Radiator® Carrier Module


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1. Introduction to Radiator Carrier Module

This document describes how to install and configure Radiator Carrier Module.

Radiator Carrier Module is designed especially for carrier use. It includes the following functionalities:

- Advanced Radiator Diameter Client and Server Software with <DiaPeerDef> and <ServerDIAMETERTelco>
- Diameter relay application with <AuthBy DiaRelay>
- General support for EIR (Equipment Identity Register), EIR client with <AuthBy DiaEIR> and test EIR server with <ServerDiaEIR>

With these features, Radiator Carrier Module provides all the essential functionalities needed for carrier-class AAA server software. Radiator Carrier Module provides also the base platform for other Radiator carrier-class components, they can be added on the top of Radiator Carrier Module. These components provide functionalities for several different use cases, such as Wi-Fi offloading and VoWiFi with Radiator SIM Module or VoLTE authentication with Radiator GBA/BSF Module.

2. Installing Radiator Carrier Module

This section the describes how to install Radiator Carrier Module.

2.1. Prerequisites


2.2. Installing and upgrading Radiator Carrier Module

The recommended method is to install Radiator and Radiator Carrier Module from operating system specific packages. If required, source code installation is also possible.

To install Radiator Carrier Module operating system specific packages:

1. Download Radiator Carrier Module distribution package for your operating system.
2. Install it with the package manager. For example with Red Hat Enterprise Linux and CentOS:
   
   ```bash
   rpm -Uvh radiator-carrier-1.6-1.el7.noarch.rpm
   ```

To install Radiator Carrier Module using source code package:

1. Download the Radiator Carrier Module distribution.
2. Unpack the file into a separate working directory.
3. Move to the distribution directory.
4. Prepare the distribution for installation.
   
   ```bash
   perl Makefile.PL
   ```
5. Run the installation. You may need the root access rights for running this command.
   
   ```bash
   make install
   ```
3. Configuring Diameter peers

Diameter peer configuration is required by the Diameter applications Radiator supports. Diameter applications and <ServerDIAMETERTelco> need peer definitions to work properly.

All Diameter peers a Radiator instance talks to, must have a matching DiaPeerDef clause. A DiaPeerDef clause defines what is advertised to the peer, which applications are supported for the peer and if Radiator should actively open connections to the peer instead of waiting for a connection from the peer.

You can configure a single instance of Radiator to support, for example, relaying requests from some peers and processing the requests locally by the other peers.

You can configure Radiator to advertise certain applications to certain peers. The peer definition also determines if Radiator should act as an initiator and establish a connection to the peer. Alternatively Radiator can act as a responder waiting for the peer connection. It is possible to configure Radiator as an initiator for some peer connections and responder for the others.

A <ServerDIAMETERTelco> clause is required to create a listen socket for the incoming Diameter peer connections.

3.1. <DiaPeerDef attribute=value,attribute=value,...>

A DiaPeerDef clause defines describes and defines a Diameter peer this Radiator instance connects to. The connection can be initiated by Radiator or the peer.

A minimal Radiator policy and charging support configuration requires one DiaPeerDef clause in addition to any AuthBy DiaPCRF, DiaPCEF, DiaRelay or other Diameter based AuthBys. When there is no ServerDIAMETERTelco clause, the DiaPeerDef clauses must be configured with the Initiator flag to connect to the Diameter peers.

A ServerDIAMETERTelco clause allows accepting incoming Diameter connections. When a ServerDIAMETERTelco is configured, Radiator will act as a Diameter responder. The settings for the connecting peers are looked up from DiaPeerDef clauses. The clauses are matched against the incoming CER (Capabilities Exchange Request) from the peer.

**Note**
At least one DiaPeerDef clause is always required.

If a ServerDIAMETERTelco clause is configured but there are no DiaPeerDef clauses, the incoming CER messages are rejected by Radiator. A DiaPeerDef is required to form a successful CEA (Capabilities Exchange Answer) back to the peer.

**Note**
A DiaPeerDef with an empty attribute list matches any Diameter peer. This can be useful to define default settings for incoming connections from Diameter peers.

