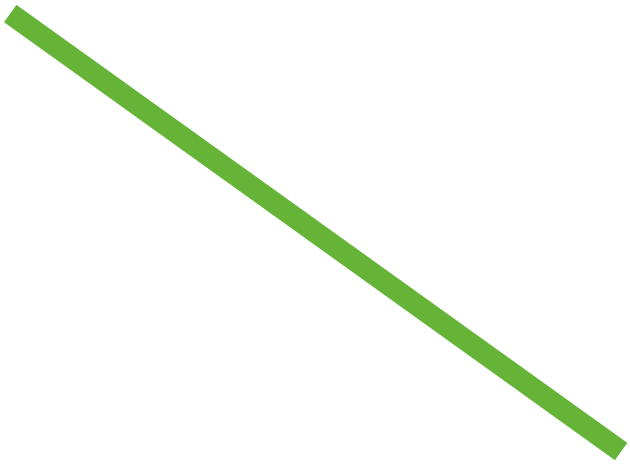
BROADCAST
THE BRIDGE
Connecting IT to Broadcast

Monitoring An IP World – OTT



Essential Guide

EG

ESSENTIAL GUIDES

Introduction

Monitoring has always been the engineers' best friend as it turns apparent chaos into order and helps us understand what is going on deep inside a system to deliver high-quality pictures and sound. As OTT continues to play a more prominent role, the need to monitor internet distribution systems is becoming increasingly compelling.

OTT and VOD have a unique property that transcends traditional broadcast systems, that is, the digital connection to the viewer is bidirectional. This gives media content providers and broadcasters unprecedented access to the viewing habits of our audiences. OTT and VOD playback devices, such as those found in mobile phones, notepads and smart TVs, request connections to a program stream. A side effect of this is that we are able to determine whether viewers are watching or not.

Understanding how many viewers are watching a service also has a double-edged effect because if we know we're losing viewers then we must do something about it. In the past, we've been able to assume all viewers are receiving an RF transmission when a single off-air monitoring point is working, but this assumption is no longer valid. OTT and VOD systems are incredibly complex and there are many points of potential failure. This is further exasperated as there are potentially competing service providers outside of the traditional broadcast chain, all processing the program stream.

One of the fundamental challenges facing us is that the internet was never designed to distribute low latency, high bandwidth, and continuous audio and video. Engineers and technologists have had to design and develop new techniques to stream audio and video services over the internet and this evolution has inadvertently led to the deployment of highly complex systems.

Monitoring is key to demystifying complexity, but internet delivery has highlighted the need to monitor many more systems other than the traditional baseband audio and video. Adaptive bit rate (ABR) delivery systems send multiple streams of the same program to viewers devices. Each of these streams varies in bit rate speeds to take into consideration the environmental conditions the viewers find themselves in. Their devices regularly switch between the higher and lower bit rates as the bandwidth available to them changes.

ABR is ubiquitous for streamed internet delivery and broadcasters and media content providers can no longer assume the viewer is just a passive consumer of streamed audio and video. The regular switching between bit rates of the viewing device makes life just a little more interesting as the adaptive nature of the switching algorithms potentially makes the quality of experience slightly different for each viewer. There are an incredible number of combinations of protocols, viewing devices and software versions.

In time the complexity will reduce, and systems will be easier to understand and maintain, but for the time-being, we must monitor the whole streaming experience from the broadcaster or media content streamer all the way through to the viewers device. Monitoring is more important to us now than ever, but we must analyze more than just the baseband audio and video. An incredible array of systems connect together to make OTT and VOD possible, all of them must be understood, analyzed and monitored.

Tony Orme
Editor, The Broadcast Bridge

Tony Orme.

Monitoring An IP World – OTT

By Tony Orme, Editor at The Broadcast Bridge

Broadcast monitoring is an intrinsic part of the workflow. From the moment the first television signals were broadcast in the 1930's knowing how the signal was performing was critical to reliably delivering video and audio to the home viewer. But as OTT continues to play an important role in a digital IP world, do we still need monitoring? And if so, why?

A proliferation of live sports channels, film networks and light entertainment delivery services have succeeded in providing home viewers with more choice than ever.

Although major live sports events tend to be licensed to a host broadcaster, a whole plethora of syndicated broadcasters often provide access to the same event.

