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Oracle Communications Policy Management in a VoLTE Environment

Enabling a seamless transition to voice over LTE services

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Table of Contents

VoLTE is Here

Voice over LTE (VoLTE) services have been a topic of discussion for several years. Now, VoLTE services are available in select networks worldwide, and the majority of communications service providers (CSPs) are now active in the planning, trial, and/or deployment stages. Once viewed as a technology several years away, VoLTE has now moved into the realm of reality. CSPs' motivations for deployment of VoLTE differ, but most look to consolidate data and voice network resources into one architecture moving forward rather than maintaining the current arrangement of two separate network architectures – the existing 3G network providing voice services (as well as data services when LTE coverage is not available), and newly deployed LTE networks, which are thus far mostly dedicated to providing high speed data services. CSPs wish to leverage the investments in their LTE networks and IMS infrastructures to cover all of their subscriber's needs, and eventually allow for the decommissioning of the 3G networks.

The first live VoLTE services were launched in South Korea in August 2012 by Korea Telecom, SK Telecom, and LG U Plus. To date, 11 CSPs have launched live VoLTE services, with 8 more launches expected in 2014. Estimations are that more than 40 CSPs will be live with VoLTE services by end of year 2015. More than 71 CSPs are currently investing in VoLTE studies, trials, and/or deployments.

VoLTE is here, and effective network policy management is key to successful VoLTE deployments…

The Unique Challenges of VoLTE and the Importance of Intelligent Policy Control

Use of LTE networks for the delivery of high bandwidth data services has been available for some time, and effective network policy management has been a key component in the management and monetization of these data services. CSPs have leveraged network policy management to maximize the use of network resources, and construct compelling marketing campaigns and personalized service offerings for their subscribers. In the context of Voice over LTE services, effective network policy management becomes even more important, and in fact, is an absolutely critical component in the network architecture.

Existing 3G mobile networks rely on a traditional circuit-switched architecture for delivery of voice services. In this environment, voice calls are delivered over dedicated voice circuits with fixed QoS and bandwidth. In the all-IP LTE network, these dedicated voice circuits are not available. Voice services are implemented via the same packet data core that delivers best-effort and other non-real-time services (e.g. buffered video streaming, etc.). Voice traffic becomes another data stream competing for bandwidth with all the other data services being delivered by the CSP.

However, voice is a real-time service, and must be delivered without delay, buffering, or dropped packets. Subscribers expect a higher quality of experience for voice services than for other data services, and there is little tolerance for imperfections which might otherwise be acceptable for non-voice data sessions. The VoLTE-enabled network must be able to properly reserve and prioritize the appropriate network resources to meet these demands.

The Policy and Charging Rules Function (PCRF) is the 3GPP network function which is responsible for establishing the rules of engagement that other network functions must follow to provide the high level of quality needed to provide seamless voice services in an LTE network. Not all PCRFs are created equal, and the key to a differentiated VoLTE offering is a best-in-class, differentiated PCRF.

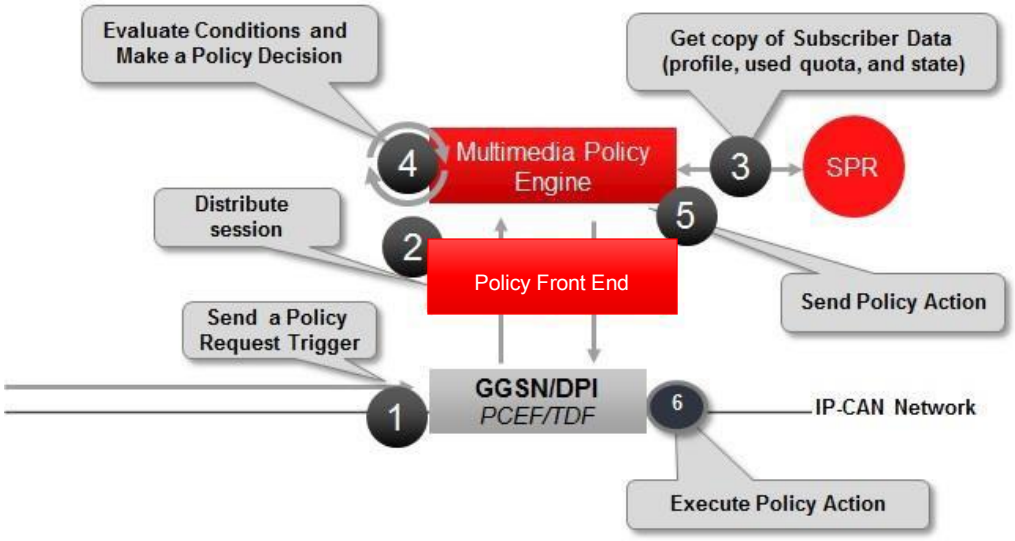
Introduction to the Oracle Communications Policy Management System

