

Mapping Diameter Interfaces to Functionality in 3GPP/3GPP2 IMS Architecture

Whitepaper by Traffix Systems

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1. Introduction

This whitepaper discuss the Diameter protocol, the interfaces build upon its functionality and its usage by different network functionalities as it is defined by the 3GPP and 3GPP2 standard organization bodies. This whitepaper includes a short overview of the Diameter protocol, discuss its usage and adoption by the standard bodies and maps the network functionality in IMS architecture to the different interfaces.

Diameter is a signaling protocol that has been specified by the IETF to perform Authentication, Authorization and Accounting (AAA) functions in IP based networks.

Diameter was firmly embraced and widely adopted by 3GPP and 3GPP2 standard bodies. Diameter has been chosen by those organizations for all AAA handling in their Next Generation IMS based networks and is designed to perform these functions in both local and roaming situations.

Diameter has been designed to ensure as much as possible backward compatibility with Remote Authentication Dial In User Service (RADIUS) protocol, widely deployed in 2nd, 2.5 and 2.75 generation networks (i.e. GSM, GPRS, CDMA, EDGE). Diameter introduces many enhancements in order to address several RADIUS Shortcomings and deficiencies (such as: no end to end security, limited size of length and identifier fields, limited failure detection mechanism, UDP based compared to TCP/SCTP based)

2. Overview

Diameter is defined as a base protocol which is used in conjunction with a set of applications. Diameter can be extended through addition of new commands and Attribute Value Pairs (AVP's) in order to face ever expanding set of new application requirements.

Thanks to those characteristics it was embraced by different specification bodies, most notably 3GPP and 3GPP2. Diameter was also chosen as fundamental cornerstone in the advanced network architecture rolled out by 3GPP coined under the name IMS.

The IMS standard provides a unified framework for delivering real-time multimedia communications services based on IP signaling networks. The 3GPP has selected Diameter as the main standard for Control and AAA functionalities. The 3GPP added additional extensions on top of the Diameter base protocol. Diameter provides a flexible, reliable, scalable AAA framework that complements the other signaling protocols used in IMS such as SIP. After winning the support of the 3GPP, IMS was equally embraced by 3GPP2, and was branded with a new name in 3GPP2 specifications – Multimedia Domain (MMD).

IMS uses Diameter in over 80% of the functionalities defined in the architecture. IMS deploys Diameter in the most central functionalities and interfaces, for example Application Server (AS) to Home Subscriber Server (HSS) connection, Proxy Call State Control Function (I/S-CSCF) to Service Location Function (SLF) and HSS connections. Diameter is connecting the Online Charging Systems (OCS) and Offline Charging System (OFCS) to different network entities. Policy Charging Rule Function (PCRF), GGSN, Media Gateway Control Function (MGCF) and other central

functionalities are all constructing their connectivity upon Diameter based interfaces.

