keeping with previous years, (91% in 2020, 83% in 2021 and 78/85% in 2022).

MPEG-2 sees a drop from the charts this year, with both VVC and AV1 seeing an uptick.

In comparison to last year, the percentage of those planning to implement H.265/HEVC and AV1 has doubled, we expect HEVC usage to increase as a result of Google adding HEVC support for Chrome in the second half of 2022.

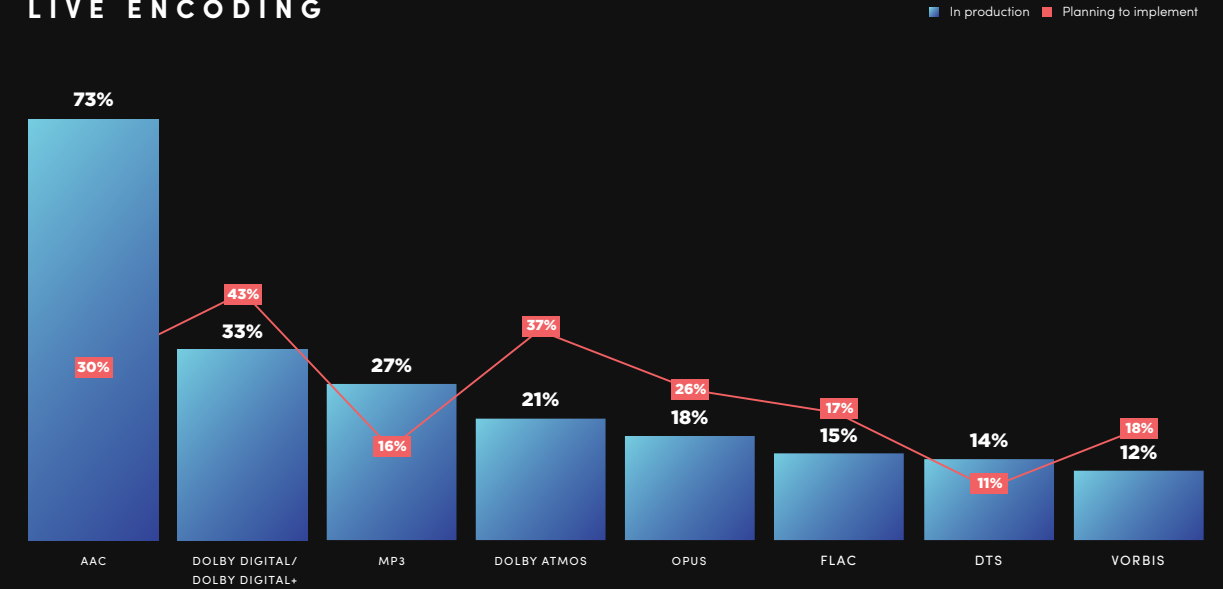
Which audio codecs are you using in production and which are you planning to implement within the next 12-24 months?

It is worth mentioning that this year we have made the distinction between VOD and Live.

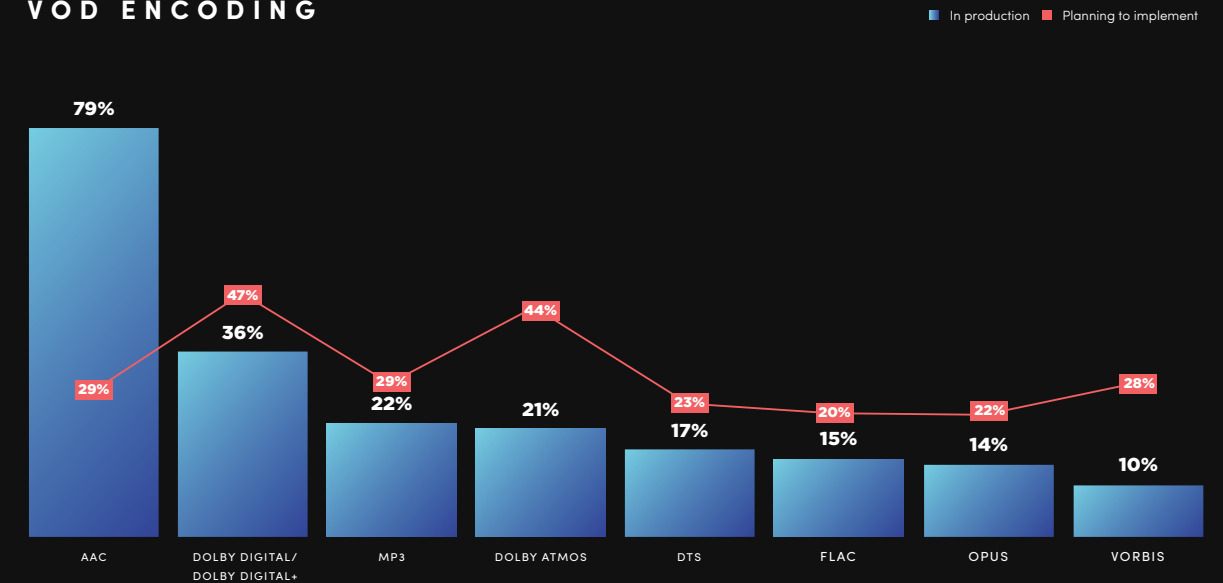
Despite splitting out the data as described above, it is clear to see that there is a similar pattern with VOD and Live for both the currently utilized and future adoption trends.

In the next 12-24 months, Dolby Digital/Dolby Digital+ is the top choice followed closely by Dolby Atmos, especially VOD.