3.1.1. Identifier

This is an optional parameter, which defines the name of the specific <DiaPeerDef> clause and its configuration.
3. Configuring Diameter peers

3.1.2. Initiator

This is an optional flag, which defines if the Radiator instance can act as a connection initiator. It is not set by default.

Initiator must be set if Radiator instance has to act as an initiator and create a connection to the Diameter peer defined by this <DiaPeerDef>. If Initiator is not set, the Radiator instance does not initiate connections but other instances, such as ePDG (Evolved Packet Data Gateway), must act as a initiator.

3.1.3. AddToRequestFromDia

This parameter defines the Diameter attributes, which are added to a request object in addition with OriginHost on page 3 and OriginRealm on page 3. The request object is created when a Diameter request message is received. The request object is then sent to the handler with the correct application AuthBy for this request.

3.1.4. PreHandlerHook

This is an optional parameter, which defines the Perl function that is called before the request object is sent to the handlers. The only passed argument is the reference to the current request object.

3.1.5. NoReplyHook

This is an optional parameter, which defines the Perl function that is called if no reply is received from any Diameter peer.

3.1.6. NoreplyTimeout

This integer defines how soon, in seconds, NoReplyHook on page 3 is called if the request stored in proxy does not receive a reply. The default value is 5.

3.1.7. ProductName

This is an optional parameter, which defines the name of the specific Diameter peer. If defined, it is sent to the other Diameter peers within the CER and CEA messages. The default value is Radiator.

3.1.8. OriginHost

This string defines the name that <ServerDIAMETERTelco> uses to identify itself to the Diameter peers. It is sent to the Diameter peers in the Diameter CER and CEA messages. The Diameter peers use OriginHost to determine whether they have connected to the correct peer. OriginHost must be specified.

3.1.9. OriginRealm

This string defines the name of the Realm the <ServerDIAMETERTelco> uses. It is sent to the Diameter peers in the CER and CEA messages. The peer uses it to determine which requests are routed to this Radiator instance. OriginRealm must be specified.

3.1.10. DestinationHost

This string defines the value for Destination-Host for Diameter requests. The usage of this parameter depends on the Diameter application that uses this <DiaPeerDef>. This is an optional parameter.

3.1.11. DestinationRealm

This string defines the value for Destination-Realm for Diameter requests. The usage of this parameter depends on the Diameter application that uses this <DiaPeerDef>. This is an optional parameter.
3.1.12. SupportedVendorIds

This is an optional parameter, which defines the supported vendor IDs announced in CER and CEA messages. This has no default value and the supported vendor ID is not announced by default. The default dictionary or the configured dictionary file consist an alias group DictVendors for all supported vendors.

Example

```
# Advertise Open System Consultants and 3GPP
SupportedVendorIds 9048, 3GPP
```

3.1.13. AcctApplicationIds

This is an optional parameter, which defines the Acct-Application-Id attributes announced in the CER and CEA messages. The Acct-Application-Id is not announced by default.

Example

```
AcctApplicationIds Base Accounting
```

3.1.14. VendorAuthApplicationIds

This is an optional parameter, which defines the authentication Vendor-Specific-Application-Id attributes announced in the CER and CEA messages. The Vendor-Specific-Application-Id is not announced by default. The parameter value is a comma-separated list of vendor:application values. Both names and direct numeric values are accepted.

Example

```
VendorAuthApplicationIds 3GPP:3GPP-Rx, 3GPP:3GPP-Gx
```

3.1.15. VendorAcctApplicationIds

This is an optional parameter, which defines the accounting Vendor-Specific-Application-Id attributes announced in the CER and CEA messages. The Vendor-Specific-Application-Id is not announced by default. The parameter value is a comma-separated list of vendor:application values. Both names and direct numeric values are accepted.

Example

```
VendorAcctApplicationIds OSC:Example accounting app
```

3.1.16. Peer

This parameter defines the name or IP address of the Diameter peer. Both IPv4 and IPv6 addresses are supported. This parameter is required when <DiaPeerDef> is configured to act as an initiator.

