

sysmocom

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OSMOCOM

OsmoGGSN User Manual

by Harald Welte

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The AsciiDoc source code of this manual can be found at <http://git.osmocom.org/osmo-gsm-manuals/>

HISTORY			
NUMBER	DATE	DESCRIPTION	NAME
1	August 2017	Initial version.	HW

Contents

1	Foreword	1
1.1	Acknowledgements	1
2	Preface	2
2.1	FOSS lives by contribution!	2
2.2	Osmocom and sysmocom	2
2.3	Corrections	2
2.4	Legal disclaimers	3
2.4.1	Spectrum License	3
2.4.2	Software License	3
2.4.3	Trademarks	3
2.4.4	Liability	3
3	Introduction	3
3.1	Required Skills	3
3.2	Getting assistance	4
4	Overview	4
4.1	About OsmoGGSN	4
4.2	Software Components	4
4.2.1	GTP Implementation (libgtp)	4
4.2.2	sgsnemu	5
4.2.3	osmo-ggsn	5
4.2.4	systemd service file	5
4.2.5	init script	5
4.3	Limitations	5
4.3.1	GSM 09.60 (GTPv0)	5
4.3.2	3GPP 29.060 (GTPv1)	6
5	Running OsmoNITB	7
5.1	SYNOPSIS	7
5.2	OPTIONS	7
5.3	Multiple instances	7
6	The Osmocom VTY Interface	7
6.1	Accessing the VTY	8
6.2	VTY Nodes	8
6.3	Interactive help	9
6.3.1	The question-mark (?) command	9
6.3.2	TAB completion	10
6.3.3	The list command	11

7 libsmocore Logging System	12
7.1 Logging to the VTY	12
7.2 Logging to a file	13
7.3 Logging to syslog	14
7.4 Logging to stderr	14
8 Configuring OsmoGGSN	14
8.1 Configuring a virtual GGSN instance	15
8.1.1 Creating/Editing a GGSN instance	15
8.1.2 Configuring a GGSN instance	15
8.1.3 Deleting a GGSN instance	16
8.1.4 Taking a GGSN instance out of shutdown	16
8.1.5 Shutting a GGSN instance down	16
8.2 Configuring an Access Point Name	16
8.2.1 Creating/Editing an APN	17
8.2.2 Configuring an APN	17
8.2.3 Deleting an APN	17
8.2.4 Taking an APN out of shutdown	18
8.2.5 Shutting an APN down	18
9 Osmocom Control Interface	18
9.1 Control Interface Protocol	19
9.1.1 GET operation	20
9.1.2 SET operation	20
9.1.3 TRAP operation	20
9.2 Common variables	21
9.3 Control Interface python example: <code>bsc_control.py</code>	21
9.3.1 Setting a value	21
9.3.2 Getting a value	21
9.3.3 Listening for traps	22
10 Glossary	22
A Osmocom TCP/UDP Port Numbers	28
B Bibliography / References	29
B.0.3.0.1 References	29

C GNU Free Documentation License	31
C.1 PREAMBLE	31
C.2 APPLICABILITY AND DEFINITIONS	31
C.3 VERBATIM COPYING	32
C.4 COPYING IN QUANTITY	32
C.5 MODIFICATIONS	33
C.6 COMBINING DOCUMENTS	34
C.7 COLLECTIONS OF DOCUMENTS	34
C.8 AGGREGATION WITH INDEPENDENT WORKS	34
C.9 TRANSLATION	35
C.10 TERMINATION	35
C.11 FUTURE REVISIONS OF THIS LICENSE	35
C.12 RELICENSING	35
C.13 ADDENDUM: How to use this License for your documents	36

1 Foreword

Digital cellular networks based on the GSM specification were designed in the late 1980ies and first deployed in the early 1990ies in Europe. Over the last 25 years, hundreds of networks were established globally and billions of subscribers have joined the associated networks.

The technological foundation of GSM was based on multi-vendor interoperable standards, first created by government bodies within CEPT, then handed over to ETSI, and now in the hands of 3GPP. Nevertheless, for the first 17 years of GSM technology, the associated protocol stacks and network elements have only existed in proprietary *black-box* implementations and not as Free Software.

In 2008 Dieter Spaar and I started to experiment with inexpensive end-of-life surplus Siemens GSM BTSs. We learned about the A-bis protocol specifications, reviewed protocol traces and started to implement the BSC-side of the A-bis protocol as something originally called `bs11-abis`. All of this was *just for fun*, in order to learn more and to boldly go where no Free Software developer has gone before. The goal was to learn and to bring Free Software into a domain that despite its ubiquity had not yet seen and Free / Open Source software implementations.

`bs11-abis` quickly turned into `bsc-hack`, then *OpenBSC* and into what is today known as its *OsmoNITB* variant: A minimal implementation of all the required functionality of an entire GSM network, exposing A-bis towards the BTS. The project attracted more interested developers, and surprisingly quick also commercial interest, contribution and adoption. This added support for more BTS models

After having implemented the network-side GSM protocol stack in 2008 and 2009, in 2010 the same group of people set out to create a telephone-side implementation of the GSM protocol stack. This established the creation of the Osmocom umbrella project, under which OpenBSC and the OsmocomBB projects were hosted.

Meanwhile, more interesting telecom standards were discovered and implemented, including TETRA professional mobile radio, DECT cordless telephony, GMR satellite telephony, some SDR hardware, a SIM card protocol tracer and many others.

It has been a most exciting ride during the last seven years. I wouldn't want to miss it under any circumstances.

—Harald Welte, Osmocom.org and OpenBSC founder, January 2016.