The Oracle Communications Policy Management (OCPM) suite contains the functionality of two 3GPP devices. The first 3GPP device is the Policy and Charging Rules Function (PCRF). This device is comprised of 3 components.

The first component is the Multimedia Policy Engine (MPE) which has world-renowned functionality and capabilities in network policy management within the telecommunications industry. The second component is the Configuration Management Platform (CMP), which serves as the OAM&P component of the product. The final component is the Policy Front End (PFE), which provides session correlation, subscriber binding, and session-stateful load distribution to the MPEs within a single OCPM system. The second 3GPP device which is part of the Oracle Policy Management suite is the Oracle Communications User Data Repository – Subscriber Profile Repository (OCUDR-SPR), which provides pre-integrated SPR capabilities to the Oracle PCRF solution, storing subscriber profile and quota usage data, and accessible to the OCPM MPE via an industry-standard Diameter Sh interface.

OCPM Functionality and Architecture Overview

The figure below shows an overview of the PCRF system architecture and flow. All OCPM components are deployed as active/standby HA clusters, but in the diagram, only single server elements are shown for simplicity. These components are described at a high level in the following subsections.



Configuration Management Platform (CMP)

The Configuration Management Platform is the Element Management System for the OCPM. The CMP provides a web-based graphic user interface for policy design and creation, KPI and alarm management, and system configuration and deployment.

Multimedia Policy Engine (MPE)

The Multimedia Policy Engine is the workhorse of the OCPM system. The MPE hosts all the policies, receives diameter traffic from connected elements via the Policy Front End, and is responsible for making policy decisions regarding events occurring within the network. The MPE is the decision maker as it operates upon requests or triggers, then evaluates the conditions upon the request and finally determines the actions for the enforcement node to follow. The policies that the MPE executes are designed and deployed via the CMP's intuitive policy wizard.

Once provisioned, the operator can deploy specific policies or policy groups to specific MPEs. This allows for greater flexibility for CSPs who have diverse network environments and subscriber needs.

Policy Front End

The Policy Front End supports the Multimedia Policy Engines through session correlation, subscriber binding, and intelligent dynamic load-balancing of Diameter sessions. Oracle uses a proprietary protocol to maintain session association between subscriber sessions and MPEs, which also allows the Policy Front End to receive loading information directly from the MPEs to make dynamic load balancing and routing decisions. The Policy Front End enables geo-redundancy on the PCRF, and facilitates IMS/LTE session correlation to insure IMS AF sessions remain correlated with their corresponding anchor PCEF sessions.

Subscriber Profile Repository

A subscriber profile describes the identity and service plan capabilities for a subscriber. In many cases subscriber data, can be diverse among the network, with some servers only using subscriber account ID's, MSISDN/IMSI or other identities. The Subscriber Profile Repository component plays a key role by storing, gathering, and organizing subscriber profiles and dynamic session data of a subscriber, including the quota management capabilities.

The OCUDR-SPR provides the SPR function pre-integrated into the Oracle Policy Management ecosystem. The coordination of features between the OCPM and OCUDR-SPR allows for advanced capabilities in quota management, including pooled quota and multi-layered pass management.

