

Test and Monitor Segment Survey 2010

The pre-supposition of better quality service and a high quality media experience is at the heart of how current service providers will defend themselves against cord cutting. This means that in the highly challenging environment of IP transmission, interactivity and multiple-device home networks, very high reliability and consistency of service, all delivered economically, become crucial to the provider. *Euromedia* spoke to major industry players to gauge how they are responding to the new challenges.

Euromedia: What are the most important recent developments impacting on Test and Monitor?

Agama: A lot has happened lately on the TV market – both from a technical and a market perspective. From a market perspective, high technical TV quality and good service assurance is no longer a competitive advantage in many geographical areas but rather a necessity, especially where a rapid rise of new players brings a tougher competitive climate. When it comes to the operators' selection of how to handle quality assurance, it not only needs to be able to detect and solve urgent issues, but to be able to work systematically and proactively to improve the customer experience.

Looking at the technical developments, we would say a top candidate would be the wider introduction of Hybrid Cable/Terrestrial/Satellite systems. These systems are, of course, more complex compared to the non-interactive one-way oriented approach of traditional cable, for instance. At the same time as these new systems present new business opportunities, using them will also introduce a new set of challenges to the operator. One example would be that test-oriented approaches to check if a new service or distribution network is OK, and will tell if parts of the new system will work over time. The packet switching parts of the transmission will, of course, not be possible to verify in such a way, since possible problems in such networks aren't static as required for a test approach, but continuously changing as in all IP networks.

This will turn more focus on 24/7 monitoring to ensure quality for both traditional and new services on these networks.

As the network and services in Hybrid TV solutions grow a little more complex to understand and manage, it also presents a fantastic new option to use the communication link to the viewers' device (STB, PC, phone or TV) to enable full end-to-end monitoring. Traditional monitoring of only the headend and some strategic locations in the network shortens time-to-fix of larger problems with the central systems. But for complex service delivery systems, our experience is that the main win with monitoring from the economic perspective most often come from customer related areas, such as lowered churn and reduced costs in handling customer problems.

Bridge Technologies: The last decade or so of strategic investment in delivery infrastructure means that more and more providers are now in a position to expand their subscriber base rapidly. As infrastructures evolve, providers are moving into a very competitive phase as they fight for market share. The resultant rapid growth has to be carefully managed because any deficiencies in the delivery chain that may have been unnoticed or insignificant at low levels of activity are highlighted when the subscriber base expands quickly. This causes a steep rise in maintenance costs and a drop in service quality, with the inevitable customer churn and drag on growth. Test and monitoring manufacturers need to respond with technologies that are capable of scaling easily in order to provide a comprehensive 'big picture' monitoring

environment encompassing the entire delivery chain from satellite to set-top box.

D-K Technologies: Without doubt, the largest single impacts are from the pending arrival of 3D, the more prevalent use of 3G and the increasing implementation of Loudness according to ITU, EBU or USA standards. All these serve to cause confusion in the market and as most companies have to meet multiple standards.

EXFO: At present there are three or four different trends affecting the industry. The first is the emergence of true convergence. This has accompanied the arrival of next generation mobile providers and also the transformation of business models, whereby traditional telcos and wireless carriers are becoming true service providers. Multiple customers are now asking for multiplay solutions that enable the monitoring of voice, video, data and mobile services on the same platform instead of requiring the deployment of four or five different systems. Service providers are effectively looking for a single vendor or solution that can be their one-stop shop.

The second trend is the dramatic increase in traffic, especially in the case of video. We are seeing a huge increase in the monitoring of user traffic and efforts to understand how best to ensure the experience of the user. In some cases, video accounts for 70% to 80% of traffic on the wire. This has led to a huge shift in monitoring the Quality of Experience (QoE) of video users, especially since video traffic is much more sensitive to error.

Other trends include a big transformation in mobile providers moving to 4G. One or two years ago we were monitoring 1GB pipes, now it's 10GB to 40 GB and some providers are talking about 100 GB in the future. In addition, huge demand for Ethernet is impacting the industry and providing a growth area driven by metro Ethernet and mobile backhaul.

