Secure Real-Time Communications

# DSC vs DRA

Confusion in the naming of Diameter Network Elements

## Contents

Within the telecom industry, there seems to be confusion as to the purpose and functionality of a Diameter Routing Agent (DRA). In the view of the GSMA, a DRA sits in front of a policy and charging rules function (PCRF) on the Rx and Gx interfaces and routes messages by IP connectivity access network (IP-CAN) session. However, often the term DRA is used to simply imply a core Diameter router in the signaling network, which may be acting as a Proxy or Relay.

A Diameter Signaling Controller (DSC) is a generic name that may imply a DRA, relay, proxy, interworking function or Diameter Edge Agent (DEA).

Understanding the definition a vendor uses for DRA is important, because carriers can waste money on a solution they don't need. Simply having a PCRF or an online charging system (OCS) pair connected to the DSC is not enough reason to start routing messages by IP-CAN or Diameter session. If a carrier is truly seeking a DRA, then the vendor must ensure that a fault-tolerant and very fast database is in place. In this paper, we will examine when session information must be kept on a DSC and when more traditional routing can accomplish the same job.

First, we need to look at the different session state types the DSC deals with. There are three principle state-based situations for the Diameter Signaling Controller:

1. **Transaction State** – Keeping transaction state is the basic job of a Relay or Proxy to receive a Diameter Request message and route it forward. The Relay or Proxy retains information on that request which can be matched up with the Answer message when it is received. The retained information is used when that Answer is forwarded back to the originator of the request. This simple state machine is described in RFC 6733 (https://tools.ietf.org/html/rfc6733) and is the basis of all Relays and Proxies. This function is widely accepted and uncontroversial, so we will put it aside for the rest of this paper.

2. **IP-CAN Session** – IP-CAN sessions relate to the user equipment (UE) and the DSC in front of a PCRF. When it is performing IP-CAN session routing, it is referred to as a DRA. The term DRA gets misused, and is often used to refer to a simple Relay or Proxy, or Diameter Signaling Controller. However, 3GPP TS 29.213 is quite specific about what a DRA is and does. The Gx, Gxx, S9, Rx, and Sd interfaces all may be IP-CAN session routed. All IP-CAN sessions from the same UE are to be sent to the same PCRF. A database of IP-CAN sessions and their destinations is used on the DRA to ensure that consistency. However, as we will see later in this paper, not all network architectures will require IP-CAN session routing for the PCRF.

3. **Diameter Session** – The Diameter sessions are discussed less than the above two, but are important for billing functions. For example, the Sy and Gy interfaces are in front of the online charging function (OCS). These are also stateful connections, but it is based on the Diameter session, not the IP-CAN session. Keeping track of session state is required so that the same OCS is used throughout the UE action. The Diameter session is similar to the IP-CAN session, because the PCRF opens the session on the OCS and closes the session when its own IP-CAN session to the UE is terminated.

## What Do IP-CAN Sessions Track?

An IP-CAN session can be thought of as the UE to Packet Data Network (PDN) connection. This is a logical connection, and many elements contribute to its implementation. A PCRF is one of the network entities responsible for managing IP-CAN sessions. A PCRF keeps track of the state of each IP-CAN session that it manages. A UE can have more than one established IP-CAN session; for example, if the UE is communicating with more than one PDN at a time, such as the public internet and the IMS network for voice conferencing. The DSC attempts to route all messages pertaining to a UE to the same PCRF. This specifically means that all messages for an IP-CAN session go to the same PCRF, but allows the DSC to correlate information with some applications where the binding can otherwise be unclear.

**There are two network makeups under consideration:**

- **Long-term Evolution (LTE):** UE -> Evolved Node B (eNB) -> Serving Gateway (SGW) -> Packet Data Network Gateway (PGW) -> PDN
- **3G (or lesser):** UE -> NodeB/Base/[other access] -> Bearer Binding and Event Reporting Function (BBERF) -> PGW -> PDN In both cases, the Gx interface between PGW and PCRF is used. In the second case, the Gxx interface between the BBERF and PCRF is also required.

