

In order to provide Quality of Service and Quality of Experience in an increasingly competitive pay-TV landscape, broadcasters and service providers need to ensure the reliability and consistency of video and audio delivery across a range of platforms and devices. *Euromedia* spoke to a range of sector players to find out how they are responding to market dynamics and enabling their broadcaster and service provider clients to maintain market share and protect revenue.

***Euromedia:* What are the most important recent developments impacting on T&M?**

**Agama:** These are exciting times in the ever-evolving TV market, where we are now starting to see a true shift with the ‘TV Everywhere’ concepts and the turn towards more individual TV services. The operator’s role is expanding and changing; at times acting as a managed TV service operator, and sometimes as an OTT operator delivering services over others’ networks. This increased dynamic in the market adds complexity to some operators, having to maintain delivery across several platforms with a diversified consumer end, and increases their need for a richer understanding of the service delivery to be able to assure each individual TV experience. In the end, this only further emphasises the role of service monitoring and quality assurance solutions as mission critical business support systems.

We also see that the competition for many operators is growing, even within the traditional managed TV delivery domain, where the viewers today have more options available than ever before. There is also a

clear risk for an even more competitive landscape with the development of strong OTT service offerings. This market trend brings even heavier incentives for operational excellence.

A minor but widespread development is that loudness is fast emerging as an important factor for operators and service providers to consider, as legislation on this is introduced in many countries. Extended regulations put high demands on operators to take control of their audio levels and subsequently it has quickly become crucial to efficiently monitor loudness.

**Bridge Technologies:** The vast increase in the available bandwidth devoted to IP digital media delivery, and the implications this has for T&M infrastructure.

**EXFO:** The convergence phenomenon has lead directly to a huge requirement for multi-play service assurance. As operators provide more and varied services (voice, video, data, mobile, etc.) across their networks they are increasingly in need of a way to monitor the quality of these services using one simple solution. As concerns about subscriber churn increase and operators continue to focus on service quality as a competitive differentiator, being able to prove service quality is becoming critical.

**Hamlet:** The switch to file-based systems need a totally different approach if the workflows are not to be dictated by the technology. Because there is no longer an ingest process, and because in multi-platform delivery the number of versions of each piece of content has risen massively, you have to consider automated quality control for much of the routine work, with intelligent software-based systems for when operators need to visually monitor parameters.

Hamlet was a pioneer in software test and measurement solutions, putting multiple test windows onto a single display in VidScope for ease of manual monitoring, and implementing automated quality control in Reel Check.

**Harris:** Recently in the T&M world, there has been a great increase in the number of customers delivering content over IP. In some cases these head ends do not have direct control over the content as it is passing through their infrastructures. Therefore their ability to perform quality control on these signals is reduced. Also they often need to transcode or remux these signals and it is vital for their operation to be able to test these signals as they arrive and as they leave to ensure consistent quality. The ability not only to check the video and audio component but also the transport stream itself is very important.

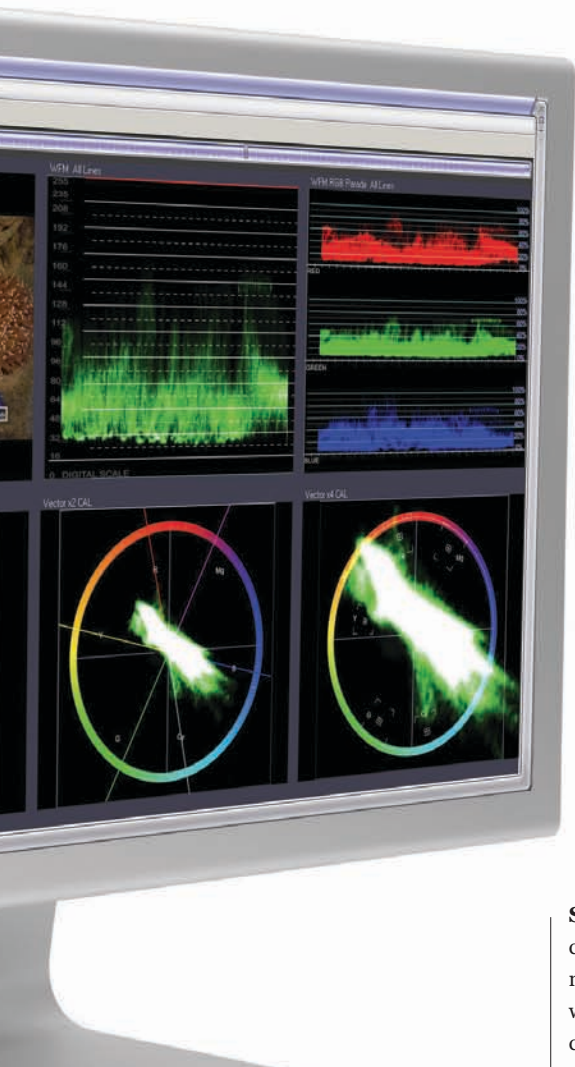
In the market there is also a continuing increase in interest in loudness. Now that loudness has become a regulatory require-



