

Accelero™ Diameter Application Platform

Enabling Policy, Charging and Subscription in EPC, IMS, MMD Networks

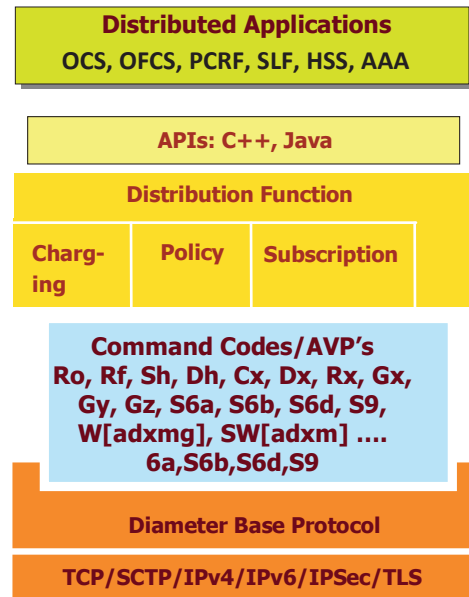
The promise of converged networks with an all-IP interconnectivity comes closer with the IP Multimedia Subsystem (IMS) in the UMTS/WCDMA/HSPA 3G network, the Multimedia Domain (MMD) of the CDMA2000/EV-DO 3G network and more recently with the Evolved Packet Core (EPC) of the LTE 4G network. While RADIUS was the original the protocol of choice, the Diameter protocol has been adopted as the standard for all aspects of policy, charging and subscription management.

Diameter is based on RADIUS but has been enhanced to support fail-over, transmission security, reliable transport, agent support, server initiated messages, capability negotiation, peer discovery and configuration and is expandable with command codes (CC) and attribute-value pairs (AVP). The base Diameter protocols have been defined in the IETF and these have been extended using additional CCs and AVPs by the 3GPP and 3GPP2 to support interfaces between the IMS, MMD and EPC network elements.

Charging/Policy functions include the On-line Charging System (OCS), Off-line Charging System (OFCS), Policy and Charging Rules Function (PCRF) that use Ro, Rf, Rx, Gx, Gy, Gz S6a, S6b, s6d and S9 interfaces. Subscription management functions include the Home Subscriber Server (HSS), Subscriber Location Function (SLF) that use Sh, Dh, Cx, Dx, and AAA that uses Wa, Wd, Wx, Wm, Wg, SWa, Swd, SWx, SWm interfaces.

Benefits of the Diametriq Diameter Platform

- ⇒ Well deployed by Tier 1 operators around the globe
- ⇒ Comprehensive Diameter application development environment
- ⇒ Designed for high performance, small footprint requirements
- ⇒ Distributed and Library Modes
- ⇒ Supports Diameter application interfaces to support IMS and LTE domains
- ⇒ Both C++ and Java API support on Intel servers
- ⇒ Adheres to the latest RFC 6733
- ⇒ High performance stack suited for PCRF, OCS, HSS



Accelero Diameter Application Platform

A key element of Diametriq's Diameter Solution Suite™ is the Accelero™ Diameter Application Platform. Diametriq offers a very high performance, scalable, reliable carrier-grade Diameter-based platform that can be used to build 3G and 4G core network elements. Accelero Diameter has been used by tier one mobile equipment vendors and deployed in tier one operator networks around the globe.

Accelero Diameter includes support for the most popular Diameter interfaces used by EPC, IMS and MMD. As an option, the platform can also include the Accelero suite of SS7 interfaces to enable interworking with legacy technologies.

Another option offers the Diameter Relay, Proxy and Redirect agents allowing the developer to build Diameter-based network elements and applications.

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Object-Oriented API

The Diameter protocol and applications are specified with a set of commands (or messages). Each command contains a set of Attribute Value Pairs (AVP). The Accelero Diameter implementation provides a user-friendly API that provides classes for each command, AVPs and the complex types. Simple Set, Get and Print methods are provided to enable access to the AVPs.

This interface provides a type-safe programming approach. Cumbersome searching within a command to retrieve the elements and the onerous task of encoding tags, etc. is completely abstracted from the developer. This results in clean, easy-to-use code.