If a transmission breaks, then the viewer has the option of switching to a different service provider. The irony is, the break-up of the pictures and sound may not be the fault of the media content provider due to the complexity of modern OTT distribution systems, but it is their responsibility. In the old days of terrestrial and satellite only distribution, the broadcaster could be confident that if they could receive a stable and high-quality off-air feed, then their viewers would have the same quality.

Good Leaving Me

The old adage "it's good leaving me" was generally accepted as transmitter feeds were common to the broadcasters monitoring system as well as their viewers. Cable distribution started to complicate this, but embedded monitoring helped highlight potential issues quickly. They also generally benefitted from being a closed private network, so the Telco operators had full control and visibility of their distribution.

OTT has complicated the seemingly simple terrestrial, satellite and cable distribution systems as it relies heavily on routing signals through many potentially unrelated networks and infrastructures. Furthermore, viewers are no longer localized, that is, they may well be far away from the limits of the transmitter network. This not only applies to towns and cities, but countries too. It's not unreasonable for viewers in the USA to want to watch a European soccer match from the USA. We can send the video and audio over dedicated SDI networks to the USA, but there may also be viewers in Canada, Australia and Japan. Viewers no longer accept regionalization and localization as limits to their viewing experience and expect to see live sports events from anywhere in the world.

Internet Restrictions

We have three fundamental challenges with distributing media over the internet, especially for live events; the internet was never designed to transport real time video and audio, and there are many independent vendors within the internet all looking to deliver high-quality video and audio to our homes that may not be aligned with each other. Third, in the internet business, the owners of the content and the owners of the transmission networks are usually separate entities – often resulting in finger pointing in case of bad service experiences on viewer's end devices.

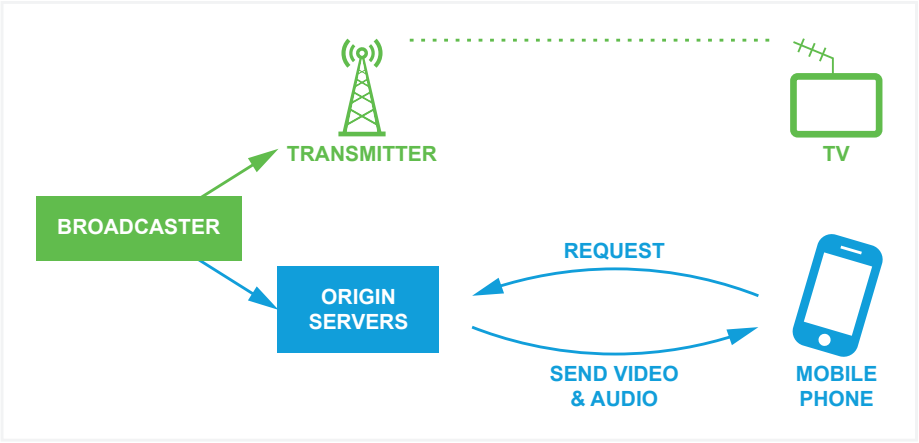


Figure 1 – In traditional broadcasting the transmitter continually streams video and audio to the home viewer as the television is a passive receiver. For OTT, devices using Web technology, such as mobile phones, notepads and smart TVs, all request segments of data from the origin server (via the edge server), therefore the viewers device must initiate the request for video and audio streams.

To understand the full challenge of OTT broadcasting, it is helpful to start at the viewer and then work back through the various networks to the broadcaster. In itself, OTT is a one-to-many delivery system, similar to terrestrial, satellite and cable broadcasting. However, it fundamentally differs as the home viewers device, whether it's a mobile phone, notepad or smart-TV, pulls the video and audio from the broadcaster.

Although multicasting through the internet is a topic of considerable research, currently, there is no commercially viable method of multicasting from a media content provider directly to a viewer (through the internet). Terrestrial, satellite and cable distributions are a form of multicasting as there is a one-to-many mapping, but without the complex protocols used in IP networks.

It's worth remembering that multicasting is used extensively in video and audio over studio IP networks such as SMPTE's ST-2110, but it is not available to us in the internet, and this is why we need CDNs for OTT distribution with the associated monitoring.

Growing Popularity

CDNs have grown in popularity in recent years as they help solve a lot of the distribution issues the internet presents, primarily the lack of multicasting and the competition for data bandwidth. Broadcasters are used to working with uncontested connections to distribute their video and audio over, but this all changes with OTT delivery.

As well as providing faster network delivery, CDNs also consist of storage, transcoding and data packet processing. Instead of thinking of a CDN as just a network connection providing higher availability for broadcasters to geographic regions, we must also think of it as a complete backbone delivery system.

