Mobile Operator Leverages nGenius Solution to Accelerate 4G Long Term Evolution Network Deployment

Overview

Region

North America

Business Challenge

- Problems encountered when validating the LTE/EPC network's ability to support mobile data services were causing delays to the deployment schedule
- Current methods for troubleshooting and analysis could not scale to the amount of data plane traffic that had to be analyzed
- Different element-based reporting features were hindering the ability to get an end-to-end view of the problem

Business Value

- Faster problem resolution down to root cause
- Scalability to handle the large volume of traffic needed for proper analysis
- Consistent view of performance across the LTE/EPC network tiers, load balancers and application servers

Customer Profile

The mobile operator is a leading provider of wireless voice and data services with over 90 million mobile subscribers. They deliver a wide array of services over their 3G UMTS and High Speed Packet Access (HSPA+) network. In addition, they are deploying a Long Term Evolution – Evolved Packet Core (LTE/EPC) network in parallel with their 3G network to support mobile data services to their customers in North America.

Business Challenge

This North American mobile operator was in the process of implementing its LTE test network prior to a full production rollout across its operating area. This service provider was making a considerable investment in capital, spectrum resources and engineering time to deploy LTE, and it was critical to fully test the network prior to carrying live traffic. They saw LTE as an important part of its ongoing long-term strategy in bringing 4G speeds to the markets it served; not only to complement its current 3G HSPA+ deployment, but more importantly, as a means to enhance the overall customer experience when using the network.

As with any new technology that introduces new network elements, new protocols and new session flows, a service provider will first put their pilot or test network through the paces. The purpose is to identify and resolve protocol and network element interaction problems before deploying the production network and loading it with live customer traffic. In the pilot phase of the LTE/EPC network deployment lifecycle, it is critical to rapidly identify problems that arise. This is important in order to address any vendor interoperability problems or abnormal service behavior that may jeopardize the launch of the production network or affect service performance.

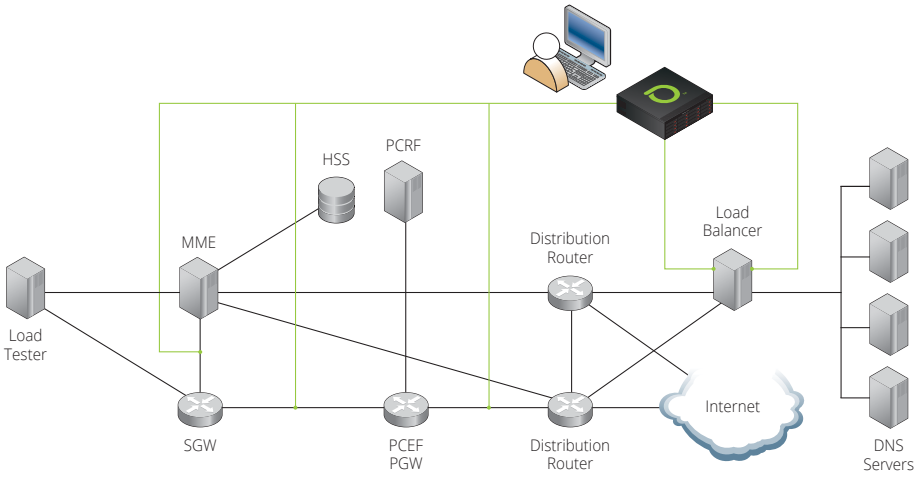

Figure 1: Typical LTE pilot network. The customer was using a load balancing device to distribute DNS transactions across a cluster of DNS servers. The nGenius solution monitors DNS performance across the LTE/EPC and data center network tiers.

While the service provider was validating service performance integrity in their LTE network, they experienced a latency problem with the Domain Name System (DNS) that was preventing progress on LTE capacity testing. DNS is a critical service-enabling application used by the network for establishing customer connections to the correct gateway node and by end users as well to resolve the Uniform Resource Locator (URL) of a target website when surfing the Web with their mobile devices. This problem with DNS was resulting in delays to the service provider's testing schedule.

Part of the testing phase for the LTE network involved stressing the network with simulated traffic to see how it would respond under loaded conditions. The engineers were loading the network with traffic that simulated a customer's ability to attach their device to the LTE network then perform a basic Web browsing transaction. The engineers were simulating tens of thousands of these sessions simultaneously and each involved a DNS query to resolve the URL of the target website. The engineers were expecting to see a large volume of DNS transactions with no timeouts and no more than 20-40ms of latency per transaction.

After a steady state run-time of two to three hours, the tests suddenly failed with a low transaction rate. The test reports provided by the load tester indicated that all DNS requests received a corresponding DNS response without a timeout, but the DNS rate fell to less than a few hundred transactions per second – significantly below what the network should have been able to handle. Occasionally, the test would recover after 15-30 minutes, quickly ramp back to the target rate, and fail again after two to three hours.

