# The Role of Packet Capture in Communication Networks

Operators and equipment manufacturers are under constant pressure to reduce downtime while improving service levels. To accomplish this, they need clear visibility into end-user quality of experience, network utilization, and application performance. This is difficult to achieve with today's traffic levels, yet global IP traffic is expected to grow threefold and mobile traffic 13-fold over the next 5 years. Reducing downtime while improving service levels might appear impossible.

Typically, engineers spend 70 to 80% of their time trying to reproduce issues. Resources are wasted with the traditional method of guessing which is the troublesome interface, turning on logging, then reproducing the issue and manually searching through log files. And, the data they are searching through might not actually have what they are looking for. Network nodes cannot reliably show the level of detail needed to troubleshoot all issues. Actual network packets are the only trusted source of the facts. Engineers need access to an always on, trusted source of historical data for high-level analytics and for detailed drill-down analysis, and more importantly, they need the data of interest quickly. This is the role that packet capture plays in communication networks, that of the trusted arbitrator which retrieves results in seconds not hours. We will dive into some of the most common applications for packet capture appliances in the following sections.

## Live Mobile Network Core Troubleshooting

A Tier #1 European mobile operator needed to be able to troubleshoot customer issues by monitoring their core network that included many 10 G links. The operator wanted to troubleshoot issues in the PCRF/IN CORE, so they used PacketInsight™ to capture and monitor the Gn (CP and UP), Gx, and Gy interfaces together.

PacketInsight, the Viavi Solutions packet-capture appliance, enabled the troubleshooting of vast amounts of data at high data rates (up to 10 G) in a fraction of the time their previous solution took. The operator required an always-on capture appliance specifically with IMSI indexing so the user-plane sessions for a given subscriber could be retrieved in seconds versus hours. This resulted in a trusted "advisor" deployed on a live network with real-time and historical visibility at lightning speed. The impact was faster turnaround times and a consistently positive impact on the provider's churn rate.

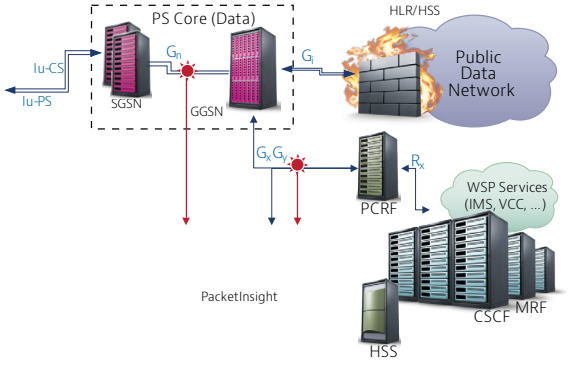


Figure 1. PacketInsight live mobile network core troubleshooting

## Multi Operator Core Network (MOCN) Revenue Assurance and Troubleshooting

The PacketInsight solution provided a Tier #1 North American mobile operator a number of capabilities:

- Capture at line rate 10 G in a live network and on multiple appliances
- Aggregate data from multiple packet-capture appliances
- Analyze results
- Provide an aggregated northbound data feed for revenue assurance purposes by a third-party analytics system on the GTP-U accumulated payload for a given EPC within the MOCN architecture