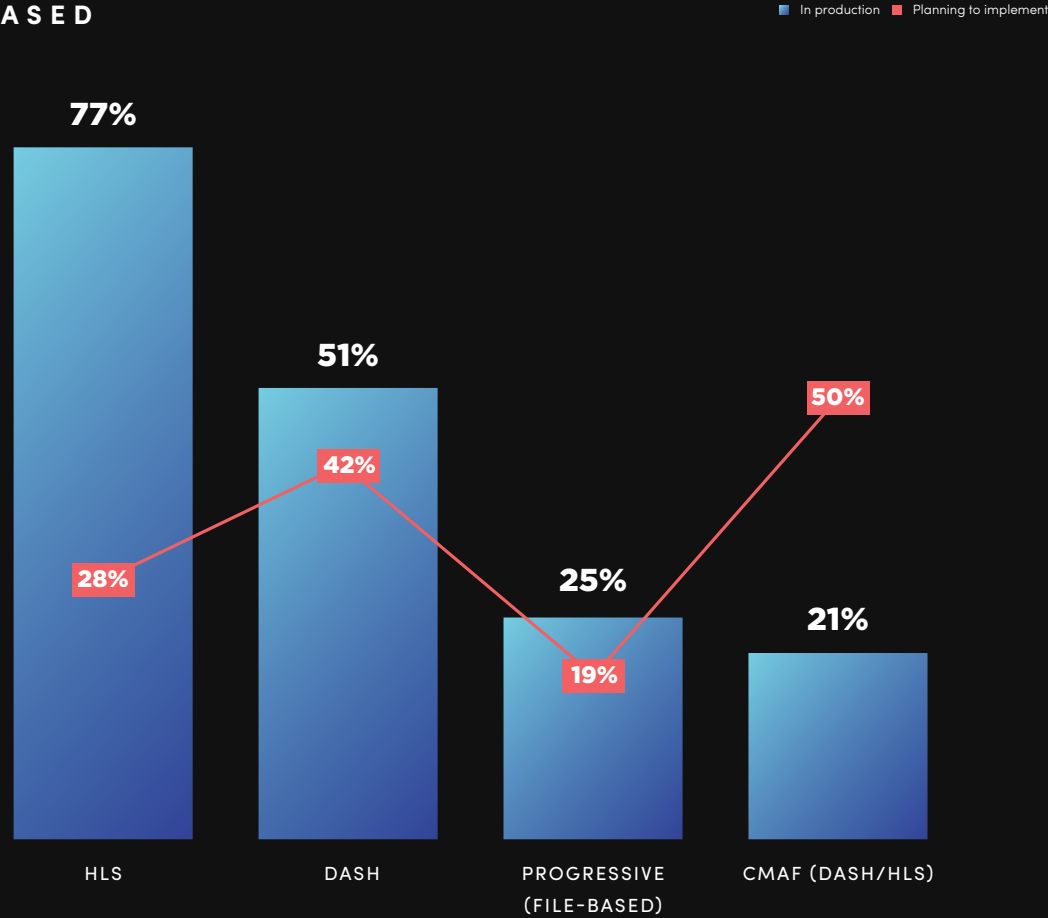
LIVE ENCODING



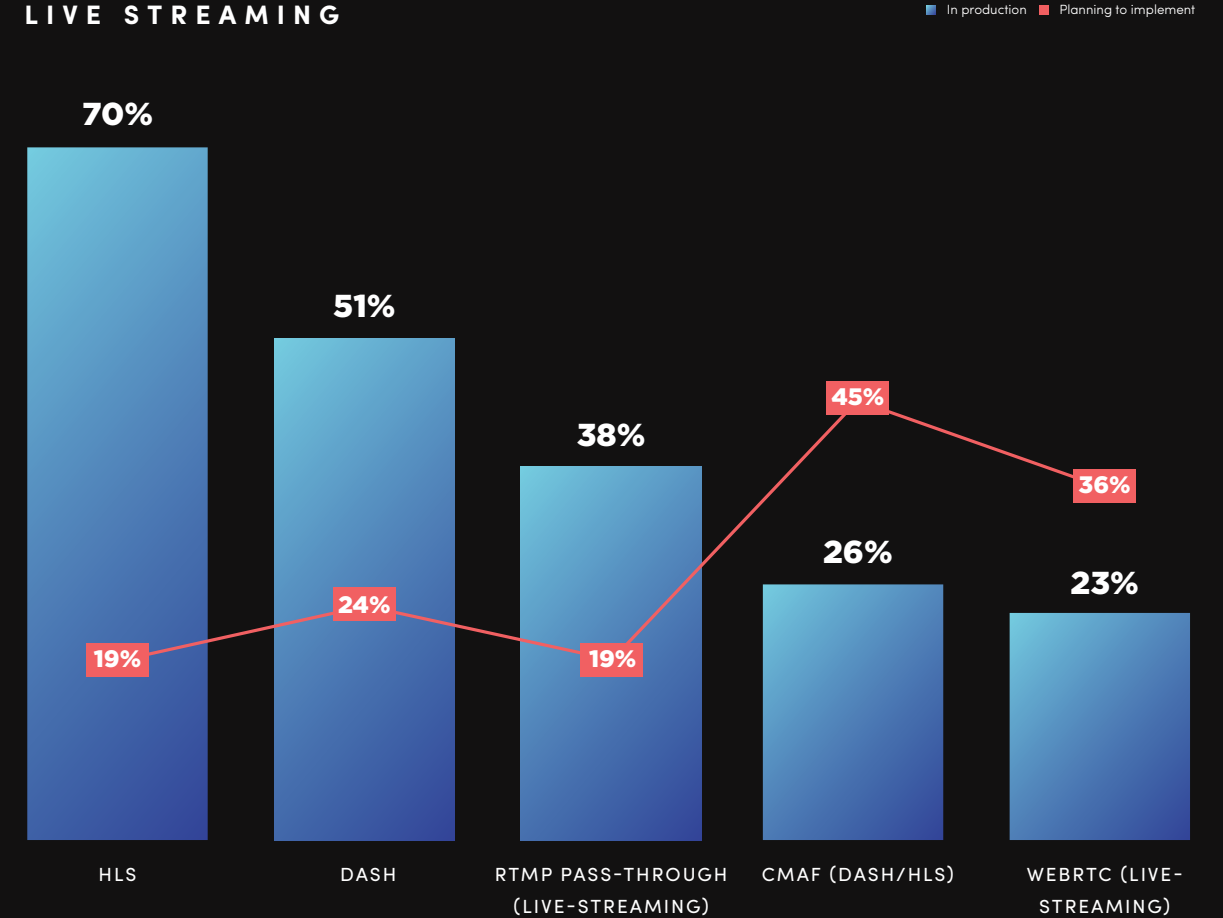
VOD ENCODING



FILE BASED



LIVE STREAMING



Which streaming formats are you using in production for distribution and which ones are you planning to introduce within the next year?

This year sees little change in the current deployments of protocols.

There is a clear indication for Live that WebRTC and CMAF are in prime position for future adoption.

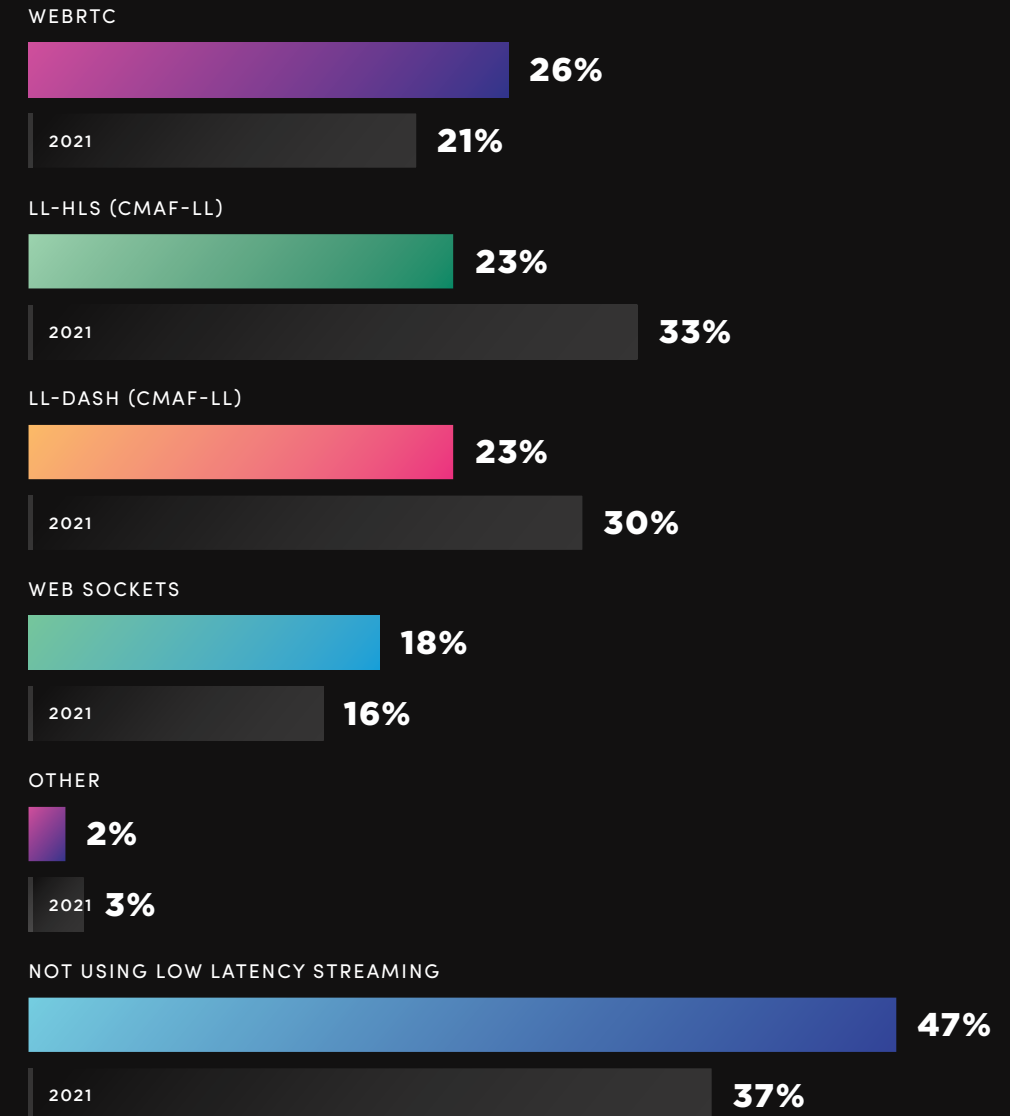
Looking at the responses for low latency may very well point to the latency challenge being widely thought to be solved through WebRTC.

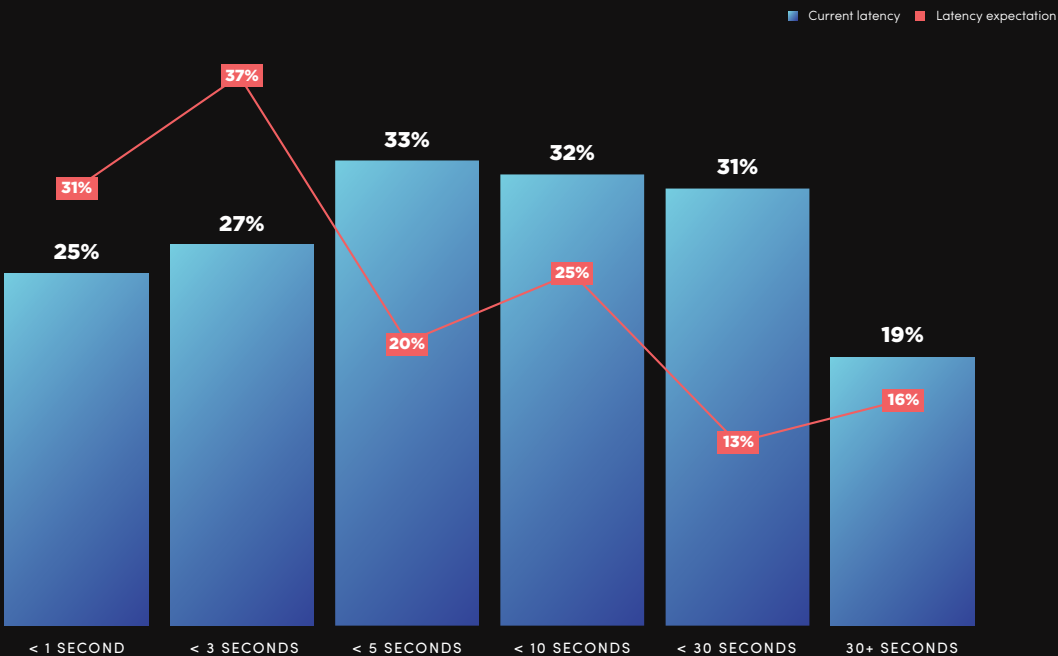
What are your thoughts on this? Join the conversation on social media using this hashtag #VideoDeveloperReport

Which technology do you use for low latency streaming?

In last year's report, Low Latency was the area where developers saw the most opportunity for innovation in their service - that may be driving some experimentation with WebRTC.

WebRTC is commonly used for real-time communications eg. live video chat, the increase in this year's report may be showing more diversity in the type of services that are responding to the report and those are becoming broader than OTT streaming (ie. new media companies).





What is your current latency, and what is your expectation/demand?