ment for the USA and some European countries, broadcasters need to ensure that the content they are delivering is with these standards. The ability to monitor and control these signals is more important than ever as broadcasters in some countries can face fines if they are not within the standards.

**JDSU:** We are currently facing one of the most complex stages in the history of telecommunications as today’s consumers not only require high quality voice services but also Internet, IPTV, Video on Demand (VoD) and TV channels from their PCs/Laptops/tablets. With the rise of mobile Internet and the proliferation of smart phones and tablet devices, people are more connected than ever and fully expect a flawless user experience. In this multi-device landscape, successful roll out of these bandwidth intensive services means achieving the best possible performance and delivery. For operators, who must ensure the customer an excellent level of quality of experience and service, a reliable and intuitive monitoring solution becomes imperative.

Service providers now have to manage simultaneous and multiple services delivered to multiple end-points over a mix of networking media – from copper to fibre. Not only is



this technically difficult to do, but it also drives up operating expense (OPEX) for service providers.

**Pixelmetrix:** There are two things going on right now. First, 'traditional' operators are moving to higher and higher bandwidths to squeeze more services in. The benefits from better compression via H.264 have already paid off, so higher bandwidth is the only option left. So what this means is you see satellite operators moving to DVB-S2 and terrestrial operators moving to DVB-T2. DVB-S2, in particular, can support some astounding bit rates and some of our clients are already approaching 90 Mb/s per transport stream. Of course, the higher the compression and the faster you go, the more fragile the entire system becomes. That means Monitoring systems become even more important to optimise QoE and avoid catastrophic failures.

DVB-T2 is a little more complicated. DVB-T is already widely established in the developed world, and consumers are not always motivated to change out their STB so soon. Greenfield deployments will almost certainly be DVB-T2, but those operators are being faced with two difficulties: first, that the general economic situation is not conducive to large new investments, but more importantly

is competition for the spectrum from the mobile telephony operators.

In the mobile space, LTE, the next generation mobile phone standard, can deliver an amazing peak bit rate of up to 100 Mb/s. Furthermore, the telecom world has deep pockets and is fighting hard to buy the spectrum used by the old-world television operators. It is a political, not technical, problem.

The other thing going on is the move to OTT – Over The Top. It would be hard to deny the rapid rise of OTT services, but there remain many problems starting at the business model, to managing QoE.

The very nature of OTT means that nobody takes responsibility. So if a consumer pays for a service, how can the operator guarantee any level of service quality? It is within that context that tools for monitoring and managing QoE become important.

**Rohde & Schwarz:** The highly improved specification for the second generation of terrestrial broadcasting, DVB-T2, was released not long ago. Rohde & Schwarz sees an increasing demand for monitoring of these DVB-T2 services worldwide.

**S3 Group:** We are witnessing significant changes across the digital TV landscape. For a number of years, innovation in the industry was represented by an increasing number of channels, delivered with increasing quality to increasingly complex, dedicated function, receivers. Today's subscribers are consuming content from a variety of sources, which has been delivered to them over a variety of different networks and they are consuming it on a variety of different receiver devices.