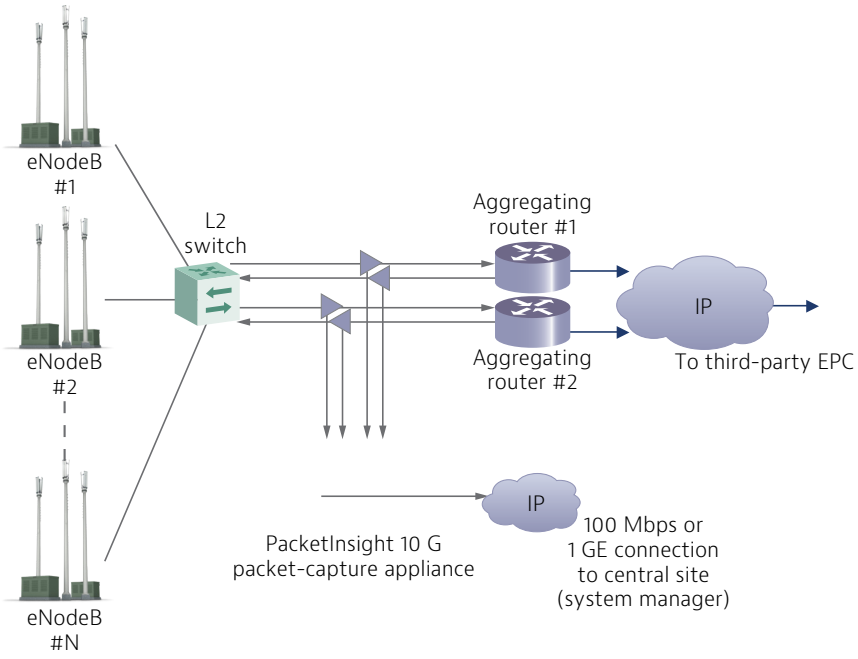


Figure 2. PacketInsight multi operator core network revenue assurance and troubleshooting

This solution includes the Viavi Signaling Analyzer Real Time (SART) as an easy-to-use yet powerful network and service troubleshooting tool. It provides detailed information on one or multiple subscriber sessions and enables the user to perform a detailed analysis of signaling procedures.

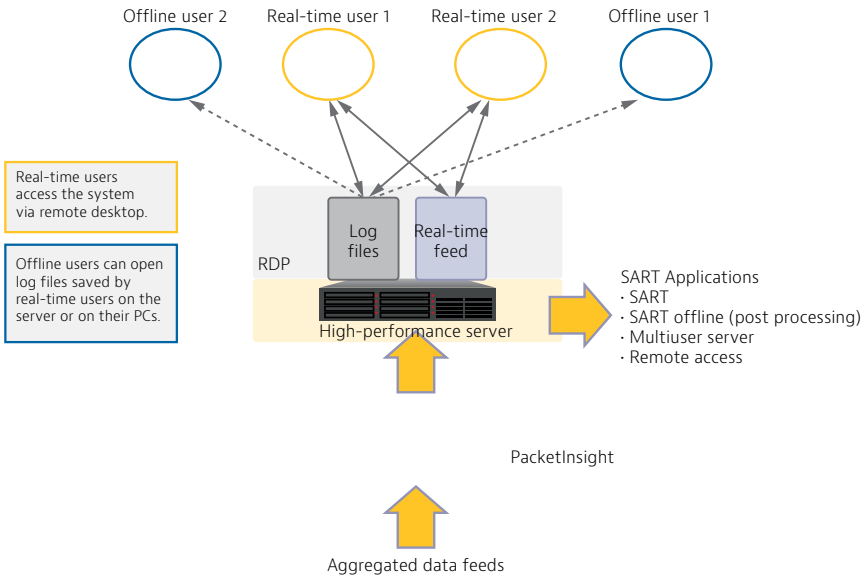


Figure 3. SART implementation

## VoIP Troubleshooting in a Live Network

A Tier #1 VoIP operator in Latin America was reporting a lot of customer problems in their VoIP network. They needed a solution that allowed real-time and historical troubleshooting. The operator needed an always-on device that could capture all data for 15 days. The solution needed to be able to retrieve both session initiated protocol (SIP) and real time protocol (RTP) for VoIP sessions of interest including signaling analysis and voice quality (MOS) on the RTP streams.

The Viavi packet-capture solution, shown in Figure 4, exceeded their expectations on storage of 15 days of data and feeding SART and TPA for real-time troubleshooting. The operator was able to go back in time and look up VoIP calls for a given subscriber and retrieve both the SIP and RTP sessions in seconds for analysis, with the TPA tool computing the VQ scores on the RTP stream. This had the desired outcome of reduced trouble-ticket times and better end-user quality of experience.