<3s is still the most popular latency expectation. Last year the report indicated that 2-5s is a more achievable range for scalable streaming than <1s), however, there's a broader spread across the >5 seconds latencies, perhaps showing that participants are taking a more granular look at the latencies they can expect and what's

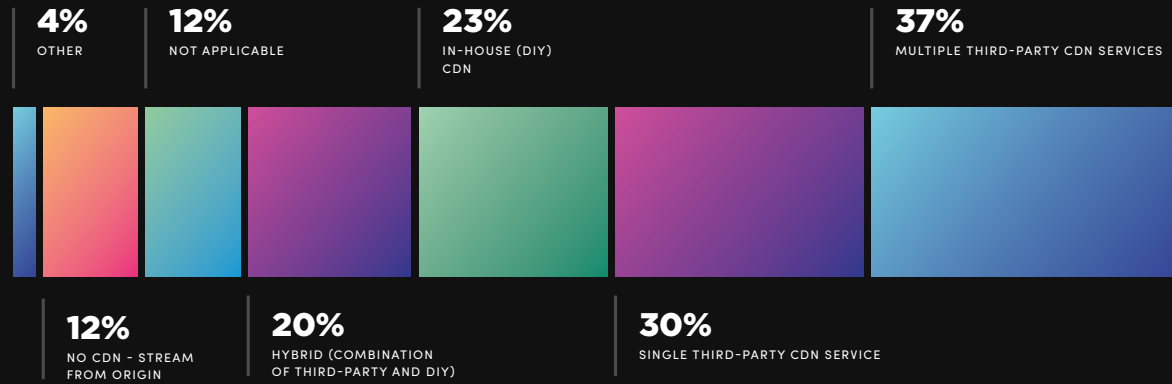
necessary for the viewer experience they want to provide.

The current latency question is new and shows developers need to embrace new technologies to reach their <3s latency expectation as most are delivering 5-30s.

Many concerns over network infrastructure, bandwidth and CDN.

The diversity of responses shows that delivering innovation in low latency cannot be achieved by a single technology in isolation but needs technologies from across the video delivery spectrum to come together.

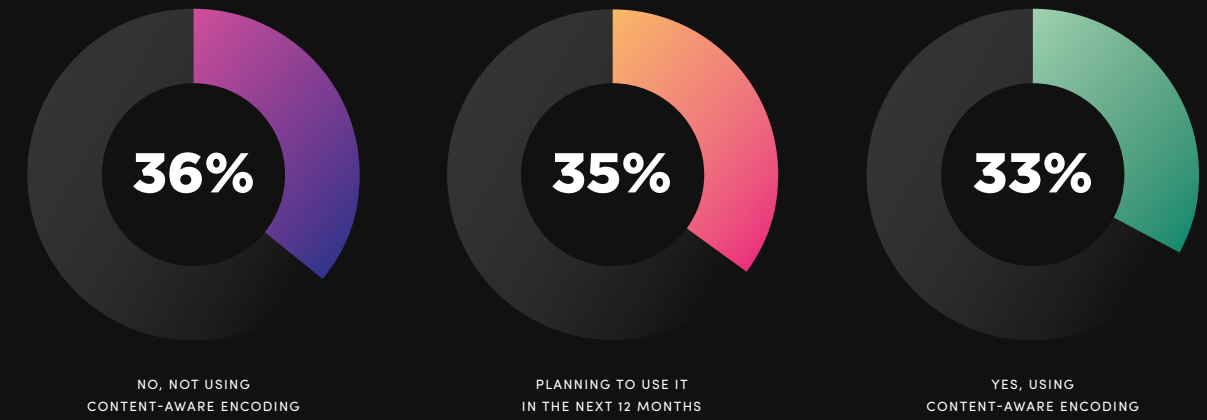
What are the key technological advancements you believe are necessary to achieve low latency?



Which CDN solution are you using?

In contrast to last year, there is an increase in the usage of third-party CDN services and in-house services but a decrease in the hybrid combination of third-party and DIY services. Is the flexibility of building your own hybrid model no longer as appealing

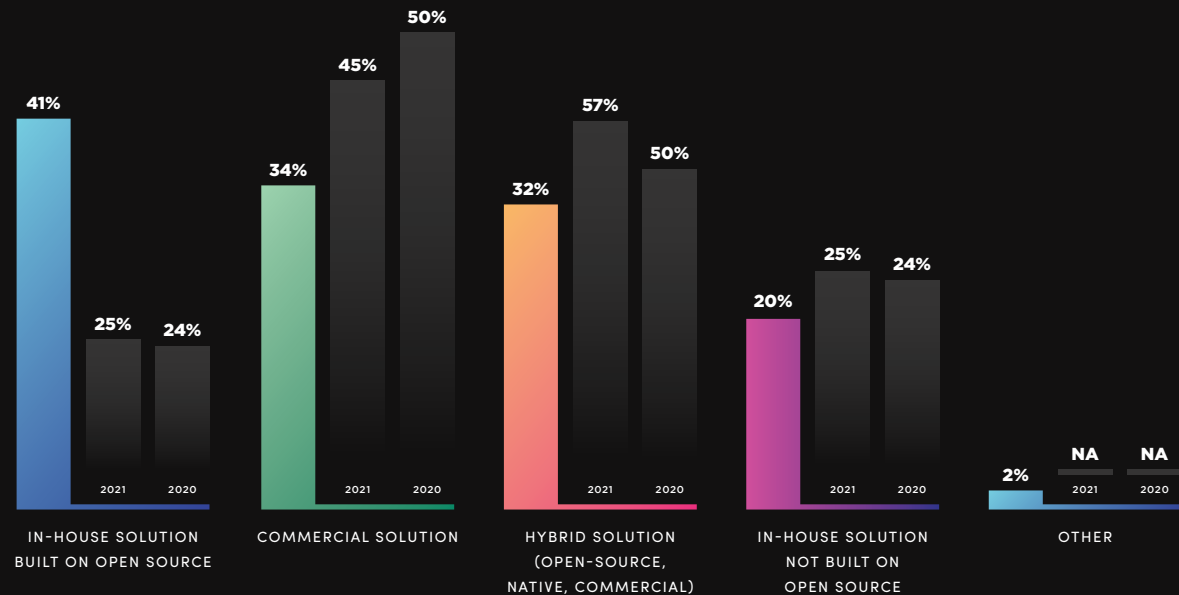
in comparison to the third-party solutions and is CDN functionality at the stage of providing the necessary flexibility and customization?



Are you using or planning to use content-aware encoding technology?

The growing understanding of the benefits to quality and bandwidth usage by using content-aware encoding is matched with the decrease in survey participants not using content-aware encoding. Last year, the usage doubled from previous years. Whilst the percentage this year of those using this technology has not increased, we looked to

find out what percentage of participants were planning to use content-aware encoding in the next 12 months. We found over one-third of the survey participants plan to deploy this technology in the immediate future.



Which player codebase are you using?

The complex nature of building a player is known across the board, as is the importance of having a fully functioning player. Whilst we saw the concern of device fragmentation

drop as a challenge in our industry, what has not changed is the fact we live in a multi-device world. This year, we have noticed a drop in the number of participants who are using a commercial solution but an increase in the percentage who are building their in-house solution on open source.

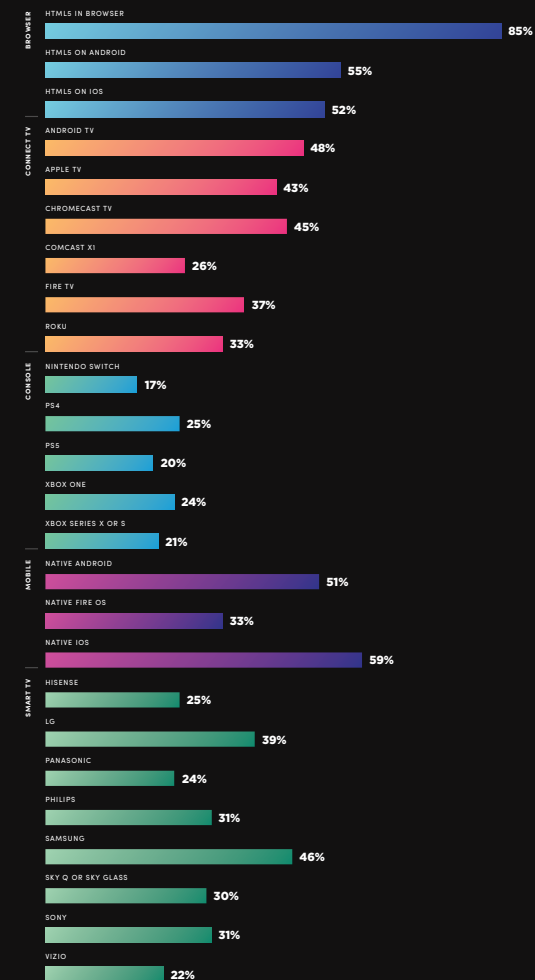
Which of the following platforms and devices do you support to stream video or audio content?

A clear increase in Smart TVs across all brands with notably almost half of all developers now supporting Samsung. The increase in the Smart TV category shows the fragmentation of devices as developers are no longer just focused on the top 1-2 brands in their market but are spreading their efforts across the 8 brands included in our report.

Games consoles have also increased, and are furthering the fragmentation as many developers need to maintain support for older consoles (PS4, Xbox One) but also introduce support for new devices (PS5, Xbox Series).

HTML5 remains the top device on browsers, no surprises there.