The traditional delivery platform of a Network Operations Center (NOC) delivering content into a single network type, to be delivered to a single consumer device, meant that an operator could be reasonably confident that if the basic network elements between their NOC and the subscriber hadn't failed in some way, then the content consumption experience that a subscriber was receiving could be reasonably assessed and tested, equivalently, at the point where the content left the NOC. This is clearly no longer the case. Content is being sourced from multiple sources, live feeds, VOD servers, managed OTT services, UGC content delivery from the likes of YouTube etc. These are delivered over multiple networks, many of which are not under the direct control of the operator. And finally when the content reaches the consumer, they may be consuming it on an operator's device such as an STB, a consumer appliance like a tablet PC, the home PC, a mobile phone or indeed any combination of these.

Collectively, these changes have required

operators to deploy much more complex and heterogeneous content delivery platforms (CDP). These have presented our industry with two challenges. Firstly, validating the development and ongoing operation of these CDPs had become very complex and time consuming. The more progressive operators who have enabled their subscribers to participate fully in this new wave of TV Everywhere technologies are faced with an environment where the particular end-to-end CDP of each and every subscriber is potentially unique when all the possible combinations of source, delivery network and consumption device are considered! The second challenge is that there is a continuing focus on minimising the cost of ongoing operation of these CDPs. While they may be expensive to deploy, the real focus is on what can be done to address to ongoing OpEx of maintaining the devices and services that subscribers are becoming increasingly used to having.

**Euromedia:** How is the Test and Monitor segment responding to these new challenges?

**Agama:** When the operator's world grows more complex, the monitoring vendors have to grow their solutions accordingly to support that. The operators are demanding an increased scope of their monitoring solutions for understanding and correlating several distribution chains within the same solution. The monitoring solution needs to manage many different system perspectives and provide solid means for the operator to systematically visualise and correlate the service quality through this range of platforms to each single customer. This whilst maintaining relevant details for a much larger variety of monitoring locations, be it monitoring in a multicast headend, CDN edge, or in any of a wide range of viewer devices – each with their own need for detailed visualisation and metric set. In addition, you also have the fundamental requirements for true end-to-end coverage and the ability to transform massive volumes of monitoring data into processed and feasible information for a wide range of roles and functions within the operator organisation. We continue to deliver components that evolve our existing solution to adapt to the market's new demands and needs, such as the recent additions supporting monitoring of adaptive bitrate streaming and multi-screen solutions.

As a monitoring vendor today, you need to provide solutions supporting everything from operational efficiency and proactivity, all the way down to deepest technical insights and analyses. We have always had our focus on the quality assurance need for the whole operator organisation, with a strong focus on the value of QA for the operator and especially our customers' customer – the viewer. With a lot

of different ways of reaching the viewers and a range of new complexity elements introduced with the turn towards more individual TV services and a more diversified consumer end, it becomes even more important to understand and manage the QoS and QoE

all the way out to the point of service consumption. This is what you can achieve with a complete system like the Agama DTB Monitoring Solution.

However, expanding the monitoring solution with new technical features and capabilities is of course still a prerequisite. If, for instance, you look at the area of loudness control mentioned earlier, you will find EBU R128 loudness monitoring support in the latest edition of Agama's head-end monitoring offering.

**Bridge:** Along with the ever greater importance of genuine end-to-end capability from the satellite to the set-top box and the mobile viewing device, T&M manufacturers need to provide massive scalability in their systems.

**Excentis:** The T&M segment continuously adapts to the new protocols that are being introduced. For some T&M measurements the introduction to IPv6 requires 'forklift' upgrades, for others (like the Excentis ByteBlower product) support for IPv6 was built-in from the start.

**EXFO:** With further development and enhancement of EXFO's Service Assurance solution to meet provider requirements. One such development has been the integration of OTT monitoring into traditional television service monitoring systems. For example, our home verifier now has a traffic module which monitors Internet services including OTT as well as IPTV services.

**Hamlet:** Those involved in the manufacture of T&M solutions have stepped up to the plate with a variety of solutions enabling the assessment of the whole process of programme production through to transmission on multiple platforms. The need for testing this process is driven by broadcasting standards based on the baseband processes which preceded digital production and distribution, which in turn are driven by the audience's expectations of quality. This sets the standard by which all other transmission mechanisms



**The R&S ETL TV Analyzer analyses TV, mobile TV and sound broadcasting signals**

unknown challenges. A number of solutions are now coming on the market for OTT, but I believe that 'the way' to manage QoE/QoS for OTT has yet to be established.