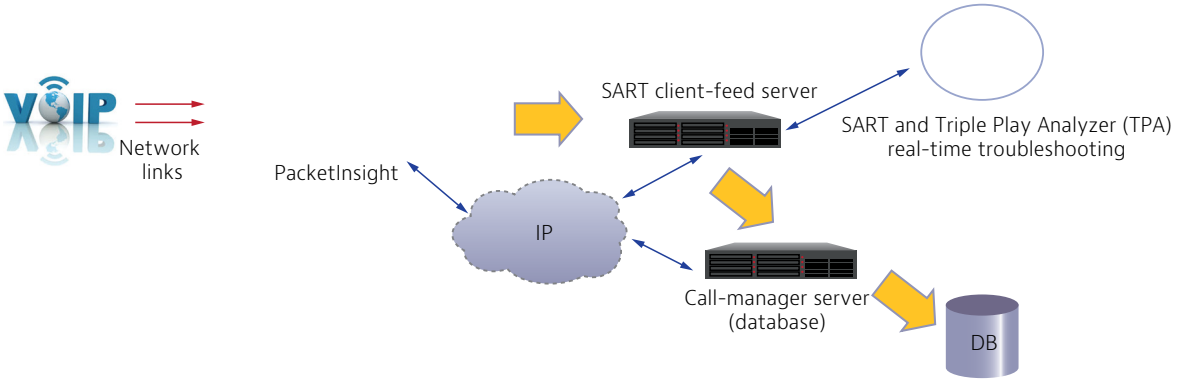


Figure 4. Viavi packet-capture solution

## 3G and LTE Lab Automation

A Tier #1 wireless operator in North America was faced with the challenge of reducing their time-to-market, with very limited lab resources, and guaranteeing quality prior to launch. The operator's lab, one of the biggest labs worldwide with 10s of terabytes of traffic a day, had many challenges. They had a limited number of RF screen rooms for testing the network, and these needed to be scheduled 24/7 for efficient use. Their existing method consisted of a test engineer reserving the room, getting the lab into a stable state by fixing any prior connectivity issues, and then starting to execute tests, analyze, and reproduce any issues found. All were time-consuming tasks in their own right. Ultimately, they needed to automate their testing, thereby reducing testing time and reducing time-to-market.

The needed automation was achieved with a packet-capture appliance at the core of the solution shown in Figure 5. The innovative architecture consisted of an active test platform where active calls and sessions were setup for functional testing purposes (although the same could apply to a load-and-stress scenario). PacketInsight captured all the vast amounts of data at a line rate of 10 G.