OTT growth continues and as we expected considering the accessibility to content and the growing number of services coming to market (SVOD, AVOD, FAST, etc.)

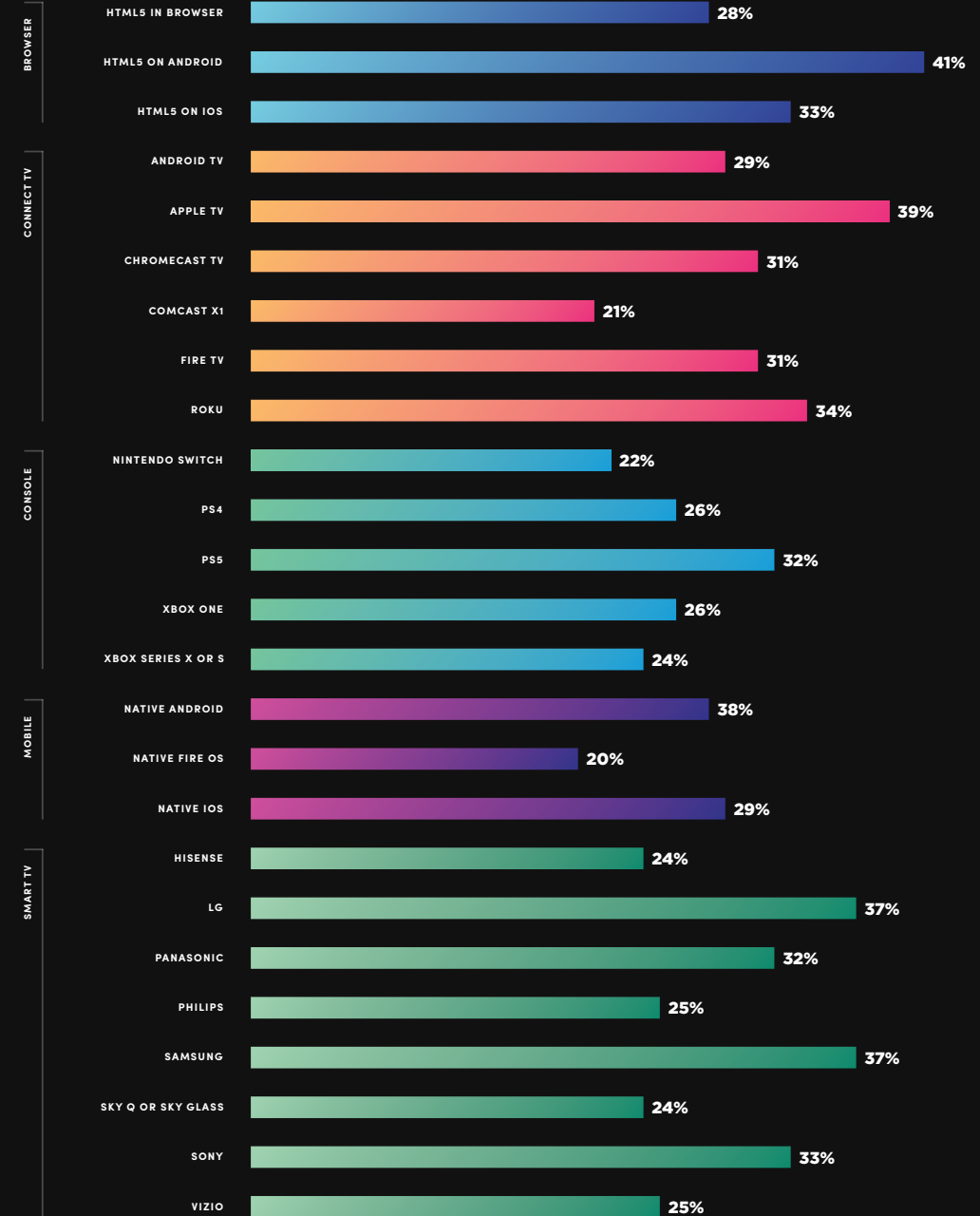


What is abundantly clear is that support for more and more devices is needed and ensuring you can test your video content on all of these devices without ending up with an expensive bill for doing so.

Which of the following platforms and devices will you support to stream video or audio content in the next 12 months?

This chart shows the challenge of device fragmentation as developers are planning to support devices in each category. Across the platforms shown there are multiple operating systems included which will require different development skill sets. The results show that development teams could be committing significant time to introduce or maintaining support for playback across a diverse range of devices in 2023.

PS5 is notable as relatively fewer developers are supporting PS5 now but it's the most popular console in this chart so streaming services are catching up with new device launches from manufacturers (Sony in this case).

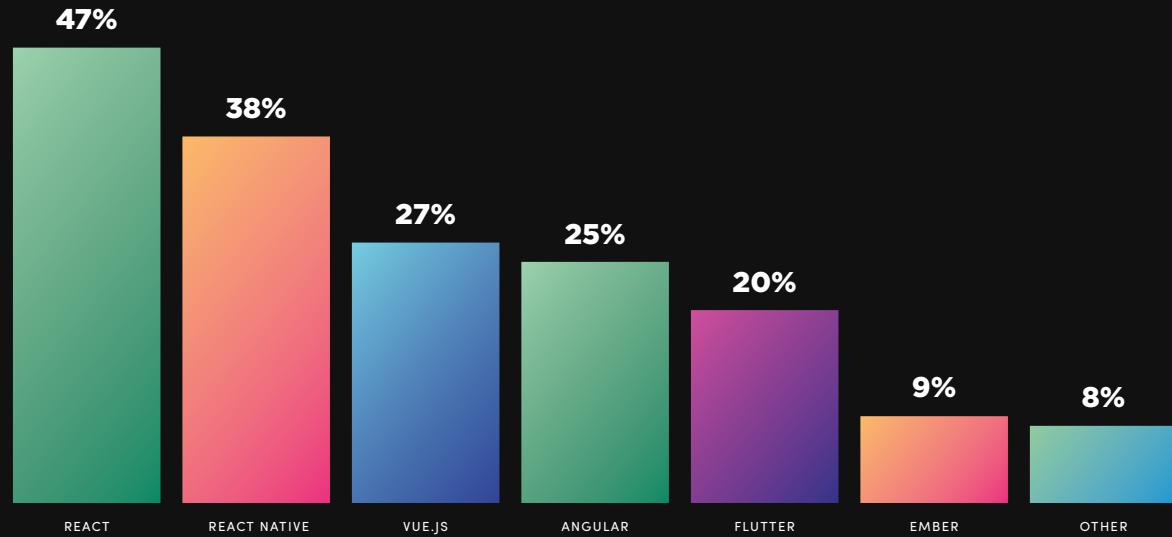


Business Insights

A night landscape featuring a city skyline with lights visible in the distance. A bright, glowing meteor streaks across the dark sky from the top left towards the horizon. The sky transitions from a deep blue at the top to a warm orange and red glow near the horizon, suggesting a sunset or sunrise. The foreground shows dark, silhouetted hills and trees.

We believe that success is linked to having the greatest understanding of your audience. When it comes to the business aspect of developer work, the data you have empowers your decision-making in providing a first-class streaming experience and informing your decision-making on topics such as monetization models, ad architecture, content protection and much more.

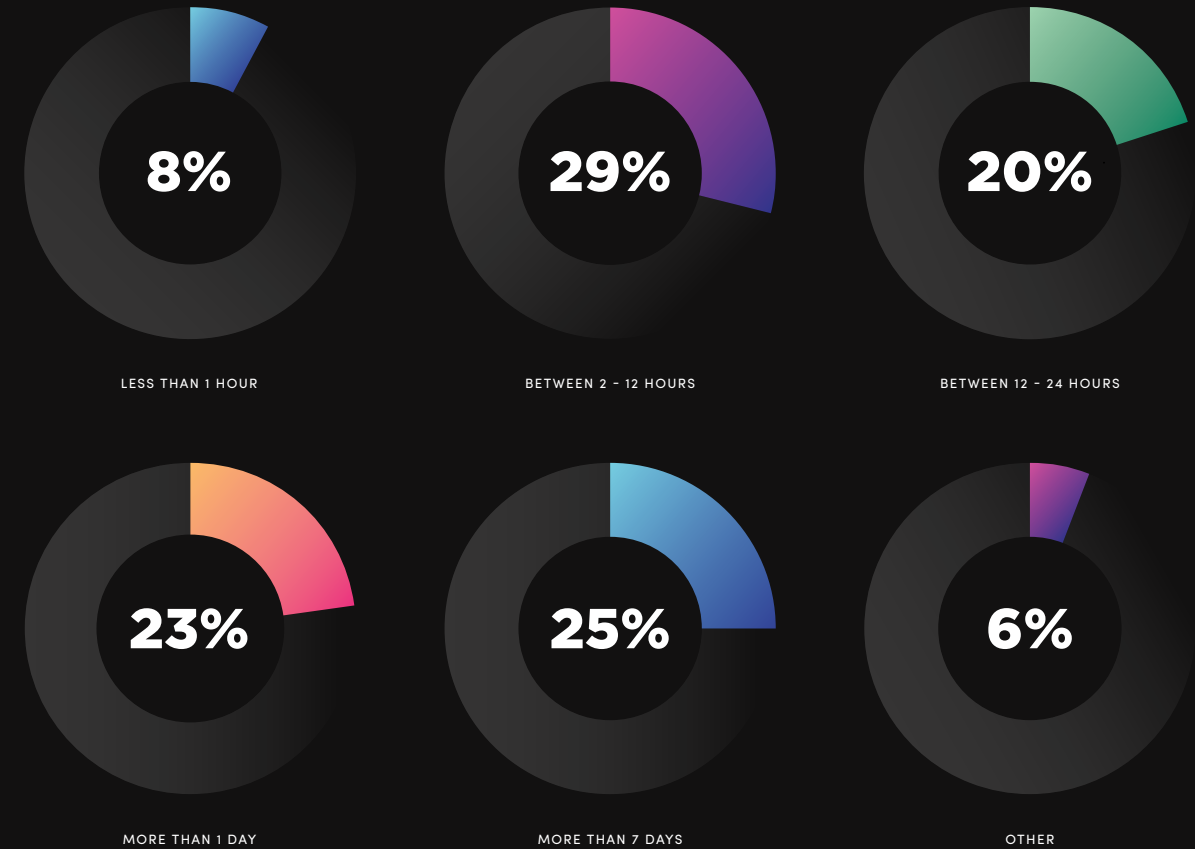
This next section goes into additional detail on a variety of topics, which contribute to your developer work and streaming experiences.



