SPECIAL REPORT

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SPECIAL REPORT

Proving network performance

By Ricardo Torres

Thanks to the growing importance of QoE, a growing number of service providers are combining traditional QoS testing and newer QoE test methodologies like RFC6349 and internet speed testing methods.

Quality of experience (QoE) is the most critical metric in achieving consumer satisfaction and reduced truck rolls. Unfortunately, tech savvy customers often attempt to validate their service level agreements (SLAs) with off-the-shelf equipment, including laptops, tablets or smartphones. Such CPU-based platforms don't have the capabilities required to reliably test gigabit broadband services at full line rate, much less today's 10G networks. In their disappointment, customers mistakenly blame the network instead of realizing that their hardware is the bottleneck.

Such dissatisfaction causes trouble tickets, truck rolls and high customer attrition. The problem is further compounded when technicians use similar off-the-shelf hardware and software to validate network performance.

Service turn up and testing are important first steps to avoid unnecessary operational expenses after the service is delivered. Also important is quality of service (QoS) testing,

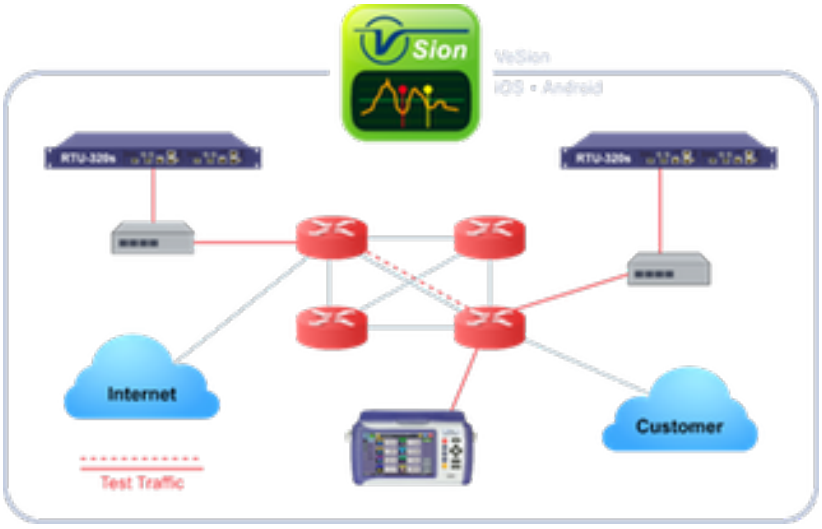


Figure 1. Broadband network with deployed test heads.

accomplished via traditional Layer 2 and Layer 3 test methodologies like RFC2544 and ITU-T Y.1564. But today, thanks to the growing importance of QoE, a growing number of service providers are combining traditional QoS testing and newer QoE test methodologies like RFC6349 and internet speed testing methods.

1G and 10G: Proving both is a challenge

The future of the 10G platform is now becoming reality as broadband providers who have already proven consistent gigabit performance are reaching to meet consumer demand for faster speeds. At 10 Gbps, service providers lay the foundation upon which consumers will interact with the digital world every day.

The deployment of 10G networks also brings new challenges. These networks overwhelm available off-the-shelf hardware even more than 1G does, which means the hardware is unable to achieve the full 10G line rate. This factor leaves the service provider unable to verify 10G network performance.