Interfaces

The Oracle Communications Policy Management system supports the following 3GPP Rel11-compatible interfaces:

- **Gxx interfaces**: Interconnection with GGSNs, PGWs, DPIs, other PCEFs using the Gx/Gxx interface
- **Sd**: Interconnection with TDFs, other DPIs using the Sd interface
- **Sy**: Interconnection with OCSs
- **Rx**: Interconnection with P-CSCFs, and other IMS AFs
- **Gy**: Interconnection with GGSNs, PGWs, DPIs, and other PCEFs for certain quota management use cases
- **Sh**: Interconnection to SPRs, HSSs, and other Sh-enabled data sources for retrieval and updating of subscriber profiles and data
- **LDAP**: Interconnection to LDAP-enable subscriber data sources for the retrieval of subscriber data
- **OSSI/XML**: Interconnection with OCUDR-SPR for SPR provisioning, 3rd party NMSs for KPI reporting
- **SNMP**: Interconnection with 3rd party NMSs for alarm reporting
- **SMPP**: Interconnection to 3rd party SMSCs for policy-based SMS notification functionality
- **SMTP:** Interconnection to 3rd party email servers for policy-based email notification functionality
- **ADS:** Interconnection to Oracle and 3rd party analytics systems for enhanced reporting and analytic functionality

Hardware and Platform Software Overview

Oracle utilizes industry standard off the shelf hardware combined with purpose built software to provide a robust highly available system to meet the needs of operators around the world. The platform is a high-capacity, low latency and highly reliable platform supporting a set of associated routing and database applications. The hardware strategy of the platform allows for deployment in a carrier-grade central office or an enterprise-class data center and addresses both blades and rack mount servers. The platform advantages include

- Field proven, carrier grade LINUX OS
- Supports mix of servers and blades
- Supports application co-mingling (for example: Oracle Communications DSR is deployable in the same footprint as other supported applications)
- Multi-threaded software takes advantage of multi-core CPUs
- Provides high availability, automatic configuration, upgrade/backout
- IPV4 support on OAM interfaces/IPV6 support on Signaling links
- Deployment in central office or data center

As described in the following, the architecture and functionality of the Oracle Communications Policy Management system provides a unique and flexible policy control platform which is well prepared to meet the challenges of the coming VoLTE rollouts.

A Robust Policy Management Solution for VoLTE Networks

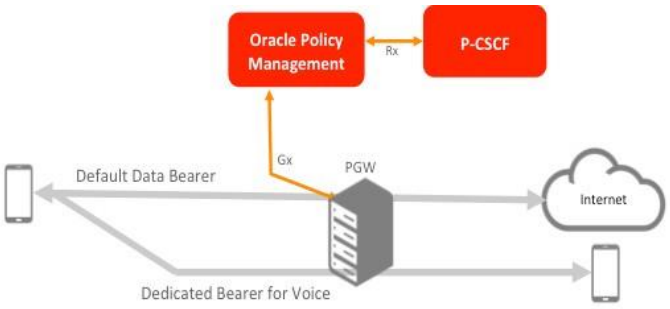
Successful deployment of a VoLTE network that meets subscriber expectations relies heavily on an intelligent and robust policy management and control infrastructure. In fact, VoLTE use cases cannot be efficiently or reliably implemented and maintained without a strong policy management component in the network.

In an all-IP LTE environment, providing the quality of experience required by subscribers for voice services results from the ability to establish and maintain reliable channels of bandwidth in real time, each dedicated to a specific subscriber's voice call. During call establishment, the P-CSCF communicates with the PCRF to negotiate the specific capabilities and functions that will be allowed for the call. This negotiation is based on many variables, including the subscribers' entitlements and available quota, the technical capabilities of the subscribers' mobile devices, and the priority of the call relative to other voice and data bearers, among others. Establishment and reliable maintenance of these dedicated bearers for voice is critical, and places many complex requirements on the policy control infrastructure:

- Programmability and flexibility:
  - UEs, RAN components, and IMS and core network functions utilize a wide array of codecs and call parameters in the establishment of voice calls.
  - CSPs require the ability to quickly design and deploy new service offerings and subscriber calling plans in this competitive environment.
  - Today's best-in-class, multi-vendor networks require seamless integration and interoperability between the various network functions.
- Scalability and resiliency:
  - Deployment of VoLTE use cases significantly increases Diameter transactions rates in the network compared to standard data services.
  - VoLTE involves correlation of multiple sessions initiated from various network elements.
  - Voice must be delivered in real-time with no buffering or dropped sessions. The PCRF is in the critical path for VoLTE call setup, and must be reliable and provide multi-level redundancy.
- Network visibility and charging coordination:
  - Access to reliable network analytics data is crucial to VoLTE service design and network optimization.
  - Seamless integration with charging and quota management systems is key to such real-time services

