R&S®PRISMON Plays Invaluable Role in PBS Cloud Encoding, Playout Evaluation

The Rohde & Schwarz measurement tool addressed technical and organizational concerns.

At a glance

Migrating a workflow to the cloud presents media organizations with many new challenges –some technical and others organizational—that can be hard to overcome without accurate measurement, says Peter Wharton, President of Happy Robotz, a Washington, D.C., -based media technology consulting company.

Executive summary

- **Customer**: Peter Wharton for PBS
- **Task**: Last year, as a consultant to PBS, Peter Wharton evaluated the R&S®PRISMON Cloud and was critical in the decision making process for PBS to select Rohde & Schwarz for that project
- **Solution**: R&S®PRISMON
- **Key advantages of this solution**: Advanced audio/video monitoring solution for distribution and delivery environments, Comprehensive and extendable set of intelligent functions for signal analysis, monitoring and quality control of audio/video content

"What is needed is a way to measure the new things that need to be measured that we didn't measure in the past in an on-premises technical environment," he says. "Things like encoding quality in the cloud, the difference in latency between a cloud signals and on-premises signals and lip sync relative to a reference signal."

The importance of objectively measuring these and other cloud performance characteristics was driven home to Wharton recently while working with PBS to evaluate the cloud as an alternative to its existing on-premises master control and playout workflow.

From The Start

A couple of years ago, PBS approached Wharton to consult on the possibility of moving these key workflows to the cloud. Doing so could not put at risk the high quality and standards PBS had established for the network. "Understandably, some people questioned whether a cloud solution could meet these lofty requirements," he says.

Answering objections without hard data proving the cloud was at least as good as what was currently in place would be next to impossible. Media engineers at PBS contended that the quality of the broadcast is one of the most important things any broadcaster has and that it was unacceptable to jeopardize that quality by using untrusted cloud-based encoding, he recalls.

"How could I prove that the quality of encoding in the cloud is as good as that of hardware-based encoding?" Wharton recalls asking himself: "I had to get beyond these sorts of obstacles and build trust."

After searching for measurement tools that could provide his client with objective measurement data, at IBC in 2018 Wharton happened upon the Rohde & Schwarz (R&S) PRISMON, an audio/video content monitoring solution for broadcast and streaming services.

"PRISMON hit a lot of the right points – it was exactly what I had been looking for. It put real metrics around our performance so that we could prove that cloud playout was every bit as trustworthy and delivered the kind of quality and reliability that we demand in broadcasting and equal to what's being used on-premise today," he says. The R&S®PRISMON is a software-based monitoring and multiviewing solution for audio and video content. It supports a wide variety of content transport and media formats used in IP and baseband environments.

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Testing The Cloud

With the R&S®PRISMON at the ready, Wharton set about conducting a methodical investigation into the performance of cloud-based media solutions from various vendors, including those for encoding, playout and transport, running on the AWS cloud, which PBS had selected as its cloud vendor from the outset for the proof-of-concept tests.

First up was addressing the latency between a signal from the cloud and an on-premise signal. Various cloud-related processes introduce latencies, including delays from encoding signals bound for the cloud, those inherent to the cloud itself and latencies for re-encoding and transmitting the signal to its destination, in addition to all of the other latencies a facility normally produces, says Wharton:

"We were using public Internet for transport and not a private network such as DirectConnect or MPLS, so the ARQ-based packet retransmission schemes added to the cloud latency." Not only did Wharton want to identify the latency of solutions from each vendor under consideration, but he also needed to find out if their latencies were deterministic. "If the latency of a feed [to a station] isn't consistent from playout, it will cause problems. When the station's automation system inserts content, it's done on a time basis. Not all stations have moved to SCTE triggers," he says.

The R&S®PRISMON allowed Wharton to identify what the latency was so PBS could accommodate it in its workflow and its timings. In fact, the device allowed measurement down to the millisecond of multiple, different latencies from multiple origination points for the same program, including the on-premise system and different cloud systems, says Wharton.

Measuring the latencies enabled Wharton to synchronize all of the feeds at once from multiple playout systems and vendors all playing the same channel, and watch them side-by-side in sync, making true comparisons possible.

The R&S®PRISMON also helped Wharton measure lip sync relative to a reference signal. "In one case, every time a different event in the playlist would play, the lip sync would drift plus or minus an entire frame," he recalls, adding that catching the lip-sync wobble and identifying its source would have been next to impossible without the R&S®PRISMON.

Video Quality

Perhaps the tallest hurdle to surmount in winning over cloud skeptics was video quality, specifically how video encoded in the cloud would stack up against the existing hardware encoding done on premise by PBS. Here too the R&S®PRISMON proved to be invaluable.

