



LTE IMS Server

Version: 2024-12-13

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1 Introduction

LTEIMS is an IMS standalone simple server. It has a built-in P-CSCF, I-CSCF, S-CSCF, HSS. It also allows SMS handling including SMS over SG by connecting to the Amarisoft MME.

2 Features

- Implements P-CSCF with built-in I-CSCF, S-CSCF and HSS.
- Support of SIP protocol.
- Support of MD5, AKAv1 and AKAv2 authentication.
- Support of ISIM cards using the XOR, Milenage or TUAK authentication algorithm.
- Support of IPsec (ESP/transport).
- Support of voice, video calls: MO and MT.
- Support of voice echo test.
- Support of hold.
- Support of SMS (GSM 3.40) using SIP MESSAGE and SMS over SG.
- Support of IPv4 and IPv6.
- Support of precondition and dedicated bearer using Rx interface or N5 interface.
- Support of emergency call.
- Configurable user database.
- External authentication using Cx interface.
- Command line monitor.
- Remote API using WebSocket.

3 Requirements

3.1 Hardware requirements

- LTEIMS can run on the same PC as the Amarisoft eNodeB if a simple and compact solution is needed. Otherwise, any reasonably recent PC with at least one Gigabit Ethernet port is acceptable.
- A VoLTE compatible UE is necessary (See [VoLTE Call], page 5, note that it may depends on UE).
- A test USIM with ISIM application should be plugged into the UE. IMSI and secret key must be known. A standard USIM may also work but it depends on the UE implementation.

3.2 Known compatible UE

The Amarisoft IMS server has been tested with the following UE models:

- Samsung S5
- LG MS870

3.3 Software requirements

- A 64 bit Linux distribution. Fedora 39 is the officially supported distribution. The following distributions are known as compatible:
 - Fedora 22 to 39
 - Cent OS 7
 - Ubuntu 14 to 22

Your system requires at least GLIBC 2.17.

4 Installation

The network access thru the Gigabit Ethernet port must be correctly configured.

LTEIMS can be run directly from the directory when it was unpacked. No need for explicit installation.

4.1 Fedora setup

If you want to use SMS over SG with the Amarisoft MME or precondition with QoS, you need support of SCTP protocol for which the necessary packages are not usually installed. In order to install them, do as root user:

- Fedora

```
dnf install lksctp-tools kernel-modules-extra
```

- Ubuntu

```
sudo apt-get install lksctp-tools linux-image-extra-3.13.0-24-generic
```

Note that linux-image-extra package name may differ depending on your kernel version.

To verify that SCTP kernel module is running, do as root user:

```
checksctp
```

If it reports that the protocol is not supported,

- check if you have a `/etc/modprobe.d/sctp-blacklist.conf` file
- edit it to comment the 'blacklist sctp' line

Then reboot the PC in case the Linux kernel was upgraded too.

4.2 License key installation

LTEIMS needs a LTEMME license key to run. Please refer to the `ltemme` documentation.

4.3 Initial testing

- Edit the file `config/ims.cfg` to set the address of the SIP interface. Normally it is the address of the Ethernet interface that will receive SIP packets.
You can keep the current config if you use it with the Amarisoft MME and its `config/mme-ims.cfg` config file.
- Start the program as root with:

```
./lteims config/ims.cfg
```

[The root access is only needed if you want IPsec support.]

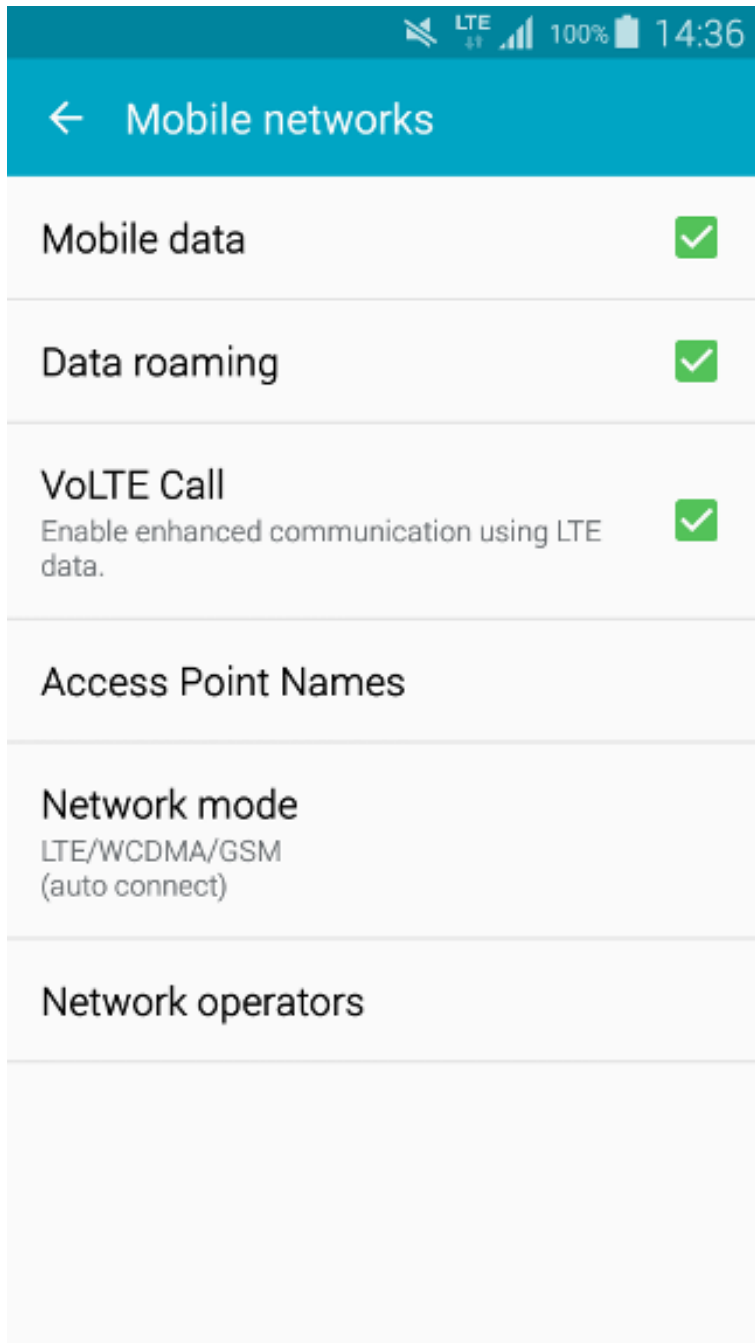
- The command line interface is used to monitor the operation of LTEIMS and to change the logging options.
Use `help` to get the list of commands and `quit` to stop the program.
- Use `users` to list the user database and registering state.

4.4 Samsung S5 configuration

Your UE must run at least Android 5.0 (Even if Android 5.0 is installed, try to update software (several times) as a sub-release is necessary).

If not, please update it.

To check your UE is configured for VoLTE, please go to **Settings/More networks/Mobile networks** of your handset and check **VoLTE Call** is checked:



We assume you are using the system with Amarisoft MME and `config/mme-ims.cfg` config file.

As there are two PDN defined, you must add them to the UE.

- Go to Settings/More networks/Mobile networks
- Turn on Data roaming
- Check VoLTE Call (If not present, it means your device is not up to date or does not support VoLTE).
- Go to Network operators, search for networks and select Amarisoft network.

- Go back to Mobile network.
- Add the first APN with the following parameters:
 - Name = Internet
 - APN = internet
 - APN type = default
- Save it and select it.
- Add second APN with following parameters:
 - Name = IMS
 - APN = ims
 - APN type = ims
- Save it and do not select it (This APN may not be displayed).
- Reboot your phone

5 Configuration reference

5.1 Configuration file syntax

The main configuration file uses a syntax very similar to the Javascript Object Notation (JSON) with few extensions.

- Supported types:
 - Numbers (64 bit floating point). Notation: 13.4
 - Complex numbers. Notation: 1.2+3*I
 - Strings. Notation: "string"
 - Booleans. Notation: true or false.
 - Objects. Notation: { field1: value1, field2: value2, }
 - Arrays. Notation: [value1, value2,]
- The basic operations +, -, * and / are supported with numbers and complex numbers. + also concatenates strings. The operators !, ||, &&, ==, !=, <, <=, >=, > are supported too.
- The numbers 0 and 1 are accepted as synonyms for the boolean values false and true.
- { } at top level are optional.
- " for property names are optional, unless the name starts with a number.
- Properties can be duplicated.

If properties are duplicated, they will be merged following [JSON merge rules], page 8, with overriding occuring in reading direction (last overrides previous).

