



Globberry



Version 1.0 - March 2017

Cloud PCRF

POLICY AND CHARGING RULES FUNCTION



Abstract

This document describes the Cloud PCRF software suite developed by Globberry and how it could be used to help CSP IT departments create robust and agile next generation BSS ecosystems.

Cloud PCRF is a 3GPP-compatible enterprise-level system for managing subscribers' individual and group Internet access policies in next generation IMS networks.

The product is based on micro-service architecture and can be deployed on an arbitrary configuration of physical or virtual servers, including servers in the cloud.



Table Of Contents

2	Introduction
4	Why Cloud PCRF?
8	Cloud PCRF in the Network
9	Product Examples
12	Cloud PCRF: Functionality
	Business Rules in BRMS
	Policies/PCC Rules
	Policy Classes/PCC Rulebases
	Shaping/QoS
	Rating Groups
	Policy Selection Criteria
	Dictionaries
	SMS and Web Notifications
	Throttling and Error Control
	PCEF-specific AVP Adjustments
18	Cloud PCRF: Architecture
20	Standards and Specifications

Policy Management Puzzle for IT Department

According to recent research, over 60% of the telecommunication operators surveyed by telecoms.com in 2016 stated that most existing BSS platforms are not capable of supporting their future business models. The reason for such a strong statement is that most service providers operate in a hyper competitive market, requiring new approaches in areas of pricing innovation, competitive differentiation, new product introduction and consistent customer experience. Innovative policy management, with the help of an advanced PCRF, can be a key for achieving improvements in the listed areas.

There is a general consensus in the industry on the critical and growing importance of policy control in the service provider BSS stack in order to stay competitive and enable new revenue sources. Most operators are already using some policy management tools, mostly for pricing of new data products, QoS shaping and roaming data offers. At the same time, new use cases of policy control, such as dynamic pricing, IoT (M2M) products, wholesale and MVNO management and many others are yet to be tested and verified.

The IT departments responsible for maintenance of the BSS ecosystem are currently operating under a lot of pressure. On the request of Marketing, they must persistently implement and test new products and completely new business models, meanwhile supporting a heavy stack of legacy systems and products, keeping OPEX and CAPEX from exploding and ensuring times-to-market that are acceptable to business. It sounds nearly impossible, but such tough limitations dictate the ultimate set of requirements that PCRF, the key policy management component, must comply with:

- Ability to support a variety of business products and policy management use cases
- Easy scalability to accommodate explosive growth of traffic
- Flexible customization for emerging use cases and new applications
- Reduced operational and capital cost
- Rapid time-to-market for new products
- Easy integration with systems from different vendors that may be present in the operator's network.

Our **Globberry Cloud PCRF** product is a universal policy management tool that meets all the listed requirements and is perfectly capable of helping you cope with all the tricky and complex aspects of policy management.

PCRF plays a key role in the next generation IMS networks by managing network resources and providing the QoS required by both traditional and new applications and technologies, such as VoLTE, LTE Broadcast, Car Connectivity and Internet of Things / M2M

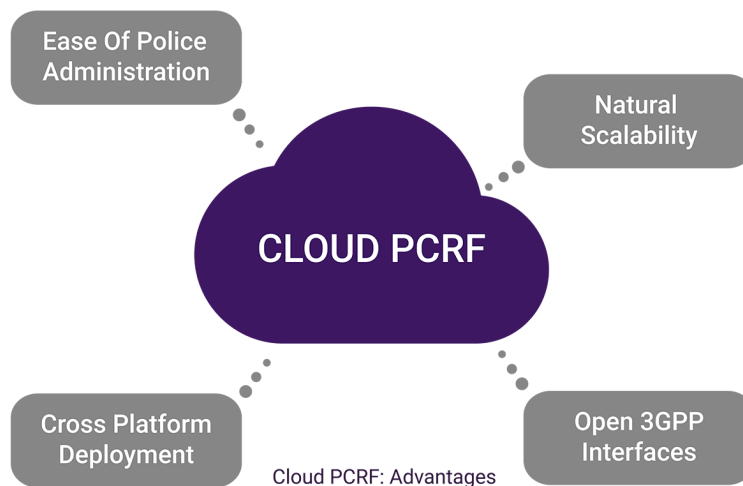
The key functions of Cloud PCRF are:

- **Policy Control.** Calculation and real-time application of the data access policies for the telecommunication network subscribers, based on business rules of any complexity, configured in the enterprise-level BRMS
- **Flow-Based Charging.** Installation of policies separating the subscriber data into flows based on traffic direction, protocol or Internet application, with different charging conditions based on the assigned rating group
- **Shaping and Gating.** Limiting data transfer speeds or blocking data transfer at a flow level or at the session level
- **Usage-Based Policy and Charging.** Accumulation of traffic usage data on a session, service or flow basis, policy modification based on the traffic volumes consumed for a given period
- **Service Personalization.** Service and parameter-dependent data usage policies, real-time policy modification with service or parameter changes
- **SMS and Web Notifications.** Policy change notifications via SMS messages or by http traffic redirection to preconfigured web pages with relevant information
- **Usage and Policy Reporting.** Integration with self-service portals and other operator systems with the purpose of providing data on the subscriber's traffic usage and the current service conditions
- **Policy Control in Roaming.** Application of special data usage policies for subscribers in roaming
- **Advice of Charge.** Control and notification of excessive data usage, especially by subscribers in roaming, with the goal of preventing unexpected charges

Over 60% of telecom operators say that most existing BSS platforms will not be able to support their business models in the near future

Cloud PCRF benefits:

