THE FUTURE OF LIVE STREAMING:
INSIGHTS FROM INDUSTRY LEADERS
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INTRODUCTION

For many content providers and rights holders, live streaming represents an exciting opportunity to connect directly with their target audiences and drive new revenue streams.

To better understand the state of live streaming, we conducted interviews with five industry leaders at CBS, NBC Sports, Nine Entertainment, Turner Broadcasting, and Viacom, as part of our ongoing thought-leadership series. Their insights cover topics around live streaming, including the pros and cons compared to traditional broadcasting, how to measure quality of experience and reliability, which business models are being used, current best practices, ongoing challenges, critical initiatives, and much more.

What emerges from these detailed interviews is a picture of an industry in transition — from one-to-many, passive broadcast experiences delivered solely to living room TVs, to personalized, interactive live streaming experiences that can be consumed across multiple devices anywhere, anytime.

These executives have seen the proof points of success gathered across hundreds of successfully executed live streaming events. But they also acknowledge the meticulous planning that is required to execute such events at any scale. The operational elements that are often cited — accessing high-quality video sources, deploying redundant encoders, establishing clear workflows, and partnering with best-in-class CDNs – all combine with the human expertise necessary to achieve success in live streaming.

Broadly speaking, whether the content is sports, news, or entertainment, it is still early days for live streaming. Various catalysts are gaining momentum, including the proliferation of connected TVs that provide living room experiences, the upcoming rollout of 5G broadband to help improve latency issues, and the evolution of both advertising and subscription-based business models, among others.

We hope that the insights and firsthand experiences shared by executives in this report contribute to the acceleration of live streaming and its widespread use.

Will Richmond
Editor and Publisher
VideoNuze
How would you describe the state of live streaming today?

We have been saying this for some time, but we would still describe this as early days for live streaming (IP-based) delivery. Each year we continue to see advancements, further stability, and new ad models.

A core tenet of Playmaker Media, NBC Sports Group’s white-label end-to-end video streaming service, is to deliver best-in-class “broadcast quality” experiences for our customers. With that, there are still new and exciting platforms and technology to further evolve the stability, quality, and latency of our products.

Are there any best practices in delivering high-quality live streaming experiences you can share? With respect to the operational aspects of executing a live stream really well, what are the most important ones (e.g., resiliency), and how are you addressing them?

NBC Sports Group and Playmaker Media are continuing to push the boundaries to deliver broadcast-level experiences on all IP-delivered devices. We believe in leveraging our company’s tremendous wealth of knowledge and excellence in broadcast delivery to apply to all of our multi-platform products. Redundancy, resiliency, and pre-event testing are critical in delivering high-quality, best-in-class digital experiences. Live event delivery, no matter the platform, is all about preparation, and the most important “best practice” is to ensure your primary and backup paths are fully prepared and tested.

Are there any particular ways you’ve used live streaming to engage your audiences beyond what you’ve typically done with broadcast (e.g., choice of camera angles, interactivity)? Do you find that either TV or OTT delivery is better at accomplishing certain things?
Yes, absolutely. We are constantly experimenting with new digital delivery experiences to complement our best-in-class linear product. Some examples that come to mind include NASCAR and the 2018 PyeongChang Olympics. For NASCAR we are able to offer multiple mosaic views that include time-synced video feeds of both the simulcast and our viewers’ favorite in-car driver cams. For the 2018 Olympic Winter Games, we offered an enhanced streaming experience to give viewers more information about the event, including stats, and biographical and historical information. These platforms are fantastic to explore and experiment with new ideas, and we have seen very encouraging results from our customers.

**Which business models are you using for your live streams (free, ad-supported, subscription, etc.)? If you’re using ad-supported, have there been any particular challenges compared to on-demand?**

Based on a diverse product ecosystem in NBC Sports, NBC Sports Gold, and Playmaker Media, we support all models of delivery, including free-to-distribute, “TV Everywhere,” ad-supported, and direct-to-consumer. While I wouldn’t point to any specific challenges with ad-supported content, one of the new and exciting areas we are exploring is ad format types that don’t yet exist. Certain sports — motorsports, soccer, or golf, for example — don’t have natural commercial breaks. Identifying how to solve for “squeeze box” ads, where content continues while an ad break plays in a separate window, is something we are focused on. Our goal is to have uninterrupted user experience for our events while supporting our advertising requirements.