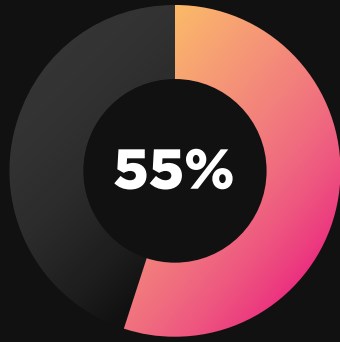
Which development frameworks do you use?

This is a new question and certainly shows that front-end web development frameworks are popular, with React in first place but also Vue.js is popular. This is a reminder that the video player sits within an overall app UX and needs to integrate well with the development frameworks used to develop the app.

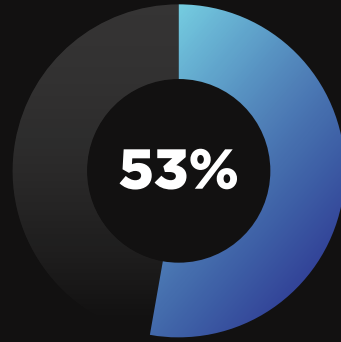
React Native is a popular framework for developing apps for native devices eg. iOS & Android apps and could help developers to save time when building apps for native devices. This also shows that many apps are not built using pure native technologies from the ground up.



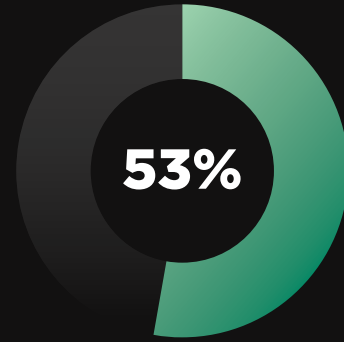
How many hours per month does your development team spend on maintaining your video player solution?



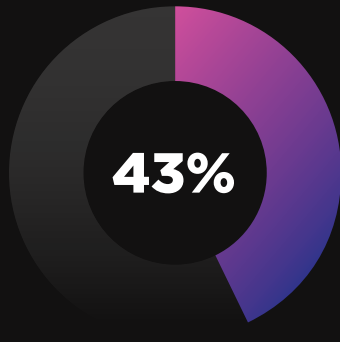
LIVE EVENTS - OCCASIONAL USE



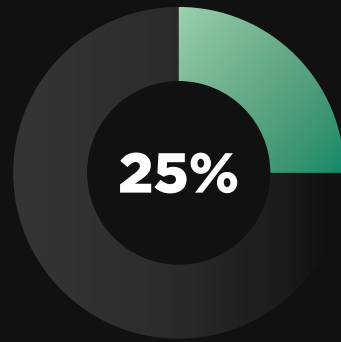
SHORT-FORM ON-DEMAND / FILE-BASED



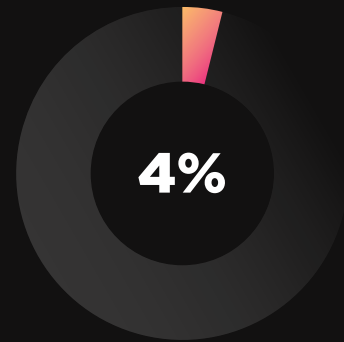
LONG-FORM ON-DEMAND / FILE-BASED



LIVE LINEAR - 24X7 CHANNELS

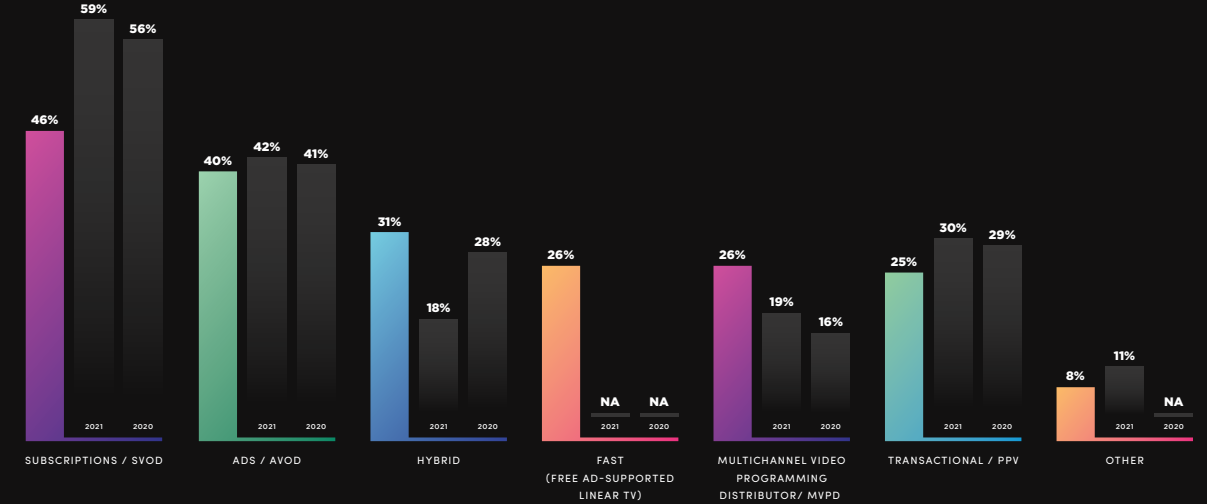


USER-GENERATED CONTENT (UGC)



OTHER

What type of content do you distribute?

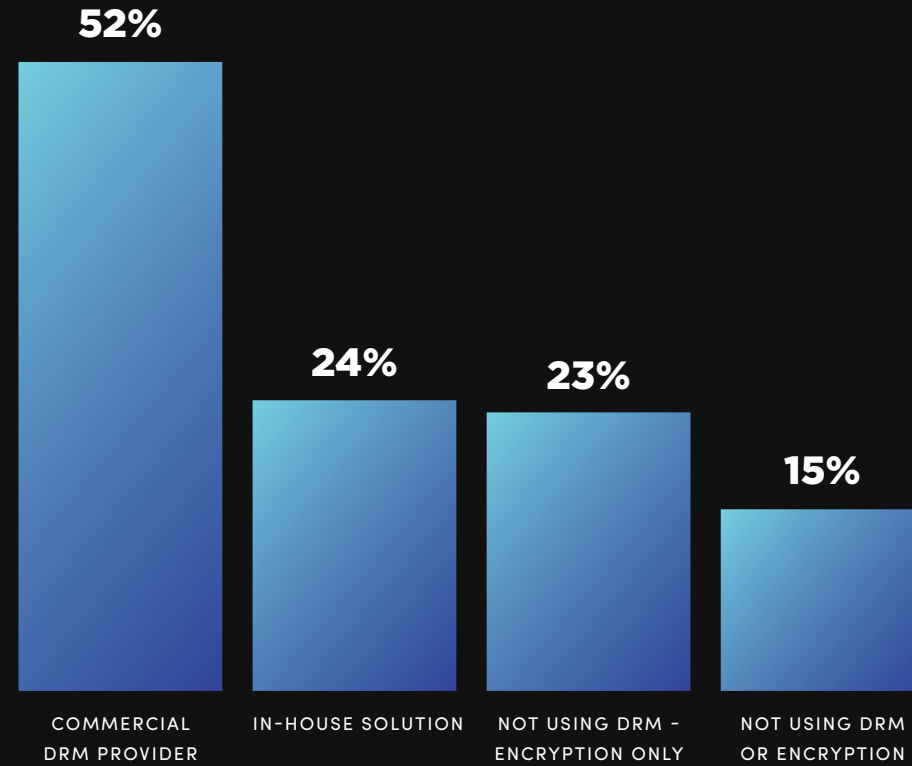


What monetization model do you use?

SVOD sees a big jump year over year as does the Hybrid Model, which we expected. A new entry this year is FAST and Transactional/PPV has moved three places down to sixth on the list.

What do you think will happen next year, will the Hybrid Model make its way to the top of the list and how are you preparing for this growth?