Any viewing device based on web-browser technology, such as cell phones, notepads, laptops and smart-TV's use the HTTP method of requesting data from a webserver. If a user wants to look at a webpage then they enter the address into the browser and the device then requests the data from the webserver. For most situations this works relatively well and there is minimal delay for the page to be displayed. When watching a program or film, the same method applies, but the requests are sent much faster and with significantly greater regularity.

In its simplest form, a webserver is just a computer that serves HTTP requests on the IP interface. As more people request webpages then the load on the server increases. Eventually it may overload, that is, there are too many user requests for it to be able to respond in time. This is usually fixed by web hosts using load-balancers; a device that can route the user requests to multiple servers all providing the same webpage data. Load-balancers work well as user requests are generally well temporally distributed and the data transferred is relatively low.

Bottleneck's And Congestion

This is not the case with video and audio OTT distribution. Not only is there a bottleneck at the program server, but across the network too. The program server, often referred to as the origin server, resides somewhere close to the broadcaster and is the first point in the OTT distribution network. The program sent from the broadcaster is usually encrypted to reduce the risk of pirate copying and then sent to the origin servers.

If just a few viewers requested programs from the origin server then the load on it would be relatively light but the data load across the internet would be much higher than just simple webpage requests. As more users request programs then the load on the origin servers as well as the internet connections increases.

The challenges are further exasperated as adaptive bit rate systems such as DASH and HLS require multiple parallel streams of variable bandwidths. Consequently, instead of pulling just one stream over the internet, users require access to six streams (approximately) of varying bit rate, and that's before we start considering manifest and other housekeeping files.

This system may work for a few dozen viewers but is clearly unsustainable as the load on the origin servers and internet significantly increases as multiple thousands and tens-of-thousands of viewers watch a live event.

Distribute Servers

One method that will significantly improve efficiency is to move the origin servers closer to the viewers and the edge servers, in effect, provide this solution. Situated in the ISPs (Internet Service Providers), the edge servers provide the multi bit rate streams, manifest and other housekeeping files needed to allow systems such as DASH and HLS to operate. Now, a single encrypted video and audio stream is distributed to the edge servers to reduce the load on the origin servers and the internet backbone.

We must remember that the video and audio being streamed is not a continuous data stream as in the traditional broadcasting sense. That is, the streams are small packets of video and audio that are sent using the TCP protocol to reliably deliver the data to the end receiver. Without this there would be no error correction and data would probably be lost.