1.1 Acknowledgements

My deep thanks to everyone who has contributed to Osmocom. The list of contributors is too long to mention here, but I'd like to call out the following key individuals and organizations, in no particular order:

- Dieter Spaar for being the most amazing reverse engineer I've met in my career
- Holger Freyther for his many code contributions and for shouldering a lot of the maintenance work, setting up Jenkins - and being crazy enough to co-start sysmocom as a company with me ;)
- Andreas Eversberg for taking care of Layer2 and Layer3 of OsmocomBB, and for his work on OsmoBTS and OsmoPCU
- Sylvain Munaut for always tackling the hardest problems, particularly when it comes closer to the physical layer
- Chaos Computer Club for providing us a chance to run real-world deployments with tens of thousands of subscribers every year
- Bernd Schneider of Netzing AG for funding early ip.access nanoBTS support
- On-Waves ehf for being one of the early adopters of OpenBSC and funding a never ending list of features, fixes and general improvement of pretty much all of our GSM network element implementations
- sysmocom, for hosting and funding a lot of Osmocom development, the annual Osmocom Developer Conference and releasing this manual.
- Jan Luebbe, Stefan Schmidt, Daniel Willmann, Pablo Neira, Nico Golde, Kevin Redon, Ingo Albrecht, Alexander Huemer, Alexander Chemeris, Max Suraev, Tobias Engel, Jacob Erlbeck, Ivan Kluchnikov

May the source be with you!

—Harald Welte, Osmocom.org and OpenBSC founder, January 2016.

2 Preface

First of all, we appreciate your interest in Osmocom software.

Osmocom is a Free and Open Source Software (FOSS) community that develops and maintains a variety of software (and partially also hardware) projects related to mobile communications.

Founded by people with decades of experience in community-driven FOSS projects like the Linux kernel, this community is built on a strong belief in FOSS methodology, open standards and vendor neutrality.

2.1 FOSS lives by contribution!

If you are new to FOSS, please try to understand that this development model is not primarily about “free of cost to the GSM network operator”, but it is about a collaborative, open development model. It is about sharing ideas and code, but also about sharing the effort of software development and maintenance.

If your organization is benefitting from using Osmocom software, please consider ways how you can contribute back to that community. Such contributions can be many-fold, for example

- sharing your experience about using the software on the public mailing lists, helping to establish best practises in using/operating it,
- providing qualified bug reports, work-arounds
- sharing any modifications to the software you may have made, whether bug fixes or new features, even experimental ones
- providing review of patches
- testing new versions of the related software, either in its current “master” branch or even more experimental feature branches
- sharing your part of the maintenance and/or development work, either by donating developer resources or by (partially) funding those people in the community who do.

We’re looking forward to receiving your contributions.

2.2 Osmocom and sysmocom

Some of the founders of the Osmocom project have established sysmocom as a company to provide products and services related to Osmocom.

sysmocom and its staff are the by far the largest developers and contributors to the Osmocom mobile network infrastructure projects.

As part of this work, sysmocom has also created the manual you are reading.

At sysmocom, we draw a clear line between what is the Osmocom FOSS project, and what is sysmocom as a commercial entity. Under no circumstances requires participation in the FOSS projects any commercial relationship with sysmocom as a company.

2.3 Corrections

We have prepared this manual in the hope it will guide you through the process of installing, configuring and debugging your deployment of cellular network infrastructure elements using Osmocom software. If you do find errors, mistakes and/or omissions, or have any suggestions on missing topics, please do take the extra time and let us know.

2.4 Legal disclaimers

2.4.1 Spectrum License

As GSM operates in licensed spectrum, please always double-check that you have all required licenses and that you do not transmit on any ARFCN that is not explicitly allocated to you by the applicable regulatory authority in your country.



Warning

Depending on your jurisdiction, operating a radio transmitter without a proper license may be considered a felony under criminal law!

2.4.2 Software License

The software developed by the Osmocom project and described in this manual is Free / Open Source Software (FOSS) and subject to so-called *copyleft* licensing.

Copyleft licensing is a legal instrument to ensure that this software and any modifications, extensions or derivative versions will always be publicly available to anyone, for any purpose, under the same terms as the original program as developed by Osmocom.

This means that you are free to use the software for whatever purpose, make copies and distribute them - just as long as you ensure to always provide/release the *complete and corresponding* source code.

Every Osmocom software includes a file called `COPYING` in its source code repository which explains the details of the license. The majority of programs is released under GNU Affero General Public License, Version 3 (AGPLv3).

If you have any questions about licensing, don't hesitate to contact the Osmocom community. We're more than happy to clarify if your intended use case is compliant with the software licenses.

2.4.3 Trademarks

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2.4.4 Liability

The software is distributed in the hope that it will be useful, but **WITHOUT ANY WARRANTY**; without even the implied warranty of **MERCHANTABILITY** or **FITNESS FOR A PARTICULAR PURPOSE**. See the License text included with the software for more details.

3 Introduction

3.1 Required Skills

Please note that even while the capital expenses of running mobile networks has decreased significantly due to Osmocom software and associated hardware like *sysmoBTS*, GSM networks are still primarily operated by large GSM operators.

Neither the GSM specification nor the GSM equipment was ever designed for networks to be installed and configured by anyone but professional GSM engineers, specialized in their respective area like radio planning, radio access network, back-haul or core network.

If you do not share an existing background in GSM network architecture, GSM protocols, correctly installing, configuring and optimizing your GSM network will be tough, irrespective whether you use products with Osmocom software or those of traditional telecom suppliers.

GSM knowledge has many different fields, from radio planning through site installation through to core network configuration/administration.

