LTE IMS Server

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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.
- Configurable user database.
- External authentication using Cx interface.
- Command line monitor.

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 reasonnably 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 25 is the officially supported distribution.
  The following distributions are known as compatible:
  - Fedora 17 to 26
  - Ubuntu 12 to 16

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, you need support of SCTP protocol for which the necessary packages are not usually installed. In order to install them, do as root user:

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

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

4.2 License key installation

LTEIMS needs a license key file to run. *It is associated to your PC, so if you replace it or change its hardware configuration you must contact Amarisoft to get a new license key.*

The following steps are needed to get this license file:

- Run LTEIMS:

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

  It says that the license key is not present and prints a 16 digit hexadecimal code.
- Send by mail to `delivery@amarisoft.com` this hexadecimal code to your contact at Amarisoft. You will get back the `ltemme.key` license key file.
- Copy the `ltemme.key` file to the `${HOME}/.amarisoft/` directory (`${HOME}` is the home directory of the `root` user). You can use the shell variable `AMARISOFT_PATH` to change this path.

Once the license key is installed, `lteims` should start normally.

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:

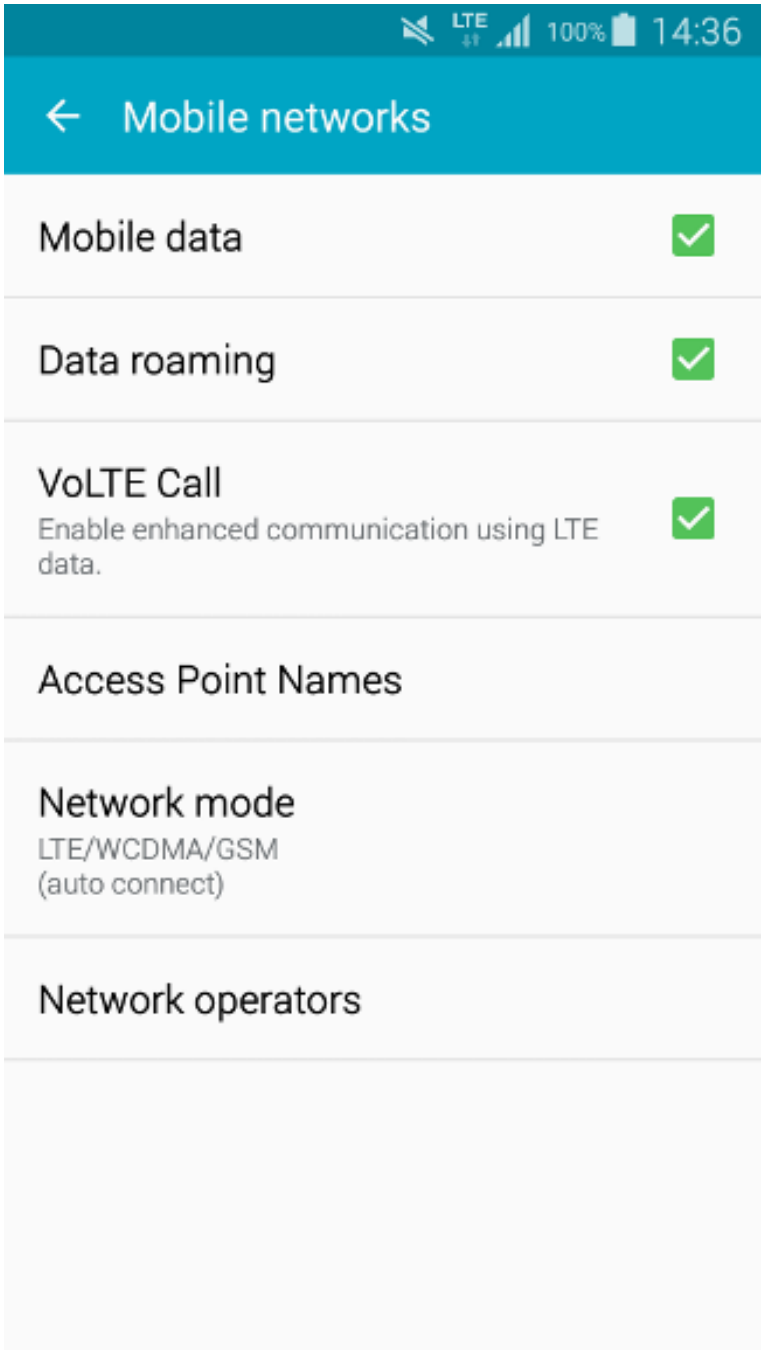
  ```
  ./lteims config/ims.cfg
  ```

  [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.

1. 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, .... ]`
2. The basic operations `+`, `-`, `*` and `/` are supported with numbers and complex numbers. `+` also concatenates strings. The operators `!`, `||`, `&&`, `==`, `!=`, `<`, `<=`, `>=`, `>` are supported too.
3. The numbers `0` and `1` are accepted as synonyms for the boolean values `false` and `true`.
4. {} at top level are optional.
5. " for property names are optional.
6. Properties can be duplicated.
   Merge will be done by recursively overriding values considering reading direction.

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

   Will be equivalent to:

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

7. 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.

The System Information Blocks use the ASN.1 GSER syntax defined in RFC 3641 (Generic String Encoding Rules for ASN.1 Types). The description of the exact content of the System Information Blocks can be found in 3GPP TS 36.331 (RRC).

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 21.