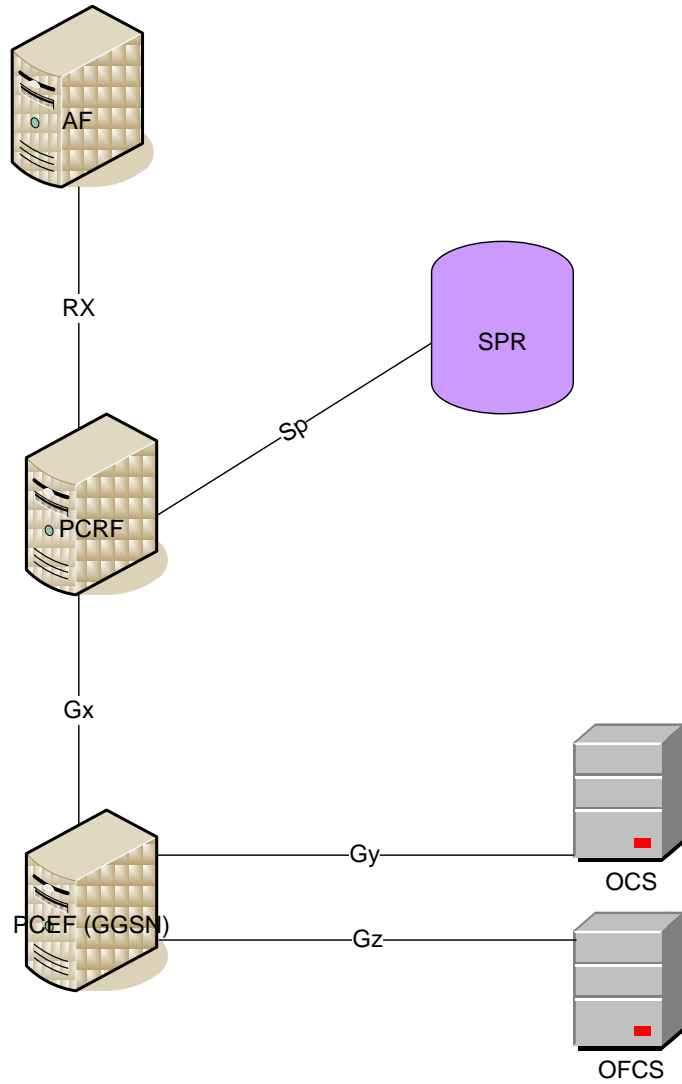


Figure 1: Example PCRF Diameter connectivity in 3GPP Release 7.

