Seagull - Radius protocol

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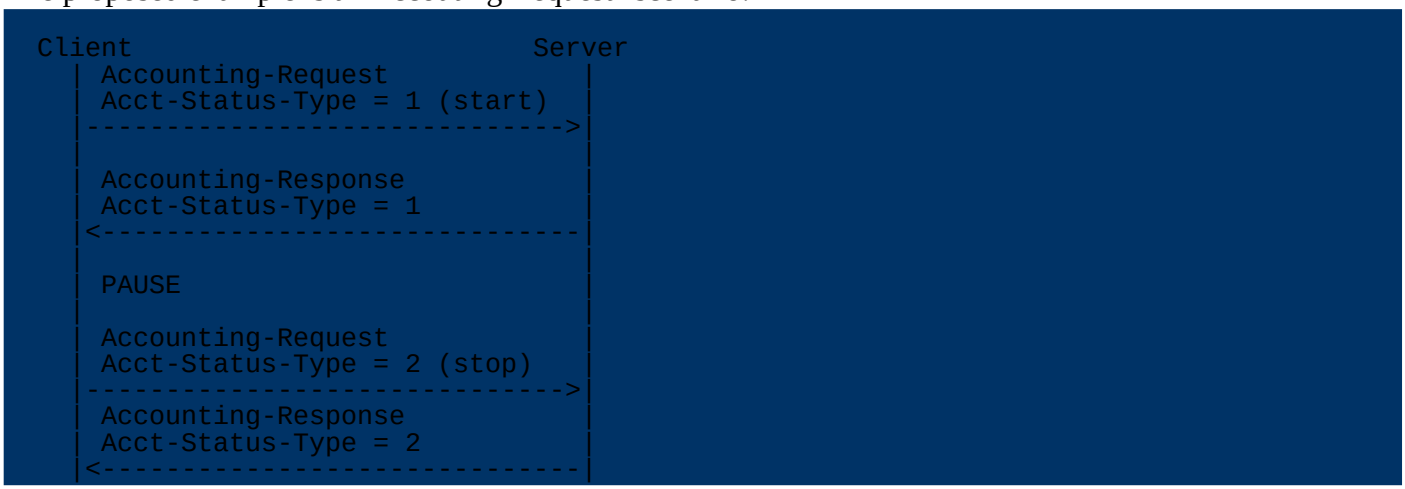
1. Radius protocol details

The Radius implementation in Seagull conforms to the RADIUS authentication RFC: RFC 2865 (http://tools.ietf.org/html/rfc2865) and the RADIUS accounting RFC : RFC 2866 (http://tools.ietf.org/html/rfc2866)

2. Getting started with Radius

2.1. First try

The proposed example is a "Accouting Request" scenario:



Note:
This scenario is included when you install Seagull. It is located in /opt/seagull/radius/ directory.

Open two terminal sessions. Terminal 2 will be the server and Terminal 1 the client. Examples are located in the "run" directory. So the first thing you need to do is to go in this directory (in both terminal windows):

```
cd run
```

In Terminal 2 window type:

```
./start_server.ksh
```

In Terminal 1 window type:

```
./start_client.ksh
```

On Terminal 2 (server side), you will see:

```
|-------------------------+-----------------------------+-------------------------|
| Start/Current Time      |       2007-07-18 14:37:43 |     2007-07-18 14:38:13 |
|-------------------------+-----------------------------+-------------------------|
|    Counter Name         |      Periodic value         |     Cumulative value    |
|-------------------------+-----------------------------+-------------------------|
| Elapsed Time            | 00:00:01:009                | 00:00:30:300            |
| Call rate (/s)          |    0.991                    |    0.132                |
|-------------------------+-----------------------------+-------------------------|
| Incoming calls          |        1                    |        4                |
| Outgoing calls          |        0                    |        0                |
| Msg Recv/s              |    2.973                    |    0.231                |
| Msg Sent/s              |    2.973                    |    0.231                |
| Unexpected msg          |        0                    |        0                |
| Current calls           |        1                    |    0.033                |
```

```
|-------------------------+-----------------------------+-------------------------|
| Successful calls        |        2                    |        3                |
| Failed calls            |        0                    |        0                |
| Refused calls           |        0                    |        0                |
| Aborted calls           |        0                    |        0                |
| Timeout calls           |        0                    |        0                |
|-------------------------+-----------------------------+-------------------------|
| Last Info               | Incomming traffic                                     |
| Last Error              | No error                                              |
|--- Next screen : Press key 1 ----------------------- [h]: Display help ------|
```