Ex:

```
{
  value: "foo",
  value: "bar",
  sub: {
    value: "foo"
  },
  sub: {
    value: "bar"
  }
}
```

Will be equivalent to:

```
{
  value: "bar",
  sub: {
    value: "bar"
  }
}
```

- Files can be included using *include* keyword (must not be quoted) followed by a string (without :) representing the file to include (path is relative to current file) and terminating by a comma.

Arrays can't be included.

Merge will be done as for duplicate properties.

If *file1.cfg* is:

```
value: "foo",
include "file2.cfg",
foo: "foo"
```

And *file2.cfg* is:

```
value: "bar",
foo: "bar"
```

Final config will be:

```
{
  value: "bar",
  foo: "foo"
}
```

8. A C like preprocessor is supported. The following preprocessor commands are available:

#define var *expr*

Define a new variable with value *expr*. *expr* must be a valid JSON expression. Note that unlike the standard C preprocessor, *expr* is evaluated by the preprocessor.

#undef var

Undefine the variable *var*.

#include *expr*

Include the file whose filename is the evaluation of the string expression *expr*.

#if *expr* Consider the following text if *expr* is true.

#else Alternative of **#if** block.

#elif Composition of **#else** and **#if**.

#endif End of **#if** block.

#ifdef var

Shortcut for **#if defined(var)**

#ifndef var

Shortcut for **#if !defined(var)**

In the JSON source, every occurrence of a defined preprocessor variable is replaced by its value.

9. Backquote strings: JSON expression can be inserted in backquote delimited strings with the ``${expr}` syntax. Example: `'abc${1+2}d'` is evaluated as the string `"abc3d"`. Preprocessor variables can be used inside the expression. Backquote strings may span several lines.

5.1.1 JSON merge rules

Merge overriding direction depends on context, i.e source may override destination or the opposite.

JSON merge is recursive for Objects and Arrays.

Example, merging

```
{
  foo: { value: "bar" },
  same: "one",
  one: 1
}
```

with

```
{
  foo: { value: "none", second: true },
```

```

    same: "two",
    two: 1
}

```

Will become:

```

{
  foo: { value: "bar", second: true },
  same: "one",
  one: 1
  two: 1
}

```

assuming first object overrides second one.

In case of Array merging, the final array length will be the maximum length of all merged arrays.

For each element of the final array, merge will be done considering defined elements only.

Ex:

```

{
  array: [0, 1, 2, { foo: "bar" } ],
  array: [3, 4],
  array: [5, 6, 7, { bar: "foo" }, 8 ]
}

```

Will be merged to:

```

{
  array: [5, 6, 7, { foo: "bar", bar: "foo" }, 8 ],
}

```

5.2 Properties

log_filename

String. Set the log filename. If no leading /, it is relative to the configuration file path. See [Log file format], page 38.

log_options

String. Set the logging options as a comma separated list of assignments.

- *layer.level=verbosity*. For each layer, the log verbosity can be set to **none**, **error**, **info** or **debug**. In debug level, the content of the transmitted data is logged.
- *layer.max_size=n*. When dumping data content, at most **n** bytes are shown in hexa. For ASN.1, NAS or Diameter content, show the full content of the message if **n > 0**.
- *layer.payload=[0|1]*. Dump ASN.1, NAS, SGsAP or Diameter payload in hexadecimal.
- *layer.key=[0|1]*. Dump security keys (NAS and RRC layers).
- *layer.crypto=[0|1]*. Dump plain and ciphered data (NAS and PCDP layers).
- *layer.verbose=[0|1]*. If **layer** is **ipsec**, dump all packets filtering informations.
- *time=[sec|short|full]*. Display the time as seconds, time only or full date and time (default = time only).
- *time.us=[0|1]*. Dump time with microseconds precision.
- *file=cut*. Close current file log and open a new one.

- `file.rotate=now`. Rename current log with timestamp and open new one.
- `file.rotate=size`. Rename current log every time it reaches `size` bytes open new one. Size is an integer and can be followed by K, M or G.
- `file.path=path`. When log rotation is enabled, move current log to this path instead of initial log path.
- `append=[0|1]`. (default=0). If 0, truncate the log file when opening it. Otherwise, append to it.

Available layers are: `ims`, `sip`, `media`, `rx`, `cx`, `n5`

log_sync Optional boolean (default = false). If true, logs will be synchronously dumped to file.

Warning, this may lead to performances decrease.

sip_addr Array. Each item is an object representing a SIP server socket defined as follow:

addr String. Set the IP address (and an optional port) on which IMS server will listen for SIP packets. The default port is 5060.

bind_addr Optional string. Defines network interface on which IMS will listen. If not specified, the `addr` parameter is used.

port_min Optional integer (Default is 10000). Defines lower bound of UDP media socket.

port_max Optional integer (Default is 20000). Defines upper bound of UDP media socket.

NB:

- SIP socket object can be represented by a simple string. Thus, it will represent `addr` parameter and all other parameters will use default value.
- For legacy, `sip_addr` can be a single SIP socket (Object or String) instead of an Array.

sctp_addr String. Set the IP address (and an optional port) for MME connection. This is only necessary for SMS over SG feature.

cx_server_addr String. Set the IP address (and optional port) of Cx SCTP connection to the HSS. The default port is 3868.

cx_bind_addr Optional string. IP address and optional port on which the Cx SCTP connection is bound. If not set, `sctp_addr` is used.

cx_origin_realm Optional string. Defines the string sent in the Origin-Realm AVP for Cx messages. Default is set to `amarisoft.com`.

cx_origin_host Optional string. Defines the string sent in the Origin-Host AVP for Cx messages. Default is set to `ims.amarisoft.com`.

cx_watchdog_duration Optional integer (range 0 to 36000000, default = 0). Tw watchdog timer in milliseconds to send the Diameter Device Watchdog Request message. The value 0 deactivates the watchdog.

<code>rx_server_addr</code>	Optional string. Set the IP address (and optional port) of Rx SCTP connection to the MME. The default port is 3868. If not set, <code>cx_server_addr</code> is used.						
<code>rx_bind_addr</code>	Optional string. IP address and optional port on which the Rx SCTP connection is bound. If not set, <code>cx_bind_addr</code> is used.						
<code>rx_origin_realm</code>	Optional string. Defines the string sent in the Origin-Realm AVP for Rx messages. Default is set to <code>amarisoft.com</code> .						
<code>rx_origin_host</code>	Optional string. Defines the string sent in the Origin-Host AVP for Rx messages. Default is set to <code>ims.amarisoft.com</code> .						
<code>rx_watchdog_duration</code>	Optional integer (range 0 to 36000000, default = 0). Tw watchdog timer in milliseconds to send the Diameter Device Watchdog Request message. The value 0 deactivates the watchdog.						
<code>use_n5</code>	Optional boolean (default = false). If set, the N5 interface is used instead of the Rx interface.						
<code>n5</code>	Optional object used to configure the N5 interface with the PCF. <table> <tr> <td><code>api_root</code></td><td>String. <code>apiRoot</code> as defined in 3GPP TS 29.501: <code><scheme>://<host>:<port></code>, where <code><scheme></code> is "http" or "https".</td></tr> <tr> <td><code>transaction_timeout</code></td><td>Optional integer (range 1 to 15000, default = 4000). Defines the timeout in milliseconds for a transaction with the PCF.</td></tr> <tr> <td><code>bind_addr</code></td><td>Optional string. IP address and optional port on which the N5 TCP connection is bound. If not set, <code>cx_bind_addr</code> is used.</td></tr> </table>	<code>api_root</code>	String. <code>apiRoot</code> as defined in 3GPP TS 29.501: <code><scheme>://<host>:<port></code> , where <code><scheme></code> is "http" or "https".	<code>transaction_timeout</code>	Optional integer (range 1 to 15000, default = 4000). Defines the timeout in milliseconds for a transaction with the PCF.	<code>bind_addr</code>	Optional string. IP address and optional port on which the N5 TCP connection is bound. If not set, <code>cx_bind_addr</code> is used.
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<code>transaction_timeout</code>	Optional integer (range 1 to 15000, default = 4000). Defines the timeout in milliseconds for a transaction with the PCF.						
<code>bind_addr</code>	Optional string. IP address and optional port on which the N5 TCP connection is bound. If not set, <code>cx_bind_addr</code> is used.						
<code>domain</code>	String. Global SIP domain used for IMPU and authentication. May be overridden at user level. This parameter is not used to recover IMPU.						
<code>tcp_threshold</code>	Optional integer (default = 1300). Set packet threshold in bytes to use TCP instead of UDP.						
<code>tcp_keepalive</code>	Optional integer (default = 900). Time in seconds before sending keepalive on TCP connections. 0 means disabling keepalive.						
<code>tcp_keepcount</code>	Optional integer (default = 2). Number of TCP keepalive failure before releasing socket.						
<code>session_expires</code>	Optional object. Defines session timer configuration. Parameters are the following: <table> <tr> <td><code>duration</code></td><td>Optional integer (default = 1800). Session duration in seconds.</td></tr> <tr> <td><code>min</code></td><td>Optional interger (default = 90). Minimum allowed session expires.</td></tr> </table>	<code>duration</code>	Optional integer (default = 1800). Session duration in seconds.	<code>min</code>	Optional interger (default = 90). Minimum allowed session expires.		
<code>duration</code>	Optional integer (default = 1800). Session duration in seconds.						
<code>min</code>	Optional interger (default = 90). Minimum allowed session expires.						