`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 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, RRC and PCDP layers).
- time=[sec|short|full]. Display the time as seconds, time only or full date and time (default = time only).
- 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`, `rx`, `cx`

`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 3368.

`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`.

`rx_server_addr`
: Optional string. Set the IP address (and optional port) of Rx SCTP connection to the MME. The default port is 3368.

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

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

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

`domain`
: String. Global SIP domain used for IMPU and authentication. May be overriden at user level.
This parameter is not used for to recover IMPU.

`tcp_threshold`
: Optional integer (default = 1300). Set packet threshold in bytes to use TCP instead of UDP.

`session_expires`
: Optional integer (default = 3600); Set session expires header value in seconds.

`precondition`
: Optional boolean (Default is false). If true, precodition with QoS will be handled by IMS.
IMS must be connected to MME to allow dedicated bearer establishment.

`qci`
: Object. Must contain two integer properties: audio and video that defines QCI to use.
Default is 1 for audio and 2 for video.

`dialog_timeout`
: Optional integer (default = 15). Time in seconds of call session. Stop call if no activity has been detected during this time.

`auth_on_register_only`
: Optional boolean (default = false). If true, don't try to auhtneticate other request than register.

`com_addr`
: Optional string. Address of the WebSocket server remote API. See [Remote API], page 13.
If set, the WebSocket server for remote API will be enabled and bound to this address.
Default port is 9000.
Setting IP address to 0.0.0.0 will make remote API reachable through all network interfaces.

`com_name`
: Optional string. Sets server name. IMS by default

`com_ssl_certificate`
: Optional string. If set, forces SSL for WebSockets. Defines CA certificate filename.

`com_ssl_key`
: Optional string. Mandatory if *com_ssl_certificate* is set. Defines CA private key filename.

`com_ssl_peer_verify`
: Optional boolean (default is false). If *true*, server will check client certificate.

`sms_expires`
: Integer (Default = 86400). Delay in seconds before SMS is removed from database

`binding_expires`
: Integer (Default = 3600). Default duration in seconds for registration.

`user_agent`
: String. SIP user agent.

`sms_retry_delay`
: Integer. Time in s to retry to send SMS.

`echo`
: String. If set, this defines the phone number for echo service.

`mt_call_sdp_file`
: String. File to use as SDP when using MT call.

5.2.1 User database options

`ue_db`

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

`imsi`
: String. Set the IMSI.