2.2. First try explained

Here is the script (start_client.ksh) that launched the client in our example:

```
#!/bin/ksh

export LD_LIBRARY_PATH=/usr/local/bin
seagull -conf ../config/conf.client.xml -dico ../config/radius-accounting.xml -scen
../scenario/radius-accounting.client.xml -log ../logs/radius-accounting.client.log
-llevel ET
```

Note:
On some systems, you might need to include the following export in your Seagull script: "export SHLIB_PATH=/usr/local/bin".

Both sides are relying on the Radius Accounting dictionary provided with Seagull: radius-accounting.xml to encode Radius messages. Refer to dictionary configuration section for more information on the format of this dictionary. The dictionary is specified using the `-dico` parameter on the command line (core.html#cli_help) .

The generic configuration (including network and other parameters) is different for the client and the server. The client uses `conf.client.xml` and the server uses `conf.server.xml`. The configuration file is specified using the `-conf` parameter on the command line (core.html#cli_help) .

Here are both files:

conf.client.xml

```
<?xml version="1.0"
encoding="ISO-8859-1"?>
<configuration name="Simple Radius
Accounting TCP/IP Client Conf">

  <define entity="transport"
    name="trans-ip-v4"
    file="libtrans_ip.so"
create_function="create_cipio_instanc
delete_function="delete_cipio_instanc
    init-args="type=tcp">
  </define>

  <define entity="channel"
    name="trans-ip-v4"
    protocol="radius-accounting-v1"
    transport="trans-ip-v4"
open-args="mode=client;dest=127.0.0.1
  </define>

  <define entity="traffic-param"
name="call-rate" value="1"></define>
  <define entity="traffic-param"
```

conf.server.xml

```
<?xml version="1.0"
encoding="ISO-8859-1"?>
<configuration name="Simple Radius
TCP/IP Server Conf">
  <define entity="transport"
    name="trans-ip-v4"
    file="libtrans_ip.so"
create_function="create_cipio_instance"
delete_function="delete_cipio_instance"
    init-args="type=tcp">
  </define>

  <define entity="channel"
    name="trans-ip-v4"
    protocol="radius-accounting-v1"
    transport="trans-ip-v4"
open-args="mode=server;source=127.0.0.1:1813">
  </define>


  <define entity="traffic-param"
name="display-period"
value="1"></define>
```

name="display-period" value="1"></define> <define entity="traffic-param" name="log-stat-period" value="1"></define> <define entity="traffic-param" name="log-stat-file" value="../logs/client-stat.csv"></def <define entity="traffic-param" name="call-timeout-ms" value="10000"></define> <define entity="traffic-param" name="display-scenario-stat" value="true"></define> <define entity="traffic-param" name="display-protocol-stat" value="true"></define> <define entity="traffic-param" name="log-protocol-stat-period" value="5"></define> <define entity="traffic-param" name="log-protocol-stat-name" value="all"></define> <define entity="traffic-param" name="log-protocol-stat-file" value="../logs/client-protocol-stat.c <define entity="traffic-param" name="max-send" value="200"></define> <define entity="traffic-param" name="max-receive" value="200"></define> <define entity="traffic-param" name="max-simultaneous-calls" value="2000"></define> <define entity="traffic-param" name="select-timeout-ms" value="50"></define> <define entity="traffic-param" name="external-data-file" value="../scenario/external_client_da <define entity="traffic-param" name="external-data-select" value="sequential"></define> </configuration>	<define entity="traffic-param" name="log-stat-period" value="1"></define> <define entity="traffic-param" name="log-stat-file" value="../logs/server-stat.csv"></define> <define entity="traffic-param" name="call-timeout-ms" value="10000"></define> <define entity="traffic-param" name="display-scenario-stat" value="true"></define> <define entity="traffic-param" name="display-protocol-stat" value="true"></define> <define entity="traffic-param" name="log-protocol-stat-period" value="5"></define> <define entity="traffic-param" name="log-protocol-stat-name" value="all"></define> <define entity="traffic-param" name="log-protocol-stat-file" value="../logs/server-protocol-stat.csv"></define> <define entity="traffic-param" name="max-send" value="2000"></define> <define entity="traffic-param" name="max-receive" value="2000"></define> <define entity="traffic-param" name="max-simultaneous-calls" value="2000"></define> <define entity="traffic-param" name="select-timeout-ms" value="50"></define> <define entity="traffic-param" name="external-data-file" value="../scenario/external_server_data.csv"></define> <define entity="traffic-param" name="external-data-select" value="sequential"></define> </configuration>

Table 1: Example client and server configuration

Now comes the real stuff: the scenario.