refresher	Optional string (default = uac). Defines session refresher when it is up to the IMS to take this decision.
method	Optional string (default = update). Defines SIP method to use for session refresh when IMS is the refresher.
force	Optional boolean (default = true). If set to true, forces the refresher in IMS request with the refresher value.
	For legacy purpose, session_expires can be an integer. If so, only duration is set and other parameters are kept to their default value.
100rel	Optional Boolean (default = true). Enable/disable 100rel support.
precondition	Optional string (default = on). Values can be "on", "off" or "silent". On: IMS will handled QoS according to the standard. Off: no precondition and no dedicated bearer establishment. Silent: dedicated bearers will be established regardless the SIP and SDP content. Note that a Rx connection is necessary to allow dedicated bearer establishment.
p_called_party_id	Optional boolean (default is false). Enable P-Called-Party-ID header for INVITE and MESSAGE requests.
ipsec	Optional boolean (default is true). Enable/disable support of ipsec.
ipsec_aalg_list	Array of strings. Each string represent IPsec authentication algorithm supported by IMS. "null" may be used to indicate no authentication. Supported algorithms are: <ul style="list-style-type: none"> • hmac-md5-96 • hmac-md5-128 • hmac-sha-1-96 • hmac-sha-1-160 • aes-cmac-96 • aes-gmac
ipsec_ealg_list	Array of strings. Each string represent IPsec encryption algorithm supported by IMS. "null" may be used to indicate no encryption. Supported algorithms are: <ul style="list-style-type: none"> • aes-cbc • des-cbc • des-ede3-cbc • blowfish • aes-ctr • aes-gcm
ipsec_mtu	Optional integer (range 68 to 65535, default = 1400). MTU for IPsec network interface.

ipsec_ifname

Optional string. If set, use this interface for IPsec. In that case, **ipsec_netns** must be set and interface must be added to the network namespace.

In this mode, used to run lteims with non root privileges, it is up to the user to configure the tun interface.

In particular:

- Add tun interface to specified network namespace
- Add **sip_addr** IP addresses to the interface
- Set MTU (**ipsec_mtu** will be ignored)
- Set routes
- Set **CAP_SYS_ADMIN** and **CAP_NET_RAW** capabilities to *PROG*

Ex:

```
setcap cap_sys_admin,cap_net_raw=ep lteims
ip tuntap add mode tun <ifname>
ip link set dev <ifname> name <ifname> netns <netns>
ip netns exec $netns ip addr add 192.168.4.1/0 dev <ifname>
ip netns exec $netns ip addr add 192.168.0.103/0 dev <ifname>
ip netns exec $netns ip link set <ifname> up mtu 1400
ip netns exec $netns ip route add default dev <ifname>
```

ipsec_netns

Optional string. Must be set if **ipsec_ifname** is set. Defines network namespace name used for ipsec.

dialog_timeout

Optional integer (default = 30). Time in seconds of call session. Stop call if no activity has been detected during this time.

auth_on_register_only

Optional boolean (default = true). If true, don't try to authenticate other request than register (unless expires is set to 0).

trunk

Optional object. If set, IMS will accept incoming calls from a SIP trunk and will forward unknown calls to SIP trunk (https://tech-academy.amarisoft.com/how_to_run_volte_call_using_a_sip_trunk.wiki).

SIP trunk must accept non authenticated requests. Parameters are the following:

addr String. IP address of the SIP trunk.

name String. SIP trunk account user name.

domain Optional string (default = same as **addr**). If set, use this for SIP uri domain.

tcp_threshold

Optional integer (default = 0). If > 0, will override global **tcp_threshold** parameter.

com_addr Optional string. Address of the WebSocket server remote API. See [Remote API], page 22.

If set, the WebSocket server for remote API will be enabled and bound to this address.

Default port is 9003.

Setting IP address to `::` will make remote API reachable through all network interfaces.

<code>com_name</code>	Optional string. Sets server name. IMS by default
<code>com_ssl_certificate</code>	Optional string. If set, forces SSL for WebSockets. Defines CA certificate filename.
<code>com_ssl_key</code>	Optional string. Mandatory if <code>com_ssl_certificate</code> is set. Defines CA private key filename.
<code>com_ssl_peer_verify</code>	Optional boolean (default is false). If <code>true</code> , server will check client certificate.
<code>com_ssl_ca</code>	Optional string. Set CA certificate. In case of peer verification with self signed certificate, you should use the client certificate.
<code>com_log_lock</code>	Optional boolean (default is false). If <code>true</code> , logs configuration can't be changed via <code>config_set</code> remote API.
<code>com_log_us</code>	Optional boolean (default is false). If <code>true</code> , logs sent by <code>log_get</code> remote API response will have a <code>timestamp_us</code> parameters instead of <code>timestamp</code>
<code>com_auth</code>	Optional object. If set, remote API access will require authentication. Authentication mechanism is describe in [Remote API Startup], page 24, section.
<code>passfile</code>	Optional string. Defines filename where password is stored (plaintext). If not set, <code>password</code> must be set
<code>password</code>	Optional string. Defines password. If not set, <code>passfile</code> must be set.
<code>unsecure</code>	Optional boolean (default false). If set, allow password to be sent plaintext. NB: you should set it to true if you access it from a Web Browser (Ex: Amarisoft GUI) without SSL (https) as your Web Browser may prevent secure access to work.
<code>com_log_count</code>	Optional number (Default = 8192). Defines number of logs to keep in memory before dropping them. Must be between 4096 and 2097152).
<code>sim_events</code>	Array of object. Each element gives an event configuration to execute for this UE. Event configuration is exactly the same as for [Remote API], page 22, messages except that message field must be event.
<code>sim_events_loop_count</code>	If set, will define <code>loop_count</code> for each event of <code>sim_events</code> , See [loop-count], page 23.
<code>sim_events_loop_delay</code>	If set, will define <code>loop_delay</code> for each event of <code>sim_events</code> , See [loop-delay], page 23.
<code>license_server</code>	Configuration of the Amarisoft license server to use. Object with following properties:

server_addr String. IP address of the license server.

name Optional string. Text to be displayed inside server monitor or remote API.

tag Optional string. If set, server will only allow license with same tag.

Example:

```
license_server: {
  server_addr: "192.168.0.20",
  name: "My license"
}
```

sms_expires Integer (default = 86400). Delay in seconds before SMS is removed from database. If a MO SMS contains the TP-Validity-Period field, it will be used instead of **sms_expires**.

sms_hook_only Optional boolean (default = false). If set, when SMS is received and at least one WebSocket client has registered to **sms** event, don't process SMS internally (Only CP/RP layer will be handled).

binding_expires Integer (default = 3600, max = 864000). Default duration in seconds for registration.

subscribe_expires Integer (default = 0, max = 864000). Subscription expiration. If set to 0, use value sent by UE.

user_agent Optional string (default = Amarisoft-IMS-2024-12-13). SIP user agent.

force_user_agent Boolean (default = true). If true, IMS user-agent will always be used, else remote peer's one will be used.

path Optional string (default = sip:ims.mnc001.mcc001.3gppnetwork.org). SIP path. If registration supports **path**, defines content of the **Path** header in registration response. If set to an empty string, **Path** header won't be set.

timer_t1 Optional number (default = 2). SIP T1 timer duration in seconds.

timer_t2 Optional number (default = 16). SIP T2 timer duration in seconds.

timer_t4 Optional number (default = 17). SIP T4 timer duration in seconds.

custom_headers Array of object. Each object represents a custom header to add to requests and/or responses, defined as follows:

name	Header name
value	Header value
codes	Number or array of numbers of the SIP responses on which to apply custom headers. 0 can be used for all codes.