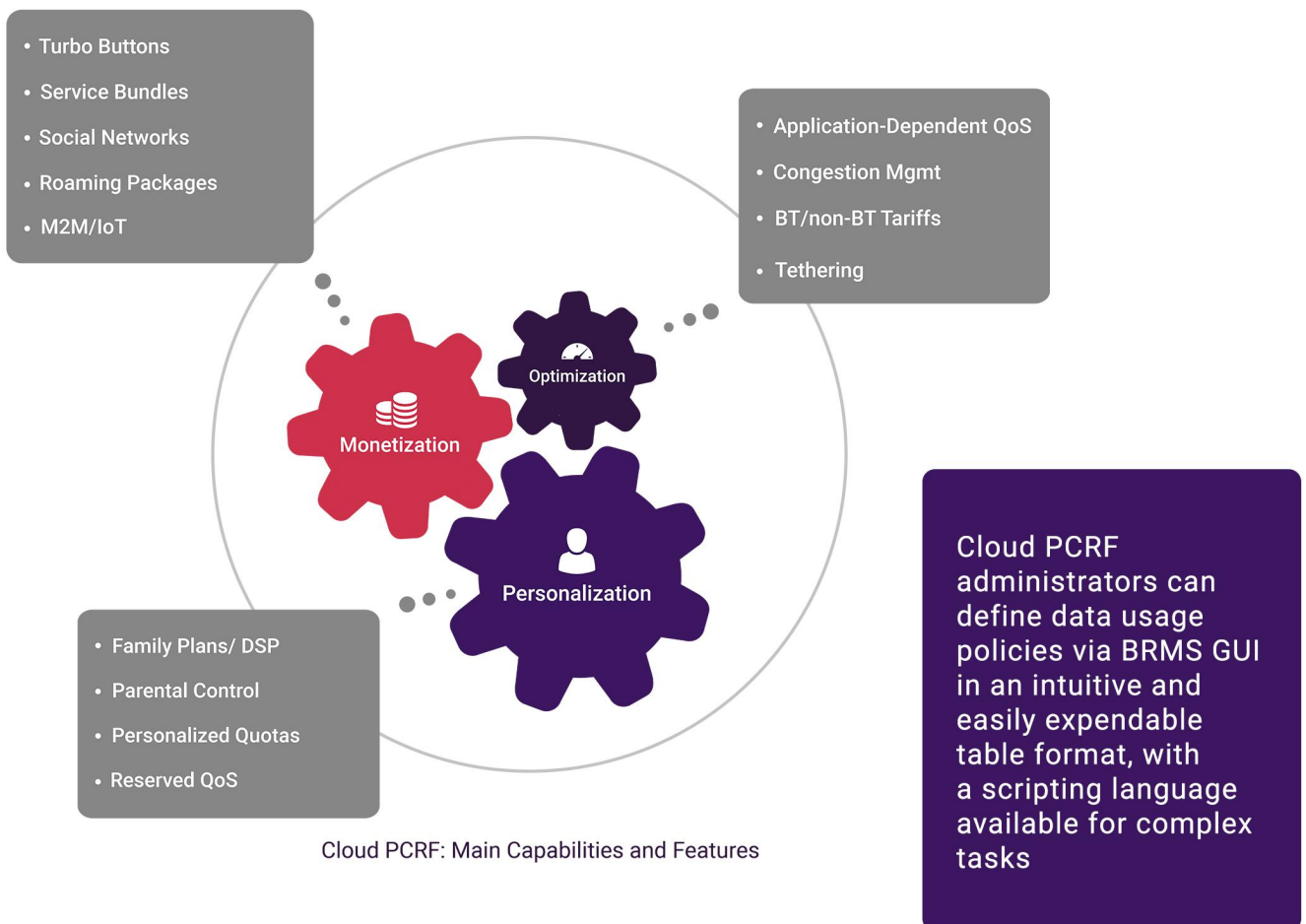
- **Ease of Policy Administration.** Business rules are managed from the GUI of an enterprise-level BRMS in an intuitive and easy-to-use table format, with a scripting language available for creating more complex rules
- **Natural Scalability.** Modular micro-service based architecture lets the operator increase the overall Cloud PCRF performance by horizontal scaling of its components without system redeployment, and, in many cases, without any interruption to the data service
- **Cross-Platform Deployment.** The distributed architecture lets the operator deploy Cloud PCRF on physical or virtual servers, including servers in the “cloud”
- **Open 3GPP Interfaces.** All Cloud PCRF interfaces with other network components are implemented according to open protocols and standards.



With the introduction of Cloud PCRF, mobile operators can:

- Quickly and easily update existing products or create new products and services, by configuring new data usage policies in the graphical user interface of an enterprise-level BRMS
- Create a new class of products with varying bandwidths, dynamically changing with the subscriber’s traffic consumption
- Implement products dependent on the session APN, subscriber location or any other data session attribute
- Introduce special tariffs for popular Internet applications and sites, such as YouTube, Facebook or WhatsApp

- Provide free access to select sites, for example, to the operator's home page or to the balance refill sites
- Collect additional revenue from subscribers by selling them paid traffic bundles (Turbo buttons) on demand
- Personalize product attributes to the needs of individual subscribers, with a process driven by the subscribers themselves
- Personalize product attributes or award bonus packages by executing marketing campaigns for select subscriber listings, specific terminal models, service regions and many other sets of subscribers
- Decrease transfer speeds or fully block data access to subscribers with especially heavy data usage, or, at times of network congestion, to all subscribers in the congested locations
- Provide special data access policies to subscribers in roaming and notify roaming subscribers in case of excessive data usage
- Collect data usage statistics to be displayed to the operator's personnel and the subscribers themselves, and to be used in the determination of subscriber preferences