**Are there specific steps you’ve taken to ensure spiky or unpredictable demand for live streams does not degrade the quality of the experience?**

All of our events run on the same infrastructure, regardless of size. The system has been designed from the ground up, to scale and ensure there is no quality impact to our end users. That being said, for events we know we will have peak demand — for example, the Super Bowl, Olympics, and World Cup — we will take some proactive steps with our data center and CDN partners to ensure we are over-provisioned for larger levels of demand, even before the event begins. This has proven to be an effective, proactive measure.

**What were some of the viewing trends you saw with the World Cup? Were these different in comparison to your expectations?**

The World Cup was a tremendous event for both Telemundo and Playmaker Media. One of the more unique viewing trends was the amount of mobile consumption. In a world where we discuss the growth of connected devices, this proves the importance of a prudent strategy to ensure best-in-class for multi-platform delivery.
How would you describe the state of live streaming today?

Live is on the rise and rightfully so, but it is still in its infancy and is still the baby brother of broadcast video. The scale of the cloud and reach of the Internet have allowed different audiences to more easily reach their niche content and allows for advertisers to more accurately put relevant content in front of intenders. Live streaming audiences, however, are thwarted by broadcast viewers. Live streaming is not yet a serious money maker, and it needs to rise to the level of broadcast in consistent quality and availability.

Though technologies like encoding and content management systems are becoming more commoditized, live streaming is still difficult to do right. The many vendors rushing into the OTT space have provided few standards, which make interoperability between providers a difficult task. Also, the unpredictability of Internet patterns and the nature of Internet delivery is very different than controlling delivery of content to the home by cable.

What are your key content and technology initiatives in live streaming?

I’ll summarize our key initiatives into three key objectives:

1. Make more relevant, engaging content available to our fans in new ways. We’ve invested in new content rights. We continue to invest in initiatives that reimagine how television should be watched and how consumers can easily access it.

2. Deliver OTT live content with broadcast quality and resiliency as close to the edge as we can. We’re taking content as close to the home as we can for our live streams in “broadcasty” ways.

3. Adopt technologies and partners that allow us to quickly provision and un-provision live streaming infrastructure. We’ve made changes to our core broadcast and delivery stack. We’ve adopted more modern technologies that allow for more agility and speed. We’re partnering with best-in-class vendors such as iStreamPlanet and Akamai to deliver content at scale.
How has the quality and reliability of live streaming changed over the past couple of years? Generally speaking, what levels are these at now? How do you typically measure them, and what are your target KPIs?

Migrating to adaptive bit rate (ABR) technologies such as HTTP Live Streaming (HLS), we are able to deliver content to more devices at better quality and allow smart players to make decisions on what they can handle. We’ve seen more homes adopt these higher bit rates, as higher bandwidth has become available in more homes. Content encoded at higher bit rates provides better picture quality and clarity. Our average consumed bit rate across all live streams is upwards of 3 Mbps (4 Mbps for sports), which is up from previous years. While the quality of content has increased, the reliability of its delivery is still a concern.

OTT is broadcast television for a new generation of viewers. As such, new baseline expectations around reliability and availability are being established. It was not long ago that most people encountered problems with live streaming and blamed buffering or failed video starts on their devices or their Internet service provider (ISP)/wireless provider’s ability to provide adequate bandwidth for live streaming. Now, consumer platforms have matured, ISPs have provided more bandwidth (even fiber to homes), and technologies like LTE (and soon 5G) have emerged. Consumers are now pointing fingers towards content distributors, who, honestly, were a part of the problem all along.

All of a sudden, we are forced to reevaluate what KPIs are acceptable given the tumultuous landscape of the Internet and our inability to control home wireless networks. We look at rebuffering ratios and generally seek to keep that under 2% of audience across all platforms. Video start failures are also particularly interesting to us, and we like to keep that at some number approaching very close to zero. Ideally, we’d also like to see video startup times in the sub-three-second range.

Are there any best practices in delivering high-quality live streaming experiences you can share?