The API also provides a flexible mechanism to support known vendor-specific extensions in this uniform format. Any unknown extensions received during runtime can be passed to the application for inspection and action. The API presents a uniform signature for all interfaces. For example, an application can use Sh and Rf interfaces seamlessly.

Distributed Server Mode

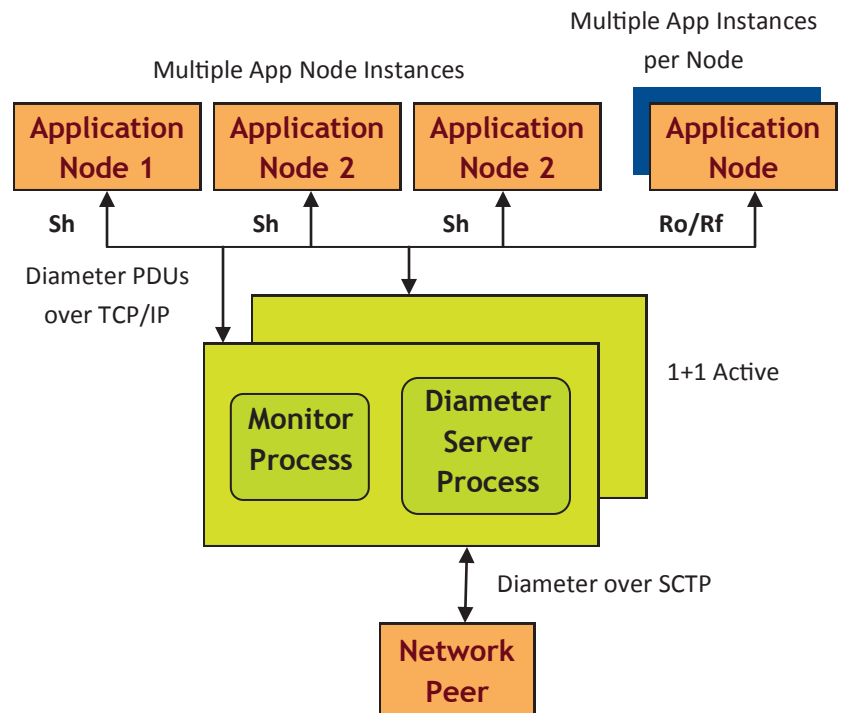
The Distributed Server Mode Package is designed to provide a single point of Diameter access to a set of distributed clients. The clients may be implemented as multiple processes, multiple nodes or a combination of both. The application clients communicate with the Diameter front-end server via an IP socket-based interface.

The Accelero Diameter front-end server provides a highly available 1+1 active-standby redundancy mechanism that synchronizes session and state information to enable recovery in the event of a failure. The front-end server provides a health monitor process to enable switchovers.

Linkable Library Mode

For compact architectures based on a single process the linkable library mode provides a seamless approach whereby the process can harness the features of the Diameter implementation in a multi-threaded model. Accelero Diameter runs in its own thread of execution, providing support for all features of capabilities exchange, watchdog, peer and session control.

Accelero Diameter also provides a multi-threaded dispatch and receive mechanism for communicating with the application worker threads. The Accelero platform extends a complete process infrastructure environment that can accelerate new application development. Library mode also supports Active/Hot Standby redundant operation.



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Technical Features

| | |
|-------------------------|--|
| Product Type | Software, Linkable Library Mode or Distributed Server Mode Configurations |
| Library Mode | Static or Dynamically Linked |
| Distributed Mode | Separate Process |
| Multi-threading Support | Thread Safe: supports both multi-threaded and single-threaded environments |
| CPU Support | Single processor/Multi processor/32 bit/64 bit |
| Platforms Supported | Linux (RedHat ES 4/5, WindRiver PNE) Solaris-9/10 Others available – contact Diametriq |
| Logging and Tracing | Dynamic levels of debug File-based logs/traces |
| Development Environment | C++, Java API-programmer interface Demo Applications |