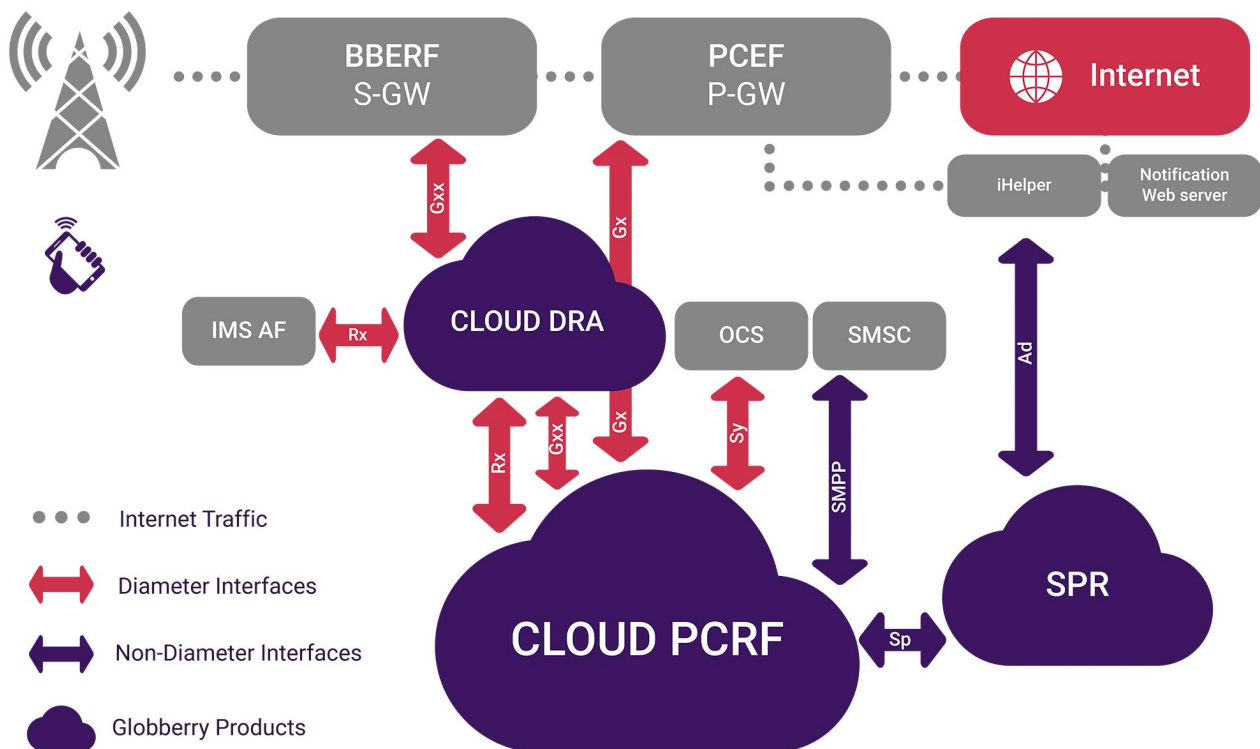
Cloud PCRF in the Operator's Network

Globberrry Cloud PCRF manages data usage policies for PCEF and BBERF as they control subscriber traffic to and from the Internet.

Cloud PCRF works in tight coordination with SPR where it gets subscriber profiles and stores their traffic usage data. Usage and other subscriber policy information may be interfaced from SPR to various operator's systems, such as an iHelper self-service portal.

Cloud PCRF can notify subscribers by sending them SMS messages and redirecting their internet sessions to the Notification Web Server.

Using Globberrry Cloud DRA (Diameter Routing Agent) in the network architecture instead of direct Diameter interfaces with PCEF, BBERF, IMS and other components can significantly simplify the network topology and greatly facilitate its future scaling.



Examples of products implemented with Cloud PCRF

Prepaid Traffic Bundles

For a daily, weekly or monthly fee, the subscriber is given a bundle of free traffic at unlimited access speeds. After the bundle quota is consumed, the traffic is subject to bandwidth limitation (shaping). The subscriber can be warned about approaching or reaching the shaping quota through an SMS or by http-redirection to a notification web site. At the end of each day, week or month the shaping is removed, and the subscriber is granted another quota for the new period. In some scenarios, the bundle may be non-repetitive, covering a single continuous period from the time of purchase until the quota is consumed or the bundle expires.

The bundle can apply to all subscriber traffic, or it can cover traffic filtered only by certain directions, protocols or Internet applications, such as YouTube. By analyzing and interpreting the session attributes, the bundle may also be tied to a geographic region, terminal model/type or the APN being used.

At the bundle's end, the shaping can be complemented or replaced with traffic charging, accomplished in coordination with billing. Traffic within the bundle may also be subject to charging at a discounted rate and/or have a limited bandwidth, but such implementations are less common.

If the subscriber purchases several traffic bundles, including bundles with different periodicity or expiration date, conditions and quotas of all active bundles are applied sequentially, in the order of their priority.

Personalized and Complimentary Bundles

The individual subscriber's quota size and some other bundle attributes can be changed by varying the parameter values of the service triggering the bundle. If the service parameters can be managed via self-service channels – such as IVR, SMS, USSD or the web portal – the bundles can be personalized by the subscribers themselves, without the operator's participation. Such personalization lets the subscribers select their preferred balance between the received amount/quality of the service and the bundle cost.

In addition to a personalized level of service, operators can also motivate and reward their subscribers by giving them complimentary bundles; usually such bundles would have a high priority and be applied first. Complimentary bundles can also be awarded through marketing campaigns, where they would typically have a limited duration and could be linked to certain regions, terminal models or predefined lists of subscribers. After the complimentary bundle quota ends, the subscriber's traffic usage continues, either on regular terms or with some other remaining bundle applied.