1. **Assume that if it can go wrong, it will.** In my experience, you need to have a backup plan and a backup plan for your backup plan — especially for high-profile events. We run a number of “pull-the-plug” scenarios against new and modified live streaming workflows to understand two things: 1) how well our redundancy works in even unlikely scenarios, and 2) how quickly and accurately our operations teams respond to those issues. Even with this focus, we are still sometimes surprised.

2. **Balance quality with performance and cost.** For instance, there’s no reason to stream talking-head content at 8 Mbps just because you can. Consumers will consume, and you’re left with the bill without the accolades of hearing “CNN’s picture quality last night was amazing” on Twitter.
With respect to the operational aspects of executing a live stream really well, what are the most important ones (e.g., resiliency), and how are you addressing them?

1. Communication and Awareness: It’s surprising how significant of a difference communication and awareness make in the execution of live events. Especially in larger organizations, communication is paramount. We strive to ensure that all groups (from source acquisition to distribution partners) have some awareness of the expected magnitude of important events.

2. Preparedness — Redundancy and Disaster Recovery: We want our consumers to begin to see the OTT space like broadcast. As such, there is little room for failure. We need operational plans and systems in place that encompass hitless failover or very fast mitigation.

3. Automation and Monitoring by Exception: We need less reliance on “eyes on glass” monitoring and more automation/monitoring that raises awareness before issues become catastrophic.

4. Scale: We need our systems and providers’ systems to handle unprecedented scale, as we’re always seeking to break concurrency records. We need to consider not only the video delivery systems, but also the surrounding systems that enable viewers to access the video (e.g., billing, authentication).

Are there any particular ways you’ve used live streaming to engage your audiences beyond what you’ve typically done with broadcast (e.g., choice of camera angles, interactivity)? Do you find that either TV or OTT delivery is better at accomplishing certain things?

What Adult Swim is doing with their home page streaming is a great example of how we’re engaging audiences. They engage their fans in real time the way users in a Facebook chatroom or gamers on Twitch would. ELEAGUE’s Game Command and TNT Overtime’s quad view provide viewers with alternate camera angles for a more engaged experience. For instance, Game Command allows you to custom-configure how you watch CS:GO events by choosing the POV of players in whom you’re interested. NBA League Pass allows you to watch up to four games at once. While watching multiple programs at once is not new to the broadcast world, the quick selection and interactivity of OTT is something that TV has yet to achieve in the way that OTT has. We’ve also experimented with VR and 360-degree viewing. Last year, CNN was able to provide a 360-degree live streaming broadcast of the solar eclipse from seven different locations around the U.S. These fan-building experiences aren’t possible without the flexibility and mobility that new OTT technologies bring.
Which business models are you using for your live streams (free, ad-supported, subscription, etc.)? If you’re using ad-supported, have there been any particular challenges compared to on-demand?

We use a combination of free, ad-supported, and subscription-based live streaming. For instance, Adult Swim streams ad-free digital programming to its website for more fan engagement. Products like FilmStruck are subscription-based only, while NBA LP is subscription-based with ads. We use an ad-supported model with some alternate CNN programming, PGA tournaments, and even March Madness. March Madness is particularly interesting because we serve and count ad impressions very differently. Ads are served in a way that is more akin to traditional broadcast. Even though it’s technically considered server-side ad insertion, we use a different model than what the market considers server-side ad insertion in that we sell and place every individual break.

If you could improve just one thing about live streaming, what would it be?

I would demand a platform-agnostic technology stack to be adopted by all platforms consuming our live streams.
How would you describe the state of live streaming today?

Accessing live streams has become second nature to our audiences, whether that is within our own sites and apps, or on social sites. We now live stream multiple times a day across multiple platforms, along with 24/7 channel simulcast streams, and major live events. The encoding platforms and tools have made the processes much easier and reduced a lot of technical complexity. There are still challenges around latency, reliability, and DRM across device stacks — and future codecs and standards are still in progress. Many parts of the chain are still to be figured out, such as will it be HEVC or AV1, HLS or Dash, UHD with HDR, 360 or 180 video, SRT vs. commercial accelerated delivery, etc.

What are your key content and technology initiatives in live streaming?

Many of our global brand channels are now live simulcast with “TV Everywhere” authentication, allowing our audience to continue watching our channels on their own devices wherever they happen to be. We also have weekly live events, such as Bellator MMA, and key events such as MTV VMAs, EMAs.