The detailed skills required will depend on the type of installation and/or deployment that you are planning, as well as its associated network architecture. A small laboratory deployment for research at a university is something else than a rural network for a given village with a handful of cells, which is again entirely different from an urban network in a dense city.

Some of the useful skills we recommend are:

- general understanding about RF propagation and path loss in order to estimate coverage of your cells and do RF network planning.
- general understanding about GSM network architecture, its network elements and key transactions on the Layer 3 protocol
- general understanding about voice telephony, particularly those of ISDN heritage (Q.931 call control)
- understanding of GNU/Linux system administration and working on the shell
- understanding of TCP/IP networks and network administration, including tcpdump, tshark, wireshark protocol analyzers.
- ability to work with text based configuration files and command-line based interfaces such as the VTY of the Osmocom network elements

3.2 Getting assistance

If you do have a support package / contract with sysmocom (or want to get one), please contact support@sysmocom.de with any issues you may have.

If you don't have a support package / contract, you have the option of using the resources put together by the Osmocom community at <http://projects.osmocom.org/>, checking out the wiki and the mailing-list for community-based assistance. Please always remember, though: The community has no obligation to help you, and you should address your requests politely to them. The information (and software) provided at osmocom.org is put together by volunteers for free. Treat them like a friend whom you're asking for help, not like a supplier from whom you have bought a service.

4 Overview

4.1 About OsmoGGSN

OsmoGGSN is a Free / Open Source Software implementation of the GPRS GGSN (Gateway GPRS support node) element in side the packet switched core network of 2G and 3G cellular networks.

The GGSN function is the tunnel endpoint on the core network side, from where the external (IP) packet data network

4.2 Software Components

4.2.1 GTP Implementation (libgtp)

The OsmoGGSN source code includes a shared library implementation of the GTP protocol used on the GGSN-SGSN interface. This library and associated header files are installed system-wide and are available to other programs/applications.

In fact, libgtp is what the OsmoSGSN also uses for its use of GTP.

4.2.2 sgsnemu

In order to test OsmoGGSN without running a SGSN and other elements of a cellular network, there is a small command-line utility called **sgsnemu** which is able to simulate the customary operations of a SGSN towards the GGSN, such as a PDP Context Activation.

sgsnemu can even be used for testing against other GGSNs, as the GTP protocol is standardized across implementations.

4.2.3 osmo-ggsn

osmo-ggsn is the actual name of the OsmoGGSN executable program. It implements the GGSN functionality. All parameters are set using the configuration file, by default located in **./osmo-ggsn.cfg**

4.2.4 systemd service file

In **contrib/osmo-ggsn.service** you can find a sample service file for OsmoGGSN which can be used with systemd.

4.2.5 init script

In **contrib/osmo-ggsn.init** you can find a sample init script to be used on systems with classic init process.

4.3 Limitations

OsmoGGSN supports both GTP0 (GSM 09.60) and GTP1 (3GPP 29.060). In the following tables the support of each individual message type is detailed. The numbers before each feature indicates the relevant section in the standard.

4.3.1 GSM 09.60 (GTPv0)

Feature	gtplib	osmo-ggsn	sgsnemu	notes
7.4 Path Management Messages				
7.4.1 Echo Request	Supported	Supported	Supported	
7.4.2 Echo Response	Supported	Supported	Supported	
7.4.3 Version Not Supported	Supported	Supported	Supported	
7.5 Tunnel Management Messages				
7.5.1 Create PDP Context Request	Supported	Supported	Supported	
7.5.2 Create PDP Context Response	Supported	Supported	Supported	
7.5.3 Update PDP Context Request	Supported	Supported	Not	
7.5.4 Update PDP Context Response	Supported	Supported	Not	
7.5.5 Delete PDP Context Request	Supported	Supported	Supported	
7.5.6 Delete PDP Context Response	Supported	Supported	Supported	
7.5.7 Create AA PDP Context Request	Unsupported	Unsupported	Unsupported	
7.5.8 Create AA PDP Response	Unsupported	Unsupported	Unsupported	
7.5.9 Delete AA PDP Context Request	Unsupported	Unsupported	Unsupported	
7.5.10 Delete AA PDP Context Response	Unsupported	Unsupported	Unsupported	
7.5.11 Error Indication	Supported	Supported	Supported	
7.5.12 PDU Notification Request	Unsupported	Unsupported	Unsupported	
7.5.13 PDU Notification Response	Unsupported	Unsupported	Unsupported	
7.5.14 PDU Notification Reject Request	Unsupported	Unsupported	Unsupported	
7.5.15 PDU Notification Reject Response	Unsupported	Unsupported	Unsupported	
7.6 Location Management Messages				
7.6.1 Send Routing Information for GPRS Request	Unsupported	Unsupported	Not applicable	
7.6.2 Send Routing Information for GPRS Response	Unsupported	Unsupported	Not applicable	
7.6.3 Failure Report Request	Unsupported	Unsupported	Not applicable	

Feature	gtplib	osmo-ggsn	sgsnemu	notes
7.6.3 Failure Report Response	Unsupported	Unsupported	Not applicable	
7.6.5 Note MS GPRS Present Request	Unsupported	Unsupported	Not applicable	
7.6.6 Note MS GPRS Present Response	Unsupported	Unsupported	Not applicable	
7.5 Mobility Management Messages				
7.5.1 Identification Request	Unsupported	Not applicable	Not applicable	
7.5.2 Identification Response	Unsupported	Not applicable	Not applicable	
7.5.3 SGSN Context Request	Unsupported	Not applicable	Not applicable	
7.5.4 SGSN Context Response	Unsupported	Not applicable	Not applicable	
7.5.5 SGSN Context Acknowledge	Unsupported	Not applicable	Not applicable	