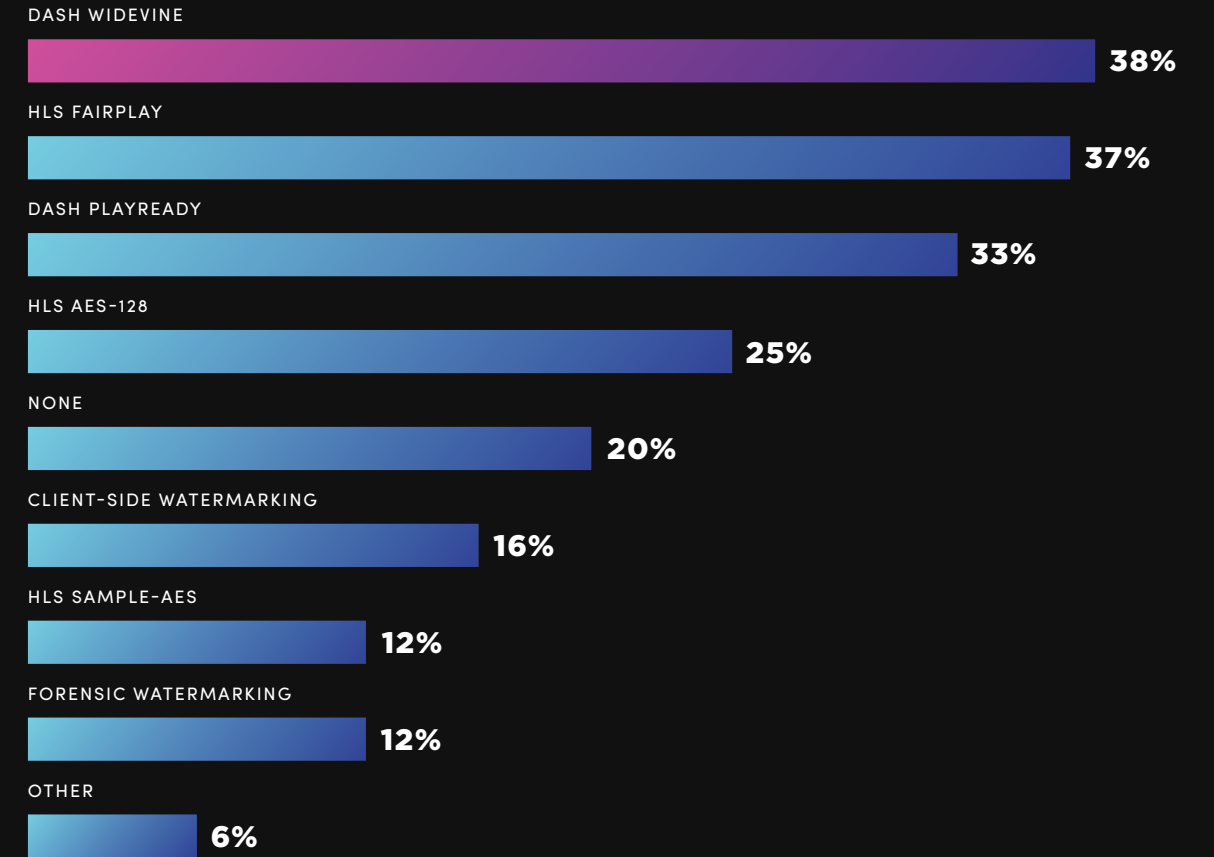
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How are you implementing DRM in your workflow?

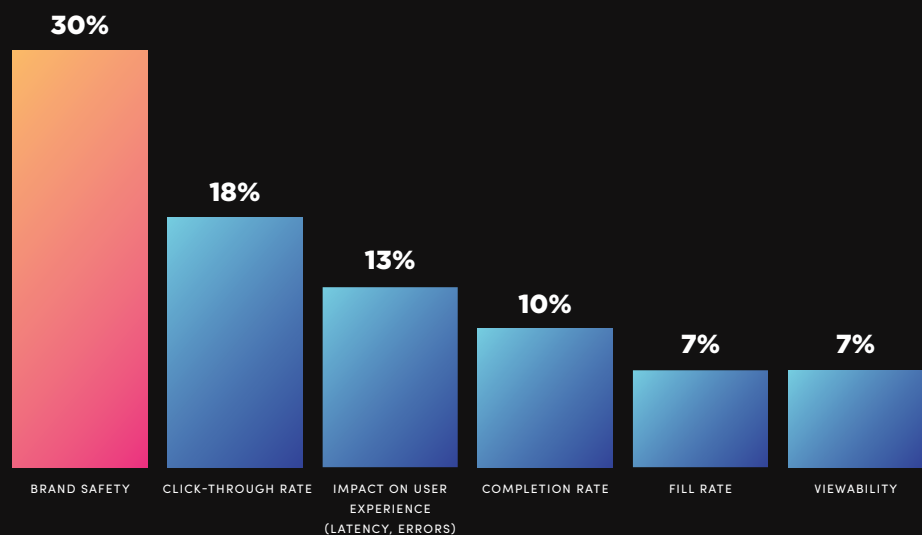
The threat of piracy continues to be a challenge, that being said, we see a positive trend continuing with more participants having stated that they are utilizing either a commercial DRM provider or an in-house solution provider.

It is worth noting that in comparison to last year, there has been an increase in the number of those using a commercial DRM provider and a slight decrease in the number of participants using an in-house solution.



What type of content protection do you use?

When running ads, what aspects are you most concerned about?



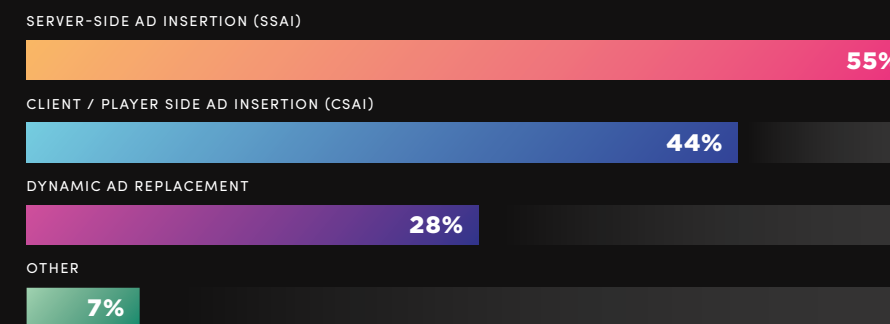
The importance of Ads and Monetization continues to grow, and we have seen the challenges and areas of interest evolve. Last year, Ecosystem Complexity was the biggest area of concern, but this year it no longer seems to be a problem for our survey participants. With the increase in ad-supported services of late and the growing number of media companies launching, openly discussing and developing ad-supported models, it's very encouraging to see Ecosystem Complexity no longer being a barrier to innovation.

Sitting at the top of the list of concerns is Brand Safety. In comparison to last year, Brand Safety was not identified as a key concern. With the complexity of the ecosystem no longer being a concern, we are aware that Brand Safety measurement and targeting is far more robust than in previous years. The growth in ad spending going through CTV and OTT platforms continues to increase along with the targeting, ad measurement capabilities and the increasing variety in types of content available to be monetized.

Brand Safety and Brand Suitability capabilities are at a level of complexity where media businesses need to be able to classify content at a very detailed level in addition to offering targeting capabilities with more nuance than ever. The granularity provides opportunities and challenges, which can be seen as two sides to a coin.

For example, more refined targeting capabilities can lead to higher ad pricing and in the same breath, you can argue that more targeting capabilities can lead to scale issues, limiting monetization options and devaluing the impact of broader reaching ad campaign activity.

What ad architecture are you using today?



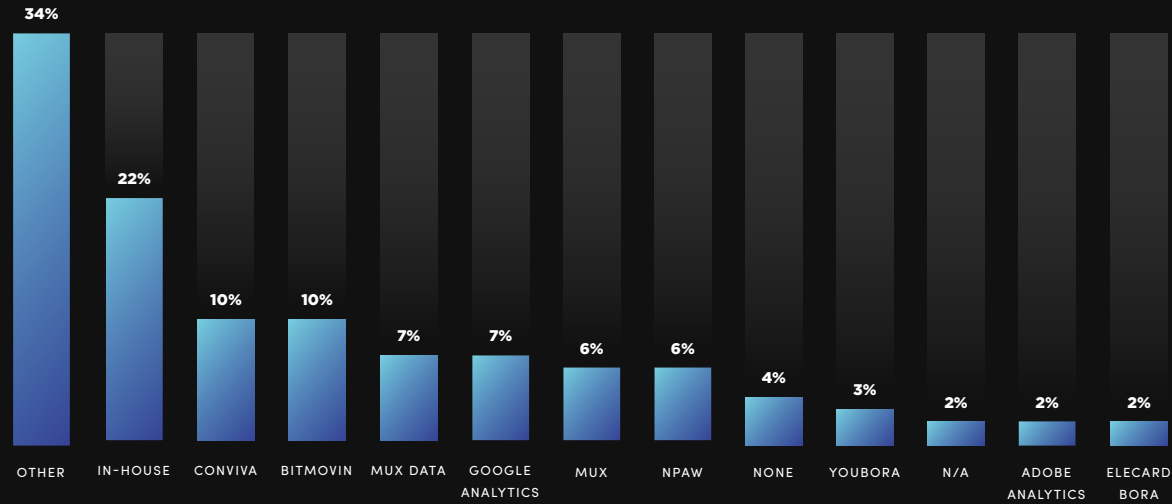
There is little change year over year on this topic. The trend remains the same, with SSAI being the frontrunner and still one step ahead of CSAI. Both have benefits and disadvantages. However, SSAI still sits as the preferred option. It is worth considering the other data points on this topic. Ad Ecosystem Complexity is no longer a top concern, and Controlling Costs has identified the key challenge for our participants.

It is possible to argue that deploying SSAI integrations within your stack can provide a scalable solution for deploying an ads/monetization strategy with cost-effectivity in mind.