The current technology initiatives we are researching and testing with include UHD live streams, low-latency delivery, accelerated delivery from venue to CDN, augmented and VR live stream integration.

How has the quality and reliability of live streaming changed over the past couple of years? Generally speaking, what levels are these at now? How do you typically measure them, and what are your target KPIs?

The live encoding technology now provides very high-quality encodes, and we typically provide a full adaptive bit rate stack up to HD for most streams. Reliability of delivery to CDNs has improved, especially with pre-packaged HLS delivery. We typically measure buffering events, rendition switching, and average bandwidth usage to identify the quality of experience to our audience.
Are there any best practices in delivering high-quality live streaming experiences you can share? With respect to the operational aspects of executing a live stream really well, what are the most important ones (e.g., resiliency), and how are you addressing them?

We are fortunate that we can bring in live feeds to our global NOCs in New York and London, but there are many occasions where we have to produce live streams from remote venues.

The key aspect is planning. Ensuring we understand the full process chain is essential. We prefer to work with the highest-quality source available, direct from OB truck where we can. This is typically baseband SDI video, but we are starting to see more delivery to us via IP delivery such as NDI, SMPTE 2110, and TICO.

We will typically use dual encoders, both running in active mode. This means that both sets of streams are available at the CDN, and either stream can be picked up by the video player. If one stream fails, the other stream is available. It also means we have to consider both streams as live — and not standby.

Delivery to the CDN can sometimes be a challenge, but we have recently been using accelerated delivery methods over UDP to ensure that there is no data loss from the encoder to CDN.

Are there any particular ways you’ve used live streaming to engage your audiences beyond what you’ve typically done with broadcast (e.g., choice of camera angles, interactivity)? Do you find that either TV or OTT delivery is better at accomplishing certain things?

We have been offering multiple video feeds for live events for quite a few years. Sometimes this is additional backstage cameras that viewers can choose between, catching celebrities’ reactions in the glamour pit at an awards show, or our presenters interviewing on the red carpet.

There are live 360-degree cameras which make you feel like you are right on stage — and provide a unique view of the show. Social networks play a big part in providing two-way interactivity, and we’ll often influence the content within the show based on direct feedback. While a mobile, tablet, or desktop user may multitask, jumping in and out of the live streams, our TV/OTT audiences are typically watching the event without interruption. We still see them interacting via their personal devices — and occasionally jumping into live social streams that complement the live linear feed.

Which business models are you using for your live streams
(free, ad-supported, subscription, etc.)? If you’re using ad-supported, have there been any particular challenges compared to on-demand?

The live streams have many varied business models in use, free, ad-supported, TVE, subscription, as well as sponsorship. The challenge can sometimes be managing how global streams are made available in different markets, often with different content restrictions and differing sponsorship and advertising opportunities. This can result in providing unique streams per region — but with the shift to HLS delivery, we can handle server-side ad-insertion and content replacement at a regional or user-specific level, providing many more opportunities on how our content can be consumed.

**Have you experimented with differentiating live streams for specific audiences based on their interests? If so, how has this worked?**

Viacom has a wide range of audiences across our channels — so it can be really interesting to see how different audiences respond to the different types of content we produce. Additionally, we can see the same content behave differently market by market.

**Are there specific steps you’ve taken to ensure spiky or unpredictable demand for live streams does not degrade the quality of the experience?**

We are pretty confident with how we have implemented our CDN partners to ensure that we can continue to deliver large streams for key events. We work with them in advance of our key events to ensure that capacity is understood region by region.
How would you describe the state of live streaming today?
Live streaming has been growing exponentially due to the proliferation of factors such as cord cutting, cell networks with flexible data plans, as well as the rise of cheaper and more powerful OTT devices in the last three years. At CBSN, the 24/7 live streaming news network from CBS News, we have witnessed exponential growth year-over-year due to the high-quality live news coverage we deliver for free across digital platforms. Many other content companies also now produce digital-first streaming content, and viewership for live streaming will only continue to grow. Research data suggests that it’s not only cord cutters, but people with cable subscriptions also consume significant amount of content through streaming on their OTT, mobile, and web devices.