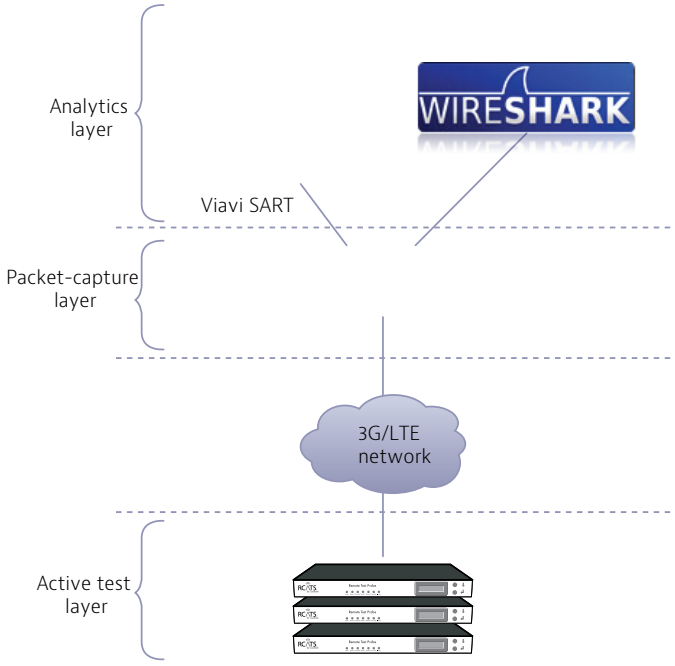


Figure 5. Packet capture in the lab

The key facet of the Viavi packet-capture solution was that it could conduct all types of searches in seconds while capturing at a 10 G line rate at the same time; while other capture solutions trade off performance. Some of the common searches used were retrieving all legs of a call for end-to-end correlation based on mobile IP, finding a single call on individual links using a mobile IP tunnel, or using specific IMSI-based searches.

The automation was introduced with some innovative integration between the active test platform and the capture appliance using standards-based XML API, whereby when issues occurred, the active test platform would instruct the capture appliance to retrieve just the relevant data pertaining to that issue and feed it into an analytics solution for real-time and historical analysis. In this case, the analytics solution was the Viavi SART solution as well as Wireshark. The end result was that the operator was able to troubleshoot complex networks with massive amounts of traffic. The operator introduced automation and rewound time on the network with the capture appliance, all without ever leaving their desk.

## Mobile Core Troubleshooting in the Lab

A Tier #1 equipment manufacturer was having low user-equipment (UE) throughput and suspected packet loss on its LTE lab network. However, the operator couldn't determine the source of the issues. There were several challenges. First, it was difficult to troubleshoot because of high data rates with multiple 10 G links. Second, the architecture was remote in nature, with certain nodes in one country and others in another.

The solution consisted of surrounding the combined packet gateway with a single PacketInsight, thereby capturing and monitoring S1-MME, S1U, S11, and SGi interfaces. Users remotely looked up the data sessions made by their UE using IMSI search. The search retrieved data on the S1U/S11 and SGi interfaces, enabling the NEM to quickly validate that the interfaces were working correctly and that the core network was fully functional. This narrowed the search down to the RAN, whereby with further capture and monitoring the eNodeB was found to have the issue.

With PacketInsight, the equipment manufacturer was able to troubleshoot at very high data rates (multiple 10 Gs), and thus could monitor and capture just as easily in the core as well as the RAN. The always-on PacketInsight let the manufacturer troubleshoot without having to reproduce the issue. It enabled users to troubleshoot complex, remote network issues with massive amounts of traffic by simply rewinding time in a single location, resulting in improved troubleshooting times, without users ever leaving their desks.

## Intelligent Core Network Capture Augmenting Wireshark

A leading Tier #1 European equipment manufacturer used an internal simulator to test their core-network nodes across technologies (2G/3G/LTE). This created a great deal of traffic, but their troubleshooting ability was restricted to the control plane only and only 100,000 packets at a time in WireShark. They were also spending 70% of their time trying to reproduce issues.

The manufacturer needed an always-on device that negated the need to reproduce the issue while intelligently capturing just their high-value data. Their prior solution consisted of a server that capped out at 5 G when using Wireshark. Beyond that threshold, their solution was throwing packets away.

PacketInsight captured 100% of traffic for detailed historical analysis. However, with the intelligent payload slicing feature, it discarded the low-value payload data, and the reduced traffic was sent on to the Wireshark server for real-time analysis. The Viavi solution, shown in Figure 6, protected the manufacturer's existing investment in time and resource training with enhanced support of Wireshark (slicing), enhancing trust with a lossless solution, while enabling full, detailed drill-down analysis.


Figure 6. Intelligent core-network capture

## IPTV Quality Issues

A Tier #1 North American service provider was experiencing quality issues with their video-on-demand solution. Content would leave the headend crystal clear, but as the video content traversed the network to a local site, the issue would occur. The end result was a poor-quality user experience and excessive manual file copies. When the operator looked at the log files, each node said something different. This was made even more difficult to troubleshoot because of high data rates (5 to 8 G of TV/movies).