First, the scenario source: radius-accounting.client.xml (radius-accounting.client.xml.html)

And now the commented version:

Scenario	Comments
<?xml version="1.0" encoding="ISO-8859-1" ?> <scenario name="Simple Radius Accouting Client scenario"> <counter>	XML header Scenario name Counters definitions In this section are initialized the counters that will

```
  <counterdef name="session-counter"
init="0"> </counterdef>
  <counterdef
name="identifier-counter" init="0">
</counterdef>
</counter>

<!-- Initialisation Scenario
<init>
</init>
-->

<!-- Traffic Scenario -->
<traffic>

  <!-- Start Accouting Request -->
  <send channel="trans-ip-v4">
    <action>
      <!-- For each new call,
increment the Acct-Session-Id
counter -->
      <inc-counter
name="session-counter">
</inc-counter>
      <inc-counter
name="identifier-counter">
</inc-counter>
      <set-value
name="Acct-Session-Id"
format="$(session-counter)"></set-val
      <set-value name="Identifier"
format="$(identifier-counter)"></set-

      <!-- This field must not be
use with a true value -->
      <restore-from-external
field="0"
entity="Authenticator"></restore-from

    </action>
    <Message
name="Accounting-Request">
      <Attribute
name="Acct-Session-Id"
value="value_is_replaced">
</Attribute>
      <!-- 1 stand for Start -->
      <Attribute
name="Acct-Status-Type" value="1">
</Attribute>
      <Attribute
name="NAS-Identifier"
value="ims.hpintelco.org">
</Attribute>
    </Message>
    <action>
      <store name="ACCT_SES_ID"
entity="Acct-Session-Id"></store>
      <start-timer></start-timer>
    </action>
  </send>

  <receive channel="trans-ip-v4">
    <action>
      <stop-timer></stop-timer>
    </action>
```

```
then be used during the calls.
For example here: we initialize the
two counter that will
be incremented every time a call is
started.

No init section




Traffic section



Actions before sending the first
Accounting-Request message:
Increment the session-counter
counter.
Increment the identifier-counter
counter.
Set the field Acct-Session-Id with
the counter session-counter

Set the field Acct-Session-Id with
the counter session-counter




restore-from-external gets some data
from an external file into the
Authentificator field.


Send the Accounting-Request message
with 3 attributes
The Acct-Session-Id attribute is
added to the message, the value had
been changed with set-value action

The Acct-Status-Type attribute is
added to the message with the value
1
The NAS-Identifier attribute is
added to the message with the value
"ims.hpintelco.org"

Actions after sending the first
Accounting-Request message:
store the value of the field
Acct-Session-Id into the variable
ACCT_SES_ID
start the timer (to measure response
time)




Actions before receiving
Accounting-Response
stop the timer

Receive the Accounting-Response
message with 2 attributes
The real values of attributes are
```

```
    <Message
name="Accounting-Response">
      <Attribute
name="Acct-Session-Id" value="na">
</Attribute>
      <!-- 1 stand for Start -->
      <Attribute
name="Acct-Status-Type" value="1">
</Attribute>
    </Message>
  </receive>

  <wait-ms value="500"></wait-ms>

  <!-- Stop Accouting Request -->
  <send channel="trans-ip-v4">
    <action>
      <!-- For each new call,
increment the Acct-Session-Id
counter -->
      <inc-counter
name="identifier-counter">
</inc-counter>
      <set-value name="Identifier"
format="$(identifier-counter)"></set-

      <!-- This field must not be
use with a true value -->
      <restore-from-external
field="1"
entity="Authenticator"></restore-from

      <restore name="ACCT_SES_ID"
entity="Acct-Session-Id"></restore>
    </action>
    <Message
name="Accounting-Request">
      <Attribute
name="Acct-Session-Id"
value="value_is_replaced">
</Attribute>
      <!-- 2 stand for Stop -->
      <Attribute
name="Acct-Status-Type" value="2">
</Attribute>
      <Attribute
name="NAS-Identifier"
value="ims.hpintelco.org">
</Attribute>
    </Message>
    <action>
      <start-timer></start-timer>
    </action>
  </send>

  <receive channel="trans-ip-v4">
    <action>
      <stop-timer></stop-timer>
    </action>
    <Message
name="Accounting-Response">
      <Attribute
name="Acct-Session-Id" value="na">
</Attribute>
      <!-- 2 stand for Stop -->
      <Attribute
```

```
set by the remote.




Make a pause in scenario (of 500ms)



Actions before sending the
Accounting-Request message

Increment the identifier-counter
set the value of the field
Identifier with the
identifier-counter



restore an external value into the
field authentificator

restore the value of the variable
ACCT_SES_ID into the field
Acct-Session-Id

Send the message Accounting-Request
The Acct-Session-Id attribute is
added to the message, the value had
been changed with restore action

The Acct-Status-Type attribute is
added to the message with the value
2
The NAS-Identifier attribute is
added to the message with the value
"ims.hpintelco.org"

Actions after sending the first
Accounting-Request message:
start the timer (to measure response
time)




Actions before receiving
Accounting-Response
stop the timer

Receive the Accounting-Response
message with 2 attributes
The real values of attributes are
set by the remote
```

```
name="Acct-Status-Type" value="2">
</Attribute>
    </Message>
  </receive>

</traffic>

</scenario>
```