How have the changes to the Ad Ecosystem affected your business? Join the conversation on social media by using this hashtag #VideoDeveloperReport

A satellite view of Earth at night, showing city lights and a thin atmosphere layer. The image captures the curvature of the planet, with a thin blue and white atmospheric layer visible against the blackness of space. The Earth's surface is dark, punctuated by numerous bright yellow and orange lights representing cities and urban areas. The lights are most concentrated in the lower right quadrant of the image, suggesting a view of a densely populated region. The overall scene is a striking contrast between the dark planet and the bright lights of human civilization.

Analytics

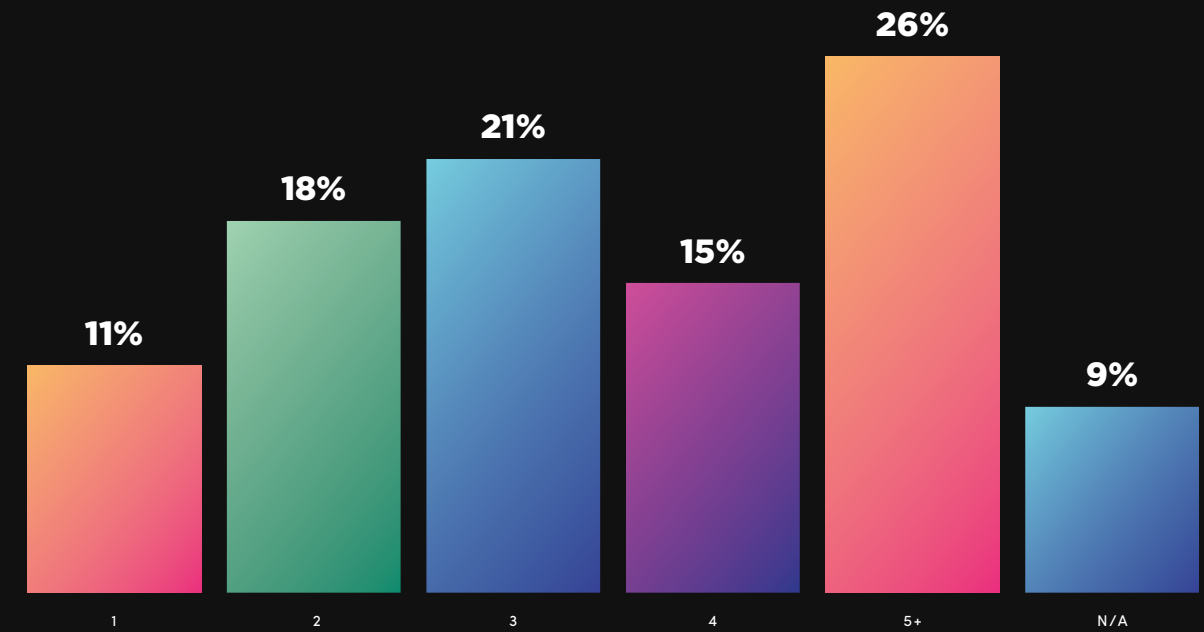


What video analytics provider/solution do you use today?

There's a shift this year when it comes to Video Analytics providers. Here's what we have observed from the results:

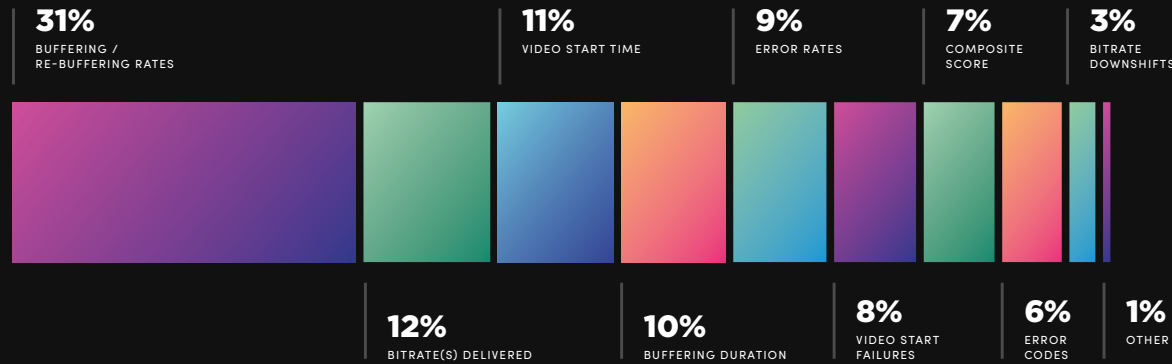
A decrease in the number of those building in-house solutions.

Year over year, there's an increase in other "other" solutions being used in addition to a growing and a significant number of participants using multiple solutions.



How many sources do you collect video streaming related data from?

This year, there has been a significant increase in the number of participants who are using a minimum of 4 sources for collecting data.

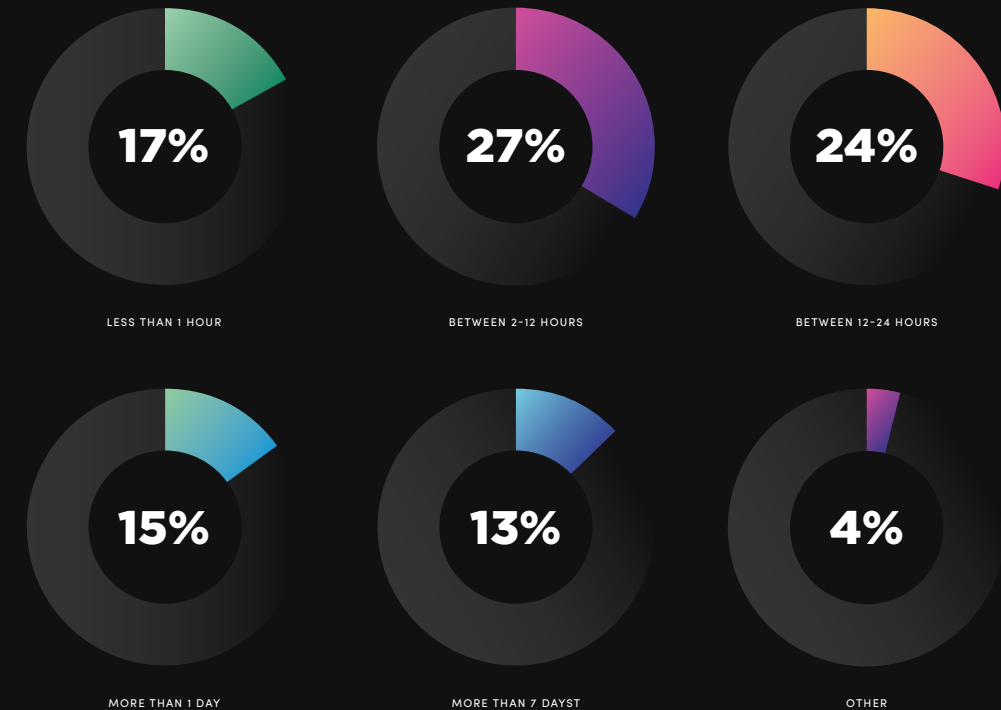


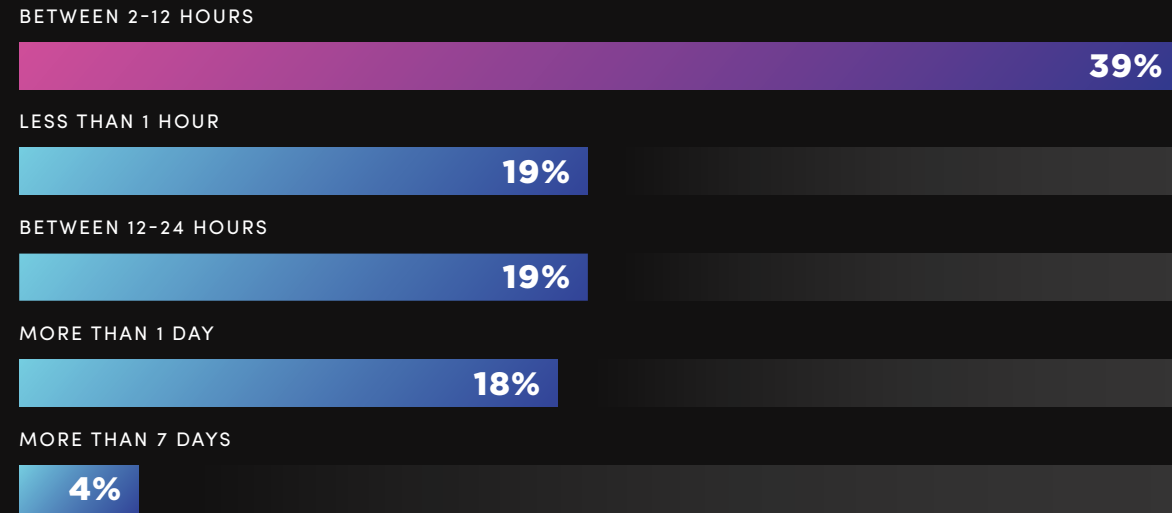
What video performance metric is most important to you?

In previous years, we saw Bitrate Delivered and Video Start Time as the key performance metrics. In this survey, the performance metric of Buffering/Re-buffering Rates climbed to the top of the list and comfortably overshadowed all other performance metrics by almost 3x.

How many hours per month does your development team spend on maintaining your video streaming analytics solution?