`sim_algo`
: Optional enumeration. xor, milenage or tuak (default = xor). Set the SIM authentication algorithm. Note: test USIM cards use the XOR algorithm.

`amf`
: Range: 0 to 65535. Set the Authentication Management Field.

`sqn`
: Optional String (6 byte hexadecimal string). Default = `"000000000000"`. Set the initial sequence number. For the XOR algorithm, the actual value does not matter. For the Milenage or TUAK algorithm, a sequence number resynchronization is initiated if the sequence number does not match the one stored in the USIM.

`K`
: String. Set the user secret key (as a 16 byte hexadecimal string).

`op`
: Optional string. Operator key (as a 16 byte hexadecimal string). When the Milenage authentication algorithm is used, either `op` or `opc` must be set.

`opc`
: Optional string. Operator key preprocessed with the user secret key (as a 16 byte hexadecimal string). When the Milenage authentication algorithm is used, either `op` or `opc` must be set.

`r`
: Optional array of 5 integers (range: 0 to 127). Allows to customize the r1 to r5 parameters when Milenage authentication algorithm is used. If the array is not present, the default values (as defined in 3GPP 35.206) are used.

`c`
: Optional array of 5 strings. Each value contains a 16 byte hexadecimal string. Allows to customize the c1 to c5 parameters when Milenage authentication algorithm is used. If the array is not present, the default values (as defined in 3GPP 35.206) are used.

`top` Optional string. Operator key (as a 32 byte hexadecimal string). When the TUAK authentication algorithm is used, either `top` or `topc` must be set.

`topc` Optional string. Operator key preprocessed with the user secret key (as a 32 byte hexadecimal string). When the TUAK authentication algorithm is used, either `top` or `topc` must be set.

`keccak_iter`
Optional integer (range: 1 to MAX_INT). Allows to customize the number of Keccak permutations performed when using the TUAK authentication algorithm. If the item is not present, the default value 1 (as defined in 3GPP 35.231) is used.

`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 string or object. 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.

`imeisv` IMEISV associated to this IMPU. Allows to filter calls and SMS for a specific UE.
Only relevant if multi_sim is set to true.

`code` Number. Only relevant for echo impu. Server will use this as SIP answer code.

`anonymous`
Optional boolean (default is false). If true, allow Anonymous connection (Emergency call).

`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 boolean. If set, will enable/disable for this IMPU. Else, IMS will try to guess it from supported header, SDP content and/or VoLTE compatibility of client.

`res_len` Optional integer. Default = 8. Defines length of response in bytes during authentication. For TUAK authentication algorithm, the value must be 4, 8 or 16 bytes long.

`authent_type`
: Optional string (Default = AKAv1). Defines minimum authentication level.
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.
Values are (from lowest security to highest):

  `none` Disable authentication.

  `MD5` MD5 digest authentication.

  `AKAv1` AKAv1 authentication.

  `AKAv2` AKAv2 authentication.

`pwd`
: Optional string. Password set for MD5 authentication. If set and *authent_type* is not set, *authent_type* is set to MD5.

`mt_call_sdp_file`
: Optional string. File to use as SDP when using MT call. Overrides global paramater.

`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`).

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.

All messages have at least following definition:

`message` String. Represent type of message. This parameter is mandatory and depending on its value, other parameters will apply.
If message is a response from server, response message will have same message member.

`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 double. Represent the delay before executing the message.
If not set, the message is executed when received.
Note that some command (*log_get*, *log_reset*, *config_get*, *config_set*, *stats*) can't be executed in future.

`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 `config_get` command.

6.2 Errors

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

6.3 Sample nodejs program

You will find in this documentation a sample program: `ws.js`.
This is a nodejs program that allow to send message to `PROG`.
It requires nodejs to be installed:

```
yum install nodejs npm
npm install nodejs-websocket
```

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

```
./ws.js 127.0.0.1:9000 '{"message": "config_get"}'
```

6.4 Common messages

`config_get`
: Retreive current config.

