Comverse
Data Management and Monetization Policy Manager
Scalability and Performance Test Report

Introduction

Policy and Charging Control (PCC) architecture is defined by the 3GPP as part of the 3GPP release 8 specifications. The various components of this architecture allow service providers to apply dynamic, on demand, rules to customer traffic using a set of well-defined protocols. One of the central components of the PCC architecture is the Policy Charging and Rules Function (PCRF) - a system that determines the policy to be applied to subscribers.

Comverse approached EANTC to provide an independent performance evaluation of their PCRF implementation - the Data Management and Monetization (DMM) Policy Manager, one of three Mobile focused components in Comverse's arsenal.

Comverse
DMM Policy Manager

☑ Solution Performance
Ready for future LTE & M2M Deployments

☑ Interface Diversity
Support of Gx, Rx, & Sy Interfaces

Test Period: October 2012
DMM Policy Manager v 6.2.1

Tested by EANTC 2012

Test Highlights

- → **Verified 31.5 Million simultaneously active subscribers in a single DMM Policy Manager chassis**
- → **Measured more than 200,000 transactions per second in a single DMM Policy Manager chassis in all scenarios including advanced LTE use-case**
- → **Tested 3GPP R11 Sy interface support and scalability**

Background

There are several drives behind the growth in the PCC market and the need to scale the various components of the PCC. Carriers are moving away from the flat rate, all-you-can-eat, data plans. The move to tiered data plans is driven by flat data average revenue per user (ARPU) while data usage is increasing exponentially. Another reason to the increase interest in PCC is Long Term Evolution deployments where the Evolved Packet Core Packet Gateway (P-GW) often supports the Policy and Charging Enforcement Function. In such deployments, a scalable and highly interoperable PCRF is needed to supplement the high-performance of the P-GW.

With such drives the components of the PCC must be agile and flexible. With analysts predicting up to 50 billion mobile devices by 2020, largely fuelled by machine-to-machine mobile communications, and hundreds of thousands of PCRF transactions originated from advanced LTE use cases, the PCC must also scale. These were exactly the goals we set for the battery of tests we put the DMM Policy Manager through.

Tested Devices & Test Equipment

The Comverse DMM Policy Manager is a software solution hosted in an IBM BladeCenter equipped with up to 14 HS23 blades. The software components of the solution include an in-memory subscriber session database and the PCRF itself. In addition, Comverse provided a Diameter Routing Agent (DRA) and Subscriber Profile Repository (SPR), running on Oracle 11.2.0.1 database. These auxiliary components were hosted on another IBM BladeCenter equipped with HS22 blades.

In order to generate the substantial amount of subscribers and the amount of transactions per second (TPS) that were required for the test we called on Developing Solutions. The test solution they provided is called dsTest. It is hosted in a Dell server with 16 cores. Using the GUI interface (called dsClient) we constructed the complicated state machines we defined and monitored the tests as they were being executed.

Figure 1 shows the logical setup of the test bed schematically. Gx is the main PCC interface for managing PCEF and was present in all test scenarios. Other test scenarios added Rx, which is mostly relevant for VoLTE/IMS and the newly introduced 3GPP R11 Sy interface to communicate spending limits to PCRF.

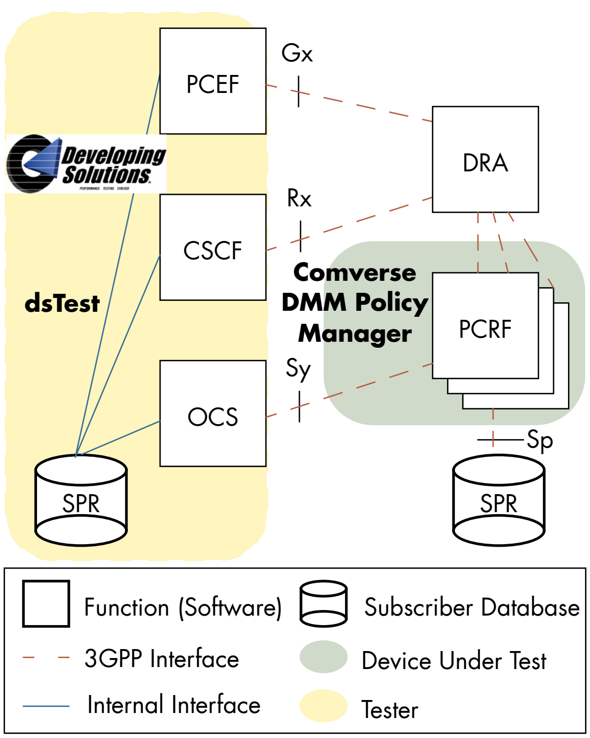


Figure 1: Logical Test Topology

The Gx and Rx interfaces from the tester were first terminated by the DRA and distributed to the PCRF instances running on individual blades. Connections to the simulated OCS were initiated from PCRF side.

