Developing Solutions dsTest®

Diameter Signaling Performance Tests

Introduction

Policy and Charging Rule Function (PCRF) and Diameter Routing Agent (DRA) implementations have increasingly gained importance in mobile networks as mobile service providers roll out Voice over LTE (VoLTE) services and other features. The "always on" nature of LTE, as well as the fine grained services that are available under the moniker VoLTE, require a subscriber to generate, unknowingly of course, a lot of Diameter messages.

In addition to the diameter signaling increase caused by VoLTE, new nodes such as the ePDG also contribute to the rising tide of Diameter signaling. For this reason we expect that testing the performance of the DRA is crucial to healthy operations of mobile networks.

To put the Diameter signaling requirements in perspective, Oracle's LTE Diameter Signaling Index published in September 2014 estimates almost 13 million Diameter messages per second in North America. This represents approximately 6.5 million transactions per second. The report also predicts global signaling rates to increase at least by 75% annually for the next 5 years. This means that over 100 million Diameter transactions per second have to be handled within five years.

Background

As an independent test lab, we are free to work with any best of breed testers. We also have to verify that the testers we use are up to the task. In any performance oriented tests we execute, we expect the tester to demonstrate superior performance to the solution we are testing.

EANTC has been testing Policy and Charging Rule Function (PCRF) implementations since 2010. Since our first public test project we have been working closely with a Texas-based company named Developing Solutions® that specializes in EPC interface testing, including Diameter signaling testing. Their flagship product, dsTest®, has been used for all our PCRF test projects.

Test Highlights

- **1.2 Million Transactions per Second (TPS) in VoLTE scenario**
- **Ready to test Diameter Routing Agent (DRA) at 2.4 Million Messages Per Second**

When Developing Solutions confided in us that they increased the performance of the tester four-fold, we responded with "prove it." Our interest was not so much in making our partner's life difficult, but to gain confidence that we could execute Policy Controller tests at greater performance – something that judging by industry trends we expect will be needed in the coming months and years. With this in mind we set up a test in which the tester is also the device under test.

Test Setup

It is important to clearly define the measurement terms used in the report. One transaction per second (or TPS) is defined as one Diameter Request and one Response. When testing a server node, such as the PCRF, the request is transmitted from the client (tester) to the server (PCRF) and the server sends a reply back to the client, this is our definition of 1 transaction.

When testing a Diameter Routing Agent (DRA), the request is transmitted from the tester to the DRA which then sends it back to the tester for processing. For thus reason DRA vendors specify performance in messages per second (MPS). When a transaction traverses the DRA, it is effectively 4 messages.

We verified the following two test scenarios:

- Figure 1 depicts the same configuration that we used in our previous tests. Developing Solutions set three servers for the test. One server with 32 CPU cores was acting as the clients and two 16-Core servers to act as the PCRF instances.

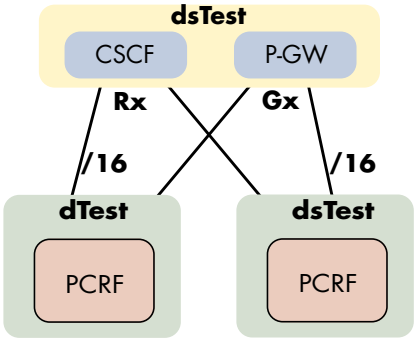

Figure 1: Developing Solutions PCRF Test Setup

- In the second scenario the large server emulated the PCRF as well as the Packet Gateway and the CSCF nodes. The two smaller servers were configured as another instance of P-GW and CSCF nodes as well as another PCRF. In this scenario, a Diameter Routing Agent will typically be positioned between the emulated client and server nodes from one dsTest making sure that the messages are transmitted to their appropriate destination. This setup is depicted in Figure 4.

Each PCRF node was configured with a total of 16 Diameter connections, 8 to the PCEFs and 8 CSCFs. The client had a total of 32 connections/nodes, 16 PCEFs (divided between the two PCRFs), and 16 CSCF (also divided between the two PCRFs). The subscriber database included 32M subscribers.

We used the same call flow (Figure 2) that we configured for our most recent public test. The transaction model was based on a real world LTE smartphone subscriber making two VoLTE calls during a single session. The call flow began with the subscriber attaching to the network (the process called UE attach) and receiving a default bearer. The emulated subscriber then initiated a VoLTE call and received a dedicated bearer for the voice flow.

After the first VoLTE call the subscriber sent location update requests and then performed another VoLTE call. We kept the ratio of Gx/Rx messages identical to the previous test with 62.5% of the messages sent over the Gx interface and 37.5% over the Rx interface. We did shorten the duration of each call to 140 seconds to accommodate the number of subscribers we had in our database. At any given time there were approximately 10 Million subscribers active simultaneously.