Turbo Buttons

If the subscriber wants to continue accessing the network at a high speed after the end of the last bundle, he or she may buy a Turbo button to do so. By its nature, a Turbo button is also a traffic bundle, but with specific characteristics: namely, it is purchased by the subscriber explicitly and usually expires in a relatively short period of time. As with all bundles, Turbo buttons have a specific traffic quota; after the quota is consumed, the subscriber can purchase another Turbo button, and so on. For the operator, Turbo buttons are a convenient way of receiving additional revenue from heavy data users.

When SMS notifications are sent out at the end of the subscriber's main bundle, many operators include in their texts the SMS or USSD-codes for ordering a Turbo button service. Similarly, instructions for ordering a Turbo button service could be added to the web pages used for http-redirect notifications. The notification web page may also contain an explicit link for Turbo button purchase, functioning via direct integration with the billing system. An option for buying another Turbo button may also be included into the notifications sent out at the end of the Turbo button bundles themselves.

Data Sharing Plans

With Data Sharing Plans (DSP), several subscribers – such as members of the same family – or several devices of the same subscriber can access and use a common traffic quota from the same bundle. The subscriber who purchased the bundle is considered a donor of the quota, and all other subscribers in the group are its acceptors. The service terms for the donor and for the acceptors may be different, for example, the bundle may have a reserved remainder only accessible to the donor.

Except for their shared use by several subscribers, in most other aspects Data Sharing Plan bundles have the same features as the regular traffic bundles described above. They can have daily, weekly or monthly renewed quotas, are applied according to their priority relative to the other bundles, and may cover only traffic, filtered by certain directions, protocols or Internet applications, rather than all traffic.

Access to Free Sites

Cloud PCRF lets the operators filter traffic from certain URLs or IP addresses and provide this traffic to subscribers free of charge. This functionality can be used to allow free access to various sites, for example, to the operator's web portal and to external account refill sites. Besides loyalty considerations, this helps the subscribers request a web consultation or add money to the account when their overall Internet access is blocked due to an insufficient account balance. As an option, free access to select sites may only be provided when the account is blocked, while with a sufficient balance, the traffic from these sites remains chargeable.



Data Access Suspension for Insufficient Account Balance

Upon receiving information about an insufficient account balance, Cloud PCRF can block a subscriber's access to the data network. The aforementioned access to free sites may still be provided, even to the subscriber being blocked. If a paid site is being accessed from a browser or another http-application, instead of blocking the access Cloud PCRF can redirect the subscriber's traffic to an informational web page maintained by the operator, explaining the reason for refusing access. The web page may contain links to the refill sites where the subscriber could replenish the account to resume data network usage.

Alternative Roaming Rules

For subscribers in roaming, Cloud PCRF lets the operator formulate an alternative set of data service policies substantially different from the policies in the home network. Roaming traffic bundles can be attached to a specific roaming country or region, or to a certain roaming operator servicing the subscriber. In most other aspects, roaming bundles come with the same functionality as the home network bundles, but usually with a smaller quota and a higher cost. The same as in the home network, subscribers in roaming may use complimentary bundles, Turbo buttons, DSP bundles and any other functionality described above, but configured specifically for roaming.

At the beginning of the first data session in roaming, Cloud PCRF can inform the subscriber of the roaming tariffs and other service conditions via an SMS or by http-redirection to the operator's informational web page. A subscriber in roaming may also be notified about excessive traffic usage above the pre-configured limits; the so-called AoC (Advice of Charge) is especially useful in roaming, due to high traffic costs.

Since the home operator is charged for all traffic provided in roaming networks visited by its subscribers, free access to the operator's web portal and account refill sites for subscribers in roaming is usually turned off, and all roaming traffic is subject to charging.

Cloud PCRF: Functionality

GUI for Business Rule Configuration

Business rules for accessing the operator's data network are configured in an enterprise-grade Business Rule Management System (BRMS) deployed on a dedicated Cloud PCRF web server.

Business rules are specified via a graphical user interface in a number of configurable **Decision Tables**, with criteria columns and result columns. Figure 1 below shows a simplified example of a Decision Table, with the criteria columns colored in blue and the result columns on the right colored in grey.

	#	Description	Source	Roaming Region	RAT Type(s)	ToS	Charging Rule Base Name
			PolicySession [session]	decision			
			originHost.cc	roamingRegion [==]	ratTypeAsDigit [in]	toS [==]	chargingBaseRule
					▲		
+	1	Home GPRS		HOME	1000,1001		home_gprs
+	2	Roaming GPRS		ROAMING	1000,1001		roaming_gprs
+	3	CDMA			1002		home_cdma

Figure 1. Simplified Decision Table Example

The criteria columns can be used to inspect and compare the value of any data session or subscriber attribute, such as the parameters of his or her services or the traffic usage volume. The result columns may contain the names of the service policies (PCC Rulebases/PCC Rules, see below), shaping parameters, notification codes, names and attributes of the traffic counters and other calculated values.

The Decision Tables are easily reconfigured to include additional business rules, as well as additional criteria and result columns, provided that the attributes in the added columns already exist in the subscriber or session profile. Usually, each Decision Table is responsible for its own set of functionality. For example, one Decision Table may contain the business rules for traffic counters, another Decision Table may contain the rules for shaping, the third one may define the notifications, and so on. Additional Decision Tables may be created through configuration at any time, to implement new functionality or new business products.