3. Configuration files

There are 3 different configuration files:

- Generic configuration file - describing traffic and network parameters
- Protocol dictionary configuration file - rarely to be edited
- Scenario file - description of the message exchanges

3.1. Generic configuration

The generic configuration file describes the network environment as well as traffic parameters.

The network environment is described through "transport channel entities (core.html#ref_transport) ". The transport entity is then used as an attribute of `send` (core.html#cmd_send) and `receive` (core.html#cmd_receive) scenario commands, as well as during the opening of the transport channel (see below).

```
<!-- Radius example -->
<?xml version="1.0" encoding="ISO-8859-1"?>
<configuration name="Simple Radius Accounting TCP/IP Client Conf">

<!-- Define the transport to be used: -->
  <define entity="transport"
    name="trans-ip-v4"
    file="libtrans_ip.so"
    create_function="create_cipio_instance"
    delete_function="delete_cipio_instance"
    init-args="type=tcp">
  </define>

<!-- Then you specify the opening of the channel, on the transport previously
described. -->

<!-- For a server listening to port 1813 on interface "127.0.0.1", it will look like
this: -->
  <define entity="channel"
    name="trans-ip-v4"
    protocol="radius-accounting-v1"
    transport="trans-ip-v4"
    open-args="mode=server;source=127.0.0.1:1813">
  </define>

<!-- For a client sending messages to port 1813 on interface "127.0.0.1", it will look
like this: -->
  <define entity="channel"
    name="trans-ip-v4"
    protocol="radius-accounting-v1"
    transport="trans-ip-v4"
    open-args="mode=client;dest=127.0.0.1:1813">
  </define>
```

3.2. Radius dictionary

Radius messages and parameters are described in XML dictionaries. The tool comes with a complete Radius dictionary.

A dictionary contains several XML sections

3.2.1. Types

"types" section contains all types needed for the protocol. For Diameter, these are:

```
<types>
  <!-- Types defined for the Attributes   -->
  <typedef name="Octet"       type="number" size="1"  unit="octet"> </typedef>
  <typedef name="Integer32"   type="signed" size="4"  unit="octet"> </typedef>
  <typedef name="Unsigned32"  type="number" size="4"  unit="octet"> </typedef>
  <typedef name="Address"     type="number" size="4"  unit="octet"> </typedef>
  <typedef name="Time"        type="number" size="4"  unit="octet"> </typedef>
  <typedef name="String"      type="string"           unit="octet"> </typedef>
  <typedef name="Text"        type="string"           unit="octet"> </typedef>
  <typedef name="Grouped"     type="grouped"                      > </typedef>

  <typedef name="Octet_16"    type="string" size="16" unit="octet"> </typedef>
  <typedef name="AddressV6"   type="string" size="16" unit="octet"> </typedef>
  <typedef name="InterfaceId" type="string" size="8"  unit="octet"> </typedef>
</types>
```