4.3.2 3GPP 29.060 (GTPv1)

Feature	gtplib	osmo-ggsn	sgsnemu	notes
7.2 Path Management Messages				
7.2.1 Echo Request	Supported	Supported	Supported	
7.2.2 Echo Response	Supported	Supported	Supported	
7.2.3 Version Not Supported	Supported	Supported	Supported	
7.2.4 Extension Headers Notification	Supported	Supported	Supported	
7.3 Tunnel Management Messages				
7.3.1 Create PDP Context Request	Supported	Supported	Supported	1
7.3.2 Create PDP Context Response	Supported	Supported	Supported	
7.3.3 Update PDP Context Request	Supported	Supported	Not applicable	1
7.3.4 Update PDP Context Response	Supported	Supported	Not applicable	
7.3.5 Delete PDP Context Request	Supported	Supported	Supported	
7.3.6 Delete PDP Context Response	Supported	Supported	Supported	
7.3.7 Error Indication	Supported	Supported	Supported	
7.3.8 PDU Notification Request	Unsupported	Unsupported	Unsupported	
7.3.9 PDU Notification Response	Unsupported	Unsupported	Unsupported	
7.3.10 PDU Notification Reject Request	Unsupported	Unsupported	Unsupported	
7.3.10 PDU Notification Reject Response	Unsupported	Unsupported	Unsupported	
7.4 Location Management Messages				
7.4.1 Send Routing Information for GPRS Request	Unsupported	Unsupported	Not applicable	
7.4.2 Send Routing Information for GPRS Response	Unsupported	Unsupported	Not applicable	
7.4.3 Failure Report Request	Unsupported	Unsupported	Not applicable	
7.4.3 Failure Report Response	Unsupported	Unsupported	Not applicable	
7.4.5 Note MS GPRS Present Request	Unsupported	Unsupported	Not applicable	
7.4.6 Note MS GPRS Present Response	Unsupported	Unsupported	Not applicable	
7.5 Mobility Management Messages				
7.5.1 Identification Request	Unsupported	Not applicable	Not applicable	
7.5.2 Identification Response	Unsupported	Not applicable	Not applicable	
7.5.3 SGSN Context Request	Unsupported	Not applicable	Not applicable	
7.5.4 SGSN Context Response	Unsupported	Not applicable	Not applicable	
7.5.5 SGSN Context Acknowledge	Unsupported	Not applicable	Not applicable	
7.5.6 Forward Relocation Request	Unsupported	Not applicable	Not applicable	
7.5.7 Forward Relocation Response	Unsupported	Not applicable	Not applicable	
7.5.8 Forward Relocation Complete	Unsupported	Not applicable	Not applicable	
7.5.9 Relocation Cancel Request	Unsupported	Not applicable	Not applicable	
7.5.10 Relocation Cancel Response	Unsupported	Not applicable	Not applicable	
7.5.11 Forward Relocation Complete	Unsupported	Not applicable	Not applicable	
7.5.12 Forward SRNS Context Acknowledge	Unsupported	Not applicable	Not applicable	
7.5.13 Forward SRNS Context	Unsupported	Not applicable	Not applicable	

Notes

- 1) The "Secondary PDP Context Activation Procedure" is not supported.

5 Running OsmoNITB

The OsmoGGSN executable (`osmo-ggsn`) offers the following command-line arguments:

5.1 SYNOPSIS

```
osmo-ggsn [-hl-V] [-D] [-c CONFIGFILE]
```

5.2 OPTIONS

-h, --help

Print a short help message about the supported options

-V, --version

Print the compile-time version number of the OsmoBTS program

-D, --daemonize

Fork the process as a daemon into background.

-c, --config-file *CONFIGFILE*

Specify the file and path name of the configuration file to be used. If none is specified, use `osmo-ggsn.cfg` in the current working directory.

5.3 Multiple instances

Running multiple instances of `osmo-ggsn` is possible if all GGSN instances are binding to different local IP addresses and all other interfaces (VTY, OML) are separated using the appropriate configuration options. The IP based interfaces are binding to local host by default. In order to separate the processes, the user has to bind those services to specific but different IP addresses.

The VTY and the control interface can be bound to IP addresses from the loopback address range.

Example: Binding VTY and control interface to a specific ip-address

```
line vty
  bind 127.0.0.2
ctrl
  bind 127.0.0.2
```

6 The Osmocom VTY Interface

All interaction with Osmocom software is typically performed via an interactive command-line interface called the *VTY*.

The Osmocom VTY is used to

- explore the current status of the system, including its configuration parameters but also run-time state and statistics
- review the currently active (running) configuration
- perform interactive changes to the configuration
- store the current running configuration to the config file
- enable or disable logging; to the VTY itself or to other targets

The Virtual Tele Type (VTY) has the concept of *nodes* and *commands*. Each command has a name and arguments. The name may contain a space to group several similar commands into a specific group. The arguments can be a single word, a string, numbers, ranges or a list of options. The available commands depend on the current node. there are various keyboard shortcuts to ease finding commands and the possible argument values.

This chapter explains the most common nodes and the commands that are available within the node.

There are common patterns for the parameters, these include IPv4 addresses, number ranges, a word, a line of text and choice. The following will explain the commonly used syntactical patterns:

Table 1: VTY Parameter Patterns

Pattern	Example	Explanation
A.B.C.D	127.0.0.1	An IPv4 address
TEXT	example01	A single string without any spaces, tabs
.TEXT	Some information	A line of text
(OptionA OptionB OptionC)	OptionA	A choice between a list of available options
<0-10>	5	A number from a range

6.1 Accessing the VTY

The VTY of a given Osmocom program is implemented as a telnet server, listening to a specific TCP port. For `osmo-nitb`, this port is 4242.