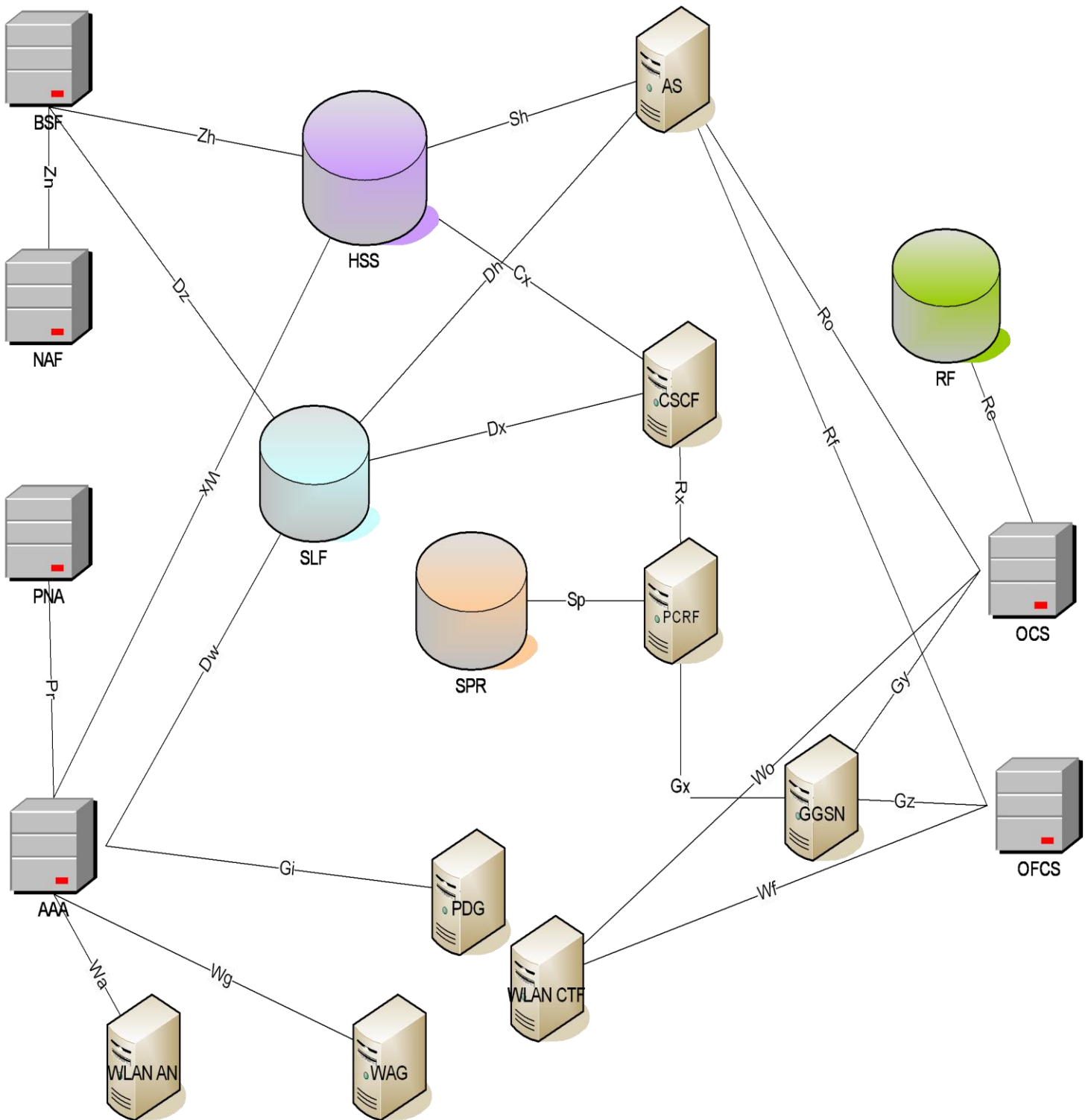


Figure 2: Diameter connectivity in 3GPP Release 7.

3. Mapping Diameter Interfaces to Functionality

Interface	Functionality	Specification body	Applicable Release
Sh	HSS - AS	3GPP/3GPP2	Rel. 7/MMD B
Cx	HSS - I/S-CSCF	3GPP/3GPP2	Rel. 7/MMD B
Dx	SLF - I/ S-CSCF	3GPP/3GPP2	Rel. 7/MMD B
Dh	SLF - AS	3GPP/3GPP2	Rel. 7/MMD B
Ro	AS - OCS	3GPP/3GPP2	Rel. 7/MMD B
Rf	AS - OFCS	3GPP/3GPP2	Rel. 7/MMD B
Sp	PCRF - SPR	3GPP	Rel. 7
Gx	PCRF - PCEF	3GPP	Rel. 7
Rx	PCRF - P-CSCF	3GPP	Rel. 7
Gz	PDG - OFCS	3GPP	Rel. 7
Gy	PDG - OCS	3GPP	Rel. 7
Gq	PDF - P-CSCF	3GPP	Rel.6
Zh	BSF - HSS	3GPP	Rel. 7
Dz	BSF - SLF	3GPP	Rel. 7
Zn	BSF - NAF	3GPP	Rel. 7
Ty	PCRF - PCEF	3GPP2	MMD B
Tx	PCSF - P-CSCF	3GPP2	MMD B
Dw	SLF - AAA Server	3GPP	Rel. 7
Wa	WLAN AN - AAA Server/Proxy	3GPP	Rel. 7
Wd	AAA Proxy - AAA Server	3GPP	Rel. 7
Wx	HSS - AAA Server	3GPP	Rel. 7
Wm	AAA Server - PDG	3GPP	Rel. 7
Wg	AAA Proxy/Server - WAG	3GPP	Rel. 7
Pr	3GPP AAA Server - PNA	3GPP	Rel. 7
Gi	PDG - AAA Server	3GPP	Rel. 7
Wo	3GPP WLAN CTF - OCS	3GPP	Rel. 7
Wf	3GPP WLAN CTF - OFCS	3GPP	Rel. 7
Re	OCS - RF	3GPP	Rel. 7

4. 3GPP specifications, Diameter interfaces

3GPP is using the Diameter protocols in the majority of its defined core functionalities. When observing the evolving architecture and changes between the different releases - 5, 6, 7 and 8 one can see a clear migration path into using Diameter in a growing number of interfaces and functionalities, sometimes even replacing other protocols inside the core network (For Example the Release 6 COPS based Go interface is replaced by the Diameter based Gx interface in Release 7 and after).