3.1.17. Port

This is an optional parameter, which defines the network port <ServerDIAMETERTelco> listens to for connections from Diameter peers. For more information, see Radiator reference manual [https://www.open.com.au/radiator/ref.pdf] under section <ServerDIAMETER>.
3.1.18. LocalAddress and LocalPort

These parameters control the address and optionally the port number used for the client source port, although this is usually not necessary. LocalPort is a string, it can be a port number or name. It binds the local port if LocalAddress is defined. If LocalPort is not specified or if it is set to 0, a port number is allocated in the usual way.

When SCTP multihoming is supported, multiple comma separated addresses can be configured. All addresses defined with LocalAddress must be either IPv4 or IPv6 addresses.

<table>
<thead>
<tr>
<th>LocalAddress</th>
<th>203.63.154.29</th>
</tr>
</thead>
<tbody>
<tr>
<td>LocalPort</td>
<td>12345</td>
</tr>
</tbody>
</table>

3.1.19. Protocol

This is an optional parameter, which allows choosing transport layer protocol, TCP or SCTP, for carrying Diameter messages. For more information, see Radiator reference manual [https://www.open.com.au/radiator/ref.pdf] under section <ServerDIAMETER>.

3.1.20. TLS_*

These parameters enable and configure of TLS (Transport Layer Security) authentication and encryption. For more information, see Radiator reference manual [https://www.open.com.au/radiator/ref.pdf] under section "TLS configuration". To enable TLS, you need to define TLS_Protocols configuration parameter with the other TLS related parameters, such as certificates, that depend on your operating environment.

Note

Old configuration parameters UseTLS and UseSSL are obsolete and should not be used. Use TLS_Protocols instead.

4. Configuring DIAMETER server

A <ServerDIAMETERTelco> clause is required to create a listen socket for the incoming Diameter peer connections.

4.1. <ServerDIAMETERTelco>

This section describes the configuring parameters of <ServerDIAMETERTelco>.

4.1.1. Peer

This parameter defines the name or IP address of the Diameter peer. Both IPv4 and IPv6 addresses are supported. This parameter is required when <DiaPeerDef> is configured to act as an initiator.

4.1.2. Port

This is an optional parameter, which defines the network port <ServerDIAMETERTelco> listens to for connections from Diameter peers. For more information, see Radiator reference manual [https://www.open.com.au/radiator/ref.pdf] under section <ServerDIAMETER>.

4.1.3. BindAddress

This is an optional parameter, which defines one or more network interface addresses that are listened to for incoming Diameter connections. For more information, see Radiator reference manual [https://www.open.com.au/radiator/ref.pdf] under section <ServerDIAMETER>.
4.1.4. MaxBufferSize

This is an optional parameter, which defines the maximum number of octets buffered in output. For more information, see Radiator reference manual [https://www.open.com.au/radiator/ref.pdf] under section <ServerDIAMETER>.

4.1.5. Protocol

This is an optional parameter, which allows choosing transport layer protocol, TCP or SCTP, for carrying Diameter messages. For more information, see Radiator reference manual [https://www.open.com.au/radiator/ref.pdf] under section <ServerDIAMETER>.

4.1.6. ReadTimeOut

This is an optional parameter, which defines the maximum time, in seconds, to wait for incoming Diameter connection to complete the initial handshaking. The default value is 10. For more information, see Radiator reference manual [https://www.open.com.au/radiator/ref.pdf] under section <ServerDIAMETER>.

4.1.7. TLS_ *

These parameters enable and configure of TLS authentication and encryption. For more information, see Radiator reference manual [https://www.open.com.au/radiator/ref.pdf] under section “TLS configuration”. To enable TLS, you need to define TLS_Protocols configuration parameter with the other TLS related parameters, such as certificates, that depend on your operating environment.

Note

Old configuration parameters UseTLS and UseSSL are obsolete and should not be used. Use TLS_Protocols instead.

5. Configuring Diameter relay

Radiator supports Diameter relay functionality with Auth DiaRelay clause. One or more Diameter relays can be supported by a single Radiator instance. The Diameter relays are independent from each other. This allows functionality similar to IP VRF (Virtual Routing and Forwarding) where multiple segregated relay Auth DiaRelay clauses can be active simultaneous.