Test Parameters

In order to demonstrate the most common operator's PCC usage, we set both emulated components and the PCRF to GPRS. In the last test, in which Gx, Rx & Sy interfaces were used, we set all Attribute Value Pairs and interfaces to Long Term Evolution (LTE) to verify the solution's ability to support high capacity in future networks. All tests used TCP as the transport protocol.

Attribute Value Pairs

In order to create realistic use cases we devised a list of Attribute Value Pairs (AVPs) that were used by the various components during the test. After establishing a session over the Gx interface (between the emulated PCEF and the PCRF) the bulk of the transactions used to generate the high TPS resulted from update messages - Credit Control Request (CCR) and Credit Control Answer (CCA). The updates included location change, time zone change and SGSN change as well as specific messages relating to individual test cases. Once our state machine cycled through the various update messages, we terminated each subscriber session gracefully using Credit Control Request-Terminate (CCR-T) messages.

We define a transaction to be the reception of a request and the issuance of its corresponding response, e.g. a Gx CCR/CCA exchange. Each such message exchange is counted as one regardless of the side issuing the request.

Test Execution

The tests were executed based on a precise test plan created by EANTC and reviewed by Comverse engineers. The test plan defined the AVPs as well as the call flow. All test runs followed the same procedure and duration. In each test case we changed the call flow based on the involved interfaces.

We defined a pool of 36 Million subscribers both on the tester and the PCRF Subscriber Profile Repository (SPR), each with a unique IMEI, E.164 (MSISDN) number and associated IP address. During the test, the tester initiated the call process for each of these subscribers at a constant rate of 17,640 logins per second. The calls then ran in parallel, executing the same 30-minute call flow from the CCR-I to CCR-T, but with a small offset for each subscriber.

Due to this staggered call flow execution, the number of simultaneously active subscribers steadily increased in the ramp-up phase of the test. At the end of 30 minutes, the first subscribers began terminating their calls. With the calls being initiated and terminated at the same rate, the number of concurrent sessions stayed roughly constant at approximately 31.75 Million, forming the steady phase of the test.

The pool of the subscribers was used twice in a loop, i.e. each subscriber performing two 30-min calls. This way, the steady phase of the test continued for approximately 38 minutes. During this time, the active subscribers one by one terminated their calls, but were constantly replaced with the subscribers starting their second call, keeping the total transactions rate per second at 210,000.

Finally, the test entered the ramp-down phase as the subscribers one by one terminated their second call. In total, one test run required roughly 100 minutes.

Test Results — Gx Interface Transactions per Second Performance

The first use case focused on the busiest interface in the PCC - the Gx interface. This interface connects between the enforcement function (PCEF) and the PCRF. Since all the transactions in this test were executed across the Gx interface, after the initial Credit Control Initialization, each subscriber performed 10 updates and then terminated the session.

The results met the performance and scalability expectations. We recorded no premature termination of subscriber or call flow. We also recorded that all 31,752,000 subscribers were indeed active simultaneously and for a duration of 30 minutes, and that the transactions rate was indeed 210,000 per second. We also monitored the PCRF's CPU and memory utilization noting that the average CPU load did not exceed 40% during the test. With the exclusion of buffer and cache memory, the PCRF consumed 32-36 Gigabytes per blade.

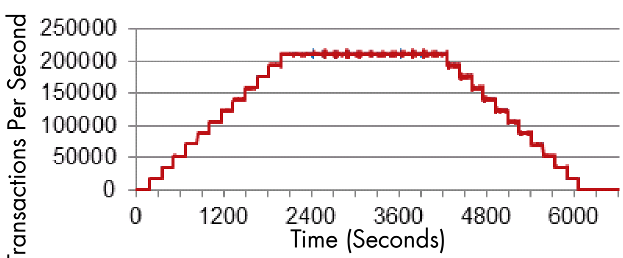


Figure 2: Transactions Per Second - Gx Interface

Test Results — Gx/Rx Interface Transactions per Second Performance

The second test case was configured to include the Application Function interface - Rx. The Rx interface connects the Call Session Control Function (CSCF, also emulated by Developing Solutions' dsTest) to the PCRF. The 3GPP defines the Application Function as an element offering applications that require dynamic policy and/or charging control over the IP-CAN user plane behavior. In essence the Rx interface enables mobile service providers to offer IMS applications, such as VoIP, in their mobile networks. This is done by applying application-level session information.

The application function requires that a subscriber first becomes active across the Gx interface and then the application specific transaction can be executed across the Rx interface. In this respect the bulk of the work is still being done by the Gx interface with the Rx first authenticating the session and then terminating it at the end of the call.

The results of the test showed the same behavior as recorded in the previous test. None of our 72 Million calls exhibited any issues, nor did the memory utilization show any differences to the previous test. The CPU utilization was higher than in the Gx-only test, however, at 60% average CPU utilization, there was plenty of CPU left.