Horizon Global Electronics: The introduction of high bandwidth services via multiple direct-to-home paths requires a combination of test and measurement devices to ensure a sustained quality of reception for the customer. We provide cost effective installation and measurement.

JDSU: New IPTV services and new DSL technologies.

Pixelmetrix: IP continues to be a major agent of change in television test and monitoring. The Content Providers and all forms of content delivery, whether terrestrial, cable, IPTV or satellite are being touched by IP in some way. Starting at the headend where now most equipment along the signal path uses IP. Cable TV has seen the greatest change with IP transport being pushed closer and closer to the viewer. This change to IP transport has introduced new problems for operators wanting to



Triveni's GuideBuilder system provides mission-critical operational capabilities.

improve QoE and QoS and retain customers.

Another significant trend is the movement towards 'Over-the-Top' delivery of television content – the so-called Internet TV. But OTT television presents tremendous problems as a business - no single party "owns" the problem of poor service quality. Who takes responsibility for end-to-end service quality when each delivery segment comes from a different company? The challenges with OTT television delivery are just beginning. Likewise, the monitoring and management techniques needed to improve service quality for competitive advantage are still in their infancy. There is a long way to go yet.

S3Group: Systems are becoming more and more complex. In the digital TV space, previously it was enough for a Set-Top Box to display video and provide audio along with a simple 'now and next' programme guide. Today we are seeing the most complex devices ever produced, with PVR recording functionality along with network connections to download content, display web pages and feed content to other devices around the home. This increased complexity comes at a cost of increased testing if the same reliability is desired.

Tektronix: Recent developments in consumer electronics have made devices such as HD-ready televisions and smart phones more affordable to a wide range of viewers. As a result, consumers are expecting ever-improving QoE to be made available on a wide range of receiver equipment. These high consumer expectations (for both video and audio) have put pressure on content producers, network operators and equipment manufacturers to deliver consistently high quality audio and video to their end users - failure to do so is likely to result in loss of subscriber revenue, as QoE has become one of the key competitive drivers.

Central to the QoE challenge is the fact that service providers and network operators need to be able to ensure that their network is delivering content adequately. This is particularly important in IP Video delivery due to the fact that most IP networks were originally developed for the transport of data; as a consequence, these networks are susceptible to lost or dropped packets as bandwidth becomes scarce and jitter increases. In the vast majority of cases this problem has no sig-

nificant impact on data services which can cope with packet resends and packets arriving out of order as they get routed along different paths through networks. Video, however, is completely intolerant to the vagaries of a best effort network, and therefore reliable and comprehensive QoS monitoring solutions are needed to control QoS, and thereby ensure high QoE.

Triveni Digital: We have successfully developed advanced solutions that meet the needs of DTV services and address the demands of HD broadcasting. It is critical that the functionality of our test and monitoring tools is extended along with service providers' evolving service and delivery models. As our customers grow their operations and introduce new services, scalability of test and monitoring systems becomes an important requirement. Additionally, new technologies such as 3DTV and mobile delivery are surfacing as the main new challenges facing manufacturers.

Euromedia: How is the T&M segment responding to these new challenges?

Agama: The two areas mentioned above - hybrid and a more competitive market - aren't something that has happened the last month. We have seen a slowly increasing demand for more systematic approaches to quality assurance and especially with a greater focus on the end customer for the last three years.

We have always focused 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. Maybe it's because of that approach we're starting to see a slight shift in the source of interest at the operators. What has been a question only at technical department level, now also seems to be an interest at management level. What initially were tools for testing has expanded with the end-to-end approach of monitoring to become an integral part of the operators' business support systems. And that's quite easy to understand if the customer care centre consumes, for example, twice as much time to handle customer issues without having real-time monitoring information from the place of actual consumption.