Please see Appendix A to check for the default TCP port number of the VTY interface of the specific Osmocom software you would like to connect to.

As telnet is insecure and offers neither strong authentication nor encryption, the VTY by default only binds to localhost (127.0.0.1) and will thus not be reachable by other hosts on the network.



Warning

By default, any user with access to the machine running the Osmocom software will be able to connect to the VTY. We assume that such systems are single-user systems, and anyone with local access to the system also is authorized to access the VTY. If you require stronger security, you may consider using the packet filter of your operating system to restrict access to the Osmocom VTY ports further.

6.2 VTY Nodes

The VTY by default has the following minimal nodes:

VIEW

The *VIEW* node is the node you automatically enter when you connect to a VTY. As its name implies, it can only be used to view the system status, but it does not provide commands to alter the system state or configuration. As long as you are in the non-privileged *VIEW* node, your prompt will end in a > character.

ENABLE

The *ENABLE* node is entered as soon as you enter the `enable` command from the *VIEW* node. Changing into the *ENABLE* node will unlock all kinds of commands that allow you to alter the system state or perform any other change to it. The *ENABLE* node and its children are signified by a # character at the end of your prompt.

You can change back from the *ENABLE* node to the *VIEW* node by using the `disable` command.

CONFIG

The *CONFIG* node is entered when you enter the `configure terminal` command from the *VIEW* node. The config

node is used to change the run-time configuration parameters of the system. The prompt will indicate that you are in the config node by a (config)# prompt suffix.

You can always leave the *CONFIG* node or any of its children by using the `end` command.

This node is also automatically entered at the time the configuration file is read. All configuration file lines are processed as if they were entered from the *VTY CONFIG* node at start-up.

Other

Depending on the specific Osmocom program you are running, there will be few or more other nodes, typically below the *CONFIG* node. For example, the OsmoBSC has nodes for each BTS, and within the BTS node one for each TRX, and within the TRX node one for each Timeslot.

6.3 Interactive help

The VTY features an interactive help system, designed to help you to efficiently navigate its commands.

Note

The VTY is present on most Osmocom GSM/GPRS software, thus this chapter is present in all the relevant manuals. The detailed examples below assume you are executing them on the OsmoNITB VTY. They will work in similar fashion on the other VTY, too - but of course the output will be different for each program.

6.3.1 The question-mark (?) command

If you type a single ? at the prompt, the VTY will display your possible completions at the exact location of your currently entered command.

If you type ? at an otherwise empty command (without having entered even only a partial command), you will get a list of the first word of all possible commands available at this node:

Example: Typing ? at start of OsmoNITB prompt

```
OpenBSC> ?
show      Show running system information
list      Print command list
exit      Exit current mode and down to previous mode
help      Description of the interactive help system
enable    Turn on privileged mode command
terminal  Set terminal line parameters
who       Display who is on vty
logging   Configure log message to this terminal
sms       SMS related commands
subscriber Operations on a Subscriber
```

press ? here at the prompt, the character will not be printed

If you have already entered a partial command, ? will help you to review possible options of how to continue your command. Let's say you remember that `show` is used to investigate the system status. But you don't know exactly what the object was called that you'd like to show: You simply press ? after typing `show` and you will see the following choice:

Example: Typing ? after a partial command

```
OpenBSC> show ?
version    Displays program version
online-help Online help
history    Display the session command history
network    Display information about a GSM NETWORK
bts        Display information about a BTS
trx        Display information about a TRX
```

timeslot	Display information about a TS
lchan	Display information about a logical channel
paging	Display information about paging requests of a BTS
paging-group	Display the paging group
logging	Show current logging configuration
alarms	Show current logging configuration
stats	Show statistical values
e1_driver	Display information about available E1 drivers
e1_line	Display information about a E1 line
e1_timeslot	Display information about a E1 timeslot
subscriber	Operations on a Subscriber
statistics	Display network statistics
sms-queue	Display SMSqueue statistics
smpp	SMPP Interface

- ① press ? after the show command, the character will not be printed

Now you decide you want to have a look at the network object, so you type network and press ? again:

Example: Typing ? after show network

```
OpenBSC> show network
<cr>
```

By presenting <cr> as the only option, the VTY tells you that your command is complete and does not support any additional arguments.

6.3.2 TAB completion

The VTY supports tab (tabulator) completion. Simply type any partial command and press <tab>, and it will either show you a choice of possible continuations, or complete the command if there's only one alternative.

Example: Use of <tab> pressed after typing only s as command

```
OpenBSC> s①
show      sms      subscriber
```

- ① press <tab> here.

At this point you then have to decide how to continue typing your command. Let's assume you choose show, and then press <tab> again:

Example: Use of <tab> pressed after typing show command

```
OpenBSC> show ①
version      online-help history      network      bts      trx
timeslot    lchan      paging      paging-group logging      alarms
stats       e1_driver  e1_line     e1_timeslot subscriber statistics
sms-queue   smpp
```

- ① press <tab> here.