Oracle Communications Policy Management: Programmability and Flexibility

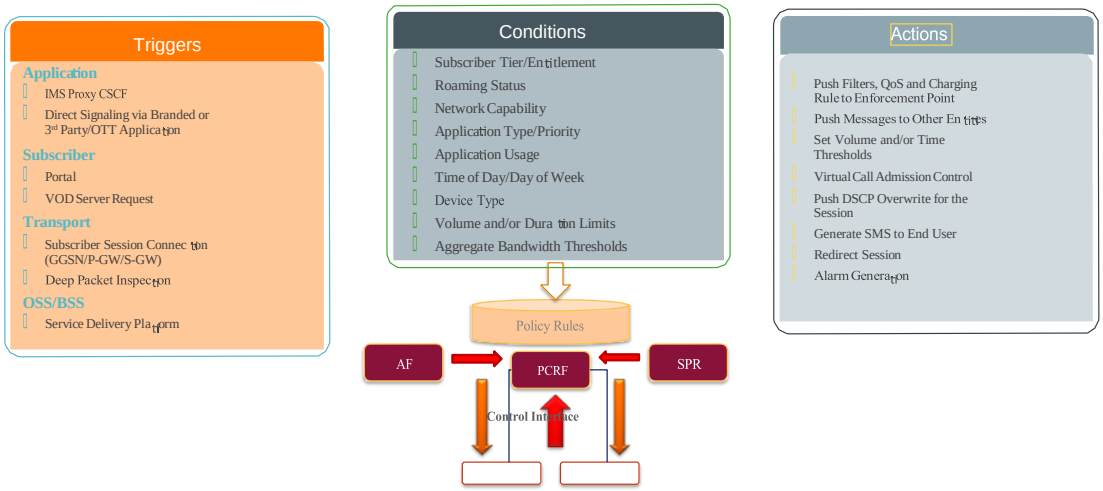
The Oracle PCRF is designed for programmability, flexibility and robustness. A standards-based, yet robust Rx interface, together with the ability to customize policies based on specific, sometimes proprietary, requirements of various IMS Application Functions (e.g. P-CSCF), is crucial to VoLTE.



The Oracle PCRF supports a variety of the most widely-deployed voice codecs. It also provides the ability to customize Diameter AVPs in real time during policy creation.