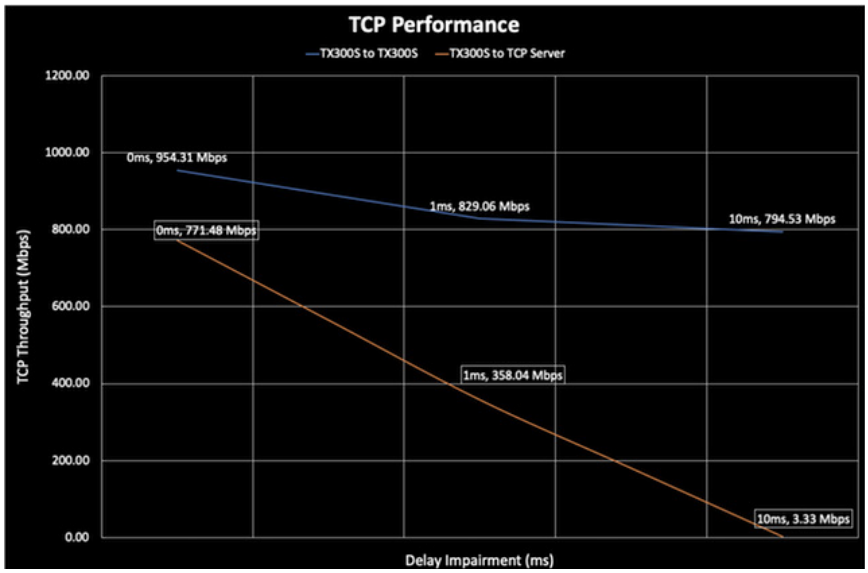


Figure 2. TCP throughput versus delay.

And the problem is even worse with the do-it-yourself approach. A problem is bound to occur when the consumer tests their service with an older laptop that has a slower CPU and is unable to achieve 1 Gbps over its copper RJ-45 10/100/1000Base-T interface. Aggravated consumers that are unable to validate their 1G networks can become a nightmare for service providers when the service goes beyond 1 Gbps, as there is really no consumer laptop available today with a 10-Gbps interface. For example, the consumer can pay for a 2-Gbps DOCSIS 3.1 service but is unable to test the network speed with their top-of-the-line video gaming laptop.

Once they realize that their laptop is only measuring 200-300 Mbps out of a 2-Gbps service, they can become frustrated and may file an unwarranted complaint with their service provider. This complaint in turn will generate a ticket that could turn into a truck roll, an unnecessary operational expense for the service provider.

To eliminate deployment failure and remove any doubt that the broadband service meets the SLA, service providers should invest in dedicated test equipment that exceeds any consumer device performance to carry out stateful TCP testing. Consistent and relevant testing methodologies, as well as dedicated and specialized hardware, are needed for testing QoE and meeting SLAs with consumers.

For this reason, leading service providers are complementing traditional RFC2544 and ITU-T Y.1564 testing with QoE testing. These service providers use the RFC6349 methodology and simple upload/download testing to ftp/http servers to validate network performance. This stateful TCP/IP (Layer 4) testing builds consumer confidence in the provider.

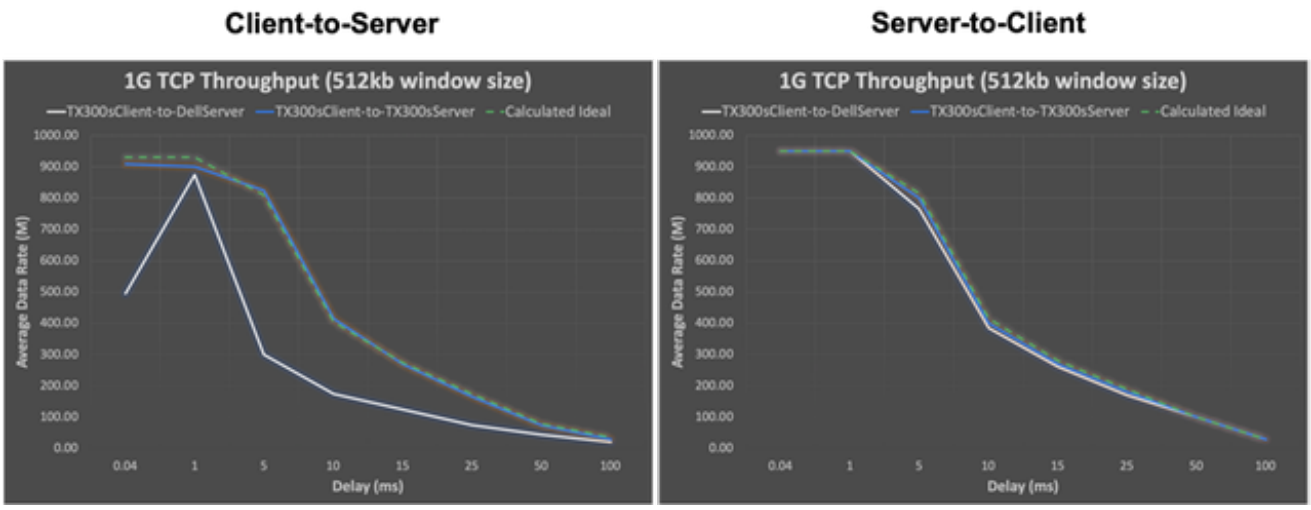


Figure 3. 1GbE data rate versus BDM.