6.3.3 The list command

The `list` command will give you a full list of all commands available at this node:

Example: Typing list at start of OsmoNITB VIEW node prompt

```
OpenBSC> list
show version
show online-help
list
exit
help
enable
terminal length <0-512>
terminal no length
who
show history
show network
show bts [<0-255>]
show trx [<0-255>] [<0-255>]
show timeslot [<0-255>] [<0-255>] [<0-7>]
show lchan [<0-255>] [<0-255>] [<0-7>] [lchan_nr]
show lchan summary [<0-255>] [<0-255>] [<0-7>] [lchan_nr]
show paging [<0-255>]
show paging-group <0-255> IMSI
logging enable
logging disable
logging filter all (0|1)
logging color (0|1)
logging timestamp (0|1)
logging print extended-timestamp (0|1)
logging print category (0|1)
logging set-log-mask MASK
logging level (all|rll|cc|mm|rr|rsl|nm|mncc|pag|meas|sccp|msc|mgcp|ho|db|ref|gprs|ns| ↔
    bssgp|llc|sdcp|nat|ctrl|smpp|filter|lglobal|llapd|linp|lmux|lmi|lmib|lsms|lctrl|lgtp| ↔
    lstats) (debug|info|notice|error|fatal)
show logging vty
show alarms
show stats
show stats level (global|peer|subscriber)
show el_driver
show el_line [line_nr] [stats]
show el_timeslot [line_nr] [ts_nr]
show subscriber (extension|imsi|tmsi|id) ID
show subscriber cache
sms send pending
subscriber create imsi ID
subscriber (extension|imsi|tmsi|id) ID sms sender (extension|imsi|tmsi|id) SENDER_ID send ↔
    .LINE
subscriber (extension|imsi|tmsi|id) ID silent-sms sender (extension|imsi|tmsi|id) ↔
    SENDER_ID send .LINE
subscriber (extension|imsi|tmsi|id) ID silent-call start (any|tch/f|tch/any|sdccch)
subscriber (extension|imsi|tmsi|id) ID silent-call stop
subscriber (extension|imsi|tmsi|id) ID ussd-notify (0|1|2) .TEXT
subscriber (extension|imsi|tmsi|id) ID update
show statistics
show sms-queue
logging filter imsi IMSI
show smpp esme
```

Tip

Remember, the list of available commands will change significantly depending on the Osmocom program you are accessing, and the current node you're at. Compare the above example of the OsmoNITB *VIEW* node with the result from the OsmoNITB *TRX* config node:

Example: Typing list at start of OsmoNITB TRX config node prompt

```
OpenBSC(config-net-bts-trx)# list
help
list
write terminal
write file
write memory
write
show running-config
exit
end
arfcn <0-1023>
description .TEXT
no description
nominal power <0-100>
max_power_red <0-100>
rsl e1 line E1_LINE timeslot <1-31> sub-slot (0|1|2|3|full)
rsl e1 tei <0-63>
rf_locked (0|1)
timeslot <0-7>
```

7 libsmocore Logging System

In any reasonably complex software it is important to understand how to enable and configure logging in order to get a better insight into what is happening, and to be able to follow the course of action. We therefore ask the reader to bear with us while we explain how the logging subsystem works and how it is configured.

Most Osmocom Software (like `osmo-bts`, `osmo-bsc`, `osmo-nitb`, `osmo-sgsn` and many others) uses the same common logging system.

This chapter describes the architecture and configuration of this common logging system.

The logging system is composed of

- log targets (where to log),
- log categories (who is creating the log line),
- log levels (controlling the verbosity of logging), and
- log filters (filtering or suppressing certain messages).

All logging is done in human-readable ASCII-text. The logging system is configured by means of VTY commands that can either be entered interactively, or read from a configuration file at process start time.

7.1 Logging to the VTY

Logging messages to the interactive command-line interface (VTY) is most useful for occasional investigation by the system administrator.

Logging to the VTY is disabled by default, and needs to be enabled explicitly for each such session. This means that multiple concurrent VTY sessions each have their own logging configuration. Once you close a VTY session, the log target will be

destroyed and your log settings be lost. If you re-connect to the VTY, you have to again activate and configure logging, if you wish.

To create a logging target bound to a VTY, you have to use the following command: `logging enable` This doesn't really activate the generation of any output messages yet, it merely creates and attaches a log target to the VTY session. The newly-created target still doesn't have any filter installed, i.e. *all log messages will be suppressed by default*

Next, you can configure the log levels for your VTY session. Each sub-system of the program in question typically logs its messages as a different category, allowing fine-grained control over which log messages you will or will not see. For example, in OpenBSC, there are categories for the protocol layers `rsl`, `rr`, `mm`, `cc` and many others. To get a list of categories interactively on the vty, type: `logging level ?`

For each of those categories, you can set an independent log level, controlling the level of verbosity. Log levels include:

fatal

Fatal messages, causing abort and/or re-start of a process. This *shouldn't happen*.

error

An actual error has occurred, its cause should be further investigated by the administrator.

notice

A noticeable event has occurred, which is not considered to be an error.

info

Some information about normal/regular system activity is provided.

debug

Verbose information about internal processing of the system, used for debugging purpose. This will log the most.

The log levels are inclusive, e.g. if you select *info*, then this really means that all events with a level of at least *info* will be logged, i.e. including events of *notice*, *error* and *fatal*.

So for example, in OpenBSC, to set the log level of the Mobility Management category to info, you can use the following command: `log level mm info`.

Equally, to set the log level of the Call Control category to debug, you can use: `log level cc debug`

Finally, after having configured the levels, you still need to set the filter. The default behavior is to filter out everything, i.e. not to log anything. The reason is quite simple: On a busy production setup, logging all events for a given subsystem may very quickly be flooding your console before you have a chance to set a more restrictive filter.

To request no filtering, i.e. see all messages, you may use: `log filter all 1`

As another example, to only see messages relating to a particular subscriber identified by his IMSI, you may use: `log filter imsi 262020123456789`

Tip

If many messages are being logged to a VTY session, it may be hard to impossible to still use the same session for any commands. We therefore recommend to open a second VTY session in parallel, and use one only for logging, while the other is used for interacting with the system.