**S3 Group:** The first challenge service providers

can or should be judged.

**Harris:** In the IP works, Harris has strived to product T&M tools that allow broadcaster in the transmission and Video Head End spaces with tools that allow them to accurately measure all aspects of their signals. From our field based handhelds devices for engineers to our flagship MSA device these tools allows engineers to measure and monitor all aspects of the transport streams from the transmitters themselves all the way to the Head End before and after the signal has been processed.

For Loudness, Harris works very closely with broadcaster and the regulatory bodies to ensure that our equipment is fully compliant with standards. Our existing loudness monitors, The CMN-LA and the LLM 1770 are upgraded to the latest standards via firmware which we provide to all of our customers.

**JDSU:** In the communications test business, innovative test solutions for service providers are becoming increasingly important to deliver the highest level of service and deal with the sharp rise in connected devices, network complexity and the immense appetite for high-bandwidth video services. LTE is a key enabling technology, for example, for this bandwidth demand and every major wireless service provider around the world has announced large-scale LTE deployment plans.

Service providers face a simple challenge: maximise the potential of these new services by rapidly growing subscribers without compromising on quality and while simultaneously reducing opex. These are challenges that can only be addressed by giving service providers a complete view of the network and service quality experience. JDSU helps ensure this quality of end-user experience as network and service delivery challenges grow.

**Pixelmetrix:** "We're all working on it" would be the standard reply. But while DVB-T2/S2 present "more of the same", the move to OTT (and LTE!) present numerous and new

face, that of an ever increasing set of platform combinations to be tested, is helping to make it much easier to demonstrate a positive return-on-investment (ROI) case for investment in end-to-end platform test automation. We have witnessed savings in excess of 75% on the effort expended on test execution when moving from manual testing to the automated alternative while simultaneously seeing better quality and reliability of test outcome.

The second challenge service providers face, that of a sustained drive to reduce OpEx, is being addressed through an application of improved test and diagnostics throughout the lifecycle of devices. S3 Group's research on this issue has indicated that high-end receiver devices, such as HD DVRs, may be costing as much as 20-30 per subscriber per year to maintain in the field when the entire set of lifecycle costs are considered. This includes such cost contributors as the cost of call centre support, the cost of truck rolls to repair issues in the home, and the cost of screening devices when they return for assessment and repair. Through judicious application of better diagnostic tools at all points along this lifecycle, problems can be isolated earlier, cutting off further problem escalation and consequently further costs as early as possible.

**Euromedia:** IP delivery has lacked standardisation. Are such issues being addressed? Are there other areas where lack of standards cause problems?

**Agama:** We sometimes get this question, and standardised or not – for us it always comes down to being able to provide the most relevant solutions to the market, and to have a close collaboration with both operators and equipment vendors. The development will always go up and down in phases; sometimes we are in a period of more standardisation and in other times it's innovation. Right now we are in the final stages of an innovative period, which most likely will result in

standardisation as the market consolidates around a few standards or technologies winning widespread use. We are beginning to see standardisations on, for instance, rapid channel change and retransmission techniques, and it probably won't be long until we see standardisations in e.g. adaptive bitrate streaming technologies.

The process of standardisation often takes time and we are, of course, following the ongoing initiatives closely, ready to adapt to standards and new innovations where our customers need support from our solutions. **Bridge:** Standards for IP will eventually be revised and updated, but there's still no guarantee that this revision will achieve the right results. Content owners considering their provision for T&M should think about whether it's safer to rely on a manufacturer's subjective or 'interpreted' criteria as a standard, or whether to use parameters which provide the complete data on the stream. Zero tolerance for errors is the fundamental requirement for completely effective monitoring, rather than misleading and arbitrary indices of acceptable quality.