Configuration changes made to the business rules on the BRMS server are "published" to the Business Rule Engines inside the Cloud PCRF components performing the main message processing with a predefined frequency, for example, once a minute. After the transfer, they take effect immediately, with no interruption to the data service.

PCC Rules: Data Service Policies

By applying the Decision Table rules, Cloud PCRF can calculate the names of the PCC policies and the conditions for their installation on the Gx-client, acting as a PCEF (Policy and Charging Enforcement Function).

In general, the policies installed on a PCEF can:

- Limit the bandwidth for certain traffic (apply shaping)
- Block a traffic flow
- Terminate a session
- Change the rating group for a traffic flow
- Bypass charging for certain traffic
- Accumulate traffic usage and compare it to an allocated quota
- Redirect an http-request to another URL (for web notification)
- Enrich an http-header with certain characteristic fields identifying a subscriber or session.

The available functionality of the PCC policies activated from PCRF largely depends on the traffic detection and processing capabilities of the PCEF equipment used by the operator. The SDF (Service Data Flow) feature lets the PCEF filter physically transmitted data packets into logical flows and apply PCC policies only to the traffic of specific flows separated by direction or URL. The ADC (Application Detection and Control) feature lets the PCEF apply PCC policies only to the traffic flows filtered by protocols and web applications. Tethering Detection lets the PCEF distinguish the tethering traffic and apply specific PCC policies to the sessions using a smartphone/tablet as a modem. Most modern PCEFs have all this functionality, and can apply it to subscriber data sessions under Cloud PCRF control.

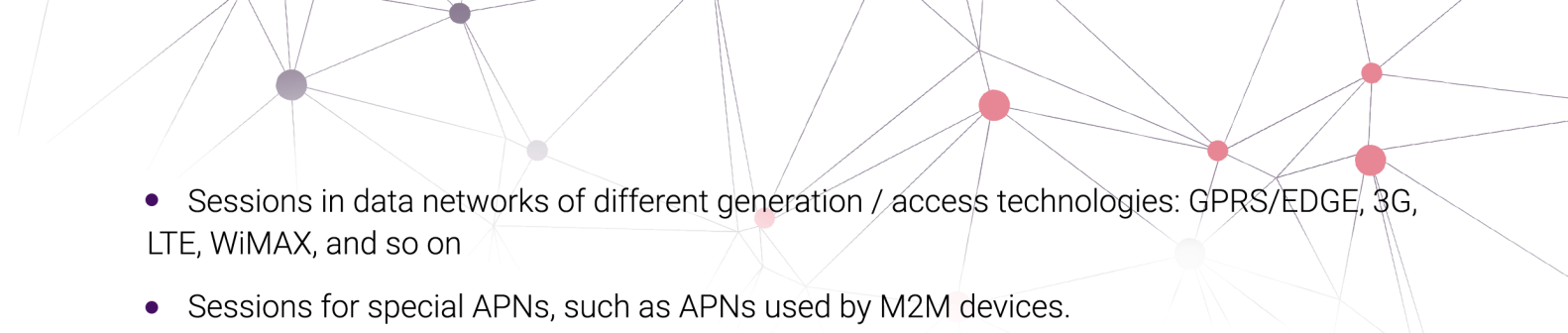
PCC Rulebases: Policy Classes

Provided by Cloud PCRF at the beginning of the session, policy class PCC Rulebase specifies the following:

- A set of PCC policies that can be installed from PCRF at any time during the current subscriber session
- The default set of PCC policies that are installed at the beginning of the session as a part of PCC Rulebase and will be active throughout the session until its termination.

The following data session types usually require separate PCC Rulebases:

- Sessions in the home network and sessions in roaming
- Sessions of subscribers with different charging methods: Online/Offline, PostPaid/PrePaid

- 
- Sessions in data networks of different generation / access technologies: GPRS/EDGE, 3G, LTE, WiMAX, and so on
 - Sessions for special APNs, such as APNs used by M2M devices.

If a certain data session class requires online charging via the Diameter Gy interface, along with PCC Rulebase, Cloud PCRF can also specify the name of a so-called Credit Control Group, which would trigger a different set of Gy charging options on PCEF.

QoS: Regulating Bandwidth/Shaping

Following the Decision Table rules, Cloud PCRF can request traffic shaping by defining QoS settings either for the entire data session or for a specific data flow within it. Each of the two methods has its own features:

- When QoS is specified at a specific data flow level, the bit rates and all other QoS attributes are defined on PCEF and cannot be controlled from Cloud PCRF; however, every data flow can have its own QoS assigned
- When QoS is specified at the session level, Cloud PCRF can specify the bit rates and all other QoS attributes; however, only one common QoS can be applied to the entire session.

The two methods above are compatible and can be used at the same time; however, if QoS is limited at the session level, the actual QoS at the data flow level can never exceed that limit, even when it is defined to be higher.

Cloud PCRF can also request the so-called gating to fully suppress all traffic of a certain data flow. Gating can be thought of as an extreme version of shaping, with a zero bit rate.

Assigning Rating Group to a Data Flow and Providing Traffic for Free

PCEF carries out charging by interfacing with a billing system, usually with Online Mediation/Offline Mediation serving as intermediaries. Cloud PCRF is not directly involved in these charging interfaces; however, it can affect charging by installing PCC policies for separating subscribers' traffic flows into different rating groups, by direction, protocol or Internet application. Each rating group may have its own charging rules and rates defined in billing, applicable during online charging via Diameter Gy as well as during offline charging via CDRs.

As a special case, Cloud PCRF can install PCC policies configured to redirect some traffic flows into rating groups with zero cost, thereby making all such traffic free to the subscriber.