3GPP Release 7 based interfaces conform to the following specifications:

- Sh interface: *3GPP TS 29.328 and 3GPP TS 29.329*
- Dh interface: *3GPP TS 29.328 and 3GPP TS 29.329*
- Rf interface: *3GPP TS 32.225 and 3GPP TS 32.299 (also IETF RFC 4006)*
- Ro interface: *3GPP TS 32.225 and 3GPP TS 32.299 (also IETF RFC 4006)*
- Re interface: *3GPP TS 32.296*
- Cx interface: *3GPP TS 29.228 and 3GPP TS 29.229*
- Dx interface: *3GPP TS 29.228 and 3GPP TS 29.229*
- Sp interface: *3GPP TS 23.203, 3GPP TS 29.328 and 3GPP TS 29.329*
- Rx interface: *3GPP TS 23.203 and 3GPP TS 29.214*
- Gx interface: *3GPP TS 29.212 and 3GPP TS 23.203*
- Gy interface: *3GPP TS 32.299*
- Gq interface: *3GPP TS 29.207*
- Zh/Dz/Zn interfaces: *3GPP TS 29.109 and 3GPP TS 33.220*
- Dw/Wa/Wd/Wx/Wg/Pr/Wo/Wf/Wm interfaces: *3GPP TS 29.234*

5. 3GPP2 specifications, Diameter interfaces

3GPP2 is using the Diameter protocols in the majority of its defined core functionalities. As in 3GPP based networks and due to the synergy between both specification bodies there is a clear migration path into using Diameter more and more along the 0, A and B release versions path.

3GPP2 Diameter based interfaces conform to the following specifications:

- Sh interface: *3GPP2 TSG-X X.S0013-0010 and X.S0013-0011*
- Dh interface: *3GPP2 TSG-X X.S0013-0011*
- Rf interface: *RFC 4006, 3GPP2 X.S0013-007 and X.S0013-008*
- Ro interface: *RFC 4006, 3GPP2 X.S0013-007 and X.S0013-008*
- Cx interface: *3GPP2 TSG-X X.S0013-005 and X.S0013-006*
- Dx interface: *3GPP2 TSG-X X.S0013-005 and X.S0013-006*
- Ty interface: *3GPP2 TSG-X X.S0013-014*
- Tx interface: *3GPP2 TSG-X X.S0013-013*

6. Acronyms

<i>AAA</i>	Authentication, Authorization and Accounting
<i>Accounting</i>	The act of collecting information on resource usage for the purpose of capacity planning, auditing, billing or cost allocation
<i>Authentication</i>	The act of verifying the identity of an entity (subject).
<i>AS</i>	Application Server
<i>AVP</i>	The Diameter protocol consists of a header followed by one or more Attribute-Value-Pairs (AVPs). An AVP includes a header and is used to encapsulate protocol-specific data (e.g., routing information) as well as authentication, authorization or accounting information
<i>BSF</i>	Bootstrapping Server Functionality
<i>Diameter Client</i>	A device at the edge of the network that performs Real-time Accounting
<i>CSCF</i>	Call State Control Function
<i>NAF</i>	Operator-controlled Network Application Function functionality.
<i>WAG</i>	WLAN Access Gateway.
<i>PDG</i>	Packet Data Gateway
<i>PNA</i>	Presence Network Agent
<i>IMS</i>	IP Multimedia Subsystems
<i>MMD</i>	Multimedia Domain
<i>OCS</i>	Online Charging System
<i>OFCS</i>	Offline Charging System
<i>HSS</i>	Home Subscriber Server
<i>MGCF</i>	Media Gateway Control Function
<i>PCRF</i>	Policy Charging Decision Function
<i>User</i>	The entity requesting or using some resource, in support of which a Diameter client has generated a request

About Traffix Systems

Traffix Systems is the Diameter control plane expert. Traffix supports telecom operators on their way to Next Generation Network (NGN, IMS or LTE) technology by providing cost saving Diameter solutions such as Diameter gateways and load-balancing solutions for the Diameter control plane achieving network connectivity and scalability and thus enabling the opportunities to generate new service revenues based on the Diameter control plane innovation.

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