The PGW is notified on the establishment of a UE to IP-CAN connection. It creates a Gx session with a PCRF. In the LTE case, this Gx session is established first, while in the other case a Gxx session from the BBERF is first.

When that Gx session is established, other network entities can make requests related to the IP-CAN session.

Figure 1 below shows the interfaces for the PCRF.

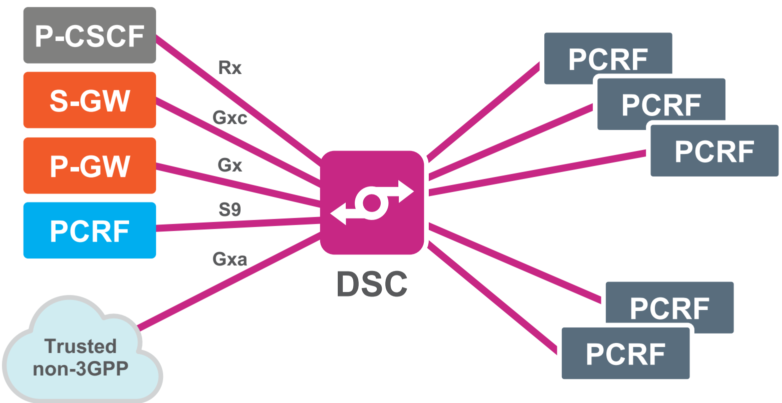


**Figure 1** – PCRF Interfaces

# When Do We Need to Track IP-CAN and Diameter Sessions?

Looking at IP-CAN sessions and Diameter sessions, one would think that we always need a database to retain information about these states. This is implied in the standards; however, in the real world we find many instances where such a session database is simply not needed.

*We will examine three scenarios of the PCRF configuration:*

- Active/standby
- Active/Active with Shared Session information
- Active/Active with independent sessions

**Active/Standby**

Quite often we are asked for a DRA, but at implementation time we discover that the PCRF is running hot/standby. In this case, the PCRF configuration is such that one system is taking all traffic and the second system only comes into play if the first is down. The role of the DSC is to simply route to the available system or to priorities to the first if both are available. There is simply no decision for an IP-CAN database to make. If that is the case, we suggest not including the IP-CAN session database, both for cost savings and to provide a simpler, more streamlined solution.

This is shown in Figure 2, right.

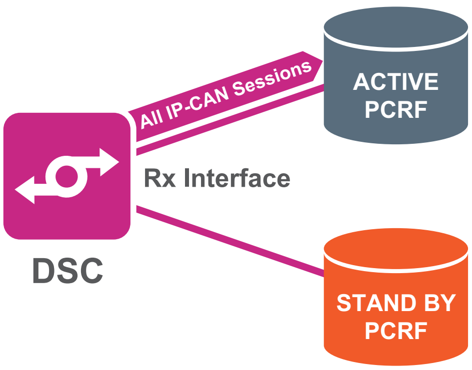


**Figure 2** – PCRF in Active/Standby Configuration

### Active/Active with Shared Session Information

Another common configuration is to see a pair of PCRFs running, but where the PCRF is actively sharing session information with its mate PCRF. We see this as superior design of the PCRF. The network element is taking into its own hands the information it needs for recovery scenarios. The reason this is better handled by PCRF itself, is that the PCRF knows how it wants to handle various failure and recovery scenarios and it is not left to the DSC to determine where a session is to be found after a momentary communication outage or when a system returns to a working state.

In this case, the DSC will simply load share between the PCRFs and can be stateless. This saves the carrier cost and complexity in the DSC.

This is shown in Figure 3, right.