Both internet speed testing and the RFC6349 testing strategies will require the deployment of dedicated TCP servers within the service provider footprint or dedicated rackmount test equipment. This dedicated equipment should be able to operate as both a TCP server and TCP client when testing against field equipment, in addition to carrying out other traditional Ethernet test methodologies like ITU-T Y.1564 and RFC2544 (see Figure 1).

Meanwhile, field service technicians and engineers require dedicated and specialized test tools beyond what is standard issue from service providers (conventional tablets, smartphones and laptops) to successfully deliver an accurate proof-of-service for their customers. Using dedicated tools designed for specific tasks helps provide repeatability and reliability in the testing methodology and procedures. This is important during the installation and delivery of new services. In addition, these tools provide the required physical interfaces to test the services: 10/100/1000Base-T, 1000Base-X, 10GBase-X and DOCSIS 3.0 and 3.1.

Testing performance

A controlled test between a client connected directly to a TCP and HTTP server proved that when a 1-msec delay was introduced (for example, due to a network impairment), throughput dropped by less than 10% when using dedicated hardware. However, throughput dropped by more than 50% when using off-the-shelf laptops. A 10-msec delay between a client and a server remain as expected (see Figure 2).

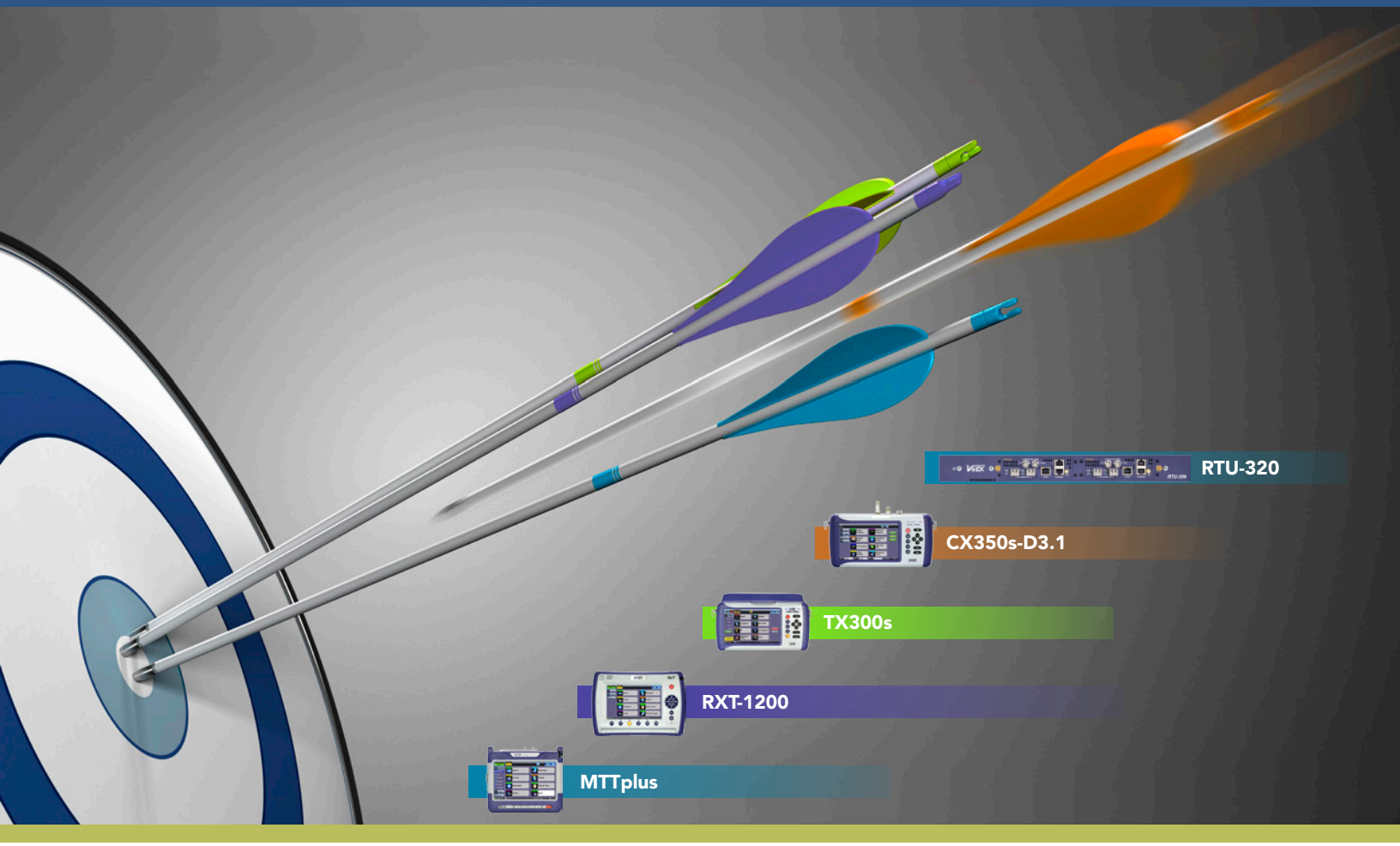
Similar results were found when testing Layer 4-7 both in the field and in a controlled lab environment. There is a clear need for dedicated test tools for TCP-based applications when testing 1-Gbps broadband services and beyond. Most laptops and tablets with software-based clients can only reach a certain level of reliable throughput performance. None of them can reliably verify SLAs for broadband services at or beyond 1 Gbps as well as dedicated hardware/FPGA-based instruments do. Service providers need to take this into account as they enter the gigabit services market.