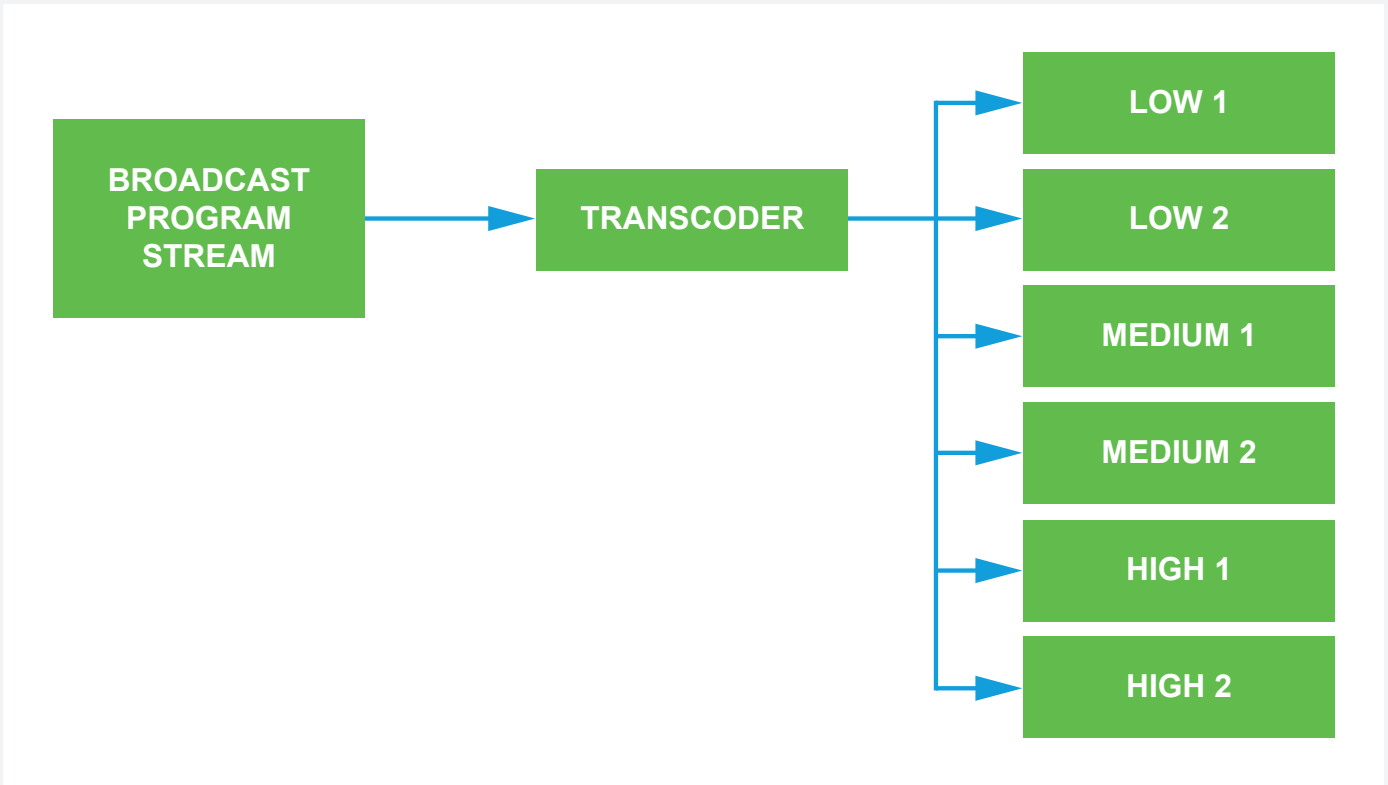


Figure 2 – each broadcast service is transcoded to provide multiple bit-rate streams resulting in six more video and audio streams for DASH and HLS type services. If this is streamed over the internet, additional data is unnecessarily streamed resulting in inefficient use of the internet and potential congestion. To avoid this, the transcoding function is placed at the edge servers.

One of the consequences of packetizing the data is that it must be buffered throughout its transmission. This adds some latency but more importantly is a source of potential buffer overflow and underflow resulting in lost packets. The packets can usually be recovered through the operation of TCP. It's not much of an issue if this happens occasionally but is more of an issue if buffer anomalies occur regularly.

OTT distribution is further challenged when we consider VOD and +1hr services. To overcome network congestion and overloading the origin servers, the assets associated with these services are also placed in the edge servers. The edge servers still request information from the origin servers but as they cache the video and audio their requests are significantly reduced.

Again, it's worth remembering that the CDN doesn't just define a high-capacity network link but also includes the storage servers, transcoders and packetizers. Even from this simple example, it can be seen that although the introduction of the CDN has greatly improved the efficiency of the OTT distribution and quality of experience for the viewer, there is a price we pay for this increased system complexity.

Monitoring Necessities

Monitoring brings order to complex systems. Through monitoring we can better understand what is going on deep within a system. This is even more important in OTT as CDNs, ISPs and networks are often provided by different vendors. CDNs share their network bandwidth and infrastructure with several clients. Although data-rate shaping potentially protects clients from the effects of bursty data from other contributors, there is still the possibility that one client may use more than their unfair share of capacity, resulting in lost packets and a break-up of their service.

As we move to OTT it soon becomes evident that monitoring has significantly moved on from just confirming the video and audio meets the relevant specifications. We must now consider the transport layer too including the IP protocols. We have done this in the past as RF can be considered a transport layer, the difference now is the complexity involved at both a system level and data-link level stemming from a plethora of options for OTT protocol types and audio/video codecs.

If a broadcaster starts receiving reports of a poor quality of service in a particular region then they could justifiably assume that a problem has occurred in a specific feed from a CDN. Placing monitoring before and after the CDN would confirm where the problem is occurring. It might also be the edge servers causing problems, but the broadcaster will be able to quickly see if the CDN to the edge servers is correct or not.

More Than Video And Audio

Analyzing the validity and frequency of the manifest and housekeeping files is critical to making sure a viewer can watch their program. Without the manifest files the viewers device will not know where the variable bit rate streams are and consequently will not know which stream to select resulting in the viewer not being able to watch their program.