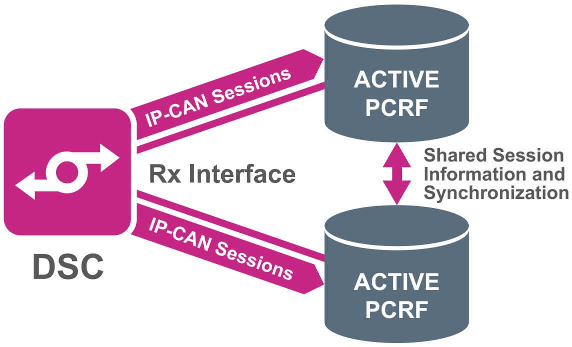


**Figure 3** – Active/Active PCRF with Shared Session Information

### Active/Active with Independent Sessions

In this last scenario, we come to the definition of DRA as provided by the GSMA in 3GPP TS 29.213. Here we see again the Active/Active PCRF. However, in this case, the existing IP-CAN session information is NOT shared between the PCRF mates. A real-world situation for an Active/Active PCRF with independent sessions would be where an operator has chosen to deploy two different PCRF vendors to minimize risk, or is in the process of slowly migrating between two different vendors.

It is the responsibility of the DRA to retain a database of where the IP-CAN session was initially sent and to ensure that all other Rx messages for the same IP-CAN session, and usually for the same UE, end up on the same PCRF.

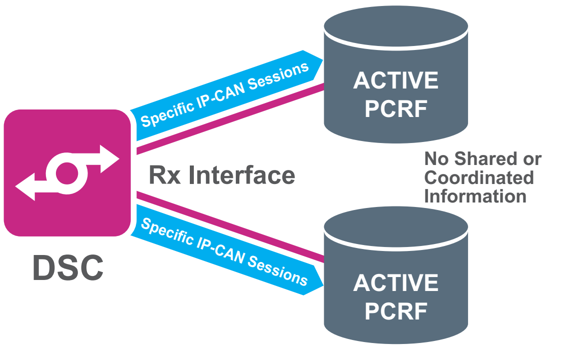


**Figure 4** – Active/Active PCRFs without Shared Session Information

This database on the DRA needs to be geo-redundant and very fast, as it is possible to have messages that follow the session initiation message follow it by only several hundred microseconds. Figure 4 shows Active/Active PCRFs without shared IP-CAN information.

Additionally, the DRA needs to be aware of how the PCRF is to handle recovery situations. For example: a PCRF is available, and sessions are started on it. If that PCRF loses communications or restarts, should the DRA assume that sessions on the system are still valid or should it assume they are lost? What about Rx messages that arrive during the downtime and should be destined for that PCRF? Should it assume the whole session lost and restart it on the second PCRF, or should it return an error?

Some of these answers can be vendor specific to the PCRF, thus it is preferable to have the mated pair of PCRFs share IP-CAN session information as discussed above.

## Conclusion

It's common for people in the communication industry to misuse DRA terms when they might just be talking about core routing, DEA or some other capability. And it's common for the industry to include DRA requirements when it might not be required. This paper's goal is to educate and inform the reader on the differences, technical details, and use cases for when DRA is needed and not needed.

Summing this up, a DRA has the job of routing Diameter or IP-CAN sessions towards specific network elements. A DSC has the job of routing Diameter messages. Ribbon stands ready to discuss the DRA topic and keep our customers well informed.

## About Ribbon

Ribbon Communications (Nasdaq: RBBN) delivers communications software, IP and optical networking solutions to service providers, enterprises and critical infrastructure sectors globally. We engage deeply with our customers, helping them modernize their networks for improved competitive positioning and business outcomes in today's smart, always-on and data-hungry world. Our innovative, end-to-end solutions portfolio delivers unparalleled scale, performance, and agility, including core to edge software-centric solutions, cloud-native offers, leading-edge security and analytics tools, along with IP and optical networking solutions for 5G. We maintain a keen focus on our commitments to Environmental, Social and Governance (ESG) matters, offering an annual Sustainability Report to our stakeholders. To learn more about Ribbon visit **rbbn.com**.

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