As Figure 3 shows, even if dedicated hardware is used on the client side but not on the server side (white line), it still does not match the performance of dedicated (blue line) hardware for both client and server or calculated ideal (green dotted line).

Figure 3. 1GbE data rate versus BDM.Figure 3. 1GbE data rate versus BDM.Technologies deployed for service assurance vary and may include FTTx, DOCSIS 3.0/3.1, GPON, point-to-point Ethernet or XGS-PON. Regardless of the technology used and deployment strategy, all service providers face the challenge of proving that their broadband service is being delivered to their customers as promised. To meet this challenge, service providers need reliable and repeatable test methodologies delivered via the proper devices to adequately support their service efforts.

Ricardo Torres *is director of product marketing and a founding member of VeEX Inc. He leads the product marketing, strategic positioning and product management of VeEX's Ethernet portfolio. He is also responsible for the company's global business initiatives encompassing Carrier Ethernet/IP networks, mobile backhaul, 40GbE/100GbE and Ethernet synchronization technologies. Prior to joining VeEX, Ricardo worked at Sunrise Telecom, where he was responsible for managing the Ethernet/IP portfolio. He has also worked at Agilent Technologies in the area of high-speed fiber-optic networking.*

Target Your Broadband Testing



VeEX Solutions Keep You On Point

Broadband service delivery can be hit and miss, since evolving technology can be a moving target for service verification teams. Service providers face tight deadlines to deploy capable infrastructure, technicians are intimidated by the technology and complexity of services to be tested, and demanding customers expect better than a satisfactory experience. VeEX works closely with service providers to develop best in class test solutions to maximize operational efficiency. VeEX has the right tools to pinpoint your specific testing requirements and environmental needs.

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Broadband *testing*

SPECIAL REPORT

CableLabs focuses on PNM best practices

By BTR Staff

The acronym for the Intelligent General Next Operations Systems CableLabs working group is … well … quite InGeNeOS. Is it not? The focus is on how to use network operations tools and techniques from ... The acronym for the Intelligent General Next Operations Systems CableLabs working group is … well … quite InGeNeOS. Is it not?

The focus is on how to use network operations tools and techniques from DOCSIS data made available from the cable modem, CMTSs, and test devices. The idea is use the DOCSIS system information in solutions that identify, diagnose, and sometimes automatically correct network problems, many times proactively.