methods	String or array of strings of the SIP method on which to apply custom headers. * can be used for all methods. If codes is set, the custom headers will be applied to the responses of the associated request.
replace	Optional boolean (default = false). If set, allow only one occurrence of the header.
sms_centre_address	Optional object used to configure the SMS centre address. Contains the following parameters:
type_of_number	Optional enumeration "unknown", "international", "national" (default = "unknown"). SMS centre address type of number.
numbering_plan	Optional enumeration "unknown", "national", "private" (default = "unknown"). SMS centre address numbering plan identification.
number	String. Contains optional '+' at first position followed by a maximum of 20 digits. SMS centre address number.
sms_retry_delay	Integer. Time in s to retry SMS sending.
100rel	Optional boolean (default = true). Enable/disable support of provisional response
echo	IMPU (See [impu], page 17). If set, this defines the phone number(s) for echo service.
mt_call_sdp_file	String. File to use as SDP when using MT call.
sms_message_filter	Optional object. Allows to define the IMS behavior for a list of SMS related messages. Each property name represents a SMS message type. The ones currently supported are cp_data , cp_ack , rp_data and rp_ack . Each property value is an enum: treat (message is processed), ignore (message is ignored) or reject (message is rejected). By default all procedures are treated. Example: <pre> sms_message_filter: { cp_data: "treat", rp_ack: "reject" } </pre>
sms_forced_cp_cause	Optional integer (range 0 to 255). Allows to override the CP error cause selected by the IMS with the one configured. Set to 0 to deactivate the override.
sms_forced_rp_cause	Optional integer (range 0 to 255). Allows to override the RP error cause selected by the IMS with the one configured. Set to 0 to deactivate the override.

mms_server_bind_addr

Defines network interface on which MMS server will listen. It is used to configure the MMSC in the UE. MMS proxy is not supported and shall not be configured in the UE.

Example:

```
mms_server_bind_addr: "192.168.3.1:1111"
MMSC: http://192.168.3.1:1111
```

mms_expires

Optional integer (default = 86400). Delay in seconds before MMS is removed from database.

5.2.1 User database options**ue_db**

Array of objects. Configure the user database. Each element is an entry for one user. Note that this part can be shared between Amarisoft MME and IMS. The following properties are available:

imsi Optional string. Set the IMSI.
Shall be present if **nai** is absent.

nai Optional string. Network specific identifier-based SUPI.
Shall be present if **imsi** is absent.

multi_sim Optional boolean (default = false). If true, allow several UEs to have the same IMSI (useful when using several identical test SIM cards in different UEs at the same time). They are distinguished with their IMEI. Note: it is only allowed with the XOR authentication algorithm.

impi String. Defines user IMPI. Must be fully filled with hostname if necessary.
If you don't know your IMPI, please look at IMS logs inside *REGISTER* request. The IMPI must match the *username* argument inside *Authorization* header.

impu Array of strings or array of objects.
Each string represent an IMPU and can be a sip URI or a telephone number.
Note that sip URI must not include hostname.
If IMPU does not start by a scheme, it is assumed to be a sip URI.
Ex:

- sip:user
- user
- tel:+33123456789

If **impu** is an object, it has following members:

impu IMPU as defined above.

imei IMEI associated to this IMPU. Allows to filter calls and SMS for a specific UE.
Only relevant if **multi_sim** is set to true.

anonymous

Optional boolean (default is false). If true, allow Anonymous connection (Emergency call) and mask impu in SIP headers.

anonymous_callback

Optional number (default is 0). If anonymous is set, defines how long in seconds after an anonymous call has been done, the network can call back the caller. In that case, caller will be identified with an sip IMPU derived from its IMEI.

authentication

Optional boolean (default is true). If false, disable authentication.

ring_only

Optional boolean (default is false). If true, IMS will go up to ringing state but not further.

precondition

Optional string. Values can be "on", "off" or "silent".

On mode: IMS will try to guess precondition from supported header, SDP content and/or VoLTE compatibility of client.

Off mode: no precondition and no dedicated bearer establishment.

Silent mode: dedicated bearers will be established whatever the SIP and SDP content.

100rel

Optional boolean (default = true). Enable/disable 100rel support for this IMPU.

preferred

Optional boolean (default: false). If set, this impu will be used for preferred identity and for INVITE request URI.

asserted

Optional boolean (default: false). If set, this impu will be used for asserted identity.

associated

Optional boolean (default: true). If set to false, this impu will not be used for associated URI.

display_name

Optional string. If set, SIP headers will use this field for display name.

domain

Optional string. Used to override user or global config.

p_called_party_id

Optional string. If set, forces P-Called-Party-ID header for INVITE and MESSAGE requests, no matter if p_called_party_id global parameter is set or not.

answer_delay

Optional number. If set, when doing a echo call on this IMPU, OK response to INVITE request will be delayed by answer_delay in seconds.

<code>sms_delay</code>	Optional number. If set, IMS will wait <code>sms_delay</code> seconds before sending SMS to this IMPU.		
<code>media_delay</code>	Optional number. Delay sending of media packet in seconds.		
<code>remote_control</code>	Optional boolean. If set to true on a echo impu, the sending of final of INVITE request will be controled by <code>dialog_set</code> remote API with <code>answer</code> action (The delay to send answer is defined by <code>dialog_timeout</code> parameter. A remote API <code>invite</code> event will be sent with <code>dialog_session_id</code> .		
<code>sdp_file</code>	Optional string. When used in echo mode, use the SDP file to force the media sent in server SDP response.		
<code>session_expires</code>	Optional object. If set, will override global session timer parameters for that impu, See [session_expires], page 11. If IMS is the server (MO call and echo call), caller configuration will be used, else (MT call) callee's one will be used.		
<code>bitrate_factor</code>	Optional number (Default = 1). Media bitrate are estimated from SDP. When setting up the dedicated bearer via Rx interface, the bitrate is multiplied by this number.		
<code>video</code>	Optional boolean (default = true). If set to false, video media will be rejected.		
<code>callflow_modifier</code>	Optional object or array of objects. This allows to modify IMS behavior and messages. Each object will define a modification in the SIP callflow. The modifier will be applied with following rules: <ul style="list-style-type: none"> • On MO dialogs, callee modifiers will be used. • On MT dialogs, caller modifiers will be used. Each object is defined this way: <table> <tr> <td><code>method</code></td><td>Optional string. Defines on which step to apply modifier (if not set, applies on any of the following). Modifier applies on reception or sending of message depending on <code>dir</code> parameter If set to <code>INVITE.OK</code>, modifier applies on final answer of INVITE request. If set to <code>INVITE.TRYING</code>, modifier applies on 100 SIP responses. If set to <code>INVITE.RINGING</code>, modifier applies on 180 SIP responses.</td></tr> </table>	<code>method</code>	Optional string. Defines on which step to apply modifier (if not set, applies on any of the following). Modifier applies on reception or sending of message depending on <code>dir</code> parameter If set to <code>INVITE.OK</code> , modifier applies on final answer of INVITE request. If set to <code>INVITE.TRYING</code> , modifier applies on 100 SIP responses. If set to <code>INVITE.RINGING</code> , modifier applies on 180 SIP responses.
<code>method</code>	Optional string. Defines on which step to apply modifier (if not set, applies on any of the following). Modifier applies on reception or sending of message depending on <code>dir</code> parameter If set to <code>INVITE.OK</code> , modifier applies on final answer of INVITE request. If set to <code>INVITE.TRYING</code> , modifier applies on 100 SIP responses. If set to <code>INVITE.RINGING</code> , modifier applies on 180 SIP responses.		