IETF Interfaces

| | |
|-------------------------------------|----------|
| Diameter Base | RFC 3588 |
| Diameter Mobile IPv4 Application | RFC 4004 |
| Diameter Network Access Server App | RFC4005 |
| Diameter Credit-Control Application | RFC 4006 |
| Diameter EAP Application | RFC 4072 |
| Diameter SIP Application | RFC 4740 |
| Diameter Mobile IPv6 | RFC 5447 |

3GPP Interfaces

| | |
|---------------------------------|----------------------|
| Ro/Rf: AS to OCS/OFCS | 32.225 Release 5 |
| Sh/Dh: AS to HSS/SLF | 29.328/329 Release10 |
| Cx/Dx: CSCF to HSS/SLF | 29.228/229 Release10 |
| Rx: AS to PCRF | 29.214 Release 10 |
| Gx: PCEF to PCRF | 29.212 Release 10 |
| Gy: PCEF to OCS | 32.251 Release 10 |
| Gz: PCEF to OFCS | 32.295 Release 9 |
| Dw/Wa/Wd/Wx/Wm/Wg/Pr: I-WLAN | 29.234 Release 9 |
| S6a/d: MME/SGSN to HSS | 29.272 Release 10 |
| S6b/SWa/SWd/SWx/SWm/H2: EPS AAA | 29.273 Release 10 |
| S9: V-PCRF to H-PCRF | 29.215 Release 10 |

3GPP2 Interfaces

| | |
|------------------------|----------------------------|
| Ro/Rf: AS to OCS/OFCS | X.S0013-007/8-A Version 1 |
| Sh/Dh: AS to HSS/SLF | X.S0013-010/11-B Version 1 |
| Cx/Dx: CSCF to HSS/SLF | X.S0013-005/6-B Version 1 |
| Tx: CSCF to PCRF | X.S0013-013-0 Version 1 |
| Ty: AG to PCRF | X.S0013-014-0 Version 1 |

Transport and Security

| | |
|--------------------------|--|
| Transport: SCTP (or TCP) | RFC 2960/4960 (Note: SCTP supplied in Linux kernel 2.6 /Solaris 10 and later.) |
| Security: IPsec and TLS | RFC 4301 and RFC 4346 (Note: Uses OpenSSL and GnuTLS) |
| IP V4/V6 | Uses Linux/Solaris IP |



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Sample Accelero™ Diameter Deployments

- **Motorola Solutions** is using Accelero™ Diameter for the LTE Public Safety Network based on Rel11 3GPP standards.
- **Amdocs/Bridgewater Systems** uses Accelero™ Diameter in its AAA Service Controller for multiple access networks, including WiMAX and CDMA.
- **Cisco** uses Accelero™ Diameter in the LTE version of its SCE Service Control Engine family for credit control.
- **TeleCommunication Systems (TCS)** uses Accelero™ Diameter in its RFC 4006 compliant Rf/Ro Credit Control Client application for their GMLC product line as a part of Release 8 LTE specific charging upgrade.
- **XIUS-bcgi** uses Accelero™ Diameter in its RFC 4006 compliant Credit Control application.

Core Expertise. Fast Delivery. Controlled Costs. Exceptional Results

At Diametriq, we partner with our customers to develop custom product solutions that help them deliver new revenue-generating products and services, improve operational efficiencies, and reduce costs. Our customers include the world's leading network equipment suppliers, software developers, and hosted service providers. We work closely with them to understand their requirements and anticipate

how our products and services can best meet their needs.

We combine wide-ranging software experience, peerless understanding of industry dynamics, and meticulously detailed software processes to deliver market-leading solutions. We can augment a customer's in-house development team with specialized expertise, or we can assume complete responsibility for a project from requirements definition to system verification - freeing up our customer to focus on other priorities. We are particularly experienced in the areas of location-based services (LBS), roaming and mobility, convergent billing, 3G/4G fixed mobile convergence (FMC), advanced messaging, and the IP Multimedia Subsystem (IMS).

Diametriq uses its **Accelero™** platform to build custom solutions. Accelero embodies the knowledge and experience of our engineering team and enables us to accelerate time to market, reduce cost, and minimize the risk associated with delivering new solutions.

We adhere to rigorous quality standards for every project. Our ISO 9000:2000 certification reflects an organization committed to producing high quality, carrier-grade communications solutions - even those requiring "five nines" reliability.



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