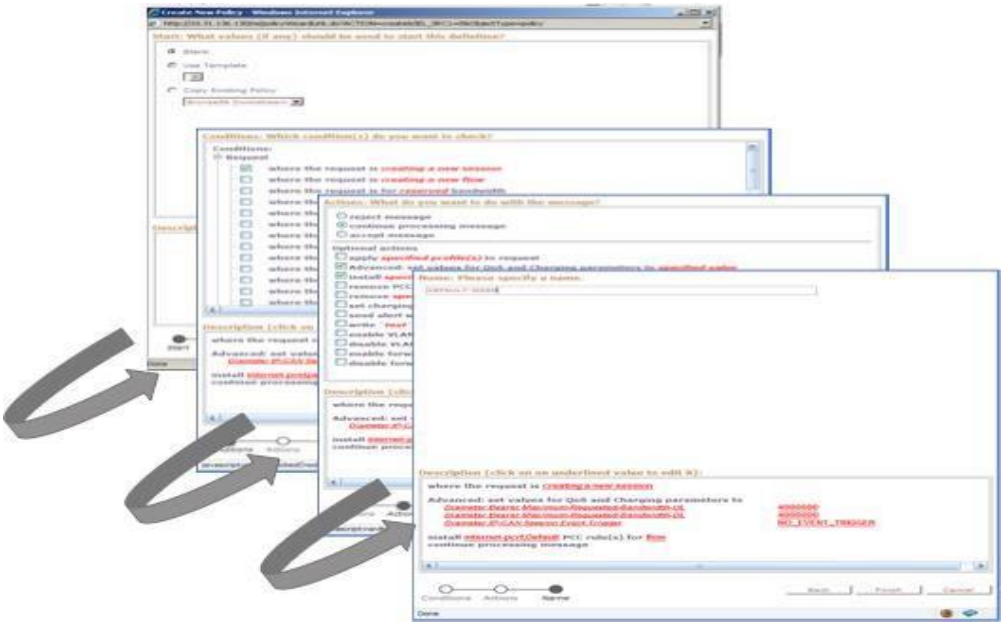
The Oracle Communications Policy Wizard

The key to effective policy creation and deployment in the network is an intuitive and flexible policy design tool. The Oracle Communications Policy Wizard provides a flexible, integrated, GUI-based tool designed specifically for seamless creation and deployment of complex network policies. As shown below, policy creation within the Policy Wizard is organized into 3 main programmable categories: Triggers, Conditions, and Actions.



- Triggers refer to events that occur in the network, or with a particular subscriber. Examples include change of RAT type, change of roaming status, depletion of quota, etc. A trigger will instruct the policy engine to begin evaluation of one or more policies to determine an appropriate response to the event.
- Conditions refer to items that the policy engine needs to examine as part of the policy evaluation. Conditions can include details regarding the subscriber (obtained from the subscriber's SPR/HSS profile), device type, application information (e.g. what type of application is requesting service), quota status, roaming status, etc. As the specific conditions are evaluated, the policy engine will filter down to a specific policy that matches the current scenario.
- Finally, Actions are the responses that the policy engine will instruct the appropriate network elements, such as PCEFs, AFs, TDFs, etc., to take as a result of the initial event that trigger the policy evaluation.

Within the Oracle Policy Wizard, the construction of policies is organized around these 3 categories. This figure shows an example of the flow-down process followed by the Policy Wizard during policy design, starting with identification of the event, followed by definition of the conditions, specification of the resulting actions to take, and finally naming and organization of the policy.



Each category within the

Policy Wizard is organized into a series of drill-down menus and hyperlinked variable definitions which make the policy creation process extremely intuitive and quick. With an extensive library of both standards-based and customizable AVPs, event, condition, and action definitions, programmable tables and input variables, and the logic to cascade policy rules together, the Oracle PCRF provides the ability to easily and quickly deploy even the most complex use cases.

Network Integration and Interoperability

Best-in-class, multi-vendor networks are the norm. The PCRF must interoperate with many different network elements, including various types of PCEFs (GGSN, PGW, DPI), HSS/SPRs, OCSs, P-CSCFs and other IMS AFs, SMSCs, email servers, analytics systems, and OSS/BSS systems, all from a variety of vendors. Although most vendors follow standards-based approaches, different interpretations of the standards, and the use of proprietary or specialized interfaces or parameters are common.

Many policy management systems can be inflexible, and many are designed to depend on inherent capabilities of the vendor's other network elements under the assumption that the elements will always be deployed together. The Oracle PCRF is designed as a standards-based, yet highly flexible, stand-alone policy management system. It has an extensive ecosystem of interoperability with more than 35 third party vendors, and is pre-integrated with a large portion of the Oracle Communications ecosystem, including DSR, SPR, Analytics, Charging, and OTT Services Gatekeeper. In addition, early adoption of new standardized interfaces, such as Sy and Sd, as well as innovative features to allow real-time customization, allow for easy deployment of the Oracle PCRF in any network environment, whether deployed in concert with other Oracle Communications elements, or with 3rd party element

Oracle Communications Policy Management: Scalability and Resiliency

The VoLTE network can be highly volatile, requiring a solution that can quickly respond to new demands for network resources and catastrophic failure conditions.