The device's ability to buffer and then sync cloud-encoded sources –one of which had 17 seconds of delay—with a source encoded on-premise at PBS allowed Wharton and others to do a true side-by-side comparison.

"When there's 17 seconds in difference, they'll see the error. But did they see it in the signal from the on-premise source? I don't know because that was 17 seconds ago," he says.

Wharton acknowledges it is difficult to discuss image encoding quality under the best of circumstances because talking about what one perceives is highly nuanced. Without the ability to synchronize feeds and do side-by-side analyses, it's even harder, he says. "Comparing encoding quality can be extremely subjective; I needed a way to make consistent objective measurements that would allow PBS to certify the cloud system met the required encoding quality."

Using the R&S®PRISMON, Wharton ran a series of comparisons that included matchups with a reference SDI signal. The R&S®PRISMON highlighted pixels that were different in red so that an immediate comparison could be made to identify where two encodings weren't identical. The highlighted pixels also made it easy to distinguish between small and big problems as well whether the issue was related to image detail or a color problem, says Wharton.

"The PRISMON actually delivered repeatable metrics using SSIM plus MOS [Structural Similarity Index and Mean Opinion Score]," he says. "Using these metrics, it would measure the encoding quality and create a graph. This allowed us to see that the measured encoding quality visually—both as pixels differences and performance graphs."

Using the data from the R&S®PRISMON, Wharton could demonstrate that the difference in encoding quality between that which was done on-premise and the cloud was under 1 percent, far below the level of perceptibility.

"These metrics provided measurable data in response to those who said the encoding quality was not good based upon their perception, a highly subjective way of assessing quality, versus this very objective measurement," he says.

Unexpected Benefits

The R&S®PRISMON also helped identify a few other problems. With its ability to compare signals on a frame-by-frame basis and log problems that are detected, the device can be set up to inspect logs for significant problems and identify where the issue happened by frame.

This capability was particularly helpful with one of the cloud-based playout system being evaluated. A few times a day, the system would repeat or drop a video frame. When that happened, it would insert a frame of color bars.

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"I realized I needed some way to look at these systems and catch over the period of an entire day four or five frames of video that were totally wrong. And that wasn't going to be by staring at a screen," says Wharton. The R&S®PRISMON, however, could do just that and log errors on a frame-by-frame basis. "We could then stand up an ElasticCache system to actually collect the Prismon logs and analyze those errors, creating a daily performance metric that compared systems and how many frame hits each actually took over a day," he says.

The device can also help PBS identify potential shortcomings in the broadcaster's future distribution system. PBS intends to evaluate the possibility of using the public Internet to transport content from the cloud and NOC to its member stations, eventually replacing the satellite network with a terrestrial IP network.

However, packet loss and jitter –the result of using the public internet—created issues with the existing integrated receiver/decoders (IRDs) and monitoring systems PBS had in place, says Wharton.

When the R&S®PRISMON was inserted into the system upstream, it did not exhibit the same impairments from the jitter. "We discovered the current receiving systems didn't have adequate input conditioning on its IP inputs to support feeds coming from the cloud," he says.

The R&S®PRISMON helped guide Wharton over the course of a few months to address the problem. Making an educated guess that the receiving systems were void of input buffers, Wharton inserted the buffers in front of the IRDs, which removed the jitter and eliminated the resulting macro-blocking and artifacts impairing video, he says.

"With the problems addressed, we could really go back and look at where the encoding might be stressed in the cloud versus on-premise and do some testing because we eliminated those other issues," he says. "The PRISMON became a very powerful tool for moving forward."

The Last Bit

Wharton credits the R&S®PRISMON with the success of the cloud evaluation at PBS. “It addressed a range of issues that one experiences with cloud playout and delivery that are new to our industry,” he says. I see even more opportunities in the future for the Prismon at PBS. Whether it’s OTT delivery or virtual MPVDs, the Prismon offers the capability to monitor all of the linear services and assure PBS that it is meeting its standards for quality and reliability.

The measurement tools and capabilities the system offers simply are not found in any other measurement system we’ve seen to date, he adds.

“The PRISMON allowed us to do the measurements we needed to do and figure out what steps had to be taken to make sure that going forward we can build the kind of high-performance system broadcasters expect,” says Wharton.

“Other systems only do one comparison at a time, so I would have had to stand up 16 of those boxes versus a single PRISMON,” he says. “Its scalability makes PRISMON an invaluable tool –one that served us well during the initial system testing and diagnostics in the engineering lab, and equally well later as part of the NOC multichannel monitoring solution–so much so that the first bit of CAPEX spent on the project was to acquire it.”

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