	<p>If set to <code>INVITE.SESSION_PROGRESS</code>, modifier applies on 183 SIP responses.</p> <p>If set to <code>INVITE</code>, <code>SUBSCRIBE</code>, <code>REGISTER</code>, <code>UPDATE</code>, <code>CANCEL</code>, <code>PRACK</code>, <code>MESSAGE</code>, modifier applies on received or sent requests.</p> <p>If set to <code>REGISTER.SOS</code>, modifier applies on reception of emergency <code>REGISTER</code>.</p> <p>If set to <code>REINVITE</code>, modifier applies on received or sent <code>INVITE</code> requests during an established dialog.</p>
<code>code</code>	<p>Optional number (between 100 and 699). If set, modifier will generate a SIP response with this code and modifier will apply on this message. If code is not set, no response will be generated.</p>
<code>stop</code>	<p>Optional boolean (default = true). If set to true and modifier applies within a dialog, dialog will be stopped. In that case, normal callflow will be stopped.</p>
<code>dir</code>	<p>Optional string (default = both). Can be <code>tx</code> to apply modifier on sent messages, <code>rx</code> to apply modifier on received messages or <code>both</code> for both type of messages.</p>
<code>transparent</code>	<p>Optional boolean (default = false). If true, modifier will be applied without stopping the normal call flow.</p>
<code>content</code>	<p>Optional string. Response body will be filled with <code>content</code> file on generated message. If set to null, any already set content with same <code>content_type</code> will be removed (Ex: use <code>application/sdp</code> to remove SDP).</p>
<code>content_type</code>	<p>Optional string. Mandatory if <code>content</code> is set, will define response content type.</p>
<code>access_network</code>	<p>Optional string (default = false). List of RAT separated by comma. If set the callflow will only be affected if <code>P-Access-Network-Info</code> matches the selected RAT. Can be <code>lte</code> (3GPP-E-UTRA), <code>nr</code> (3GPP-NR), or <code>n3gpp</code> (IEEE).</p>
<code>custom_headers</code>	<p>Optional Array of object. Apply specific headers on the generated response as defined in [custom_headers], page 15, except that <code>code</code> and <code>methods</code> parameters are useless.</p>
<code>impu</code>	<p>Optional string. Is set, modifier will be applied only if counterpart of the dialog matches this IMPU:</p> <ul style="list-style-type: none"> • On MO dialogs, caller IMPU.

	<ul style="list-style-type: none"> • On MT dialogs, callee IMPU.
<code>imei</code>	Optional string. Is set, modifier will be applied only if counterpart (Cf <code>impu</code>) has same IMEI provided during registration.
<code>ttl</code>	Optional integer (> 0) (Time To Live). If set, callflow modifier will be removed after having being applied <code>ttl</code> times.
<code>tts</code>	Optional integer (default = 0) (Time To Start). If set, callflow modifier will not be applied for the the <code>tts</code> times it has been triggered. This will differ <code>ttl</code> decreasing.
<code>send_delay</code>	Optional number (default = 0, max = 60). Delay in seconds of SIP message sending
<code>code</code>	Deprecated. See <code>callflow_modifier</code>
<code>method</code>	Deprecated. See <code>callflow_modifier</code>
<code>content</code>	Deprecated. See <code>callflow_modifier</code>
<code>content_type</code>	Deprecated. See <code>callflow_modifier</code>
<code>transparent</code>	Deprecated. See <code>callflow_modifier</code>
<code>authent_type</code>	<p>Optional string (default = AKA_{v1}). Defines minimum authentication level.</p> <p>If client does no specify authentication algo, server will use this value. Else, server will allow authentication only if client provided algo is at least the one specified by this parameter.</p> <p>Values are (from lowest security to highest):</p> <ul style="list-style-type: none"> <code>none</code> Disable authentication. <code>MD5</code> MD5 digest authentication. <code>AKAv1</code> AKA_{v1} authentication. <code>AKAv2</code> AKA_{v2} with MD5 hash authentication. <code>AKAv2-SHA-256</code> AKA_{v2} with SHA-256 hash authentication.
<code>authent_qop</code>	<p>Optional string (default = none). Defines authentication qop parameter and can be:</p> <ul style="list-style-type: none"> <code>none</code> Don't set qop. <code>auth</code> Use <code>auth</code> qop directive.
<code>pwd</code>	Optional string. Password set for MD5 authentication. If set and <i>authent_type</i> is not set, <i>authent_type</i> is set to MD5.
<code>mt_call_sdp_file</code>	Optional string. File to use as SDP when using MT call. Overrides global parameter.

`domain` Optional string. If set, overrides global config.

`auth_on_register_only`
 Optional boolean. If set, overrides global config.

`force_sms_over_sg`
 Optional boolean. If set, forces use of SMS over SG.

`ue_db_filename`
 Optional string. If present, store the current IMS state in a persistent file. The IMS state contains in particular the registration info and pending SMS.

6 Remote API

You can access LTEIMS via a remote API.

Protocol used is WebSocket as defined in RFC 6455 (<https://tools.ietf.org/html/rfc6455>).

Note that Origin header is mandatory for the server to accept connections.
This behavior is determined by the use of `nopoll` library.
Any value will be accepted.

6.1 Messages

Messages exchanged between client and LTEIMS server are in strict JSON format.

Each message is represented by an object. Multiple message can be sent to server using an array of message objects.

Time and delay values are floating number in seconds.

There are 3 types of messages:

- Request

Message sent by client.

Common definition:

message String. Represent type of message. This parameter is mandatory and depending on its value, other parameters will apply.

message_id

Optional any type. If set, response sent by the server to this message will have same `message_id`. This is used to identify response as WebSocket does not provide such a concept.

start_time

Optional float. Represent the delay before executing the message.
If not set, the message is executed when received.

absolute_time

Optional boolean (default = false). If set, `start_time` is interpreted as absolute.
You can get current clock of system using `time` member of any response.

standalone

Optional boolean (default = false). If set, message will survive WebSocket disconnection, else, if socket is disconnected before end of processing, the message will be cancelled.

loop_count

Optional integer (default = 0, max = 1000000). If set, message will be repeated `loop_count` time(s) after `loop_delay` (From message beginning of event).
Response will have a `loop_index` to indicate iteration number.

loop_delay

Optional number (min = 0.1, max = 86400). Delay in seconds to repeat message from its `start_time`. Mandatory when `loop_count` is set > 0.

- Response

Message sent by server after any request message as been processed.

Common definition:

message String. Same as request.

message_id
 Optional any type. Same as in request.

time Number representing time in seconds since start of the process.
 Usefull to send command with absolute time.

utc Number representing UTC seconds.

- Events

Message sent by server on its own initiative.

Common definition:

message String. Event name.

time Number representing time in seconds.
 Usefull to send command with absolute time.

6.2 Startup

When WebSocket connections is setup, LTEIMS will send a first message with name set to `com_name` and type set to `IMS`.

If authentication is not set, message will be `ready`:

```
{
  "message": "ready",
  "type": "IMS",
  "name": <com_name>,
  "version": <software version>,
  "product": <Amarisoft product name (optional)>
}
```

If authentication is set, message will be `authenticate` :

```
{
  "message": "authenticate",
  "type": "IMS",
  "name": <com_name>,
  "challenge": <random challenge>
}
```

To authenticate, the client must answer with a `authenticate` message and a `res` parameter where:

```
res = HMAC-SHA256( "<type>:<password>:<name>", "<challenge>" )
```

`res` is a string and HMAC-SHA256 refers to the standard algorithm (<https://en.wikipedia.org/wiki/HMAC>)

If the authentication succeeds, the response will have a `ready` field set to `true`.

```
{
  "message": "authenticate",
  "message_id": <message id>,
  "ready": true
}
```

If authentication fails, the response will have an **error** field and will provide a new challenge.

```
{
  "message": "authenticate",
  "message_id": <message id>,
  "error": <error message>,
  "type": "IMS",
  "name": <name>,
  "challenge": <new random challenge>
}
```

If any other message is sent before authentication succeeds, the error "Authentication not done" will be sent as a response.

6.3 Errors

If a message produces an error, response will have an error string field representing the error.

6.4 Sample nodejs program

You will find in this documentation a sample program: **ws.js**.

It is located in **doc** subdirectory.

This is a nodejs program that allow to send message to LTEIMS.

It requires nodejs to be installed:

```
dnf install nodejs npm
npm install nodejs-websocket
```

Use relevant package manager instead of NPM depending on your Linux distribution.

Then simply start it with server name and message you want to send:

```
./ws.js 127.0.0.1:9003 '{"message": "config_get"}'
```

6.5 Common messages

config_get

Retrieve current config.