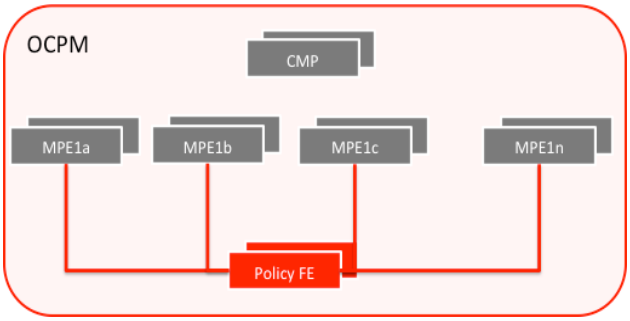
The Oracle PCRF is a highly scalable, highly reliable network element that provides multiple levels of redundancy, including local HA as well as multi-site geographical redundancy.

Scalability

VoLTE places intense performance requirements on the network, increasing the overall Diameter messaging five- fold. Oracle PCRF is designed in a modular fashion to facilitate rapid capacity expansion as the network dictates. One Policy Front End (PFE) is capable of hosting

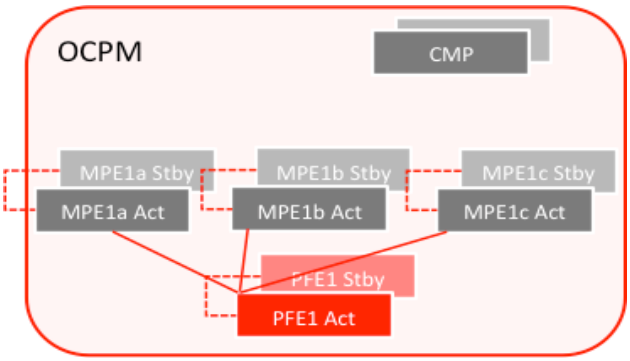
multiple MPEs (policy engines). The number of MPEs supported by a single PFE is governed by the total amount of Diameter TPS that is to be driven through the PFE.

As the capacity needs of the network grow, the policy system may scale easily by simply adding more MPEs. The Policy Front End takes care of the connectivity, routing and load sharing of new MPE servers in the system such that addition of MPEs is transparent to the core network elements.



Local High Availability

Call continuity is critical. All servers within the Oracle Policy Management system are deployed as active/standby HA clusters for transparent failover during server failures. This includes the PFE, all MPEs, and the CMP.



The active/standby PFE and MPE servers share a Diameter Identity, and are connected via a VIP. Furthermore, all subscriber binding and session state data is replicated in real time between each active server and its standby server within the cluster. The PCRF's COMCOL middleware constantly monitors the status of servers, and

orchestrates server activation in the event of a failure. Thus, failover from the active to standby server is a transparent process which occurs with no impact to the live traffic in the network. The replication of subscriber binding and session state data from active to standby server means that the standby server always has an up-to-date view of the currently active sessions in the network, and can immediately begin processing traffic related to those sessions upon failover. This is critically important in maintaining voice call continuity

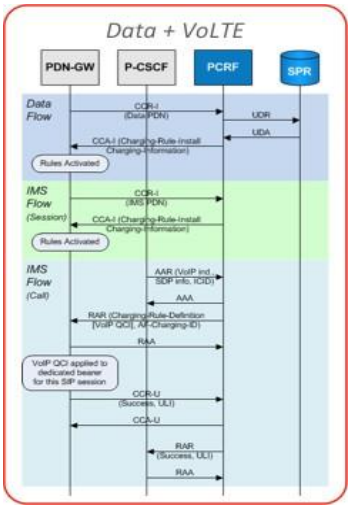
Session Correlation

Session correlation becomes critically important with VoLTE use cases. Unlike other data-only use cases, in which all sessions may be Gx, and thus contain a common subscriber identifier, VoLTE use cases necessarily involve the use of the Rx interface from a P-CSCF. In many cases, the Rx message does not use the same subscriber identifier as the Gx. However, for proper policy execution, all related Gx and Rx messages must be delivered to the same policy engine (i.e. MPE). Otherwise, the Rx requests will be rejected and the voice call cannot be established.

The Oracle PCRF Policy Front End provides robust session correlation capabilities, and since the PFE is responsible for load distribution to the MPEs, this insures that all messages related to a session will be properly delivered to the correct policy engine, thus insuring that the voice call will be properly processed.