The large possible cost reductions with process aware end-to-end monitoring solutions have driven the monitoring market

quite a bit from the traditional definition of test and monitoring. Today we see a growing difference between 'test and monitoring', where monitoring often consists of alarms based on individual technical parameters sent from technically-oriented equipment, and the 'monitoring and business support systems' we mostly discuss with operators. The two biggest differences is the shift towards a focus on the unique viewer in combination with support for the non-technical parts of the organisation. It's easy to show where in the organisation the biggest economical wins are drawn from full real-time understanding of service delivery end-to-end.

Bridge Technologies: Since IP and broadcast are two very different technologies but both are involved in the delivery chain, Test and Monitoring systems that are confined to one or other domain do present serious drawbacks. Providers that rely on separate tools for monitoring broadcast and IP find it very difficult to resolve issues which arise from the interaction between the two domains. Because of the lack of a 'big picture', it takes longer to identify and correct service-affecting errors. If the Test and Monitoring sector is to respond, a wider move towards comprehensive Test and Monitoring systems (that embrace both broadcast and IP standards with intelligent correlation of data between both domains) is required.

D-K Technologies: Most of the Test and Monitor manufacturers have followed these developments and are ready to adopt these requirements into production of their equipment when the market requests it.

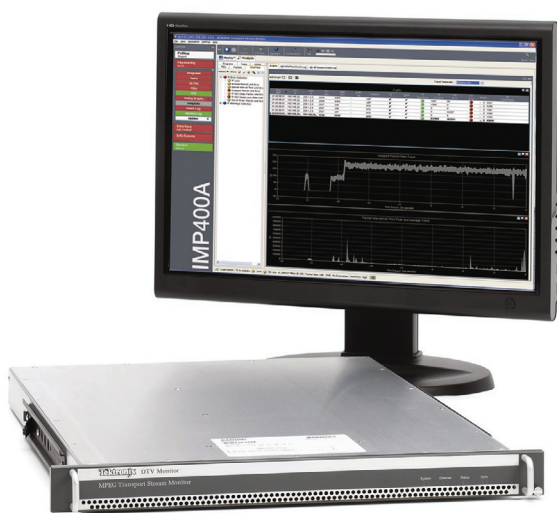
EXFO: There is a lot of consolidation primarily driven by the goal of providing multiplay systems to customers. Carriers want to avoid fragmented solutions and they want one vendor that can provide a fully integrated multiplay system, either by organic means or via consolidation. Smart vendors are developing test and monitoring solutions that are applicable to any type of traffic while using the same underlying software and hardware.

There is also a move towards next generation systems, next generation databases and next generation platforms providing high-level scalability. Cloud based services are also coming into the equation. The main question remains, how do you scale when dealing with this huge amount of data?

Horizon: By working closely with broadcasters, manufactures and installation engineers we can quickly adapt to changes that enable us to keep up with and predict equipment requirements.

JDSU: IPTV is yet again expanding to include new services like 3DTV. But how does this impact T&M? It does not with the use of these early 'frame compatible' offerings in which the current SD or HD bandwidth is the same and

the content is carried in today's standard MPEG-2 Transport Stream packets. Only a small software upgrade to the STB is needed. Typically active classes are needed in these stereoscopic presentations to view the 3D effects, but the transport streams are basically the same so current T&M solutions can continue to ensure quality at the packet loss and jitter quality level. Advanced 3D programming based on MVC (Multi-View Coding) will provide a much richer 3D experience and require increased bandwidth and additional changes in the TV and STB. New T&M metrics will become important too providing additional insight into the stream content. New DSL technologies: Vectored DSL provides the promise of significantly greater bandwidth over copper loops through a



Tektronix has various tools for verifying QoS.

process of crosstalk cancellation. T&M impacts will be felt in requirements for new modem designs and greater throughput capabilities, especially in portable tools. Vectored DSL coupled with DSM (Dynamic Spectrum Management) which manages cross talk over multiple loops or copper pairs in a cable binder group requires significant enhancements to DSLAM's and new computing power to support DSM. T&M will be impacted through new EMS (Element Management Systems) outputs and analysis software. Bonded ADSL and especially VDSL is another new technology able to increase bandwidth. T&M will need to support dual modem test configurations to properly support bonded service testing.