NetScout Solution

In order to resolve this DNS server problem, the engineers turned to nGenius® solution to provide them the visibility, service performance views and extensive packet storage capabilities they needed to help troubleshoot their LTE/EPC pilot network. They deployed an InfiniStream® appliance in the network and connected the monitoring interfaces to the different tiers in the EPC in order to isolate where the DNS problem was occurring.

The plan was to monitor the DNS transactions on the data plane traffic that simulated the customer Web surfing activity. InfiniStream appliances can capture, analyze and store a large amount of traffic and generate packet flow-based Key Performance Indicators (KPIs) and usage metrics. It allowed the engineers to observe in real time the performance of the DNS transactions across the different tiers in the LTE service delivery network as well as in the IP services core. The degree of visibility and actionable intelligence they got from the nGenius solution was a significant improvement over what they were able to get from their existing tools. The nGenius solution provided the engineers with a comprehensive performance view across the EPC and the servers that hosted the DNS service, and it was a perfect fit for the automated analysis and high-volume application testing required in this pre-production network.

The engineers were able to follow a workflow using the IP-centric KPIs and metrics provided by the nGenius solution. nGenius utilization were compared with reports from the functional and load test platform that was simulating user sessions. The latter suggested that the DNS throughput problem that the engineers were observing was not being caused by packet loss. However, they needed evidence to back up this observation.

The engineers next ran a "Responses Over Time" report to confirm that each DNS request was being paired with a successful DNS response. The report confirmed that there were no failed responses for the DNS transactions over the time frame of the test.

The next step in the troubleshooting workflow was to find out if throughput on the DNS application was being impacted by response time latency. The "Response Time" report for DNS clearly indicated that average latency dramatically increased at exactly the same time DNS throughput fell. The engineers used the DNS KPIs to confirm that the application was experiencing long response time delays for over 30% of the requests sent to the servers during the time that the DNS throughput declined.

The engineers were able to dig deeper into the problem by leveraging average/peak response time measurements from the nGenius solution. With these views, they were able to determine the severity of the response time delays. With the "Response Time Distribution" report, they were able to graphically view the breakdown of the delays into time-based categories which made it easier to visually observe how many transactions appeared in specific delay categories. The report clearly indicated that something was wrong with the DNS application, but the real question was, what was causing it and where.

In order to isolate the response time problem to a root cause, the engineers needed to measure the delays each tier of the test network added to the overall DNS response time when the slow throughput condition was occurring. The distributed monitoring and forensic analysis capabilities of the nGenius solution made this simple.

"The nGenius solution was able to reduce the troubleshooting effort by at least two weeks, avoiding the corresponding labor and testing delays that would have otherwise jeopardized the completion of the project."

Deep-dive analysis was used to correlate the packets from the various monitoring points across each hop. It was found that the EPC network elements did not add significant delay to the DNS transactions; however, the load balancer and the DNS servers were identified as the source of the problem. After the engineers were able to isolate the problem to the load balancers using the integrated workflows of the nGenius solution, further investigation and testing revealed that the DNS servers and the policies on the load balancer were not configured properly. They were able to rectify the policy issue and retest the end-to-end system and demonstrated that the problem was corrected.

Business Value

Before using the nGenius solution to help them with the LTE/EPC troubleshooting, the engineers initially turned to other tools at hand. The one they were trying to use to analyze the problem was of no use in this situation, because the volume of DNS test traffic that needed to be captured and analyzed was far beyond its capabilities – even in a test network. In addition, the troubleshooting effort was hindered by differences in reporting features across the various hardware platforms that limited visibility to the end-to-end DNS data path. The nGenius solution provided the engineers with comprehensive performance visibility across the EPC to the DNS servers that helped them rapidly analyze and isolate the root cause of a very complex service performance problem.

According to the customer and their network equipment supplier, the nGenius solution was able to reduce the troubleshooting effort by at least two weeks, avoiding the corresponding labor and testing delays that would have otherwise jeopardized the completion of the project.

Conclusion

The nGenius solution enabled this service provider to rapidly troubleshoot and resolve a service performance problem in their pilot LTE/EPC network that existing approaches were not able to address. The end-to-end visibility, performance at scale, IP-centric KPIs and consistent view of the data across the network tiers allowed them to rapidly analyze and resolve a service delivery problem to keep their LTE/EPC deployment on schedule.

Solution Highlights	
NetScout Equipment Deployed	nGenius solution analytics and InfiniStream appliances.
Users	The nGenius solution is used by Network Operations and LTE deployment teams.
Breadth of Coverage	The nGenius solution is used to analyze and report on data plane and control plane performance in the existing 3G mobile core. The customer uses it to troubleshoot problems with service performance and High Value Accounts, analyze congestion issues, and for developing planning studies, It is also used to troubleshoot data plane performance in the LTE test network and the multiple tiers in the IP services core. Also, monitor and troubleshoot data center and business critical applications.
Services Covered	Mobile control and data plane applications, retail applications, service-enabling applications including DNS.
Networks Covered	3G mobile data core, data centers, links to retail outlets and LTE/EPC test network including S11, S5, SGi, load balancer, and links to DNS servers.

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