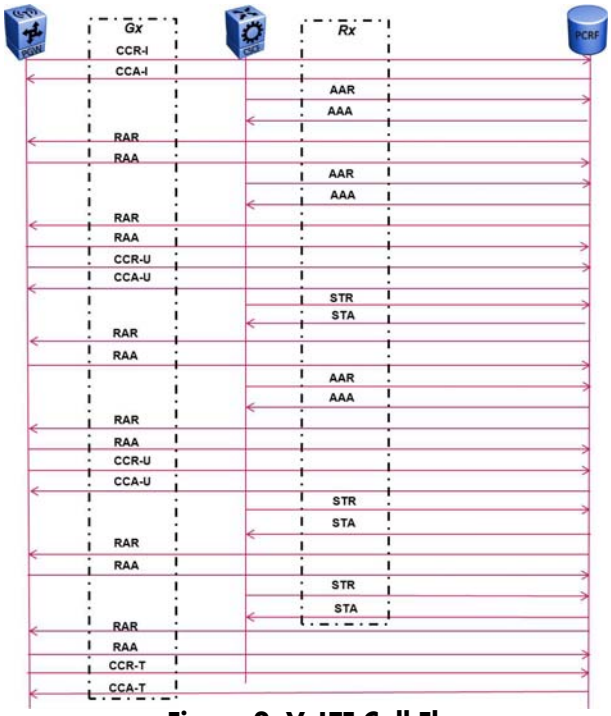

Figure 2: VoLTE Call Flow

PCRF Transaction Rate for VoLTE

To date the highest transaction rate that was verified publicly by EANTC has been 250,000. To reach this transaction rate we used a Dell PowerEdge R820 server with 768GB of memory and Intel Xeon E5-4650 clocked at 2.70Ghz.

For this engagement, Developing Solutions used the exact same server without making any hardware changes except for reducing memory to 512GB. The significant performance increase we measured here was due to code optimization work by Developing Solutions in the last 18 months.

As the results in Figure 3 show, we were able to generate and sustain 1.2 Million transactions per second for the duration of the test. This directly translates to 480% increase in performance. Having been able to verify this impressive transaction rate enables us, a test lab that depends on such tools to perform our job, to have the confidence needed to measure any PCRF implementation in the market and to challenge vendors to show their readiness for the signaling storm.

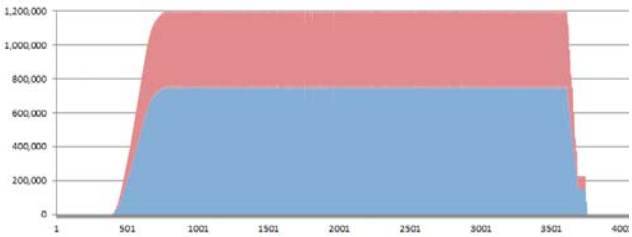

Figure 3: PCRF Performance Results

Performance in DRA Context

A Diameter Routing Agent (DRA) is exactly as its name indicates – it is a function in the evolved packet core (EPC) that routes diameter messages to their destination. A DRA is required when a number of Diameter servers exist in a network. The DRA can be used to add redundant paths and load balance. It can also protect the PCRF and Home Subscriber Server (HSS) from spikes in traffic by throttling it. For policy and charging interfaces, it must maintain state about the subscriber's sessions and ensure that each VoLTE call is placed on the correct PCRF.

The challenge to a test solution that is aimed at measuring DRA performance is performing at high rates while also maintaining the same state that the DRA would have to maintain. Since one function of the Diameter Routing Agent is to alleviate potential bottlenecks from the PCRF, we reasoned that it should also be able to demonstrate the ability to sustain higher Diameter signaling rates than the PCRF.

Using this logic, we setup the second scenario to demonstrate that dsTest can maintain the same signaling rate when emulating both client and server on the same 32 core hardware as would be required to measure a DRA's performance. Running dsTest from a single instance provides accurate latency measurements as well as the ability to measure latency across the DRA.

Figure 4 depicts the test setup. If a DRA was available for the test, we would have replaced the components marked with green (these are the two 16-Core Dell servers) with the DRA and run the test. The dsTest depicted in yellow was hosting both multiple PCRF instances as well as multiple P-GWs and CSCF nodes.

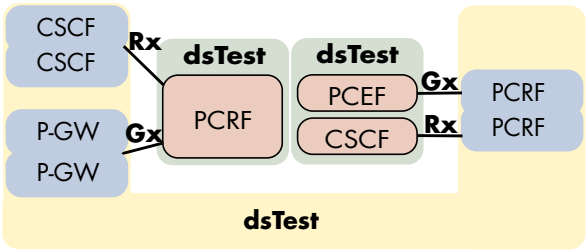

Figure 4: Developing Solutions DRA Test Setup

The results of the test are taken from the perspective of the 32-core Dell dsTest server. As with the PCRF test scenario, we were able to generate and sustain 1.2 Million transactions per second for the duration of the test with the amount of messages processed at 2.4 Million messages per second. Surely this will allow us to challenge any current DRA on the market.

Summary

From a test lab perspective, we reached the goals that we set: both scenarios produced solid, repeatable results showing impressive signalling performance on hardware that is no longer the newest in the market. Given the performance we measured on the 16-Core servers, we also have two data points demonstrating how the solution could scale based on a tester's needs.

The results demonstrate to mobile service providers that the tools exist to verify that their mobile network will not crush under diameter signalling load. Diameter is after all the protocol that facilitates revenue generation in mobile networks, verifying that it could work as your subscribers use more and more services is a solid path to assuring your revenue stream.

About Developing Solutions

Developing Solutions is focused on testing the wireless and IMS core network. Our test solution, dsTest, is intended for performance and functional testing. The software runs on several distributions of Linux and is designed to take advantage of the latest processor technology available from COTS hardware in order to provide high performance and capacity. dsTest can scale cost effectively to over 200 million subscribers and/or 1.2 million+ transactions per second.

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About EANTC

The European Advanced Networking Test Center (EANTC) offers vendor-neutral network test services for manufacturers, service providers and enterprise customers. Primary business areas include interoperability, conformance and performance testing for IP, MPLS, Mobile Backhaul, VoIP, Carrier Ethernet, Triple Play, and IP applications.

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