No matter whether you are using a third-party vendor or in-house solution for your analytics, the time spent by development teams is a considerable amount. The questions to ask are: is your chosen solution (in-house or outsourced) providing you with easy ways to carry out root cause analysis of errors and hassle-free methods of integration? Looking at the results this year vs last year, the time required to maintain analytics solutions has increased with those spending between 12 and 24 hours and those needing more than 24 hours has increased.

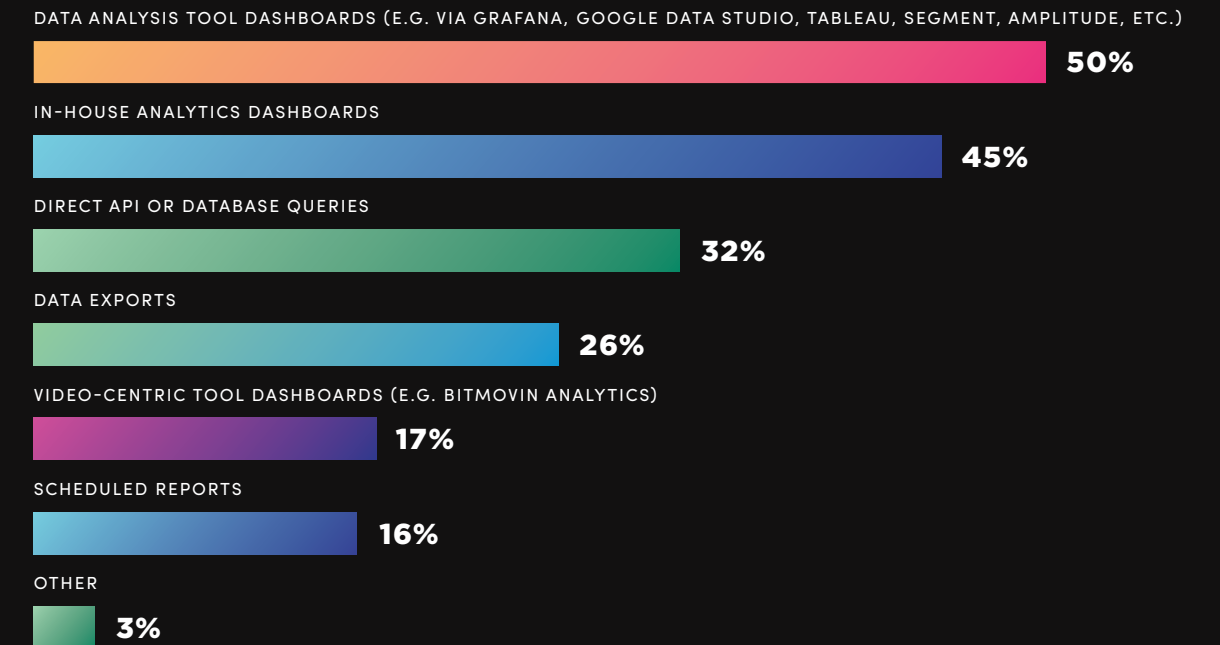




On average, how long does it take your team to find the root cause of streaming-related issues?

How do you access your video analytics data?

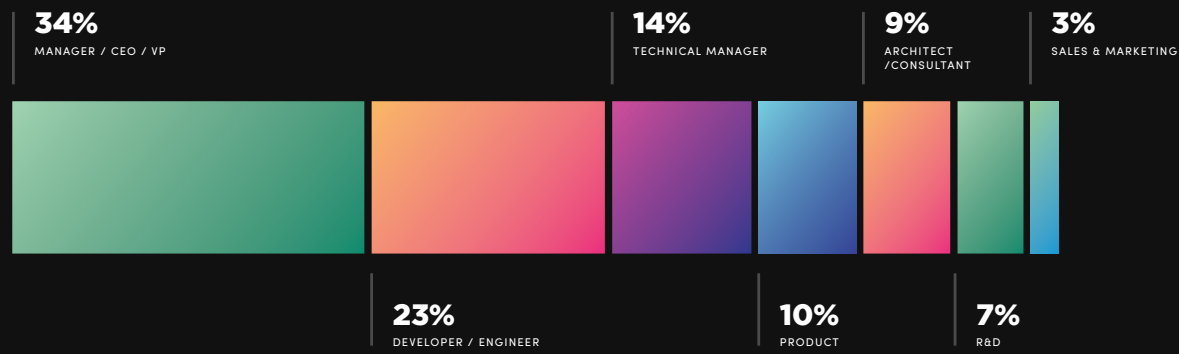
When it comes to your Analytics needs, the trend from last year continues. The vast majority of participants remain focused on having data accessible via custom dashboards and tools with integrations with the likes of Google Data Studio, Tableau, Segment, Amplitude and many more.



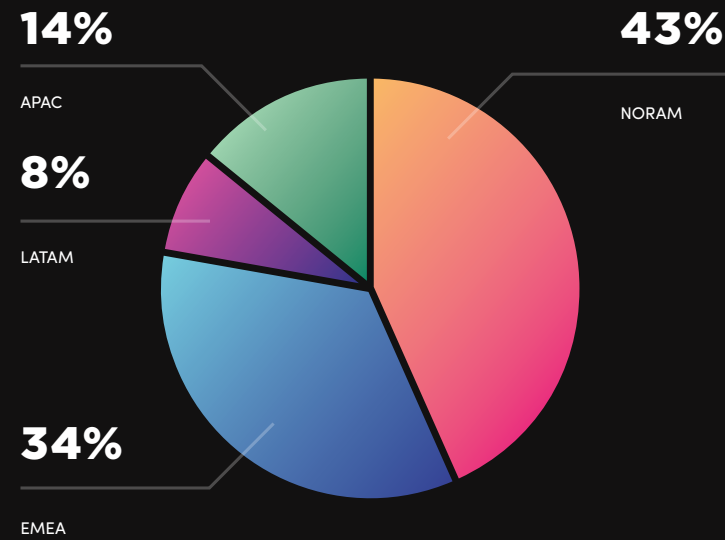


Survey Participant Breakdown

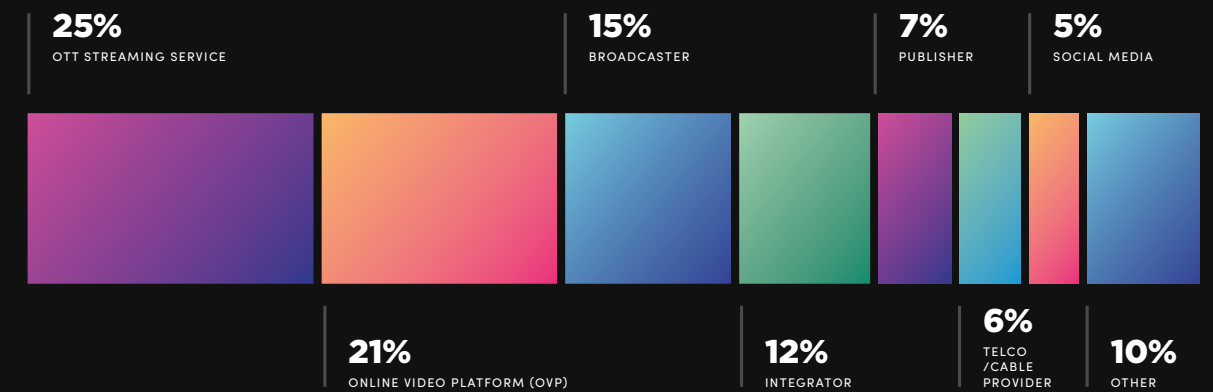
Job Title



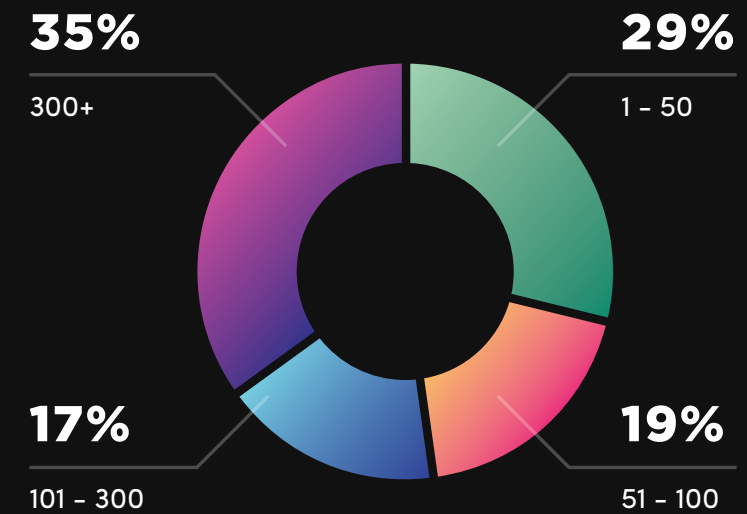
Regional Breakdown



Which industry are you in?



How many employees does your company have?



Built for technical professionals in the OTT video market, Bitmovin's software solutions are designed to optimize customer operations and reduce time-to-market, resulting in the best viewer experience imaginable. This is achieved through Bitmovin's unparalleled device reach, flexible integration, and commitment to supporting their customers.

Bitmovin's cloud-native solutions ensure the most flexible and scalable media encoding, playback, and analytics solutions are available. Optimize your content globally using future-proof codecs on the largest number of devices and screens in the market today. Enable teams to customize media workflows to align with rapidly evolving changes in business so they can identify, reduce, and control operational costs quickly. With Bitmovin, be on every screen, every new device, in every market, quicker than the competition can even blink.