Response definition:

type	Always "IMS"
name	String representing server name.
logs	Object representing log configuration. With following elements:
layers	Object. Each member of the object represent a log layer configuration:
layer name	Object. The member name represent log layer name and parameters are:
level	See [log_options], page 9,
max_size	See [log_options], page 9,
key	See [log_options], page 9,

	crypto	See [log-options], page 9,	
	payload	See [log-options], page 9,	
	verbose	Optional boolean. [log-options], page 9,	See
	count	Number. Number of bufferizer logs.	
	rotate	Optional number. Max log file size before rotation.	
	path	Optional string. Log rotation path.	
	bcch	Boolean. True if BCCH dump is enabled (eNB only).	
	mib	Boolean. True if MIB dump is enabled (eNB only).	
locked	Optional boolean. If true , logs configuration can't be changed with config_set API.		
custom_headers	Array. Current custom headers configuration See [custom.headers], page 15.		

config_set
Change current config.
Each member is optional.
Message definition:

logs	Optional object. Represent logs configuration. Same structure as config-get (See [config-get logs member], page 25). All elements are optional. Layer name can be set to all to set same configuration for all layers. If set and logs are locked, response will have logs property set to locked .
-------------	--

precondition
See [precondition], page 12,

session_expires
See [session_expires], page 11,

sms_retry_delay
See [sms_retry_delay], page 16,

sms_expires
See [sms_expires], page 15,

sms_hook_only
See [sms_hook_only], page 15,

binding_expires
See [binding_expires], page 15,

subscribe_expires
See [subscribe_expires], page 15,

auth_on_register_only
See [auth_on_register_only], page 13,

dialog_timeout
See [dialog_timeout], page 13,

<code>p_called_party_id</code>	See [p-called_party_id], page 12,														
<code>sms_message_filter</code>	See [sms_message_filter], page 16,														
<code>sms_forced_cp_cause</code>	See [sms-forced_cp-cause], page 16,														
<code>sms_forced_rp_cause</code>	See [sms-forced_rp-cause], page 16,														
<code>mms_expires</code>	See [mms-expires], page 17,														
<code>custom_headers</code>	Optional array. If set, will replace <code>custom_headers</code> as defined in config file (See [custom_headers], page 15) or previous call to <code>config_set</code> .														
<code>100rel</code>	See [100rel], page 16,														
<code>tcp_threshold</code>	See [tcp-threshold], page 11,														
<code>tcp_keepalive</code>	See [tcp-keepalive], page 11,														
<code>tcp_keeppcount</code>	See [tcp-keeppcount], page 11,														
<code>log_get</code>	<p>Get logs.</p> <p>This API has a per connection behavior. This means that the response will depend on previous calls to this API within the same WebSocket connection.</p> <p>In practice, logs that have been provided in a response won't be part of subsequent request unless connection is reestablished. To keep on receiving logs, client should send a new <code>log_get</code> request as soon as the previous response has been received.</p> <p>If a request is sent before previous request has been replied, previous request will be replied right now without considering specific min/max/timeout conditions.</p> <p>Message definition:</p> <table><tr><td><code>min</code></td><td>Optional number (default = 1). Minimum amount of logs to retrieve. Response won't be sent until this limit is reached (Unless timeout occurs).</td></tr><tr><td><code>max</code></td><td>Optional number (default = 4096). Maximum logs sent in a response.</td></tr><tr><td><code>timeout</code></td><td>Optional number (default = 1). If at least 1 log is available and no more logs have been generated for this time, response will be sent.</td></tr><tr><td><code>allow_empty</code></td><td>Optional boolean (default = false). If set, response will be sent after timeout, event if no logs are available.</td></tr><tr><td><code>rnti</code></td><td>Optional number. If set, send only logs matching rnti.</td></tr><tr><td><code>ue_id</code></td><td>Optional number. If set, send only logs with matching ue.id.</td></tr><tr><td><code>layers</code></td><td>Optional Object. Each member name represents a log layer and values must be string representing maximum level. See [log-options], page 9. If <code>layers</code> is not set, all layers level will be set to <code>debug</code>, else it will be set to <code>none</code>.</td></tr></table>	<code>min</code>	Optional number (default = 1). Minimum amount of logs to retrieve. Response won't be sent until this limit is reached (Unless timeout occurs).	<code>max</code>	Optional number (default = 4096). Maximum logs sent in a response.	<code>timeout</code>	Optional number (default = 1). If at least 1 log is available and no more logs have been generated for this time, response will be sent.	<code>allow_empty</code>	Optional boolean (default = false). If set, response will be sent after timeout, event if no logs are available.	<code>rnti</code>	Optional number. If set, send only logs matching rnti.	<code>ue_id</code>	Optional number. If set, send only logs with matching ue.id.	<code>layers</code>	Optional Object. Each member name represents a log layer and values must be string representing maximum level. See [log-options], page 9. If <code>layers</code> is not set, all layers level will be set to <code>debug</code> , else it will be set to <code>none</code> .
<code>min</code>	Optional number (default = 1). Minimum amount of logs to retrieve. Response won't be sent until this limit is reached (Unless timeout occurs).														
<code>max</code>	Optional number (default = 4096). Maximum logs sent in a response.														
<code>timeout</code>	Optional number (default = 1). If at least 1 log is available and no more logs have been generated for this time, response will be sent.														
<code>allow_empty</code>	Optional boolean (default = false). If set, response will be sent after timeout, event if no logs are available.														
<code>rnti</code>	Optional number. If set, send only logs matching rnti.														
<code>ue_id</code>	Optional number. If set, send only logs with matching ue.id.														
<code>layers</code>	Optional Object. Each member name represents a log layer and values must be string representing maximum level. See [log-options], page 9. If <code>layers</code> is not set, all layers level will be set to <code>debug</code> , else it will be set to <code>none</code> .														

Note also the logs is also limited by general log level. See [log_options], page 9.

short	Optional boolean (default = false). If set, only first line of logs will be dumped.
headers	Optional boolean. If set, send log file headers.
start_timestamp	Optional number. Is set, filter logs older than this value in milliseconds.
end_timestamp	Optional number. Is set, filter logs more recent than this value in milliseconds.
max_size	Optional number (default = 1048576, i.e. 1MB). Maximum size in bytes of the generated JSON message. If the response exceeds this size, the sending of logs will be forced independently from other parameters.

Response definition:

logs	Array. List of logs. Each item is a an object with following members:
data	Array. Each item is a string representing a line of log.
timestamp	Number. Milliseconds since January 1st 1970. Not present if com_log_us is set in configuration.
timestamp_us	Number. Microseconds since January 1st 1970. Only present if com_log_us is set in configuration.
layer	String. Log layer.
level	String. Log level: <i>error</i> , <i>warn</i> , <i>info</i> or <i>debug</i> .
dir	Optional string. Log direction: <i>UL</i> , <i>DL</i> , <i>FROM</i> or <i>TO</i> .
ue_id	Optional number. UE.ID.
cell	Optional number (only for PHY layer logs). Cell ID.
rnti	Optional number (only for PHY layer logs). RNTI.
frame	Optional number (only for PHY layer logs). Frame number (Subframe is decimal part).
channel	Optional string (only for PHY layer logs). Channel name.
src	String. Server name.
idx	Integer. Log index.
headers	Optional array. Array of strings.
discontinuity	Optional number. If set, this means some logs have been discarded due to log buffer overflow.
microseconds	Optional boolean. Present and set to true if com_log_us is set in configuration file.

log_set	Add log. Message definition:
log	Optional string. Log message to add. If set, <i>layer</i> and <i>level</i> are mandatory.
layer	String. Layer name. Only mandatory if <i>log</i> is set.
level	String. Log level: <i>error</i> , <i>warn</i> , <i>info</i> or <i>debug</i> . Only mandatory if <i>log</i> is set.
dir	Optional string. Log direction: <i>UL</i> , <i>DL</i> , <i>FROM</i> or <i>TO</i> .
ue_id	Optional number. UE_ID.
flush	Optional boolean (default = false). If set, flushes fog file.
rotate	Optional boolean (default = false). If set, forces log file rotation.
cut	Optional boolean (default = false). If set, forces log file reset.
log_reset	Resets logs buffer.
license	Retrieves license file information.
quit	Terminates lteims.
help	Provides list of available messages in <i>messages</i> array of strings and events to register in <i>events</i> array of strings.
stats	Report statistics for LTEIMS. Every time this message is received by server, statistics are reset. Warning, calling this message from multiple connections simultaneously will modify the statistics sampling time. Response definition:
cpu	Object. Each member name defines a type and its value cpu load in % of one core.
instance_id	Number. Constant over process lifetime. Changes on process restart.
counters	Object. List of counters, with following sub members:
messages	Object. Each member name is the message name and its value is its occurrence. To get list of message, type <i>cevent help msg</i> in LTEIMS monitor.
errors	Object. Each member name is the error name and its value is its occurrence. To get list of message, type <i>cevent help error</i> in LTEIMS monitor.
register	Register client to message generated by server. Message definition:
register	String or array of string. List of message to register to. Can be <i>users_update</i> , <i>sms</i>
unregister	String or array of string. List of message to unregister. Can be <i>users_update</i> , <i>sms</i>

ipsec Report ipsec SAs.