While Proactive Network Maintenance (PNM) relies on many sources, including field meters, sweep systems, and network management information from network devices including CMTSs, having a PNM-capable cable modem is a "huge advantage" for operators, since these are at every customer location, said Jason Rupe, principal architect at CableLabs. The DOCSIS specification document identified at least 10 PNM data responses that are PNM data elements, including full band spectrum capture, receive modulation error ratio (MER) per subcarrier, pre-equalization settings, and forward error correction (FEC) data.

Data consumption - a case for usage-based billing

"The InGeNeOS group has proposed solutions for how to make use of these data elements and how to solve some of the most service-impactful operations problems that cable operators deal with," said Rupe. "Find LTE ingress, detect and locate echo cavities, or find and eliminate noise ingress in more efficient, less expensive ways."

Currently, the group is working on identifying and documenting methods that allow operators to take data and create tools or manually use the data to perform maintenance or operations tasks. Rupe said he expects the best practices will include basic information

such as how to parse the data sources to make them understandable, how to plot data, and other mechanics.

"We probably will have quite a lot about various methods for identifying plant issues in those data once they are parsed, from basic statistical methods all the way to anomaly detection and machine learning. We might even include some material that explains basic best practices for setting up the service or the plant at the start. You can't get much more proactive with maintenance than that," Rupe said.

Since PNM cuts across all technologies, the InGeNeOS group plays a role in emerging tech, including the up and coming Full Duplex DOCSIS. The group is drafting a point of view document, which tracks what has already been discussed and discovered. The specification team will be able to use this like requirements.

"I think the role of the group should be to act as the voice of service quality and reliability for the industry," Rupe said. "Before creating the next technology, we have to participate in the design process to ensure (it) incorporates quality and reliability in the design. You can't expect just to test a poorly designed network to make it reliable, as a deployed product is much more expensive to fix than one in the design phase."

Some of the problems the group has worked on, and continues to work on, include upstream noise funneling, which is often sourced in customer homes. Improved detection is only part of the solution, Rupe said, which also requires searching for new technologies to mitigate the sources. Rupe said InGeNeOS also has been discussing some "curious" RxMER observations that have been made in the field.

"I expect we'll keep pushing on this until we find the causes, document them, and then develop methods for operators to use," Rupe said. "We've recently learned that amplifiers can have interesting impacts on RxMER results after finding a ripple pattern due to an echo tunnel from an impedance mismatch in the plant."

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SPECIAL REPORT

Getting the installation right: Preventative quality assurance focused on cable shielding integrity

By Ralph Ciarla Effigis, Geo-Solutions.

Training and equipping technicians to get the installation right is paramount in turning customers into lifelong clients. This starts with adding a critical step as part of their installation routine: tracking potential cable shielding integrity issues. By having installation technicians make sure no existing impairment will eventually degrade their cable network on the one hand, and using the best quality passive equipment for installations on the other hand, MSOs can be confident that their subscribers will get what they yearn for: clarity, speed and, above all, long-term satisfaction.

In today's competitive landscape for broadband services, it is of utmost importance to ensure the very best experience to subscribers. Technology is continually evolving, and as cable operators upgrade their HFC plants to deliver specialty programming and HDTV, the last stretch of cable that connects residential areas and businesses is not to be overlooked.

Cable TV technicians primarily operate within the home and are at the forefront of potential events or cable issues. As such, they are best positioned to bridge the gap between the external plant and the subscriber's premises. Not only do they troubleshoot and solve problems, but they also engage in first-hand customer experience.

For this reason, training and equipping technicians to get the installation right is paramount in turning customers into lifelong clients. This starts with adding a critical step as part of their installation routine: tracking potential cable shielding integrity issues. By having installation technicians make sure no

Actionable Advice for Installation Technicians

- Verify that all unused taps and wall plates are terminated
- Replace any drop cable/connectors that are damaged or showing signs of wear (e.g., animal chews, connector oxidation, broken shield)
- Install company-specified coaxial cable in areas prone to direct pickup for increased shielding effectiveness
- Eliminate any consumer-grade components (e.g., jumper cables, splitters, terminations) from the cable installation
- Report any illegal hookup to your management (they are surely badly installed).

existing impairment will eventually degrade their cable network on the one hand, and using the best quality passive equipment for installations on the other hand, MSOs can be confident that their subscribers will get what they yearn for: clarity, speed and, above all, long-term satisfaction.