Installing monitoring probes deep inside the CDNs would provide reliable feedback of the inner workings of the CDN thus helping the broadcaster quickly find any issues with their feeds. This provides distinct advantages for both the CDN provider and the broadcaster. It's entirely possible that something could have gone wrong at the broadcasters end and the CDN provider is being presented with data that cannot be displayed on the viewers device. Knowing this would be extremely useful.

Adding centralization to the monitoring further improves the efficiency of the system. Probes strategically placed deep inside the OTT network as well as within the broadcast facility can all be connected together. Not only does this provide a centralized monitoring facility but it also gives the management software the opportunity of comparing the measurements of all the other probes in the system.

Collaborative Monitoring

Centralized aggregation, analysis, and visualization of monitoring data in a distributed system helps broadcasters understand problems that may be occurring as well as issues that have yet to materialize but are in the process of emerging. For example, the data rate of a link between an origin server and edge server may increase even though the amount of streaming content has not increased. This could indicate large packet errors due to the number of resends.

OTT systems have delivered unparalleled levels of service for viewers. However, to achieve the high quality of service viewers not only expect, but demand, has resulted in OTT systems becoming incredibly complex. This is further exasperated by the number of vendors and service providers involved in an OTT broadcast chain.

To help make sense of this complexity broadcasters must not only understand the intricacies of OTT playout, such as CDNs, but must also invest heavily in connected monitoring systems to help them understand where issues effecting quality of service are either materializing, or about to materialize.

The Sponsors Perspective

Social Revolution Highlights Need For Effective Media Monitoring – Are You Ready?

By Hannes Strobel, Vice President Media Technologies, Rohde and Schwarz

When broadcast TV was the only media consumption option available to consumers – video monitoring was regarded as a luxury. Today it is seen as an essential requirement in all forms of media content delivery.

There has been a constant rise in the uptake of over-the-top (OTT) streaming services and with this comes an essential requirement to monitor, assess and trouble shoot content distribution networks (CDN) from the broadcast production center through the content distribution network.

This rise in demand has been constant, however the coronavirus pandemic has shone a new and intense light on this area. We live in unprecedented, uncertain times. The availability of reliable live OTT streaming services has become a critical requirement of our socially distanced lives as we fight the pandemic. And yet broadcasters, telecoms carriers and network operators are increasingly challenged by their content distribution network's capacity and the uninterrupted availability of the content. In this environment, reliable video monitoring is essential to locate and remedy distribution issues.

This is more than just a short-term anomaly: this social crisis could lead to long-term changes in workflow and behavior, with many organizations developing new business strategies that see them leveraging cloud-based technologies. These changes will have a profound effect on people's working practices and many organizations' capital investment policies.

Demand for OTT streaming services has grown exponentially. Network operators have admitted to experiencing capacity issues, while Netflix has resorted to streaming only standard definition content to save bandwidth capacity. Against this background, we are advising customers to urgently review their video monitoring capabilities. What monitoring resources do they currently operate, where are the areas of relative weakness in their monitoring networks, and what combination of monitoring technologies best meets their current and future operational needs?

The rise (and rise) of OTT services highlights an increasing need for virtualized monitoring capabilities since these can reach out of the media production center and throughout the content distribution network. With some of Rohde & Schwarz's larger broadcaster customers, they require more than one CDN provider to support their OTT streaming operations. In this situation monitoring is even more important since users can monitor and record the operating efficiency of each infrastructure, identifying exactly where a fault or bottleneck occurs within a content distribution network.

Such is the efficiency of virtualized monitoring that within live OTT streaming networks, it can pin-point and trouble-shoot an operational issue before it becomes a problem that consumers are aware of. Another advantage of the fully virtualized solution is that zero CAPEX investments are required, and operators can flexibly adapt to their requirements and situation.

PRISMON Media Monitoring – Evolution Not Revolution

Media monitoring has been a key focus for us for many years. Our PRISMON suite of systems represents more than 10 year's development by a talented team of software and hardware engineers. Naturally the first generations of PRISMON were on-premise installations, more recently we have seen an increasing need for more dynamic virtualized monitoring facilities.

We introduced a cloud-based virtualized media monitoring platform – PRISMON.cloud – which enables content owners and network providers to monitor their data streams far beyond the broadcast production center into the consumers' homes. This resource provides reassurance: that consumers are enjoying a premium QoS and when faults occur, they are identified and located immediately.

Virtualization is a key technological evolution focus and it will empower many broadcast and media organizations to work differently, more efficiently and more profitably. But, this is not the answer for every scenario, in every scale of operation. Before embarking on a voyage towards virtualization, the user must ask themselves some fundamental questions.