5.1. <AuthBy DiaRelay>

This section describes the configuration parameters of <AuthBy DiaRelay>.

5.1.1. Identifier

This is an optional parameter, which defines the name of the specific <DiaPeerDef> clause and its configuration.

5.1.2. DiaPeerDef

This parameter defines the Diameter Peer the Radiator instance connects to.

Example

```
# Relay the requests to peer defined by DiaPeerDef with
# Identifier osc-pcrf
DiaPeerDef osc-pcrf
```
6. Configuring <MessageLog FILECARRIER>

This section describes the configuring parameters of <MessageLog FILECARRIER>.

6.1. Filename

This string defines the file name into which the log statistics are saved. The default value is %L/messagelog. The file name can include special formatting characters.

6.2. Format

This enumeration is an optional parameter, which defines the file output format. The possible values are text, libpcap, and text2pcap. The default value is text and it is also applied when the value is not defined.

7. Configuring EIR

This section describes how to configure EIR parameters.

The EIR is a database that contains information on mobile devices that are banned from using the network or need to be tracked for some purpose. The devices are listed by their IMEI (International Mobile Equipment Identity).

7.1. <AuthBy DiaEIR>

This section describes the configuring parameters of <AuthBy DiaEIR>.

<AuthBy DiaEIR> queries IMEI status from EIR using Diameter S13/S13' interface. It can also query the software version and IMSI (International mobile subscriber identity) status. The result from EIR determines if the request is accepted or rejected.

Radiator Carrier Module distribution package contains an example configuration file goodies/eir-client.cfg.

7.1.1. DiaEIR

This object list enables EIR check and identifies the used DiaEIR clause. This has no default value but it must be set.

7.1.2. MakeAnswer

When MakeAnswer is set, a simple Diameter answer with either DIAMETER_SUCCESS or DIAMETER_UNABLE_TO_COMPLY is sent if <AuthBy DiaEIR> does not return ignore. This parameter is not set by default.

7.1.3. EIR_UnknownAction

EIR_UnknownAction defines the return value for <AuthBy DiaEIR> if the EIR request gets DIAMETER_UNKNOWN_EQUIPMENT. The value can be either accept or reject. accept is the default value.

7.1.4. EIR_AttributesHook

This parameter is a hook that allows customising how to set IMEI and other values are passed to EIR. This has not any default value.

When this is set, IMEIAttribute, IMSIAAttribute, and SoftwareVersionAttribute are ignored.
Here is an example that shows how to get the values from current request attributes:

```perl
EIR_AttributesHook sub
    { my $p = $_[0]; my $imei = $_[1]; my $sv = $_[2]; my $imsi = $_[3];
      $$imei = $p->get_attr('X-OSC-SIM-IMEI');
      $$sv   = $p->get_attr('X-OSC-SIM-Software-Version');
      $$imsi = $p->get_attr('X-OSC-SIM-IMSI');
    }
```

### 7.1.5. IMEIAttribute

This parameter defines the IMEI attribute in the current request that must have a value for IMEI. This is ignored when `EIR_AttributesHook` is defined. The default value is `OSC-SIM-IMEI`.

### 7.1.6. SoftwareVersionAttribute

This parameter defines the software version attribute in the current request that must have a value for software version. This is ignored when `EIR_AttributesHook` is defined. The default value is `OSC-SIM-Software-Version`.

### 7.1.7. IMSIAttribute

This parameter defines the IMSI attribute in the current request that must have a value for IMSI. This is ignored when `EIR_AttributesHook` is defined. The default value is `OSC-SIM-IMSI`.

### 7.2. `<DiaEIR>`

This section describes the configuring parameters of `<DiaEIR>`.

#### 7.2.1. Identifier

This parameter defines the name of the specific EIR clause in the configuration. This must be defined, otherwise you cannot refer to this EIR clause.

#### 7.2.2. DiaPeerDef

This parameter defines the Diameter Peer which the this clause connects to.

#### 7.2.3. EIRCache

`EIRCache` is Identifier of the EIRCache clause. If this is not set, no caching is done. This is not set by default.

### 7.3. `<EIRCacheInternal>`

This section describes the configuring parameters of `<EIRCacheInternal>`.