  Response definition:

  `type` Always "IMS"

  `name` String representing server name.

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

  `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 8,

  `max_size` See [log_options], page 8,

  `count` Number. Number of bufferizer logs.

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

  `logs` Object. Represent logs configuration. Same structure as config_get (See [config_get logs member], page 15).
  All elements are optional.

`log_get` Get logs.
: Message definition:

  `min` Optional number (default = 1). Minimum amount of logs to retreive. Response won't be sent until this limit is reached (Unless timeout occurs).

  `max` Optionnal number (default = 4096). Maximum logs sent in a response.

  `timeout` Optional number (default = 1). If at least 1 log is available and no more logs have been geenrated for this time, response will be sent.

  `rnti` Optional number. If set, send only logs matching rnti.

  `ue_id` Optional number. If set, send only logs with matching ue_id.

  `layers` Optional Object. Each member name represents a log layer and values must be string representing maximum level. See [log_options], page 8.
  By default, each layer is set to *debug*.
  Note also the logs is also limited by general log level. See [log_options], page 8.

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. Number of seconds since start of session or start of day.
- `layer` String. Log layer.
- `level` String. Log level: *error*, *warn*, *info* or *debug*.
- `dir` Optional string. Log direction: *UL*, *DL*, *FROM* or *TO*.
- `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.

`discontinuity`
Optional number. If set, this means some logs have been discarded due to log buffer overflow.

Note that only one request can be sent by client.
If a request is sent before previous one has returned, previous one will be sent without matchine min/max/timeout conditions.

`log_reset`
Resets logs buffer.

`stats` Provides statistics.
Every time this message is received by server, statistics are reset.

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 occurence.
  To get list of message, type *cevent help msg* in LTEIMS monitor.
- `errors` Object. Each member name is the error name and its value is its occurence.
  To get list of message, type *cevent help msg* 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 users˙update, sms
- `unregister` String or array of string. List of message to unregister. Can be users˙update, sms

6.5 LTE messages

`users` Get users state.
Response definition:

- `users` Array of object. Each item represent a user with following parameters:
  - `impi` String. IMPI of user (IP Multimedia Private identity).
  - `bindings` Array of object. One for each contact binding:
    - `uri` String. Contact URI.
    - `q` Number. Contact priority.
    - `video` Optional boolean. Video support.
    - `sms` Optional boolean. SMS pending.
    - `imeisv` Optional string. IMEISV.
    - `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.

`sms` Send SMS.
Message definition:

- `impi` Optional string. IMPI of user (IP Multimedia Private identity).
- `impu` Optional string. If IMPI is not ser, 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.
- `dcs` Optional integer (default is 4). When binary is set, defines data coding scheme.

`mt_call` Initiate a mobile terminating call.
Message definition:

- `impi` String. IMPI of user (IP Multimedia Private identity).
- `sip_file` Optional string. Define file to use as sdp. Will override *mt_call_sdp_file* parameter.

`caller` Optional string. Use it to force caller IMPU.

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 occured 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 occured as defined above.

`dialog_stop`
Forces termination of a dialog.
Message definition:

`session_id`
String. Session ID of dialog to stop.

`unregister`
: Force a network deregistration of a binding. Message definition:

  `uri` String. Binding URI (Address of Record)

6.6 LTE events

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

`SMS` Generated by SMS reception:

`sender` String. SMS originator.

`destination` String. SMS destination.

`text` String. SMS text.

`binary` String. If text is not set, base64 encoded string of SMS data.

`dcs` Integer. Data coding scheme

6.7 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.

`mt_call` *`impi`* `[`*`sip_file`*`]`
Initiate a mobile terminating call.
Define file to use as sdp. Will override *mt_call_sdp_file* parameter.

`quit` Stop the program and exit.

8 Log file format

9 License

Abbreviations

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