Firstly, does the user prefer flexibility in their production and distribution workflows, which is one of the key advantages of a virtualized environment. Or do they prefer operational efficiency – especially in 24/7 media processing operations? Quite simply, in any case a software-based solution running on a bare-metal on-premise installation is the preferred way to do a future proof setup.

Supported by

Also, if broadcasters are migrating from a broadcast specific standards and interface landscape to a generic IT/IP environment, then the migration has to be complete in order to realize the potential benefits of this new environment. However, life is never black and white – there are many shades of grey and this is where the strength of the relationship between the user and technology partner becomes so important during the transition phase.

For example, the development of a SMPTE 2110 standard on flexible COTS (commercial off the shelf) standard IT hardware requires the skillsets of two different types of people – Hardware near SW engineers that understand the way hardware works and can tune the software to get the maximum hardware performance; and software developers that implement the extended monitoring and analyzing feature set that is possible on the standard IT hardware at reasonable costs.

Our company has built our reputation over many decades on our hardware near SW engineering capabilities. We have also developed skillsets that are valuable when we address the needs of virtualized workflows.

With all these skillsets, we can advise customers: both advice and support throughout the signal processing chain and also on how the virtualized infrastructure is being set up. In order to maximize both latency and data throughput and stability, we can optimize the data processing throughput in a virtualized framework.

The question is how does a broadcaster create bridges to that asynchronous IT/IP world in ways that enable their viewers to consume AV content in a manner they are familiar and happy with? It requires specialist knowledge and skillsets, but the big challenge is to customize a virtualized environment to the specific needs of that user.

Third-Party Interoperability In Virtualized Environments

Virtualized environments will never be limited to just one vendor's products but will be a basket of several different products from a range of companies. This requires a great deal of interactivity and interoperability within the broadcaster's workflows. In this environment things will inevitably go wrong from time to time. It is essential that the broadcaster has a strategy in place for when this occurs so that the impact is minimized. IP and Software based systems give us a great toolset to ensure the stability of the workflow with enhanced redundancy solutions developed in the last 10 years.

There is another important area where your technology partner should provide advice and support. In an ideal world, the user will test any new software's ability to operate effectively within their virtualized environment, but this is not always possible. In this situation, standards such as SMPTE 2110 become important since they help promote operational stability and interoperability. However, three different vendors can interpret a standard differently and this will affect the way they operate together (or not). This is a factor that a broadcaster needs to build into their virtualization strategy and it is one where their technology partner should be able to provide advice.

We note the amount of commentary around the Cloud, IP and virtualization. This is one interesting way to proceed in engineering workflows for a broadcaster but it is not a broadcaster's cure-all. Software systems running on bare metal on-premise installations still have their advantages, especially in static 24/7 scenarios. It is not an either/or; black/white question. Instead it is a question of balancing workflow flexibility and versatility against operational efficiency. And it will develop over the coming years as virtualization's enabling technologies evolve. It is a question that needs careful consideration from experienced technologists. We are investing in virtualized architectures, but this does not signpost the immediate end for dedicated bare-metal with SW only workflow offerings – far from it – it merely offers greater choice to the customer and future proof migration scenarios.

There is one last point to consider. The coronavirus pandemic is creating a profound impact on our society and that impact could be long-lasting. Streaming is an ever-increasing reality of our lives and content and service providers are adapting to these demands. Cloud-based media monitoring such as PRISMON.cloud will be a key factor in deciding who wins and who loses by providing a broadcast grade, reliable service to their customer. Monitoring Quality of Service is key to achieving that.

At the same time, within the media technology vendor market, it is a sad fact of life that not all companies will survive the economic downturn that will inevitably come. Unless companies possess the financial resources to provide a financial injection and support their flagging cashflows in coming months, they will be forced to cease operations. In this environment, it is so vitally important for customers to select the right technology partner.

As we are a privately owned company with excellent financial resources at our disposal, we are able to support our cashflow, and continue investing in the research & development of the next generation of monitoring systems – both on-premise and virtualized into the cloud.

BROADCAST
THE BRIDGE
Connecting IT to Broadcast

CI
CORE INSIGHTS

EG
ESSENTIAL GUIDES


MEDIA


ARTICLES

For hundreds more high quality original articles and Essential Guides like this please visit:

thebroadcastbridge.com

05/2020

Supported by

ROHDE&SCHWARZ
Make ideas real