**Excentis:** Delivery of video and audio over IPv4 has been in use for some time now, and this will shift to IPv6. The usage of IP for transport is not really the biggest problem for standardisation. The standardisation challenges are more on the middleware to be used on the set-top box, TV-sets, or any other devices. Also the problem of a standardised DRM or CA hinders full interoperability.

**EXFO:** EXFO's Service Assurance solutions embrace current standards in every service area and we are currently looking carefully at emerging standards like HTML 5 video.

**Hamlet:** Standards are driven by what those who pay will accept in terms of quality, whether it is the advertiser or the subscriber. The level of degradation will depend to a certain degree on the nature of the channel, but ultimately if the quality falls below a certain threshold the customers will rebel.

As ever, that threshold will depend on the content. For a long while ENG was not broadcast quality but because it gave viewers an insight it was deemed admissible. Today we regularly see very low bandwidth satellite transmissions from news sites, with very poor video quality and a lot of freezes, but the audience accepts it because the alternative is not to have any pictures.

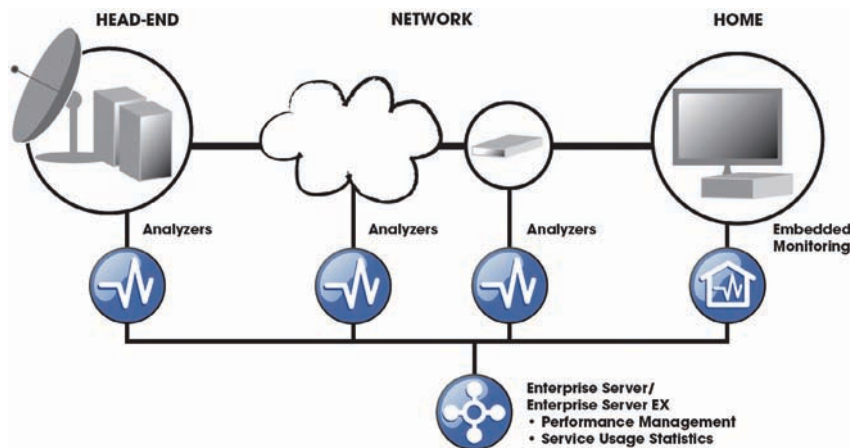
That does not apply to other genres. As audiences buy HD televisions and HD receivers they actively seek out better picture and sound quality, and are vociferous if the expected quality is not reached. Setting standards is an imperative to guide the industry to greater levels of quality, and therefore customer acceptability.

**Harris:** Harris is constantly working with customers who are working in these spaces to understand the daily challenges faced by them. Our MSA measurement platform works with a combination of ASI, IP and RF signal and will measure the transport stream to the ETR TR 101-290 standards and well as analysing the signals with the ISO standards for MPEG-2 and H.264. This allows the customer to ensure the content is of both a high broadcast quality, identifying such issues as macro blocking and audio issues as well and

initiatives have been underway pretty much since the initial transition to digital for TV. Unfortunately companies have frequently had entirely different starting positions and desired outcomes and consequently have found it hard to reach consensus. The rapid growth of OTT delivered content over the 'raw' Internet has injected new urgency into this discussion for digital TV operators and there seems to be a growing consensus that HTML5 can represent a solid base for progress. The Digital TV industry has learned many hard won lessons from previous attempts across various standards bodies to resolve the conflicting business requirements from different participants in the pay-TV industry. We believe this experience will be of benefit when contributed into bodies such as W3C as they go about the work of establishing the next generation of the Internet's core standards

where video will be a vital element. **Euromedia:** Broadcasters and service providers are increasingly offering 'TV Everywhere'. What are the challenges of ensuring QoS and QoE across a range of platforms and devices?

**Agama:** A dramatic increase in both volume and variety of end devices, as well as in volume of asset versions and



ensure the relevant PID table information is present and correct and the ancillary data for such things as aspect ratio and embedded audio are present and correct.

**Pixelmatrix:** We don't agree that 'IP Delivery' itself is without standardisation. How to deliver video/audio over IP is well established and works well. The latest generation of compression headends, for example, are 100% IP. No ASI at all. The problems are beyond the transport and into the services themselves. For example, EPG, recommendation engines and interoperability between delivery platforms is where the real problems are happening. Even compatibility between the client/STB and the head end.