7.2 Logging to a file

As opposed to Logging to the VTY, logging to files is persistent and stored in the configuration file. As such, it is configured in sub-nodes below the configuration node. There can be any number of log files active, each of them having different settings regarding levels / subsystems.

To configure a new log file, enter the following sequence of commands:

```
OpenBSC> enable
OpenBSC# configure terminal
OpenBSC(config)# log file /path/to/my/file
OpenBSC(config-log)#
```

This leaves you at the config-log prompt, from where you can set the detailed configuration for this log file. The available commands at this point are identical to configuring logging on the VTY, they include `logging filter`, `logging level` as well as `logging color` and `logging timestamp`.

Tip

Don't forget to use the `copy running-config startup-config` (or its short-hand `write file`) command to make your logging configuration persistent across application re-start.

Note

libosmocore currently does not provide file close-and-reopen support by `SIGHUP`, as used by popular log file rotating solutions. Please contact the Osmocom developers if you require this feature to be implemented.

7.3 Logging to syslog

syslog is a standard for computer data logging maintained by the IETF. Unix-like operating systems like GNU/Linux provide several syslog compatible log daemons that receive log messages generated by application programs.

libosmocore based applications can log messages to syslog by using the syslog log target. You can configure syslog logging by issuing the following commands on the VTY:

```
OpenBSC> enable
OpenBSC# configure terminal
OpenBSC(config)# log syslog daemon
OpenBSC(config-log)#
```

This leaves you at the config-log prompt, from where you can set the detailed configuration for this log file. The available commands at this point are identical to configuring logging on the VTY, they include `logging filter`, `logging level` as well as `logging color` and `logging timestamp`.

Note

Syslog daemons will normally automatically prefix every message with a time-stamp, so you should disable the libosmocore time-stamping by issuing the `logging timestamp 0` command.

7.4 Logging to stderr

If you're not running the respective application as a daemon in the background, you can also use the stderr log target in order to log to the standard error file descriptor of the process.

In order to configure logging to stderr, you can use the following commands:

```
OpenBSC> enable
OpenBSC# configure terminal
OpenBSC(config)# log stderr
OpenBSC(config-log)#
```

8 Configuring OsmoGGSN

All configuration of OsmoGGSN is performed using the VTY. For more general information on the VTY interface, see `FIXME`.

8.1 Configuring a virtual GGSN instance

OsmoGGSN can run multiple GGSN instances inside one program/process. Each GGSN instance binds to its own transport-layer GTP IP address and has its own set of APNs and associated IP address pools + tun/gtp devices.

In most usage cases, you will only have a single GGSN instance inside your configuration file, like in below example:

Example: Single GGSN configuration section

```
ggsn ggsn0
gtp state-dir /tmp
gtp bind-ip 127.0.0.6
apn internet
gtpu-mode tun
tun-device tun4
type-support v4
ip prefix dynamic 176.16.222.0/24
ip dns 0 192.168.100.1
ip dns 1 8.8.8.8
ip ifconfig 176.16.222.0/24
no shutdown
```

8.1.1 Creating/Editing a GGSN instance

Creating/Editing a GGSN instance can be done by the following sequence of VTY commands:

```
OsmoGGSN> enable ❶
OsmoGGSN# configure terminal ❷
OsmoGGSN(config)# ggsn ggsn0 ❸
OsmoGGSN(config-ggsn)# ❹
```

- ❶ Change into privileged mode
- ❷ Enter the interactive configuration mode
- ❸ Create or edit the GGSN instance `ggsn0`. The name can be any ASCII string, its significance is only to the local user.
- ❹ Your prompt is now in the `ggsn` config node, where you can configure the properties of this GGSN instance.

NOTE

After creating a new GGSN instance, it is in `shutdown` mode. See `FIXME` to take it out of shutdown, but make sure to configure it fully before taking it out of shutdown.

8.1.2 Configuring a GGSN instance

The following two mandatory configuration statements have to be given for every GGSN instance:

```
OsmoGGSN(config-ggsn)# gtp state-dir /var/lib/ggsn/ggsn0 ❶
OsmoGGSN(config-ggsn)# gtp bind-ip 127.0.0.6 ❷
```

- ❶ Store the GSN restart state in the specified directory
- ❷ Bind the GGSN instance to the specified local IPv4 address

There are some further configuration statements that can be used at the GGSN node, some examples are given below. For a full list, see the OpenGGSN VTY reference manual (`FIXME`).

```
OsmoGGSN(config-ggsn)# default-apn foobar ❶
```

- ❶ Configure a default APN to be used if the user-requested APN is not found. The named APN must previously be configured

8.1.3 Deleting a GGSN instance

A GGSN instance can be removed like this

Example: Deleting a GGSN instance

```
OsmoGGSN> enable ❶  
OsmoGGSN# configure terminal ❷  
OsmoGGSN(config)# no ggsn ggsn0 ❸
```

- ❶ Change into privileged mode
- ❷ Enter the interactive configuration mode
- ❸ Delete the GGSN instance

8.1.4 Taking a GGSN instance out of shutdown

Example: Taking a GGSN instance out of shutdown

```
OsmoGGSN> enable ❶  
OsmoGGSN# configure terminal ❷  
OsmoGGSN(config)# ggsn ggsn0 ❸  
OsmoGGSN(config-ggsn)# no shutdown ggsn ❹
```

- ❶ Change into privileged mode
- ❷ Enter the interactive configuration mode
- ❸ Enter the config ndoe of the GGSN instance ggsn0
- ❹ Take the GGSN instance out of shutdown

8.1.5 Shutting a GGSN instance down

If you would like to take a GGSN instance out of service, you can put it into shutdown mode. This will make the entire GGSN unavailable to user traffic and permit you to e.g. reconfigure it before taking it out of shutdown again.