Attaching Policies to Subscriber and Session Attributes

The configurable business logic for policy application may depend on the data session and subscriber attributes; the former are supplied in the incoming Diameter Gx messages and the latter are stored by the operator in the centralized Subscription Profile Repository (SPR). As a practical matter, among these attributes, the following ones are used for determination of the data usage policies most often:

- Charging type: online vs. offline, PostPaid vs. PrePaid
- Terminal device/mobile phone type, vendor and model
- Network generation (2G/3G/4G/LTE) and APN used to access the network
- Subscriber location in the network; in the case of roaming – specific operator, country or region of the world
- Used traffic volume, in general or in the context of a specific data flow
- Services active in billing and values of their parameters.

If necessary, Cloud PCRF can interpret a parameter value of an active service as a personalized option for the subscriber's service policy, such as a personal traffic quota or an identifier of the donor in a DSP bundle.

When a service parameter is changed or a new service is added during an active data session, Cloud PCRF reevaluates the subscriber's service policies in real time, and installs the new policies on the PCEF, if any, using a Re Authorization Request (RAR) message, without interrupting the session.

Dictionaries

Oftentimes, data service policies should depend not on the specific attribute value, but, rather, on the category it belongs to. For example, a subscriber's location can be determined from his or her current base station identifier; however, it is more logical to associate the service policy with an entire region rather than a specific base station. For this purpose, Cloud PCRF contains functionality that lets the operator combine related values into named dictionaries, and then associate business rules in the Decision Tables with the dictionary names. When business rules are evaluated, the current value of the session or subscriber attribute is compared to a predefined list of values, and the policy is applied only when the attribute value is found in the specified dictionary.

The Cloud PCRF dictionaries can be hierarchical, and, besides the data, also contain other lower level dictionaries. For example, the base station identifier dictionary may categorize data at the country, region and city levels, and the mobile device serial number dictionary may categorize data at the equipment class, manufacturer and model levels. Also, Cloud PCRF Dictionaries support wildcard values/value groups.



EDR Generation

Cloud PCRF outputs all data session state changes and the resulting policy modifications to EDR (Event Data Record) file flows. EDR files enable historical analysis of the session state changes and the data service conditions delivered to the subscribers, facilitating detection of incorrectly configured policies, handling of subscriber complaints and many other common tasks.

An EDR is a structured record in the CSV format, containing detailed information about the Cloud PCRF event. A typical EDR contains the following data:

- Current subscriber attributes, such as his or her services and their parameters
- Common data session attributes such as APN and the IP-address allocated to the session
- Attributes of the current message, such as the reported traffic volume
- Installed policies and the current data service conditions.

EDR records are produced at the beginning and at the end of each data session, as well as with any policy changes, service activations and deactivations, traffic usage reports, and changes in access technology or location. Additionally, EDR records are produced for all errors leading to abnormal responses from Cloud PCRF, to help the operator understand and handle any network accidents or unexpected situations.

SMS and Web Notifications

Cloud PCRF can notify subscribers about events occurring in the system, by sending them SMS messages or by http-redirecting their Internet sessions to predefined web pages. For the http redirection to work, the subscriber must be using the http protocol, thus, such notifications will only work in a browser or another http-application when the subscriber has an active data session in progress. To receive an SMS notification, the subscriber must have a real telephone number, thus, SMS notifications are generally not available on tablets and mobile modems.

In the Decision Tables of Cloud PCRF, the notifications are configured as templates attached to arbitrarily defined notification codes. For SMS notifications, the template contains the SMS text, and for web notifications it contains the URL for http-redirect. When the notification is triggered, its text may be adjusted by substituting some relevant data, such as the traffic volume consumed by the subscriber or the shaping bit rate. Cloud PCRF can be configured to suppress its notifications during certain periods, for example, at nighttime.

Inside Cloud PCRF, notifications are triggered by code from the Decision Tables, usually within the same business rules that calculate the data service policies. Additionally, Cloud PCRF offers a web service for triggering the notifications with certain codes from outside systems. This web service can be used, for example, by operators' marketing systems to display promotion offers to select subscribers.

Throttling and Error Handling

Cloud PCRF administrators can configure the throughput limits for their Diameter Gx interface, in terms of TPS and bursts. For the messages in excess of the limit, instead of calculating the data service policies according to the business rules, Cloud PCRF returns a trivial response with an error return code. This functionality protects Cloud PCRF and the SPR behind the PCRF from abnormal load increases to levels that cannot be handled. The PCEF reaction to responses with error return codes is usually configurable and may lead, for example, to authorization of a new session with default access parameters or to the continuation of an existing session with its current settings.

Cloud PCRF administrators can specify a few different throughput limits for different Diameter request types, thereby providing a set of subsequent cutoff levels for Diameter messages of different importance. As an example of possible use, through configuration of message priorities, the operator may guarantee that the existing data sessions are serviced first, and new data sessions are only started when sufficient bandwidth is available for processing the Diameter Gx requests.

If the online charging system is unavailable, due to an accident or for any other reason, Cloud PCRF can be temporarily switched to a so-called Degraded Mode, leading to all subscribers being charged offline. The Degraded Mode can be useful to operators who would want to provide service to their subscribers, even on incorrect terms, rather than cut off their network access during problems with charging. Network glitches may lead to Cloud PCRF data sessions being stuck in an incorrect state. Cloud PCRF offers two mechanisms for handling such situations:

- Periodic interrogation of the client network elements regarding the status of data sessions that have not been updated for a long time, with subsequent deletion of the sessions that could not be found
- Limiting the number of simultaneously active sessions per subscriber, with a new session creation leading to the deletion of the oldest one when the limit is exceeded.