**S3 Group:** Standards have typically been most successful where there have been compelling business drivers incentivising all market participants to put the standards in place and to work the standards to everyone's mutual benefit. The problem we have seen in IP delivery standardisation arises in our opinion due to the variety of different business models which these standards have sought to address. It is not as if there have not been attempts at IP delivery standardisation; such

types of content, introduce an explosion of media files delivered over a large set of platforms. This obviously adds to the operator's challenge of understanding the customers' perceived quality due to the diversity of what is actually consumed and how it is delivered.

These new challenges only further strengthen the needs for massive, powerful and comprehensive monitoring solutions with holistic approaches. With the 'TV Everywhere' concepts, it's no longer sufficient to provide insights for only one TV system or limited parts of the distribution, but you have to provide the means for visualising and understanding several complete distribution chains within the same solution. The operator has to be able to efficiently manage, control and evaluate the QoS and QoE of the different distribution platforms to customers consuming TV in very different settings, all with their own potential problem sources. To achieve this understanding and to have the means for operational excellence in this complex environment, the operator will need a wide-ranged and massive monitoring solution in both scope and scalability.

**Bridge:** The main challenge is to integrate

the variety of platforms and devices into a unified test and monitoring environment. Content owners who don't have a unified T&M environment for their cable/broadcast/IPTV operations will find their overheads climb steeply if they try to extend into 'TV everywhere' services. It's important therefore to get the fundamentals right with a fully integrated end-to-end environment for the conventional services, and then extend into new services keeping the T&M provision for



these within the same environment. And it's vital to find a T&M vendor that has a genuinely integrated offering for 'TV Everywhere' services, that will allow the service provider to manage the T&M operation efficiently without a major spike in the workload.

**Excentis:** The challenges of ensuring QoS and QoE over a range of platforms, devices and most importantly interfaces are huge. A significant number of the new devices will typically be connected over a wireless interface like WiFi, 3G or LTE in the future. Ensuring a consistent good QoE over these wireless interfaces for a high-quality video or audio stream is a difficult task. It is important that operators thoroughly compare and check the performance and stability of any WiFi-products they offer.

**EXFO:** This issue truly highlights the importance of having a truly multiplay service assurance solution. When multiple networks and service types are involved (e.g. mobile device to the tower, Ethernet backhaul to the network, MPLS across the network, etc) you really need to implement a solution that can seamlessly monitor the QoS and QoE of each subscribers traffic no matter what service is being used for delivery. Failure to do so will result in monitoring blind spots that will be certain to cause major problems in the future!

**Hamlet:** The problem is exacerbated by the fact that we want higher quality and more content, available on multiple platforms including mobile. To meet this expectation will mean higher speed transmission and new compression protocols, as well as the storage and playback capacity to cope with this burgeoning new environment.

The first challenge is to define what quality means in this context. Some of it is new to our industry: the impact of IP transmission variability leading to the risk of buffer overflows or underflows at the receiver, for instance.

The second challenge is the sheer volume of content to be managed. What was once a piece of broadcast video now has to be converted to so many resolutions, codecs and wrappers that individual quality control becomes impossible – the number of permutations is vast. So we have to define ways in which we perform quality control on the original high quality version of the content and on the processes which generate the other versions, to minimise the possibility of quality errors on all the deliverables.

**Harris:** One of the main issues our customers encounter is network issues in the IP world that can delay their transmission. Our T&M tools will monitor the IP packet data and measure (among other things) loss rates, delay and dropped packets as well as quantisation rates and packet jitter. In addition we provide quality data in the RF and ASI world by measuring noise and providing an easy to read constellation diagram for engineers to provide real time feedback on the potential hundreds of signals they are working with.

**JDSU:** We are seeing more network equipment, more network equipment vendors, dynamic routing and automated failover of equipment which increases complexity for monitoring and troubleshooting.

Service providers must ensure that they segment issues that are time consuming and expensive and which inevitably impact operating expenses (OPEX) and mean-time-to-repair (MTTR).