3.2.2. Header

"header" section contains the description of message header. For Radius, this is:

```
<header name="Message" length="Length" type="Code">
  <fielddef name="Code"          size="1" unit="octet"> </fielddef>
  <fielddef name="Identifier"    size="1" unit="octet"> </fielddef>
  <fielddef name="Length"        size="2" unit="octet"> </fielddef>
  <fielddef name="Authenticator" type="Octet_16"> </fielddef>
</header>
```

3.2.3. Body

"body" section contains the description of message body (which naturally comes after the header). For Radius, this is:

```
<body>
  <header name="Attribute" length="Attr-Length" type="Attr-Type">
     <fielddef name="Attr-Type"   size="1" unit="octet"> </fielddef>
     <fielddef name="Attr-Length" size="1" unit="octet"> </fielddef>
  </header>
</body>
```

3.2.4. Dictionary

"dictionary" section contains all possible parameters that a message can contain. Here is a description for some Radius attributes:

```
<dictionary>
  <!-- RADIUS Attribute definitions -->
  <Attribute>
```

```
    <!-- RADIUS Base Attribute definitions see RFC 2865 -->
    <define name="User-Name" type="String">
      <setfield name="Attr-Type" value="1"></setfield>
    </define>
    <define name="User-Password" type="String">
      <setfield name="Attr-Type" value="2"></setfield>
    </define>
    <define name="CHAP-Password" type="String">
      <setfield name="Attr-Type" value="3"></setfield>
      <!-- composed by CHAP-Id Octect and String -->
    </define>
    <define name="NAS-IP-Address" type="Address">
      <setfield name="Attr-Type" value="4"></setfield>
    </define>
    <define name="NAS-Port" type="Integer32">
      <setfield name="Attr-Type" value="5"></setfield>
    </define>
    <define name="Service-Type" type="Integer32">
      <setfield name="Attr-Type" value="6"></setfield>
    </define>
  </Attribute>
</dictionary>
```

3.2.5. Message

"Message" section contains all possible Diameter messages (from RFC 2865 and 2866). Here is an example of Radius messages:

```
    <define name="Access-Request">
       <setfield name="Code" value="1"></setfield>
    </define>
    <define name="Access-Accept">
       <setfield name="Code" value="2"></setfield>
    </define>
```

3.3. Actions in scenario commands for Radius

The <send> and <receive> scenario commands include an <action> and <message> sections.

The <action> section can be placed before or after the <message> section.

Actions placed before the message (called "**pre-actions**") are executed before the message is actually sent or received. Actions placed after the message (called "**post-actions**") are executed after the message is sent or received.

For example, actions that can be placed before a message are actions to set the values of some ids or to set some fields using external values, before sending a message. Example:

```
  <send channel="trans-ip-v4">
    <action>
      <!-- For each new call, increment the Acct-Session-Id counter -->
      <inc-counter name="session-counter"> </inc-counter>
      <inc-counter name="identifier-counter"> </inc-counter>
      <set-value name="Acct-Session-Id"
                 format="$(session-counter)"></set-value>
      <set-value name="Identifier"
                 format="$(identifier-counter)"></set-value>

      <!-- This field must not be use with a true value -->
      <restore-from-external field="0" entity="Authenticator"></restore-from-external>

    </action>
```

```
```

Actions that can be placed after a message are actions to store some values after the message has been received. Example:

```
<action>
      <store name="ACCT_SES_ID" entity="Acct-Session-Id"></store>
    </action>
  </send>
```

The list of possible actions is available in the reference section.

4. Radius authentication

The authentication implementation in Radius protocol is to be used as an example. The "crypto_method" method, used for the authentication, is defined in "library-crypto/CryptExternalMethods.hpp" (http://gull.svn.sourceforge.net/viewvc/gull/seagull/trunk/src/library-crypto/CryptExternalMethods.hpp?view=marku and implemented in "library-crypto/CryptExternalMethods.cpp" (http://gull.svn.sourceforge.net/viewvc/gull/seagull/trunk/src/library-crypto/CryptExternalMethods.cpp?view=marku in the sources.
It can be modified to match the exact authentication algorithm.