What are your key content and technology initiatives in live streaming?
On the technology side of things, 100% uptime and being fully redundant is the new standard. We’re also working on supporting multiple streaming formats beyond HLS, cloud-based encoding, and audio streaming. On the content side, our research data suggested that our viewers also wanted content genres focused on topics such as international news, local/regional coverage, social issues, politics, etc. that our content teams are working on. This may also require us to have multiple live streaming channels to make the content more relevant to our viewers, including international and local streams.

How has the quality and reliability of live streaming changed over the past couple of years? Generally speaking, what levels are these at now? How do you typically measure them, and what are your target KPIs?
Our focus has been to have 100% uptime and parity with broadcast and cable in terms of reliability. We measure the reliability through overall uptime, rebufferring rate, startup time, playback failures, and overall video quality rates. We use some internally developed tools and some external vendors for measurements, Quality of Service (QoS), and Quality of Experience (QoE) data.
Are there any best practices in delivering high-quality live streaming experiences you can share? With respect to the operational aspects of executing a live stream really well, what are the most important ones (e.g., resiliency), and how are you addressing them?

These days, your live stream can never be down or unavailable, so operationally you need to provide redundancy to your infrastructure, which can include encoders, CDNs, broadcast master control, and studio space. We are working on developing redundancy at each level of the live streaming production: studio, control rooms, master control, playout servers, encoders, CDN, internal and external networks, all the way to applications-level video players. It’s the entire chain.

Are there any particular ways you’ve used live streaming to engage your audiences beyond what you’ve typically done with broadcast (e.g., choice of camera angles, interactivity)? Do you find that either TV or OTT delivery is better at accomplishing certain things?

Our live streaming product follows a more traditional broadcast format; however, we experimented with 360-degree cameras to provide a more enhanced viewing experience. We provide our viewers the ability to switch between different live streaming channels, breaking news alerts, and DVR functionalities. We’re also experimenting with AR/VR streaming, speech-to-text captioning, better audio codecs, etc. to provide better and more engaging experiences to our viewers.

Which business models are you using for your live streams (free, ad-supported, subscription, etc.)? If you’re using ad-supported, have there been any particular challenges compared to on-demand?

We are an ad-supported live streaming news network, available 24/7 on web, mobile, and OTT devices. When CBSN launched in 2014, 24/7 live streaming dynamic ad insertion was not reliable. Also, there were issues around measurement, viewability measurement, and support on non-HLS players. The overall ad insertion technology has evolved significantly in the last three to four years, especially on the reliability and monitoring side.

If you could improve just one thing about live streaming, what would it be?

Better enforcement of the HLS standard or a universal standard, as it seems video players out in the market are drifting away from the HLS spec and thus you have different playback experiences across different devices.
Which devices have you found are most important for viewers watching live streams? Do you anticipate this will change?

OTT devices and smart TVs are arguably the most important as they represent a significant portion of our traffic. With the cord-cutter generation, we anticipate the growth of these devices to only increase. Mobile devices have also been consistent and a key audience for us. With the introduction of 5G technology, it would be interesting to see how it impacts the data consumption pattern.
How would you describe the state of live streaming today?
If I could describe it in one word, it would be “nascent,” as it’s still not quite broadcast standard yet. We are still missing robust monitoring tools to track uptime and availability at key points in our contribution and distribution chains. We have control over delivery right to the audience in the broadcast ecosystem; OTT delivery relies on many different partners and handoffs, which are challenging to monitor and switch around (if/when required) in real time.

We are still very reliant on broadcast processes and infrastructure, and these traditionally don’t advance quickly and constrain what is possible for the rapidly evolving live streaming ecosystem. Over and above that, we are also grappling with issues around content rights, monetization, inventory management and signaling. In saying this though, the onus is on us as a media and technology organization to find solutions to those problems and push the boundaries in order to give our consumers a quality broadcast-like experience.

What are your key content and technology initiatives in live streaming?
A key initiative at the moment is looking at how we can leverage our current DevOps processes and pipeline to rapidly build and deploy ad-hoc channels to enable the business to turn on a dime, and move towards much more niche and personalized experiences that are very genre- or audience-specific.