**S3 Group:** Each new platform and device brings its own challenges. Consumers have different expectations of QoS (and QoE) depending on what source the content is coming from, what network it's being delivered over and what device they are viewing it on. This makes it impossible to adopt a "one size fits all" approach to managing QoS on today's complex content delivery platforms. Adding to

the challenge is the growing importance of devices like iPads and PCs being used to consume services. Unlike traditional Set Top Boxes whose performance could be carefully planned and managed, these consumer-purchased devices may be running a variety of other software applications that can impact on the QoS.

Another issue we have seen service providers struggle with during the deployment of TV Everywhere style

solutions is the impact which multiple device interaction in the home can have on individual device performance. No matter how much testing has been performed on each device individually, emergent behaviour when multiple devices are operating and co-operating in a single home network can have a dramatic impact in reducing the QoS. With the number of potential scenarios scaling exponentially with the number of devices supported in a single home network, this once again provides an area where careful application of test automation can make a significant impact in reducing the cost of comprehensive testing.

**Euromedia:** What are the major new challenges coming up? Are these more likely to be related to delivery protocols, devices, or display modes?

**Agama:** We believe the major challenges for all monitoring solution vendors will continue to lie within the domain of dramatic increases in capacity and complexity with the coming scale-outs, where TV services can have tens of millions of end devices and massive volume of content streams even in the edge locations. These challenges will require new approaches and ways of thinking when it comes to quality assurance and full-coverage continuous monitoring, and how the result is visualised. However, these scale-out developments will further drive the progress towards control and understanding of the end point, the actual point of service consumption. Highlighting the operational perspectives of an increasingly diversified TV domain, further enhancing system perspective visualisations to cover an ever-growing platform and geographical outlook of the services, will require even higher versatility from the monitoring vendor, and this is something Agama stands well prepared for.

**Bridge:** There are no insurmountable challenges if providers plan carefully and lay the

right T&M foundations. The danger for any provider is in letting the scale and variety of services they try to provide outstrip the capability of the T&M operation. New delivery protocols, new devices and display modes are relatively easy for operators to deal with if they have created a T&M environment that is sufficiently scalable and based on the right technologies.

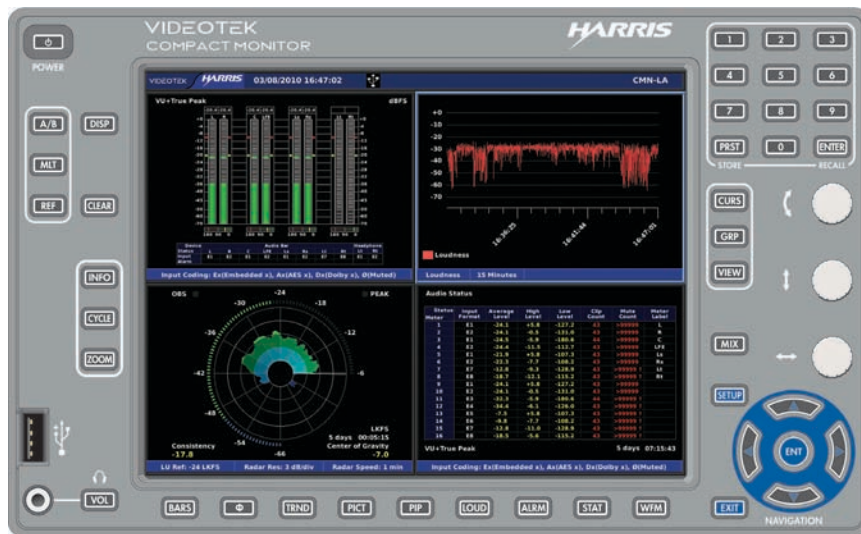
**Excentis:** One of the major new challenges is ensuring a good QoE over wireless interfaces. Tablets will be used more and more to consume content, and they will use a wireless interface to obtain their content. Providing a good QoE experience even in challenging environments is key to success.