Response definition:

SAs Array. List of object representing a security association with following definition:

- type** String. IP version, can be IPv4 or IPv6.
- dir** String. Direction, can be **in** or **out**.
- spi** Number. SPI.
- ue_id** Number. Associated **ue_id**.
- mode** String. ESP type, can be **tunnel** or **transport**
- src** String. Source IP address.
- dst** String. Destination IP address.
- tun_src** Optional string. Tunnel source IP address.
- tun_dst** Optional string. Tunnel destination IP address.
- src_prefix** Number. Source network prefix.
- dst_prefix** Number. Destination network prefix.
- authent_key** String. Authentication key in hexadecimal form (Empty string authentication is disabled).
- cipher_key** String. Ciphering key in hexadecimal form (Empty string ciphering is disabled).

6.6 LTE messages

users_get

Get users state.

Message definition:

registered_only. Optional boolean (default = false). If set, only registered user will be dumped.

Response definition:

users Array of object. Each item represents a user with following parameters:

- impi** String. IMPI of user (IP Multimedia Private identity).
- force_sms_over_sg** Optional boolean. Current SMS over SG forcing state.
- bindings** Array of object. One for each contact binding:
 - uri** String. Contact URI.
 - impu** Array of strings. List of associated IMPUs.
 - q** Number. Contact priority.

	video	Optional boolean. Video support.
	sms	Optional boolean. SMS pending.
	imei	Optional string. IMEI.
	expires	Integer. Number of seconds before binding expiration.
	dialogs	Array of object. One for each current dialog:
	remote	String. IMPI of remote user.
	sms	Integer. Number of pending SMS.
users_add	Add users. Message definition:	
	users.	Array of object. Same as info in configuration file: See [ue-db], page 17.
user_set	Configure user. Message definition:	
	impi	String. IMPI of user to configure.
	force_sms_over_sg	Optional boolean. Set/unset forcing of SMS over SG.
impu_set	Configure impu. Message definition:	
	impu	String. IMPU to configure.
	*	Same parameters as impu configuration object. See [impu configuration], page 17.
impu_add	Add impu. Message definition:	
	impu	String or object. IMPU to add See [impu configuration], page 17.
	impi	String. User for which to add IMPU. Can be set to echo to add it to the echo list.
impu_del	Remove impu. Message definition:	
	impu	String or object. IMPU to add See [impu configuration], page 17.
	impi	String. User for which to remove IMPU. Can be set to echo to remove it from the echo list.
sms	Send SMS. Message definition:	
	impi	Optional string. IMPI of user (IP Multimedia Private identity).
	impu	Optional string. If IMPI is not set, try to get user from IMPU (IP Multimedia Public identity).
	text	String. SMS text to send.
	sender	Optional string. Sets SMS sender.
	validity	Optional integer (Default = 86400). Validity period in seconds.

binary	Optional string. If set (and text is not set), must be a base64 string representing binary data of the TP-User-Data.
binary_hex	Optional string. If set (and text is not set), must be an hexadecimal string representing binary data of the TP-User-Data.
tp_udl	Optional integer. Used when binary is set. If present, it sets the TP-User-Data-Length field. If not present, the TP-User-Data-Length field is set to the number of octets of the binary field.
tp_udhi_present	Optional boolean (default is false). When binary is set, indicates if TP-User-Data start with a user-data header or not.
pid	Optional integer (default is 0). Defines protocol identifier.
dcs	Optional integer (default is 4). Defines data coding scheme. If the text parameter was provided, it's up to the user to ensure that the dcs value is coherent with the encoding automatically selected (7 bit default GSM alphabet or UCS2).
sos	Optional boolean (default = false). If set, will only try to reach emergency registered UEs.
sms_flush	Flush pending SMS. Message definition:
impi	String. IMPI of user (IP Multimedia Private identity).
mms	Send MMS. Message definition:
filename	String. File name to send. Extensions jpg, jpeg, png, gif and txt are supported.
from	String. Sender phone number.
to	String. Receiver phone number.
sos	Optional boolean (default = false). If set, will only try to reach emergency registered UEs.
mt_call	Initiate a mobile terminating call. Message definition:
impi	String. IMPI (IP Multimedia Private identity) of user to call.
impu	String. IMPU (IP Multimedia Public identity) of user to call.
contact	String. Contact SIP uri of user to call.
sip_file	Optional string. Define file to use as sdp. Will override <i>mt_call_sdp_file</i> parameter.
caller	Optional string. Use it to force caller IMPU. If IMPU is in user database, the P-Asserted-Identity header will be added.
sos	Optional boolean (default = false). If set, will only try to reach emergency registered UEs.
duration	Optional number. If set, call duration in seconds (The server will close the dialog).

Response definition:

session_id

String. If call has started, provides its session ID.

dialog_get

Get list of current pending dialogs.

Dialog will persist 30s after being stopped. Message definition:

session_id

Optional string. If set, filter on session ID.

Response definition:

dialogs Array of object representing dialogs as follow:

session_id

String. Dialog session ID.

state

String. Dialog state, can be **init**, **ringing**, **start**, **hold** or **stop**.

type

String. Dialog type, can be **server**, **echo** or **mt call**

to

Callee IMPU.

from

Caller IMPU.

mt_dialog

Optional string. In case of server dialog, session id of associated MT dialog.

mo_dialog

Optional string. In case of client dialog, session id of associated MO dialog.

date

Integer. Dialog creation time in seconds since 1st January 1970.

duration

Number. Number of seconds since dialog has started.

event_list

Array of object representing events that has occurred during dialog lifetime.

Each element have the following definition:

type

String. Event type, can be **state**, when a state change occurs, **send** and **recv** when receiving or sending message.

timestamp

Number. Event time in seconds since dialog creation.

state

String. Dialog state when event has occurred as defined above.

medias

Array of object representing media state.

Each media is an object having following definition:

type

String. Media type, can be **audio** or **video**.

qos

String. QoS state, can be:

- disabled: QoS not enabled, IETF mode used.

- required: QoS required but not yet initiated.
- pending: QoS dedicated bearer establishment in progress.
- erab_set: QoS done.

dir String. Media current direction, can be `sendrecv`, `sendonly`, `recvonly` or `inactive`.

rtp_addr String. RTP packets destination address.

rtp_rcv_count
Integer. Number of RTP packets received.

rtp_send_count
Integer. Number of RTP packets sent.

rtcp_addr
String. RTCP packets destination address.

rtcp_rcv_count
Integer. Number of RTCP packets received.

rtcp_send_count
Integer. Number of RTCP packets sent.

dialog_set

Perform action on dialog Message definition:

session_id
String. Session ID of dialog to stop.

action String. Action to perform.

Action	Description
stop	Forces termination of the dialog.
answer	Triggers INVITE final answer of an echo called configured with <code>remote_control</code> option.
reinvite	Forces sending of INVITE if the dialog is started.

hold	If call is not held locally, hold it, unhold it. Applies on MT and ECHO calls only.
downgrade	Downgrades call by removing one media.
media	Modify media behavior.
ecall-info	In case eCall has been set during INVITE, forces sending of SIP INFO message to trigger MSD report.
code	Optional integer. If action is answer , forces SIP code. If action is stop , set protocol cause of SIP reason header.
reason	Optional string. If action is stop , set reason text of SIP reason header.
reason_protocol	Optional string. If action is stop , set protocol of SIP reason header.
sdp_file	Optional string. Applicable on MT call dialogs only. Forces a new SDP to be sent.
media	Optional string. If action is downgrade , defines media to remove (Can be audio or video). If action is hold , hold/unhold only applies to this type of media
rtp	Optional boolean (default = false). If action is media , set it to false to block rtp packet streaming or true to re-enable it.
rtcp	Optional boolean (default = false). If action is media , set it to false to block rtcp packet streaming or true to re-enable it.
unregister	Force a network deregistration of a binding. Message definition:
uri	String. Binding URI (Address of Record)

6.7 LTE events

Following events are sent by IMS if they have been registered on WebSocket.

sms Generated by SMS reception:

<code>sender</code>	String. SMS originator.
<code>destination</code>	String. SMS destination.
<code>text</code>	String. SMS text.
<code>binary</code>	String. If <code>text</code> is not set, base64 encoded string of SMS data.
<code>dcs</code>	Integer. Data coding scheme.
<code>date</code>	Integer. SMS sending date in seconds since January 1st 1970.
<code>users_update</code>	Event generated when a change occurs on a user (Registration, call, sms...).
<code>users_update</code>	Array of object. Each item represents a user (See <code>[users_get]</code> , page 30).
<code>dialog</code>	Generated when a dialog's state has changed.
<code>dialog</code>	Object. Same as <code>[dialog_get]</code> , page 33,