PacketInsight was used as an always-on device waiting for and capturing issues as they occurred, as shown in Figure 7. HD-movie downloads were captured as they traversed across the network along with their headers. PacketInsight used its IP Flows feature to keep track of sequence numbers of the captured traffic. With this tool, packet loss was identified on a specific interface, resulting in duplicate packets and connection issues.

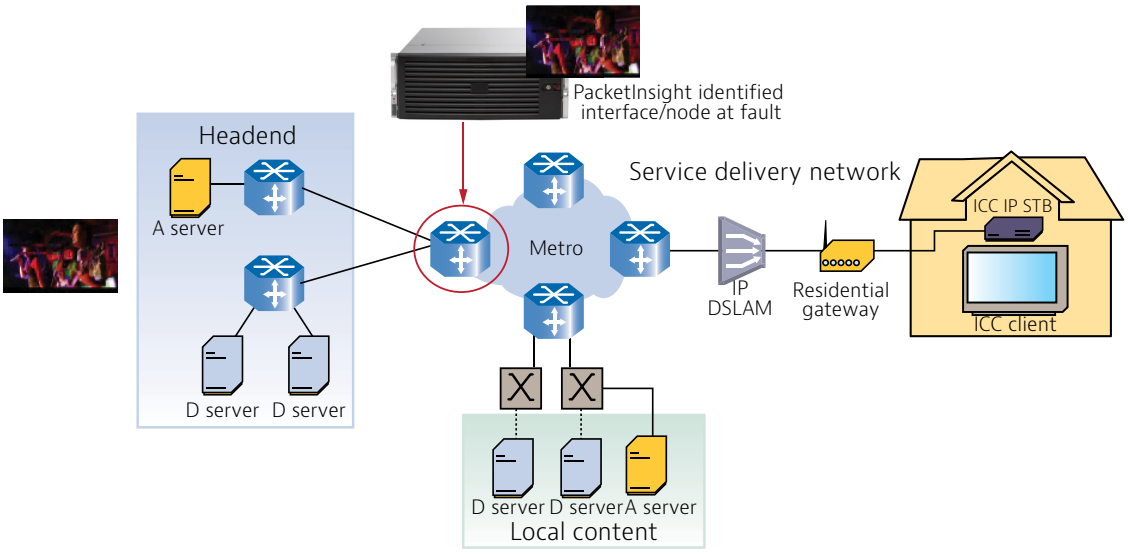


Figure 7. IPTV troubleshooting implementation

According to the operator's NOC manager, "They were experiencing a constant 3% error rate. The operator could not trust each vendor's node data as each one said something different. PacketInsight provided an independent arbitrator role to come in and identify the node at fault. When used in conjunction with the Viavi Triple Play Analyzer (TPA), it provided what the user experience would look like at each point in the network and zeroed in on the problem interface in a fraction of the time they had already spent. After using PacketInsight to capture streaming video and troubleshooting with TPA, they identified enough errors to bring the error rate down to a constant 0.4%, an 86% reduction in issues."

## Summary

A flight recorder is only helpful if it captures a complete picture with no data loss. The same holds true for communication networks, and this is the first cornerstone in the capture appliance role: full line-rate capture at 10 G. Simply having 10 G ports on an appliance is not enough, it needs to actually capture at full line rate, which is not common with first-generation appliances today.

The second cornerstone that resonates with operators and equipment manufacturers is that of traditional capture appliances being data jail cells: they captured it but they cannot get the data out quick enough. Next-generation capture appliances need to unlock the data from slow search mechanisms and enable lightning-fast retrieval speeds while capturing at 10 G. This is the key to next-generation capture appliances.

Once these cornerstone building blocks are embedded in the DNA of a capture-appliance design, then the true value can be enabled with detailed analytics for that first, high-level view of a situation or issue. And, more importantly, the revealing of the facts. Actual network packets are the only source of facts when it comes to troubleshooting, and getting just the facts that matter, reliably and quickly, is what efficient troubleshooting is all about.

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