**EXFO:** The rise of 4G services like LTE and the insatiable consumer demand for mobile video services like facetime are likely to be the next big wave to impact the industry. Also real-time video is being pushed up the network rather than being pulled down from servers that will create a significant strain on backhaul services. Due to the fact that video traffic (and the video consumer) is much more sensitive to quality issues, monitoring the video consumers QoE will become the biggest challenge for providers who want to remain competitive. Consumers want to watch their programming immediately and they want it in HD on the screen of their choice – they're willing to pay for the privilege, but if their provider can't deliver they'll very quickly take their money elsewhere!

**Hamlet:** Delivery protocols remain the big challenge, as outlined above. As new devices are added to the mix, so the number of variants for each piece of content continues to rise.

The other challenge for the immediate future is stereoscopic 3D. If this is to achieve success with an audience and raise real revenue for the content owner and broadcaster then quality is absolutely paramount. To date, we can develop sophisticated tools to help the producer achieve accurate matching between the two 'eyes', but we have yet to fully understand what makes satisfying 3D and perhaps more importantly what makes 3D uncomfortable to watch.

These quality threshold tests have ultimately to become automated processes, in the way that, for example, we can now protect viewers with automated testing for content that may trigger photo-sensitive epileptic episodes.



**Harris:** As content is now being consumed on a variety of devices (Computers, smartphones and tablet devices) the need now is to be able to transcode and deliver this at a variety of bitrates and codecs. Having a single platform that can measure all of these signals simultaneously and troubleshoot these issues in real time is very important. A single solution that can be a central hub for signals in this space ultimately reduces costs as several devices can be consolidated and would also allow a single measurement standard can be applied to provide a consistent test and measurement standard.

**JDSU:** Not only are more engineers required as there are more subscribers reporting faults within the home, but without being able to diagnose the cause of the fault before dispatch, engineers are essentially shooting in the dark and it may require several return trips to adequately identify the fault and get the equipment needed to fix it. This approach is far too costly and can also lead to customer churn due to dissatisfaction with the speed of fault resolution.

These are challenges that can only be addressed by giving service providers a complete view of the network and service quality experience within each subscriber's home. When it comes to fault diagnosis and resolution, service providers need to rely on a test strategy that can get as close to the customer as possible.

Our home performance management (Home PM) gives service providers the necessary visibility into every home to provide full quality of service and quality of experience reporting of customers experiencing degraded service. With proactive service fault management and continuous performance monitoring of home networking equipment, home performance management automatically alerts providers to customers experiencing degraded services. Whether the service is IPTV, Internet or VoIP.

Once home performance management detects service degradation issues, it provides

the critical information necessary to resolve the problem. Its rapid and accurate fault demarcation capabilities support in-service diagnostic testing and on-demand real-time data collection that facilitates fault investigation and root-cause analysis, reducing mean-time-to-repair (MTTR).

**Pixelmetrix:** OTT Delivery protocols will certainly be an issue.

The entire OTT delivery model swaps everything around. In OTT, it is the client that is in charge. The client decides which programmes, which quality level/bitrates. The operators completely lose control. Part of that loss of control is the client itself. We've got iPhones, computers, etc, all with different software. That will lead to all kinds of compatibility issues if there is no move towards standardisation.

**Rohde & Schwarz:** Content is moving from high-definition toward ultrahigh definition to ensure an unchallenged viewer experience. The challenge is to provide this content to consumers via the existing distribution networks. This requires improved delivery protocols and also has an impact on next-generation consumer devices.

**S3 Group:** We expect to see continuing growth in the diversity of devices being used to consume content and the complexity of the multi-device home networks into which they are placed. We expect to see the fusion of web and broadcast delivery taking centre stage driven by the compelling economics of broadcast technologies for the most popular networks and broadband for the longest-tail content.

This hybrid delivery approach has now made its way as far as the TV screen itself with the rapid rise of Connected TVs. We believe that the pay-TV industry will thrive into the future based on a combination of compelling content and easy discovery of that content. It is also essential that the pay-TV industry find a solution to the issue of portable, yet robust DRM to enable consumers who want to stay on the right side of the law to store, consume and (increasingly) share content that matters to them in a simple and intuitive way and on commercial terms which they, the consumers, find reasonable. Delivering this content from wherever, over whatever network and to whichever device while maintaining appropriately high QoS delivery will remain a significant testing and monitoring challenge for the companies operating today's complex content delivery platforms.