Pixelmetrix: For simple IP transport of television, the monitoring technologies have matured considerably and have settled in to MPEG-2 transport stream over UDP. Monitoring the performance of IP delivery is no different than RF – coming down to data loss/corruption and timing impairments (such as jitter) affecting content integrity. More importantly, effective

monitoring continually verifies the expected channels are actually there.

Ensuring the correct channel line-up is more important in an IP transport environment, because unlike the old days of physical patch cords, an IP stream can be dropped simply by mistyping a provisioning command in a router somewhere along the way.

Appropriate monitoring strategies for OTT, however, are still evolving. Unlike UDP-based IP transport, OTT services are based on the connection-oriented TCP protocol, making it technically much more difficult to monitor multiple viewer streams. Furthermore, the wide diversity of technical implementations for OTT, many confidential and proprietary, places another burden on the monitoring system vendors.

S3 Group: Automation of testing is a fundamental shift in the way testing is carried out, especially in the world of Set-Top Box and other digital devices that are now as much dependant on quality firmware as they are on working, reliable hardware. While traditionally this has been carried out by writing test scripts and then executing them by hand, we have seen significant developments in automating the execution part of this process. There are several clear benefits; the tests are more reliably executed, so they are more repeatable in terms of their findings and tests can be executed more

often, in fact many times over night, requiring no human intervention.

Finally, tests that are difficult for humans to do reliably (especially those that are repetitive in nature) can now be designed into test scripts being confident that they are going to be executed the same way each time. Building on this, having a central database of all testing results allows better analysis of test results, since patterns and difficult bugs can be isolated and examined using data-mining techniques.

Tektronix: Currently, there are a number of tools available for assessing QoS, and the more advanced diagnostic monitoring probes (such as the IPM400A, for example) use sophisticated analysis to make measurements of quality parameters enabling the root cause of service delivery issues to be determined.

Dealing with the emerging focus on QoE is more complex from a test and monitoring perspective. To measure these parameters, network operators need to be able to objectively rate a programme at different points in the network to understand and pinpoint when and where degradation has occurred.

Tektronix has recently introduced two new key technologies for monitoring QoE. These tools are able to decode compressed content, and provide objective assessments on key QoE parameters such as Black, Frozen and 'Blocky' frames, as well as audio parameters such as loudness. These instruments have been designed to allow users to set their own alarm trigger thresholds, thereby flagging only those issues that really impact viewers.

Triveni Digital: To enable high-performance monitoring of video transported over an IP network, the market has introduced router-integrated video monitoring and analysis. This model allows core routing decisions to be based on video quality of service (QoS). By integrating video analysis into the routing infrastructure, manufacturers are enabling service providers to implement a comprehensive approach to video monitoring and analysis – and one that also simplifies the network, enables easy scaling, and reduces overall operations costs. Because every packet that crosses the network traverses a router, router-integrated monitoring facilitates dynamic, automated corrective actions, such as switching to an alternate stream source, based on real-time analysis.

Euromedia: Does a lack of standardisation in IP delivery, adaptive streaming, CDNs and UIs hamper T&M developments?

Agama: We don't really consider this to be a big problem. The economical gains are of the size where one is ready to take some steps to achieve these wins. A lot of technicalities have been discussed over the years, like new non-standardised equipment, integration in STBs, and so on, but in the end it's all back to economy – the operators select what's best for them from the total perspective. This means that sometimes these non-standard components add so much value it's worth the extra steps to do specific integrations.

Most vendors fully understand that it's necessary for the whole community of vendors to enable successful service roll-outs for the operator. If the operator growth is hindered in any way, this will mean less business with that operator. There is not a real problem overcoming non-standard areas, such as STB integrations, common tests, etc.

In the long run, for us it's important to always follow the market and to have a close collaboration with both operators and equipment vendors. To keep up with the market you need to provide future proof and upgradable solutions, and always be open to change.