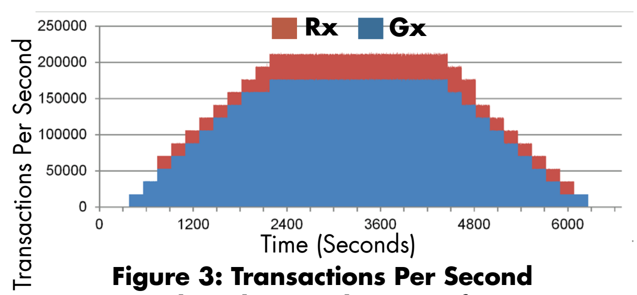


Figure 3: Transactions Per Second Combined Gx and Rx Interfaces

Test Results — Gx/Sy Interface Transactions per Second Performance

The Sy interface is relatively new - it was introduced in 3GPP release 11. The interface is meant to enable advanced online charging scenarios through notifications from Business Support Systems (BSS) to PCRF. The interface connects between the Online Credit System (OCS) and the PCRF. Such function clearly exists already; however, until the introduction of the Sy interface, usage tracking required both Gx and Gy interfaces to keep records as well as potentially costly integration between the Policy Manager and OCS.

As in the previous tests we used the tester to emulate the OCS and bring up the Sy interface to the PCRF. We augmented our call flow to include spending limit request and answer, per subscriber, as soon as the session was initiated. This was followed by notification exchange and only then the update messages between the PCEF and PCRF were initiated. As in the Gx/Rx test case, the bulk of the transactions were still being generated over the Gx interface.

The results of the test showed performance across the Gx/Sy interfaces as in the previous test cases. The PCRF's CPU was also comfortably running at 50% utilization leaving enough room for future growth.

Test Results — Gx/Rx/Sy Complete Topology Performance in LTE Scenario

Once we verified that all the various interfaces performed with a consistent transactions per second rate we were challenged by combining all interfaces in a single call flow.

We configured all AVPs required for LTE (e.g. access-type E-UTRAN) and build a call flow that consisted on: Subscriber initialization which included spending limit request (Sy interface transaction); Rx authentication request; IMS bearer establishment; Authentication Request (Rx interface transaction); Several update messages; Session termination (Sy, Rx and finally Gx interface transaction).

This realistic call flow facilitated the same transactions rate as in all other test cases while utilizing all interfaces. In this test case the DMM Policy Manager was serving as the PCRF while the tester was emulating the PCEF, OCS and CSCF.

The results of the test followed the other test cases showing a slightly lower message exchange rate at 203,000 transactions per second. We then decided to try and reach a target TPS of 300,000, but could not complete the test due to lack of time and the need to move forward to the linearity test.

Test Results — Solution Performance Linearity

The Comverse DMM Policy Manager is hosted in an IBM blade server that can host up to 14 servers. This modular design means that a mobile service provider can grow the PCRF as the number of customers increases. In this test we looked at verifying exactly this idea - linearity. In essence we expected that each additional blade added to the server will increase the performance of the PCRF by a fixed and predictable rate.

The test used a single interface - the Gx. We run the test 4 times for 1, 5, 9, and 14 blades expecting the TPS to grow each time by multiples of 15,000 TPS. The same procedures that were used in all test cases were used in this test and the same steady state duration was used. As the results below show, the DMM Policy Manager scales linearly as promised by Comverse.

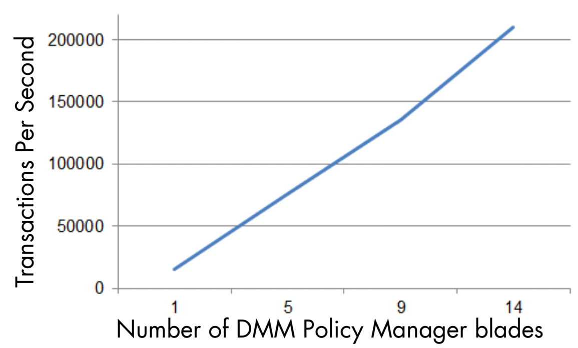
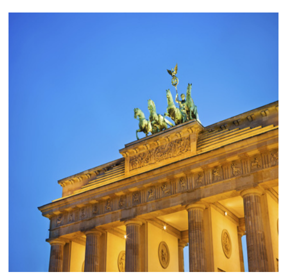


Figure 4: Solution Linearity

Summary

The conducted tests verified Comverse's DMM Policy Manager performance in a single chassis: 31.5 million simultaneously active subscribers and more than 200,000 policy transactions per sec. In addition, the tests demonstrated Comverse's DMM Policy Manager's support for a variety for 3GPP interfaces, namely Gx & Rx and the newly released R11 Sy interface. These results of the tests show that the solution is suitable for advanced LTE and M2M scenarios.

About EANTC



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