6.8 Examples

1. Config

1. Client sends

```
{
  "message": "config_get",
  "message_id": "foo"
}
```

2. Server replies

```
{
  "message_id": "foo",
  "message": "config_get",
  "name": "UE",
  "logs": {
    "phy": {
      "level": "error",
      "max_size": 0
    },
    ...
    "rrc": {
      "level": "debug",
      "max_size": 1
    }
  }
}
```

2. Error

1. Client sends

```
{
  "message": "bar",
  "message_id": "foo"
}
```

2. Server replies

```
{  
  "message_id": "foo",  
  "message": "bar",  
  "error": "Unknown message: bar"  
}
```


7 Command line monitor reference

The following commands are available:

help Display the help. Use **help *command*** to have a more detailed help about a command.

log [*log_options*]
 Display the current log state. If *log_options* are given, change the log options. The syntax is the same as the **log_options** configuration property.

mme Lists MME connections

sms *impi* or *impu text*
 Send a SMS to the user identified by *impi* or *impu* if *impi* has not been found.

sms_flush *impi*
 Flush pending SMS.

mms *filename from to*
 Send a MMS to the user identified by *to*. Extensions jpg, jpeg, png, gif and txt are supported. For any other extension value, the content type is interpreted as octet stream.

mt_call *callee* [-d *duration*] [*sip_file*] [*caller*]
 Initiate a mobile terminating call.
 callee can be IMPI, IMPU or contact URI.
 sip_file Define file to use as sdp. Will override *mt_call_sdp_file* parameter.
 caller can be used to force caller IMPU. If IMPU is in user database, the P-Asserted-Identity header will be added.
 duration duration of the call in seconds before server closes it.

dialog Lists all dialogs.

dialog_set *dialog-index action*
 Perform action on dialog.
 Can be **stop**, **hold** or **reinvite** (Cf [dialog.set], page 34).

quit Stop the program and exit.

8 Log file format

8.1 IMS, SIP

When a message is dumped, the format is:

```
time layer dir id message
```

time Time using the selected format.

layer Indicate the layer.

dir FROM or TO or - (No direction associated).

id For IMS, represents a unique ID associated with a UE binding.
For SIP, represents a unique ID associated to a SIP dialog.

message Log message.

8.2 CX, RX

When a message is dumped, the format is:

```
time layer dir addr message
```

time Time using the selected format.

layer Indicate the layer.

dir FROM or TO or - (No direction associated).

addr Source IP address for incoming messages.
Destination IP address for outgoing messages.

message Log message.

8.3 MEDIA

When a message is dumped, the format is:

```
time layer id dir protocol/media message
```

time Time using the selected format.

layer Indicate the layer.

dir FROM or TO or - (No direction associated).

id SIP associated dialog id.

protocol Can be either RTP or RTCP.

media Media type: audio, video or text.

message Log message.

9 Change history

9.1 Version 2024-12-13

- added `anonymous_callback` IMPU parameter
- added `send_delay` to `callflow` modifier
- added `ecall-info` to `dialog_set` remote API

9.2 Version 2024-09-13

- added `bitrate_factor` parameter to `impu` configuration
- added `video` parameter to `impu` configuration
- added `media` parameter for `action_set/hold` remote API to hold a specific media only
- added SMS status report and SMS command support
- added `license` remote API
- added `tts` parameter to `callflow_modifier` object
- `com_logs_lock` parameter is renamed to `com_log_lock`. `com_logs_lock` is still supported for backward compatibility
- added `com_log_us` parameter
- added `reason` to `dialog_stop` monitor command
- added `sos` parameter to `sms` remote API
- added eCall support

9.3 Version 2024-06-14

- OpenSSL library is upgraded to 1.1.1w
- added `ipsec_ifname` and `ipsec_netns` parameters to allow IPsec with non root privileges
- added AKAv2-SHA-256 authentication scheme
- added AES-GCM IPsec cipher
- added AES-GMAC IPsec authentication

9.4 Version 2024-03-15

- added `ttl` parameter to `callflow_modifier` object
- added `reason_protocol` parameter to `dialog_set.stop` remote API
- added `sms_delay` parameter to `impu` configuration
- added SIP trunk documentation
- added support of '+' in `sms_centre_address`
- added `ipsec_mtu` parameter
- updated SIP code list

9.5 Version 2023-12-15

- session timer support added
- added `loop_count` and `loop_delay` to remote API messages
- added `sim_events`, `sim_events_loop_count` and `sim_events_loop_delay`
- added `com_ssl_ca` parameter for SSL verification

- added `dialog` remote API event
- added `session_expires` parameter to `impu` object
- added `duration`, `min`, `refresher`, `method` and `force` to `session_expires` object

9.6 Version 2023-09-08

- added `media` action to `dialog_set` remote API to allow blocking or not rtp and/or rtcp streams
- `sms_centre_address` parameter is added
- `ipsec` remote API added
- `tcp_threshold` can now be changed during runtime with `config_set` remote API
- `sms_flush` remote API added

9.7 Version 2023-06-10

- N5 interface support is added
- added `impu_add` and `impu_del` remote API
- added `echo` monitor command
- added `auth` qop parameter
- `com_logs_lock` parameter added to disable logs configuration change via remote API

9.8 Version 2023-03-17

- `com_addr` parameter now uses `::` address instead of `0.0.0.0` in the delivered configuration file to allow IPv6 connection
- added `media_delay` to callflow modifier
- `auth_on_register_only` default value is changed to `true` instead of `false`
- added `REGISTER.SOS` callflow modifier
- added `INVITE.RINGING` callflow modifier
- added `INVITE.SESSION_PROGRESS` callflow modifier
- added `REINVITE` callflow modifier
- added code `-2` to callflow modifier
- added `code` and `reason` parameters for `dialog_set/action` stop remote API
- added `downgrade` action and `media` parameter to `dialog_set` remote API

9.9 Version 2022-12-16

- added `custom_headers` for `callflow_modifier`
- added `path` parameter for registration
- added `dialog_set` remote API and monitor command. Replaces `dialog_stop`, `reinvite` and `dialog_answer` APIs
- added `hold` action on `dialog_set` remote API and monitor command
- added `imei` and `impu` filters on `callflow_modifier`
- added `sdp_file` to `dialog_set/reinvite` remote API
- added `utc` parameter to remote API response messages

9.10 Version 2022-09-16

- "ipsec debug" monitor is now deprecated. Set `ipsec.verbose` to 1 in log configuration
- `callflow_modifier` is added to `impu` definition and allows multiple modifiers
- allowed `callflow_modifier` based on `P-Access-Network-Info` header
- `tcp_keepalive` default value changed to 15 minutes
- `tcp_keeppcount` parameter is added
- `custom_headers` parameter is added to `config_get` and `config_set` remote API
- `date` parameter is added to `sms` remote API event

9.11 Version 2022-06-17

- OpenSSL library is upgraded to 1.1.1n
- `code` parameter in `impu` object now accepts the value -1 to ignore an incoming SIP message
- `tcp_keepalive` is added to control keepalive on TCP sockets
- allowed dual emergency/non emergency registration
- `sos` option is added to `mt_call` and `sms` remote APIs
- `start_timestamp` and `end_timestamp` are added to `log_get` API

9.12 Version 2022-03-18

- IMEI is now taken into account to improve calls between UEs using the same IMSI
- `binding_expires` parameter maximum value is increased from 3600 to 864000

9.13 Version 2021-12-17

- a new `sdp_file` parameter is added to force the SDP used in echo mode
- a new `answer_delay` parameter is added to IMPU configuration to delay final answer to INVITE request
- a new INVITE.OK option has been added to `method` parameter of IMPU configuration to apply code on final answer to INVITE request.
- a new `remote_control` option has been added to IMPU configuration. It can be handled via a new `invite` remote API event and a new `dialog_answer` remote API.
- a new `transparent` option has been added to IMPU configuration to avoid affecting normal callflow.
- a new `impu_set` remote API is added to dynamically update `impu` configurations.
- REGISTER handling has been added to `impu method` parameter.
- INVITE.TRYING handling has been added to `impu method` parameter.
- `license` monitor command is added

9.14 Version 2021-09-17

- the minimum GLIBC version is now 2.17
- logs can be displayed with microseconds precision
- `precondition` global parameter syntax is updated. Legacy boolean values are still available but we recommend to use `on` and `off` instead
- `force_user_agent` parameter is added to avoid overriding the UE user-agent string when forwarding SIP packets between UEs
- `prefered` parameter is renamed to `preferred`. Legacy name is still supported
- the logging format is further described

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Abbreviations

APN	Access Point Name
IMPU	IP Multimedia Public Identity
IMPI	IP Multimedia Private Identity