#### 7.3.1. Identifier

This parameter defines the name of the specific EIR clause in the configuration. This must be defined, otherwise you cannot refer to this EIR clause.

#### 7.3.2. CacheTimeout

`CacheTimeout` defines (in seconds) for how long the successful EIR responses are cached. The default value is 1800 (30 minutes).
7.3.3. NegativeCacheTimeout

If EIR cannot be connected or it returns an answer that cannot be successfully processed, 
NegativeCacheTimeout defines the time (in seconds) for how long time the answer is cached. Using this 
feature gives EIR time to recover from the possible error condition. The default value is 300 (5 minutes).

7.4. <ServerDiaEIR>

This section describes the configuring parameters of <ServerDiaEIR>. Apart from the parameters listed here, 
<ServerDiaEIR> inherits other parameters from <ServerDIAMETER>. <ServerDIAMETER> is documented in 

Radiator Carrier Module distribution package contains an example configuration file goodies/eir-
server.cfg. The test IMEIs are currently listed in ServerEIR.pm. Different test IMEIs trigger different 
responses, including errors, from this example EIR server. You can add your test device's IMEI into 
ServerEIR.pm. Later it will be possible to create a separate configuration file for <ServerDiaEIR> that 
contains the IMEI list.

7.4.1. VendorAuthApplicationIds

VendorAuthApplicationIds is an optional parameter that defines the Vendor-Specific-Application-Ids 
announced in CEA. The default value is S13/S13'.

8. Configuring <ServerDHCP>

This section describes the configuration parameters of <ServerDHCP>. <ServerDHCP> handles DHCP 
(Dynamic Host Configuration Protocol) requests by converting them to RADIUS requests. The converted 
RADIUS requests can be used for authentication and dynamic address allocation.

To serve DHCP requests, Radiator must be able to bind to DHCP server port 67. This typically requires that 
Radiator is run as root. Because DHCP uses fixed port numbers 67 and 68, there cannot be other DHCP services 
or Radiator instances configured with <AddressAllocator DHCP> or <ServerDHCP> on the same host, 
unless separate bind IP addresses are available.

DHCP options in Radiator configuration use the names defined by IANA. For example, DHCP option 51 that is 
typically known as "lease time" or "IP Address Lease Time" is called "Address Time" in Radiator configuration. 
For a configuration example, see goodies/server-dhcp.cfg.

8.1. UsernameOption

This string parameter defines the name of the DHCP option that is used as a value for User-Name in the request 
dispatched to Handler. The default value is Hostname.

8.2. DefaultUsername

This string parameter defines the User-Name that is used in requests dispatched to Handler if 
UsernameOption does not define this option in the DHCP request. The default value is Unknown-DHCP-User.

8.3. DHCPyiaddrAttr

This string defines the attribute name in RADIUS reply for yiaddr in DHCP replies. The default value is 
Framed-IP-Address.
8.4. DHCPSubnetMaskAttr

This string defines the attribute name in RADIUS reply for Subnet Mask option in DHCP replies. If this is left empty, DefaultDHCPSubnetMask is used instead. The default value is **Framed-IP-Netmask**.

8.5. DefaultDHCPSubnetMask

This is a string parameter. If *DHCPSubnetMask* has no value, this is used instead. Special formatting characters are supported. This has no default value.

8.6. DHCPRouterAttr

This string defines the attribute name in RADIUS reply for Router option in DHCP replies. All instances in the reply are added. This has no default value.

8.7. DHCPDomainServerAttr

This string defines the attribute name in RADIUS reply for Domain Server option in DHCP replies. All instances in the reply are added. This has no default value.

8.8. DHCPAddressTimeAttr

This string defines the attribute name in RADIUS reply for Address Time, also known as lease time, option in DHCP replies. The default value is **Session-Timeout**.

8.9. DefaultDHCPAddressTime

This is an integer parameter. If *DHCPAddressTime* has no value, this parameter is used instead. Special formatting characters are supported. The default value is **86400**.

8.10. DHCPClientIdentifier

This string defines the value used for Client Id option in DHCP replies. Special formatting characters are supported. The default value is `%(User-Name)`.