Geo-Redundancy

While some CSPs prefer a geographically redundant policy network even for standard data services, geo- redundancy becomes critical in a VoLTE environment. During a VoLTE call setup, the P-CSCF will initiate an Rx request to the PCRF in response to receiving a SIP request from the gateway. This Rx request serves two purposes: 1) engages the PCRF for admission control, confirming that the subscriber in question has appropriate entitlements for VoLTE service, and 2) engages the PCRF to install policies in the gateway to allow for the establishment of a dedicated data bearer to carry the voice data. Upon receiving a positive acknowledgement from the PCRF, the P-CSCF will send a SIP response back to the gateway, indicating that call setup may proceed.



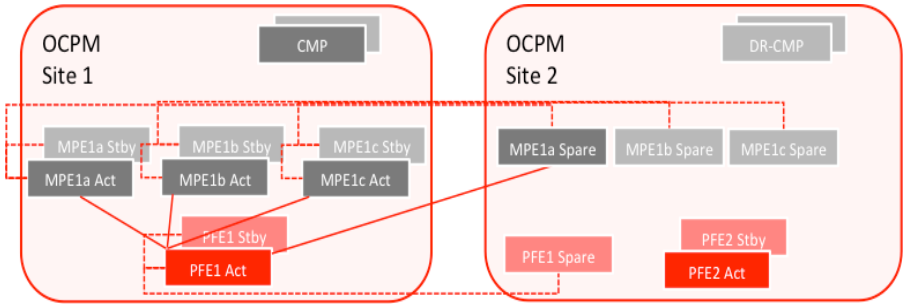
If the PCRF is unreachable, the P-CSCF will be unable to complete the call setup process, and should send a SIP Abort to the gateway, thus terminating the call setup attempt.

For data only services, it may be possible to establish default static policies within the gateways, or even simply use a default bearer to provide best effort data service. The speed and quality of data delivery may be impacted, but it would be possible to deliver some form of service to the subscriber.

However, this is not possible for voice services. The failure of the SIP transaction will result in a failed call setup. In this case, the call may be dropped back to 3G / CS mode, but a VoLTE call is not possible. For this reason, a robust geo-redundancy solution for the policy network is viewed as critical.

The Oracle Communications Policy Management geo-redundancy solution involves the deployment of HA clusters consisting of server triplets. The GR triplet cluster consists of the normal active/standby HA server pair at the local site, plus the addition of a third spare server at a remote mate deployed at a geographically diverse site.

Using the same mechanism as the local HA case described previously, the active server within a cluster replicates subscriber binding and session state data to its standby and spare servers within the cluster. All servers within the cluster contain the data necessary to take over session processing during failure. In the event of a single active server failure, the local HA process is engaged, as described earlier. However, in the case of failure of both active and standby servers in the local pair, or upon complete site failure, the spare servers at the remote mate site assume processing of those ongoing sessions. The spare servers share the same Diameter Identity as their active/standby mates. However, they receive a different IP address. This process is also transparent to the core network, since the core network elements will only connect to the Policy Front Ends, and will be unaware of the fact that a spare MPE server is handling the traffic.



Furthermore, in the event of a PFE active/standby failure or a complete site failure, the spare PFE server at the remote mate site takes over management of those sessions. However, the core network does not connect to the spare PFE server. In this case, the gateways and other core network elements would route all traffic to the remaining active PFE at the geographically diverse site (PFE2 in the diagram). PFE2 would in turn forward traffic related to ongoing sessions hosted by PFE1 spare directly to that spare server. Thus, even a full site failure is transparently handled by the PCRF system.

Oracle Communications Policy Management: Network Visibility and Charging Coordination

Corollary to proper handling of network policies related to VoLTE use cases, having proper visibility into the effectiveness of those policies is key to refining services offerings, or defining new services based on subscriber and network feedback. Also important is effective coordination with external charging systems, and the ability to efficiently manage quota in real-time directly within the policy network.