PCEF-specific AVP Adjustments

PCEF equipment from different vendors may support slightly different versions of the Diameter Gx protocol, even with full 3GPP compliance declared. Through the Decision Table configuration, Cloud PCRF lets the administrators vary the expected and returned AVP values, depending on the served equipment type, determined by the host or realm of the Diameter client. The logic for AVP adjustment may be configured separately for the initial, update, termination and RAR messages.

Cloud PCRF can simultaneously work with a number of PCEFs, including PCEFs from different vendors. For each PCEF, Cloud PCRF adjusts the returned AVPs according to the specifics of its Diameter interface. When data sessions of the same subscriber are activated on a few different Diameter interfaces, Cloud PCRF can aggregate the data in a common subscriber profile, and calculate the service policies, based on the combination of data available from all sources. Furthermore, events occurring on one Diameter interface may affect the data service policies on a different Diameter interface in real time.

Cloud PCRF: Architecture

Cloud PCRF is an enterprise-level system with the architecture based on micro services. Cloud PCRF's logical modules exist as autonomous components, interacting with other Cloud PCRF modules via ReST/http. The system uses a Service Discovery mechanism to detect running modules and build links between the components in real time. Such architecture offers great flexibility for horizontal scaling of the internal Cloud PCRF components, as additional modules of known types can be started up in the Cloud PCRF environment in real time, automatically taking over some of the load. The architecture also ensures high reliability and accessibility, as separate modules are executed in separate containers, and failure of a single module simply leads to redistribution of its load among all other remaining modules of the same type, through the automatic rebalancing algorithms implemented in Cloud PCRF.

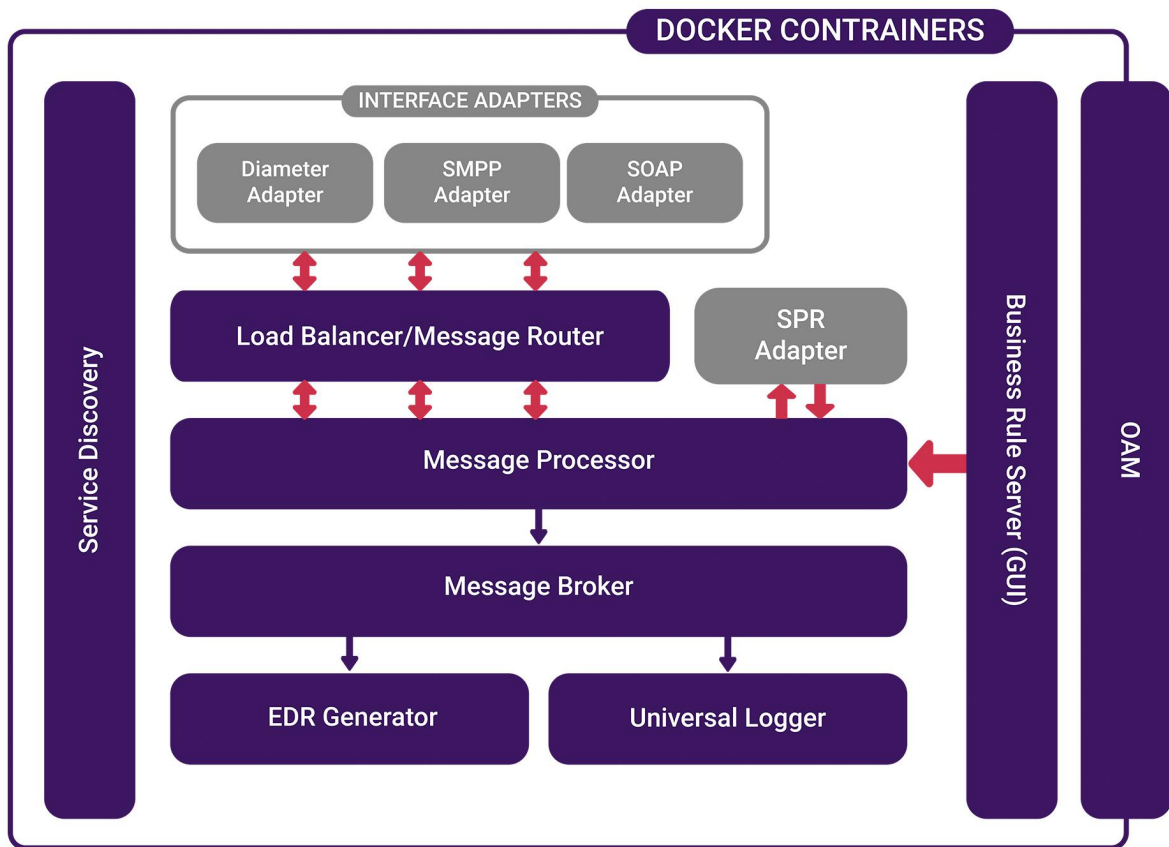
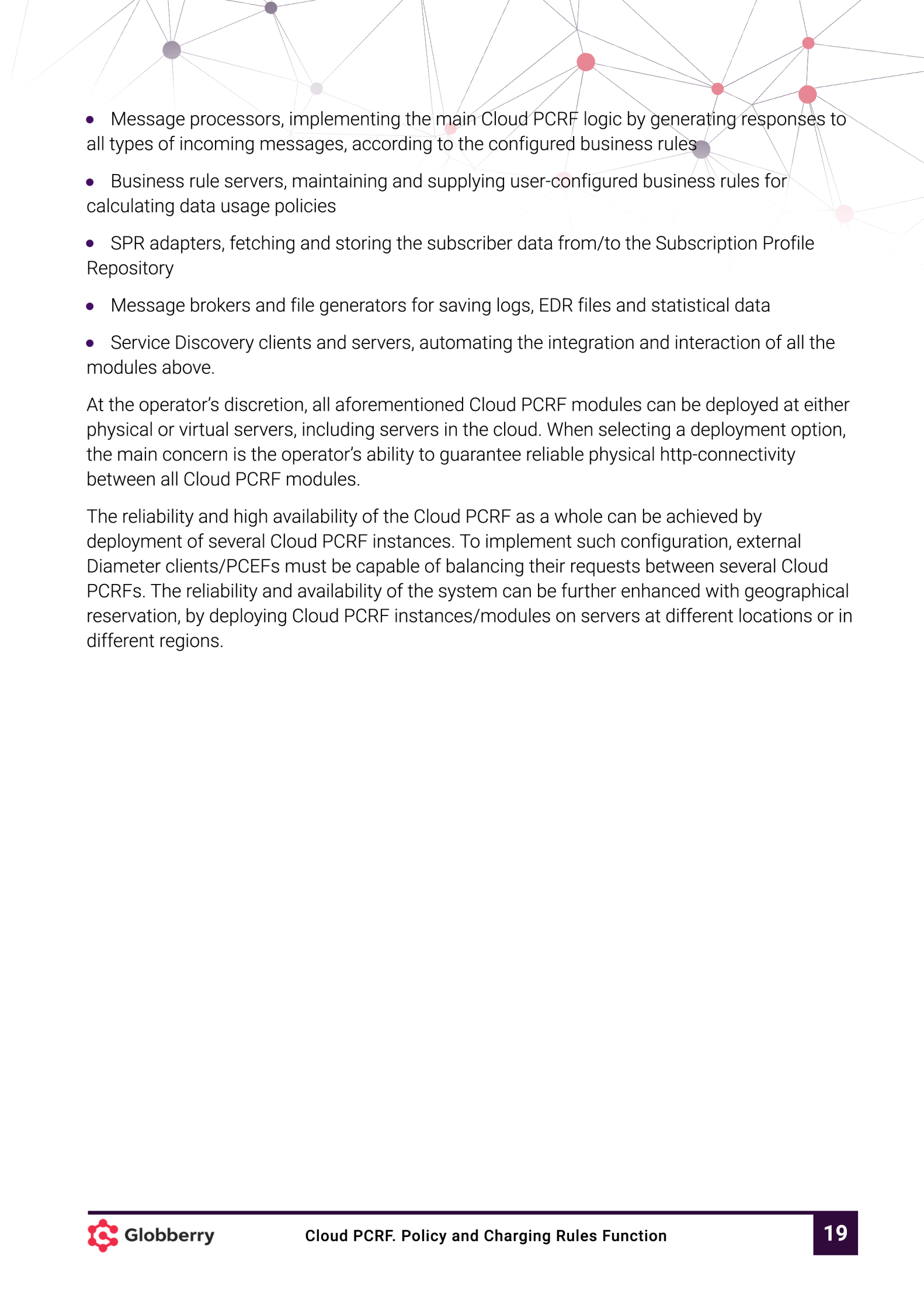