9. <AuthBy DiaINTERNAL>

This section describes how to configure <AuthBy DiaINTERNAL> module.

<AuthBy DiaINTERNAL> provides similar functionality to Radiator's <AuthBy INTERNAL>. Radiator Carrier Module distribution package contains an example configuration file *goodies/dia-internal.cfg*.

Here is an example of using <AuthBy DiaINTERNAL>:

```xml
<AuthBy DiaINTERNAL>
  Identifier authby-dia-internal

  # DefaultResult defaults to DIAMETER_UNABLE_TO_COMPLY. Other results are not set by default.

  #AuthResult DIAMETER_SUCCESS
  #AcctResult DIAMETER_SUCCESS
  #DefaultResult DIAMETER_SUCCESS
</AuthBy>
```
9.1. DefaultResult

This string parameter defines the Diameter result to use if no request specific result code is specified. The default value is `DIAMETER_UNABLE_TO_COMPLY`.

9.2. AuthResult

This string defines the Diameter result that is used for NASREQ Authentication requests. This is not set by default.

9.3. AcctResult

This string defines the Diameter result that is used for NASREQ Accounting requests. This is not set by default.

10. Using VSA framework for customised attributes

This section describes how to enable advanced attribute encoding and decoding with Radiator's VSA (Vendor-Specific Attributes) framework.

Radiator's VSA framework supports creating vendor-specific modules for encoding and decoding attributes that have non-standard formats. The attribute type for these attributes is set to `custom` in Radiator's dictionary.

At this moment, Radiator Carrier Module includes a customised dictionary file, `dictionary.custom_vsa`, and 2 vendor-specific modules:

- `Vendor_10415.pm`
  This module contains the routines for customised 3GPP VSAs.

- `Vendor_40808.pm`
  This module contains the routines for customised Wi-Fi Alliance VSAs.

The customised dictionary file, `dictionary.custom_vsa`, redefines some attributes present in the default dictionary file. The redefined attributes are passed the included vendor-specific modules.

Here is an example of decoding attribute `3GPP-GPRS-QoS-Profile` when `dictionary.custom_vsa` is first disabled and then enabled:

```
*** Received from 127.0.0.1 port 59458 ....
Code: Access-Request
Identifier: 193
Authentic: \x230\x232\x168\x151\x191\x071\x203\x164\x199\x206
Attributes:
User-Name = "mikem"
Service-Type = Framed-User
NAS-IP-Address = 203.63.154.1
NAS-Identifier = "203.63.154.1"
NAS-Port = 1234
Called-Station-Id = "123456789"
Calling-Station-Id = "987654321"
NAS-Port-Type = Async
User-Password = o<244><24><21><12><191><OZ<171<k<203><164><199><206
3GPP-GPRS-QoS-Profile = "99-23731f9301858574597878"
```

11. Abbreviations

Capabilities Exchange Answer
- CEA (Capabilities Exchange Answer)
  - Acronym: CEA

Capabilities Exchange Request
- CER (Capabilities Exchange Request)
  - Acronym: CER

Dynamic Host Configuration Protocol
- DHCP (Dynamic Host Configuration Protocol)
  - Acronym: DHCP

Evolved Packet Data Gateway
- ePDG (Evolved Packet Data Gateway)
  - Acronym: ePDG

Equipment Identity Register
- EIR (Equipment Identity Register)
  - Acronym: EIR

Home Location Register
- HLR (Home Location Register)
11. Abbreviations

Acronym: **HLR**

**Home Subscriber Server**

HSS (Home Subscriber Server)

Acronym: **HSS**

**International Mobile Equipment Identity**

IMEI (International Mobile Equipment Identity)

Acronym: **IMEI**

**International mobile subscriber identity**

IMSI (International mobile subscriber identity)

Acronym: **IMSI**

**Transport Layer Security**

TLS (Transport Layer Security)

Acronym: **TLS**

**Virtual Routing and Forwarding**

VRF (Virtual Routing and Forwarding)

Acronym: **VRF**

**Vendor-Specific Attributes**

VSA (Vendor-Specific Attributes)

Acronym: **VSA**