Bridge Technologies: Lack of standardisation does not help the operators. It's difficult for them to evaluate what is really effective in test and monitoring when there is no agreed and common understanding of the correct



Problems may exist in the transport layer, says Bridge Technologies.

approach and standards. RFC4445 looked at jitter, packet loss over time, and many other factors, but the key – and unresolved – question is how data on these factors is interpreted: an ‘index’ of compliance is little help to a customer because it often masks the existence and true cause of errors. Some manufacturers also focus on monitoring subjective factors such as picture quality, making it the arbiter of service levels while ignoring the transport layer. Yet problems may exist in the transport layer which do not affect picture quality under current conditions, but which may become very significant when conditions change. It’s important to monitor the factors which are fundamental to efficient delivery, and zero tolerance for errors should be the starting point, with monitoring systems giving clear data on errors over time. Misleading and arbitrary indices of acceptable quality do not help operators track down and resolve the cause of problems when they arise due to changing conditions.

D-K Technologies: No, manufacturers must stay abreast of all changes and be ready. Good dialogue between the various parts of the chain helps with this and a lot of dialogue goes on behind the scenes to make sure the T&M companies are prepared.

EXFO: The lack of standards is a double-edged sword. In the beginning it is good for test and monitoring providers as uncertainty in the industry is a major driver and creates a lot of opportunity. At the same time, it creates a lot of challenges to help customers understand and monitor the relevant protocols. Overall, it drives vendors to develop flexible and open solutions.

Horizon: The IP delivery environment is a field that we take an active interest in and our future test and measurement devices will be incorporating many of the features that are required for the installation and diagnosis of multiple IP sources.

Pixelmetrix: Of course it does. Even worse is that many operators are adopting a ‘mix-and-match’ strategy where they combine different elements (transport, streaming, DRM, middleware, etc) from different vendors. The permutations of those choices make the implementa-

tion of a monitoring system very difficult.

Tektronix: The most important area for us to consider with IP delivery are the protocols used in adaptive streaming. Although there are standardised adaptive streaming CODECs such as SVC, it is correct to say that there is a lack of standardisation with the leading proprietary candidates that are starting to become adopted. However, the underlying technologies of these proprietary protocols are well understood and as such are not a hindrance to developing support.

Triveni Digital: The question of standardisation in IP delivery is an issue mostly from a middleware perspective. The lack of open and well-defined middleware standards makes it more difficult for end customers to use third-party solutions for quality of service (QoS) monitoring. This raises the question, “Who is watching the henhouse?” Standardisation is key to cost-effective service management and monitoring using readily available off-the-shelf systems. IPTV standards will also make it possible for content providers and service providers to work with interoperable quality-monitoring equipment, thus reducing both the cost and complexity of monitoring throughout the delivery chain.

Euromedia: How does T&M cope with portable media services?

Agama: To us, there are different kinds of portability. One dimension is the mobility – both services/content that are used everywhere and services/content that can be transferred between different locations/units. From a quality assurance perspective, one of the most important dimensions is if it’s a connected service or not.

The approach to assure quality in downloaded pod transmissions viewed or listened to on a mobile non-connected device is very different from doing the same for e.g. with mobile TV or OTT-like services.

From Agama’s perspective, it will all come down to a discussion with the relevant parties interested in securing the quality of the service on what’s most important to their business. When the most important areas to monitor are known, we can apply relevant components from our product line and do any necessary integration to configure our end-to-end monitoring solution to that specific scenario.

With our business-focused approach to end-to-end monitoring of services, it doesn’t really matter if it’s a 4G phone; an STB, a PC or an advanced TV set that is the viewer’s screen. It will still be the same question for the organisation earning money from such a service if the customer isn’t satisfied. It will always be in their interest to quickly and costs efficiently understand what’s wrong and fix it.

Bridge Technologies: At this point, portable media delivery is not a mature field,

and customers are still tolerant of lower service standards. The Test and Monitoring sector does need to provide solutions for portable media, however, as the take up of viewing over portable devices increases.