Why is tracking potential shielding integrity issues so critical?

One might argue that cable operators already have enough control over their shielding performance. I would say that is only partially true, since their performance is mostly limited to the outside plant. When it comes to customer homes, you get a completely different picture. Just think of when people buy a couple of new television sets, or when they build an extra room with a do-it-yourself type of wiring. In such cases, there can be a shielding effectiveness difference of up to 50 dB between the cable operator's professionally installed passive equipment, such as coaxial drop and splitters, and the same type of passive equipment of a lower build quality purchased and installed by the client.

On top of that, with the additional LTE spectrum now falling directly into the broadband cable spectrum, impairment events are on the rise. Cable leakage in the UHF spectrum can also cause harmful interference to over-the-air services such as broadcast television, LTE, public safety, trunked two-way radio and other communications. Considering not only the compliance requirements adopted by the Federal Communications Commission (FCC) to address these issues under Part 76, but also the repeated truck rolls incurred due to such interferences, controlled quality installations should be regarded as increasingly important for cable operators.

MSO's best bet: adopting a preventive quality assurance approach

The best way to increase shielding effectiveness across the plant is using a preventive approach. This involves the addition of a quality installation control process while your installation staff is already at the customer premises. Such an approach has tremendous benefits. It reduces customer service calls, truck rolls and mean time to repair. It ensures compliance with the FCC Part 76 regulations. It increases the cable network's achievable spectral efficiency. And above all, it ensures a higher level of customer satisfaction, not to mention the role it plays in achieving sustainability (but let's save that discussion for another day).