Additionally, as part of our effort to solve some of the problems I have mentioned above, we are currently working on features like:

- Live dynamic ad insertion to solve the monetization issue.
- Measuring QoS and monitoring the streams for reliability and stability.
- Scaling of services to support large audience demands — this isn’t only limited to content consumption, but also authentication and identity services.
- Increasing our supported platform footprint, specifically supporting more connected devices.
How has the quality and reliability of live streaming changed over the past couple of years? Generally speaking, what levels are these at now? How do you typically measure them, and what are your target KPIs?

An issue we continue to have in Australia is around broadband connectivity. At the moment, Australia ranks 55th in the world when it comes to average download speeds. This really constrains how far we can push the quality envelope even before taking things like delivery costs into account.

Over the past year, we’ve focused on increasing the reliability of our streams as well as the reach of our platform by rolling it out on a number of connected devices. This has been well accepted by our audiences and has resulted in instances where our live stream numbers are beating our broadcast numbers for certain shows and genres.

As an organization, we are striving for “four nines” (99.99%) availability and uptime across our platforms, and measure this via a number of internal operations and third-party monitoring tools. Quality of streams are also monitored via Quality of Service (QoS) tools, and we keep an eye on complaints and feedback through social channels and our customer service portal.

Are there any best practices in delivering high-quality live streaming experiences you can share? With respect to the operational aspects of executing a live stream really well, what are the most important ones (e.g., resiliency), and how are you addressing them?

The setup and architecture you put in place at the start is very important. When you have an issue with your live streams, it is these things that reduce end-user impact and keep brand reputation intact.

We’ve set up proactive monitoring at multiple points along the stream from the encoder to the edge to look at performance around areas like playback success, startup time, stream consistency, and video quality. This has generally alerted us about issues before they become major and revenue impacting. In the event of an issue, we’ve tried to design our systems to support a fast failover. This generally requires us to switch to a prewarmed backup stream.

Are there any particular ways you’ve used live streaming to engage your audiences beyond what you’ve typically done with broadcast (e.g., choice of camera angles, interactivity)? Do you find that either TV or OTT delivery is better at accomplishing certain things?

Additional camera angles, especially during sporting events, has always been a popular feature. We’ve also looked at integrating live data feeds to supplement these events. For our NRL (Rugby League) events, we’ve given our audience real-time video on demand (VoD) highlights of alternative angles. We’ve done some work with 360-degree video for our Netball matches in the past, and played around with interactive stats and a second-screen experience to supplement events and shows.
Generally, what we have found is that only the superfan engages with such additional product features. We haven’t been able to achieve scale with any of these offerings just yet. With respect to the question about TV vs. OTT, the obvious answer is that OTT drives a great deal more insight for us and affords addressability; broadcast still is the most efficient way to reach larger audiences, though.

**Which business models are you using for your live streams (free, ad-supported, subscription, etc.)? If you’re using ad-supported, have there been any particular challenges compared to on-demand?**

We are primarily looking at the ad-supported business model for our live streams. At present, we simulcast our multichannel live broadcast online but are moving toward dynamic ad insertion to better monetize these streams.

Challenges that we’ve faced have been around supporting late changes to TV schedules; quality of source metadata; signaling of ad avails; and frame accuracy of segment, program, and commercial boundaries.

**Have you experimented with differentiating live streams for specific audiences based on their interests? If so, how has this worked?**

This hasn’t been something we have experimented with yet. There have been plenty of other challenges to keep us busy so far.

**Are there specific steps you’ve taken to ensure spiky or unpredictable demand for live streams does not degrade the quality of the experience?**

We start by leveraging the data from our audience forecasting engine. This is a cross-platform forecasting tool we built in house, which is able to predict spikes in audience. We’ve built our own machine learning (ML) models for this, which rely on consumption data and metadata; we are also investigating what insight Natural Language Processing (NLP) — a component of artificial intelligence as the ability for a computer program to understand human language — might be able to provide about our content.

This tool has been a great resource to predict audience numbers and warn us when there is going to be large demand from our viewers. We then prepare by prewarming additional infrastructure by working with our CDN partners and our hosting partners to ensure that the capacity to handle the surges is there when needed, and the viewing experience is not interrupted or degraded. Operationally, we also make sure key staff are available and monitoring in real time so we are aware of and can mitigate any potential issues before they escalate.