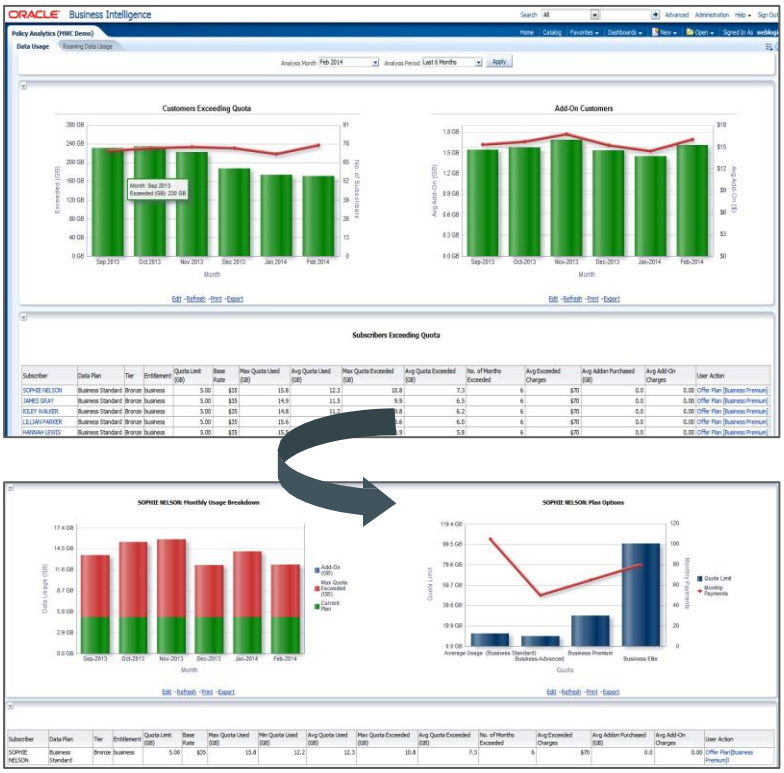
Policy and Charging Coordination

Ensuring accurate quota tracking and charging is critical in both data and voice applications. The real-time nature of voice makes it even more crucial. Voice and charging may need to be separated. CS voice may need to be further separated from LTE voice. Charging rules may need to change upon a CS <> VoLTE handover. The Oracle PCRF provides many capabilities to assist CSPs in the efficient and accurate disposition of quota and charging rules.

The Oracle PCRF is pre-integrated via the Sy interface with Oracle Communications Billing and Revenue Management, thus providing an efficient policy and charging ecosystem ready for the VoLTE network. The Oracle PCRF has also completed Sy interoperability with two major 3rd party OCS providers. The PCRF's Sy implementation is standards-based and ready for network deployment.

In addition to integration with Oracle and 3rd party charging systems, Oracle Communications Policy Management also provide a full set of on-board, integrated quota management features. In concert with the integrated Oracle Subscriber Profile Repository (OCUDR-SPR), the PCRF's on-board quota management features allow for real-time quota tracking and reporting, with updating to the charging system via the SPR. A full complement of features are available, including pooled / shared quota, multi-pass management, roaming quota, and quota based on application and/or subscriber situation.

Oracle Communications Policy and Charging Analytics



The Oracle PCRF is pre-integrated with the Oracle Communications Data Model to provide direct access to analytics based on policy event records pushed from the PCRF. The solution provides visibility into how specific policy rules impact a CSP's subscribers.

CSPs can use the solution to guide the implementation, monitoring, and optimization of network policies in order to maximize offer and plan effectiveness.

The solution provides visibility into how often policies are being executed and why (based on time- of-day, subscriber, device type, etc.), allowing the CSP to determine the impact of newly introduced policies.

Quota usage can be tracked and quota history examined to determine whether new offers are having the desired effects.

Traffic patterns and loading trends can be analyzed to determine if revisions to optimization policies are needed.

The PCRF policy event record may also be separately exported to a 3rd party analytics system.

Summary

Oracle Communications Policy Management is designed to handle the stringent demands of today's 3G and LTE networks. It is exceptionally poised to fulfill the unique requirements needed for a successful VoLTE rollout. As the core of Oracle Communications Policy Management solutions, it is the industry's most robust and widely deployed with over 60 customers across 33 countries. With this deep network and service innovation experience, Oracle Communications understands the policy requirements of the most demanding broadband, next-generation networks, and is positioned to help CSPs through the next evolution of the mobile network.

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