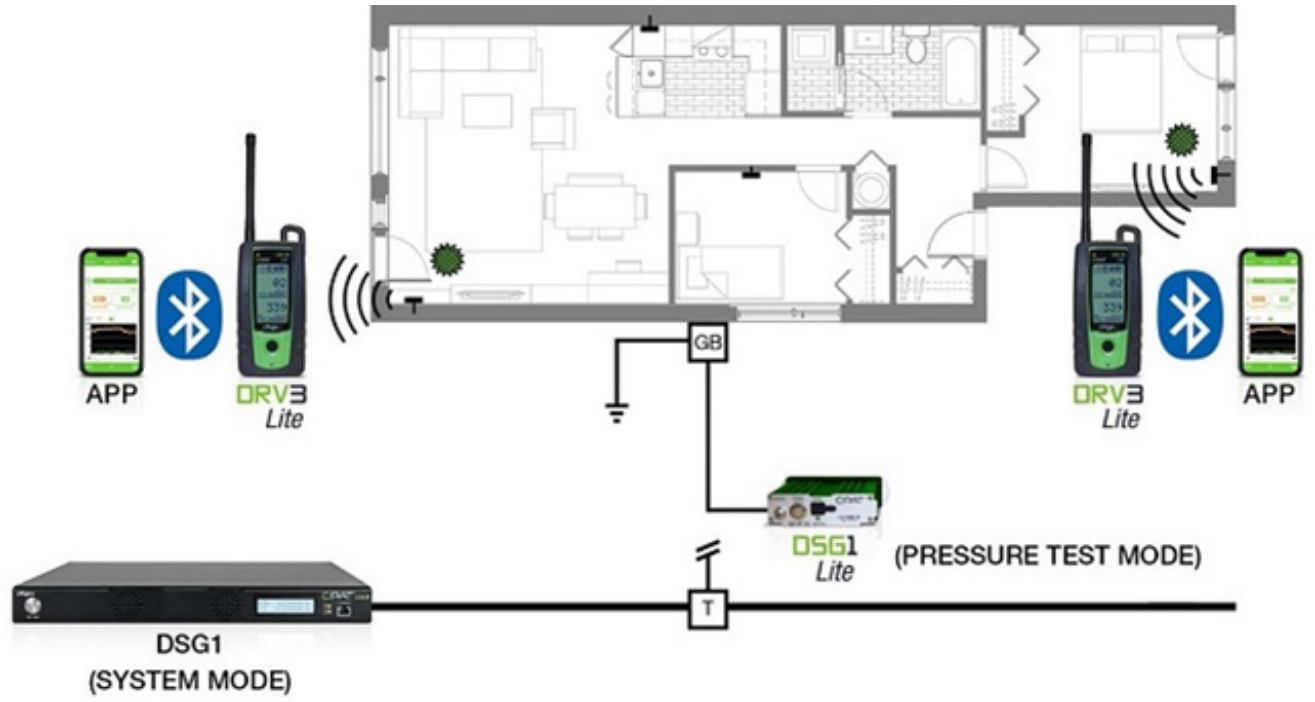

Figure 1. Pressure test and system mode kits for in-home installation certification using a continuous egress and ingress monitoring system.

Let's get practical

To get going with a preventive quality assurance approach, the first step would be for cable operators to make sure the best quality passive equipment is used, to increase their plant's shielding integrity. One thing to check for is whether the cable installation procedure is being correctly applied by staff and contractors.

Staff should discard any passive equipment not provided by the company, since this equipment will likely have insufficient shielding integrity against interferences.

Once a cable installation or service call has been completed, a proactive step should be included to the service procedure: performing a "leakage pressure test." This will ensure there is no cable leakage present.

A leakage pressure test is conducted by applying a high RF level set of carriers at the drop input. While using a cable leakage receiver, the staff will walk through each room within the customer's premises to make sure that there are no leaks present before they leave, thus avoiding potential expensive and polluting truck rolls.

Working with the right tools

The first aspect to look out for when selecting detection tools is that they come in a comprehensive, ready-to-use kit. The kit should include all devices necessary to ensure total quality for in-home and multiple dwelling unit (MDU) installations, chiefly enabling easy and efficient leakage and ingress detection and repairs.

Devices should be user-friendly and operate in a continuous mode. This will ensure that once technicians have completed their installation work, they can easily make sure no impairments are present that could show up within the cable network. Moreover, as the technicians will be

carrying their gear all day, the devices should be lightweight and have a good battery life.

Egress and ingress pressure tests

Technicians will be more effective in identifying hard-to-find events if the devices they use enable them to pressure test both egress and ingress using high-level test signals. Operators will also get a better overview of all in-home issues if devices come with documented, time-stamped detection and repair processes. Features like timestamps will also help them validate their technicians' or subcontractors' productivity.

Dual-mode leakage testing

Kits should enable the performance of both pressure and systems tests. When working in pressure test mode, technicians should typically carry a portable device that generates leakage carriers, which in turn would be detected by a portable digital leakage meter. The meter should work in dual mode, and be dual-frequency agile. An example of such a kit in action is shown in Figure 1. With its dual-tuner design, the detection meter provides simultaneous visual and audio indication of detected leaks in the VHF and UHF bands. Alternatively, if technicians are working in system mode, the leakage carriers are generated by a signal generator located at the head-end. Switching from system to pressure test mode can be done with a press of a button.

Ticket management via mobile application

Equipping technicians with a mobile application for managing their repair tickets is great for boosting efficiency. For example, techs can be assigned new installation or repair tickets in real time. They can also create events in offline mode, thus saving on mobile coverage charges. They could use the app to record measurements before and after their intervention. The app would also enable them to close-out events.

Web-based management

Plant managers want to make efficiency gains with their preventive maintenance program. A web-based management application that can be accessed from anywhere, anytime by an unlimited number of authorized users may help them shorten the lifecycle of leakage and ingress events and consequently reduce the number of service calls. The application should be able to store data in an open format. This will facilitate custom reporting and integration with cable operators' other systems.

A worthwhile investment

It goes without saying that adopting a preventive approach involving testing shielding integrity entails efforts in terms of resources and installation staff training. Considering the impact of new technologies on cable leakage and ingress – among them DOCSIS 3.1 – and given the huge benefits to be expected in the long run from such an approach, the investment is no doubt worthwhile, whether you see it in terms of service call and related carbon footprint reduction, regulatory compliance or customer satisfaction.

Ralph Ciarla *oversees Customer Experience – CPAT FLEX, at Effigis Geo-Solutions.*

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