Figure 2. Cloud PCRF Component Diagram

Cloud PCRF contains modules of the following types:

- Diameter, SOAP and SMPP interface adapters, converting messages to and from the Cloud PCRF's internal format
- Load balancers/message routers, responsible for message distribution among Cloud PCRF internal components

- 
- Message processors, implementing the main Cloud PCRF logic by generating responses to all types of incoming messages, according to the configured business rules
 - Business rule servers, maintaining and supplying user-configured business rules for calculating data usage policies
 - SPR adapters, fetching and storing the subscriber data from/to the Subscription Profile Repository
 - Message brokers and file generators for saving logs, EDR files and statistical data
 - Service Discovery clients and servers, automating the integration and interaction of all the modules above.

At the operator's discretion, all aforementioned Cloud PCRF modules can be deployed at either physical or virtual servers, including servers in the cloud. When selecting a deployment option, the main concern is the operator's ability to guarantee reliable physical http-connectivity between all Cloud PCRF modules.

The reliability and high availability of the Cloud PCRF as a whole can be achieved by deployment of several Cloud PCRF instances. To implement such configuration, external Diameter clients/PCEF's must be capable of balancing their requests between several Cloud PCRF's. The reliability and availability of the system can be further enhanced with geographical reservation, by deploying Cloud PCRF instances/modules on servers at different locations or in different regions.

Standards and Specifications

3GPP

Policy and Charging Control Architecture: [TS 23.203](#)

Charging rule provisioning over Gx interface: [TS 29.210](#)

Rx interface and Rx/Gx signaling flows: [TS 29.211](#)

Policy and Charging Control (PCC) over Gx reference point: [TS 29.212](#)

Policy and Charging Control (PCC) over Rx reference point: [TS 29.214](#)

Cx and Dx interfaces based on the Diameter protocol: [TS 29.229](#)

Policy and Charging Control (PCC) over S9 reference point: [TS 29.215](#)

Policy and Charging Control: Spending limit reporting over Sy reference point: [TS 29.219](#)

Diameter charging applications: [TS 32.299](#)

IETF

Diameter base protocol: [RFC 3588](#) / [RFC 6733](#)

Diameter Commands for 3GPP: [RFC 3589](#)

Diameter Credit-Control Application: [RFC 4006](#)

GSMA

LTE and EPC Roaming Guidelines: [IR.88](#)

IMS Profile for Voice and SMS: [IR.92](#)

IMS Profile for Conversational Video Service: [IR.94](#)



globberry.com
info@globberry.com