D-K Technologies: As long as the original is made to testable standards and the result is transmitted correctly, there is little that can be done to ensure the received signal is OK. The same is true for all broadcast media so it is imperative the front end is made as good as possible.

EXFO: There is a trend in the industry where carriers are increasingly required to provide visibility all the way to the portable device, especially handhelds. There are three ways that vendors can cope with this; the first is to deploy software agents on the devices and monitor what is happening; second, you can rely on standards that exist on the devices and leverage these standards to communicate with them through open interfaces; and third, independent interfaces can be used to understand what the device is doing. The problem with the first is that it is very expensive. The second is the approach that EXFO is behind, and works through cooperation between device vendors and carriers in order to develop open standards that can provide QoS and QoE data to any standards based solution. The third approach is a traditional approach and simply does not scale.

Pixelmetrix: There are really two radically different worlds when one speaks of ‘portable media services’. On one side is the traditional ‘mobile guys’ – with an architecture converging on standards from 3GPP/LTE, and the other side coming from the IT world where ‘streaming video’ is sent to iPads and computers (and more recently Internet-enabled TV sets) – these are the so-called ‘Over-the-Top’ services.

Of the two, the latter, OTT, is the new, exciting and up-and-coming entrant to the market. Unfortunately, while many operators are asking how they can validate and improve service quality of these services, there are few if any comprehensive solutions available today. Aside from the obstacles presented by the numerous technology permutations, many of the platforms are still closed. This makes it difficult for monitoring vendors to provide solutions for every problem.

Tektronix: From a device perspective, we have supplied CODEC analysis tools for many years and indeed many of the devices, which are becoming available on the market, were developed using these tools. From a service perspective, there is a drive by operators to provide managed services for these devices along with other devices in the home and it is likely that these lower bit rate streams will need to be monitored where premium content

is concerned. As far as user-generated content is concerned, operators so far have treated these streams as data services and they are not monitored for content quality. One aspect of all IP delivery technologies is that they are an extension of file-based workflows to the home and in some ways are similar to VOD.

Triveni Digital: In ensuring quality of service (QoS) for mobile delivery, the focus of test and monitoring systems should be that the transport and the MPEG / video layer is monitored correctly. If this part of the delivery chain is monitored properly, then the likelihood of issues appearing on any mobile device can be minimised before they become apparent to the end user through loss of picture or compromised viewability. Just as strategic and tactical monitoring can provide cost-effective and proactive maintenance of stream quality for more conventional services, it also can support provision of a high-quality signal for mobile delivery.

Euromedia: What are the major new challenges coming up: More congested networks, customer-provided CE devices, 3D TV?

Agama: Generally, we believe that the major operator challenges in the long run lies within customer retention and signing up new subscribers, rather than specific new technologies. Of course, it's more complicated to set-up the processes and equipment if a lot of the infrastructure is not under the control of any operator, like for some OTT services as well as for customer provided devices and home networks.

But, as we most of the time come back to – if there's money in it, there will be a driver to make it work. Here, the monitoring solution providers' challenge is to be able to support the operator's whole organisation, from customer care and operations to management, to continuously enable new services, improve service quality and minimise cost.

On a more technical note, the home network is now much more complex. Where does the operator responsibility end if the customer connects his own wireless device, media players, and uses several services from different operators over the same communication links? Which service should be prioritised upon congestion, how much goodwill is necessary in areas not really under the operator's responsibility?

Bridge Technologies: Undoubtedly network optimisation is a major challenge as well as last mile congestion. Video is now the prime consumer of bandwidth, as each new generation of CE devices increases the demand for video. HD services and 3D increase the load too. Core network load is not where the real problem lies though. It's the last mile where Operators are reluctant to invest heavily in upgrading until the

subscriber income justifies it. Given the tariffs subscribers are paying today for their service offerings they should (as a minimum) be provided with network infrastructures that are at least in keeping with the video traffic they must absorb, in order to ensure the free flow of real-time packets and minimise service quality issues.