4.1. Seagull implementation

At first, the message is built with the "Authenticator" field filled with '0000000000000000' in the scenario:

```
<Message name="Accounting-Request">
      <setfield name="Authenticator" value="0000000000000000"> </setfield>
      ...
```

In the pre-action part of the scenario, the "Authenticator" field is set with the result of the authentication method:

```
<set-value name="Authenticator" method="authentication" message_part="all"
                format="shared_secret=$(SH_SE)"></set-value>
```

The "method" field selects the function to be used for the authentication from the ones defined in the dictionary.
The "message_part" defines which part of the message is used for the authentication (in this case, the entire message is used).
The "format" defines additional parameters if the method needs some (In this case, the "shared_secret" parameter is passed to the method with the value of the memory zone "SH_SE". The memory zone "SH_SE" can be filled by a "restore from_exernal" action for example).

4.2. Authentication dictionary

The authentication method must be defined in the dictionary with its name, the name of the function to be used and the name of the library in which the function is defined.
Example:

```
<!-- external methods for fields modifications -->
<external-method>
       <defmethod name="authentication"
                  param="lib=lib_crypto.so;function=crypto_method_radius">
       </defmethod>
</external-method>
```

The authentication method "name" is used in the scenario to call the authentication function.
The "param" defines the name of the library "lib=lib_crypto.so" and the name of the function "function=crypto_method_radius".

4.3. Authentication scenario

Here is the commented version of the Radius client using the "authentication" method defined in "library-crypto/CryptExternalMethods.hpp" and implemented in "library-crypto/CryptExternalMethods.cpp" in the sources

Client XML scenario.	Comments
<?xml version="1.0" encoding="ISO-8859-1" ?>	XML header
<scenario name="Simple Radius Accouting Client scenario">	
<counter> <counterdef name="session-counter" init="0"> </counterdef> <counterdef name="identifier-counter" init="0"> </counterdef> </counter>	The counters are declared ("session-counter" and "identifier-counter")
<!-- Traffic Scenario --> <traffic>	Send on "trans-ip-v4" channel as defined in the config file Pre-actions for each Accounting-Request message to be sent...
<!-- Start Accouting Request --> <send channel="trans-ip-v4"> <action> <!-- For each new call, increment the Acct-Session-Id counter --> <inc-counter name="session-counter"> </inc-counter> <inc-counter name="identifier-counter"> </inc-counter>	For each new call, increment the session-counter and identifier-counter counters
<set-value name="Acct-Session-Id" format="$(session-counter)"></set-val	Set the field "Acct-Session-Id" with "session-counter"
<set-value name="Identifier" format="$(identifier-counter)"></set-	Set the field "Identifier" with "identifier-counter"
<set-value name="Authenticator" method="authentication" message_part="all" format=""></set-value>	Set the field "Authenticator". The "authentication" method is defined in the dictionary. It uses the entire message as defined in message_part="all". The result of the method is placed in the field after the generation of the rest of the message.
</action> <Message name="Accounting-Request"> <setfield name="Authenticator" value="0000000000000000"> </setfield>	Send an "Accounting-Request" message that is initialized as follows before the above pre-actions are applied: Set the field "Authenticator" with a default value "0000000000000000". The value is replaced by the "set-value" action at the execution of the scenario.
<Attribute name="Acct-Session-Id" value="value_is_replaced"> </Attribute> <!-- 1 stand for Start --> <Attribute name="Acct-Status-Type" value="1"> </Attribute>	Set the attribute "Acct-Session-Id" with a default value "value_is_replaced". The value is replaced by the "set-value" action

```
      <Attribute
name="NAS-Identifier"
value="ims.hpintelco.org">
</Attribute>
    </Message>
    <action>
      <store name="ACCT_SES_ID"
entity="Acct-Session-Id"></store>
      <start-timer></start-timer>
    </action>

...

</traffic>

</scenario>
```

```
at the execution of the scenario.

Set the attribute "Acct-Status-Type"
with a default value "1".
Set the attribute "NAS-Identifier"
with a default value
"ims.hpintelco.org".

Post-actions for each
Accounting-Request message that is
sent...
Store the value of the field
"Acct-Session-Id" in the memory zone
"ACCT_SES_ID". It is used to
identify the session.
```