D-K Technologies: Trying to get everybody to agree a standard so that all ancillary costs, training and hardware etc, can be kept within reason and which will allow easy exchange of products.

EXFO: The main challenge is traffic. Correlation, aggregation and making a sense of data are growing problems; the amount of data being collected now is tremendous.

Quality of Service (QoS) is a major challenge, as is the issue of consolidation as installation, monitoring and trouble-shooting are increasingly required to be bundled together. Traditionally speaking this process would be handled by anything up to 20 companies. The demand for this to be managed from one platform is now creating a huge opportunity in this sector. A vendor that is able to provide a 'one-stop-shop' solution has a huge advantage in this environment.

Horizon: The biggest challenge we face is to insure that high bandwidth multi-path direct-to-home platforms are installed to the highest standard, which is where our meters for Satellite, Terrestrial and Cable are cost-effective tools that ensure that the quality the service is efficient as possible reducing customer call backs and that installations can be performed quickly, accurately and that the installation engineer has the necessary tool to troubleshoot any problems that they may encounter.

Pixelmetrix: Science tells us: "Gas expands to fill the available space". The same is true for bandwidth, so network congestion is here to stay. On the mobile networks, in particular, the increased use of smart phones and their internet-based apps will stress mobile networks to the edge. Trying to deliver video on top of that will pose a very big problem for operators.

The bigger challenge is the business case. All forms of traditional television (cable, satellite, IPTV and terrestrial) are 'product resale' businesses. Content providers create a product and the delivery companies sell that content for a profit. Many IPTV operators are now thinking of offering OTT services (or allow access to them). Without a doubt, that would certainly increase network traffic – but the question remains open as to how they'll make money.

Tektronix: Network congestion and workflow complexity are two great challenges that will need to be faced. 3D, more HD content, more content to multiple devices and in the long term Ultra HDTV will all drive ever increasing network bandwidth and in turn requirements for higher bandwidth technolo-

gies such as 40 Gbps networking. This in turn is driving efforts to reduce bandwidth requirements with improved CODEC efficiency beyond that provided by the latest generation such as H.264/AVC. As far as 3D is concerned more efficient CODECs such as MVC are being deployed to allow full resolution 3D transmission with a modest increase in bandwidth over the equivalent 2D content.

Another advantage of this approach is that both 2D and 3D content can be contained within a single video stream, as it is backwards compatible with H.264/AVC Next generation CODECs such as HEVC which aim to halve the video bitrate for a given video quality at the expense of computational complexity. Improved computational performance should be able to offset this complexity and allow service providers more flexibility in balancing quality versus bandwidth. Proliferation of file-based media assets will certainly lead to workflow challenges to ensure that the right content is delivered to the right device at the right time. As a result, test equipment vendors will be increasingly required to integrate their solutions into these workflows to ensure that the service provider is able to deliver the best Quality of Experience to its viewers.

Triveni Digital: While 3DTV is a challenge in that it does require some added signalling, it is contained within the MPEG stream just like any other video signal and is subject to the same rules as 2D content. The basic timing and buffer models, for example, are the same for 2D and 3D broadcasts. As a result, Triveni Digital's monitoring and analysis systems can be employed for both conventional broadcasts and for new 3D services. We feel that increased ad verification and more point-to-point IPTV are also significant new challenges that will require sophisticated analysis and reporting.

Euromedia: What are your general observations about the T&M segment?

Agama: The connected home that comes with the introduction of interactive digital TV services, is a new frontier for many operators. New revenue streams are apparent, but so are problems of maintaining quality and the risk of escalating support costs. Operators must act to improve their operations at the same time as reducing their costs. Implementing processes and solutions to monitoring these new aspects will help in doing so, since this will allow for early real-time detection and understanding of problems on both communication and service level which otherwise could be very expensive to handle.

Ultimately, a good monitoring system will allow an efficient and insightful handling of quality issues. Over time, this efficiency not only translates into more satisfied customers, but it can also contribute to a reputation for quality in the market.