Example: Shutting down a GGSN instance

```
OsmoGGSN> enable ❶  
OsmoGGSN# configure terminal ❷  
OsmoGGSN(config)# ggsn ggsn0 ❸  
OsmoGGSN(config-ggsn)# shutdown ggsn ❹
```

- ❶ Change into privileged mode
- ❷ Enter the interactive configuration mode
- ❸ Enter the config ndoe of the GGSN instance ggsn0
- ❹ Shut down the GGSN instance

8.2 Configuring an Access Point Name

An Access Point Name (APN) represents a connection to an external packet data network, such as the public Internet or private corporate networks.

APNs are selected by terminals (MS/UE) when establishing PDP contexts.

Each OsmoGGSN GGSN instance can have any number of APNs configured. Each APN is identified by a string name.

8.2.1 Creating/Editing an APN

Example: Creating a new APN

```
OsmoGGSN> enable ❶
OsmoGGSN# configure terminal ❷
OsmoGGSN(config)# ggsn ggsn0 ❸
OsmoGGSN(config-ggsn)# apn internet ❹
OsmoGGSN(config-ggsn-apn)# ❺
```

- ❶ Change into privileged mode
- ❷ Enter the interactive configuration mode
- ❸ Enter the config node of the GGSN instance `ggsn0`
- ❹ Create or Edit an APN called `internet`
- ❺ Your prompt is now in the `ggsn` config node, where you can configure the properties of this GGSN instance.

NOTE

The newly-create APN is created in `shutdown` mode. See `FIXME` to take it out of shutdown.

8.2.2 Configuring an APN

Example: Configuring an APN

```
OsmoGGSN(config-ggsn-apn)# gtpu-mode tun ❶
OsmoGGSN(config-ggsn-apn)# type-support v4 ❷
OsmoGGSN(config-ggsn-apn)# ip prefix dynamic 176.16.222.0/24 ❸
OsmoGGSN(config-ggsn-apn)# ip dns 0 192.168.100.1 ❹
OsmoGGSN(config-ggsn-apn)# ip dns 1 8.8.8.8 ❺
OsmoGGSN(config-ggsn-apn)# ip ifconfig 176.16.222.0/24 ❻
```

- ❶ Use the userspace GTP-U handling using a TUN device
- ❷ Support (only) IPv4 Addresses
- ❸ Specify the pool of dynamic IPv4 addresses to be allocated to PDP contexts
- ❹ Specify the primary DNS server to be provided using IPCP/PCO
- ❺ Specify the secondary DNS server to be provided using IPCP/PCO
- ❻ Request OsmoGGSN to configure the `tun4` device network/netmask

NOTE

If you use the optional `ip ifconfig` command to set the network device address/mask, OsmoGGSN must run with `root` or `CAP_NET_ADMIN` support. It might be better to configure related tun devices at system startup and run OsmoGGSN as non-privileged user. See `FIXME` for more details.

8.2.3 Deleting an APN

An APN configuration can be removed like this

Example: Deleting an APN

```
OsmoGGSN> enable ❶
OsmoGGSN# configure terminal ❷
OsmoGGSN(config)# ggsn ggsn0 ❸
OsmoGGSN(config-ggsn)# no apn internet ❹
```

- ❶ Change into privileged mode
- ❷ Enter the interactive configuration mode
- ❸ Enter the config node of the GGSN instance `ggsn0`
- ❹ Delete the APN `internet`

8.2.4 Taking an APN out of shutdown

In order to bring a deactivated APN in `shutdown` state into active operation, use the `no shutdown` command at the APN node as explained in the following example:

Example: Taking an APN out of shutdown

```
OsmoGGSN> enable ❶
OsmoGGSN# configure terminal ❷
OsmoGGSN(config)# ggsn ggsn0 ❸
OsmoGGSN(config-ggsn)# apn internet ❹
OsmoGGSN(config-ggsn-apn)# no shutdown ❺
```

- ❶ Change into privileged mode
- ❷ Enter the interactive configuration mode
- ❸ Enter the config ndoe of the GGSN instance `ggsn0`
- ❹ Enter the config ndoe of the APN `internet`
- ❺ Take the APN out of shutdown

8.2.5 Shutting an APN down

If you would like to take an APN instance out of service, you can put it into shutdown mode. This will make the APN unavailable to user traffic and permit you to e.g. reconfigure it before taking it out of shutdown again.

Example: Shutting down an APN

```
OsmoGGSN> enable ❶
OsmoGGSN# configure terminal ❷
OsmoGGSN(config)# ggsn ggsn0 ❸
OsmoGGSN(config-ggsn)# apn internet ❹
OsmoGGSN(config-ggsn-apn)# shutdown ❺
```

- ❶ Change into privileged mode
- ❷ Enter the interactive configuration mode
- ❸ Enter the config ndoe of the GGSN instance `ggsn0`
- ❹ Enter the config ndoe of the APN `internet`
- ❺ Shut down the APN

9 Osmocom Control Interface

The VTY interface as described in Section 6 is aimed at human interaction with the respective Osmocom program.

Other programs **should not** use the VTY interface to interact with the Osmocom software, as parsing the textual representation is cumbersome, inefficient, and will break every time the formatting is changed by the Osmocom developers.

Instead, the *Control Interface* was introduced as a programmatic interface that can be used to interact with the respective program.

9.1 Control Interface Protocol

The control interface protocol is a mixture of binary framing with text based payload.

The protocol for the control interface is wrapped inside the IPA multiplex header with the stream identifier set to IPAC_PROTO_OSMO (0xEE).

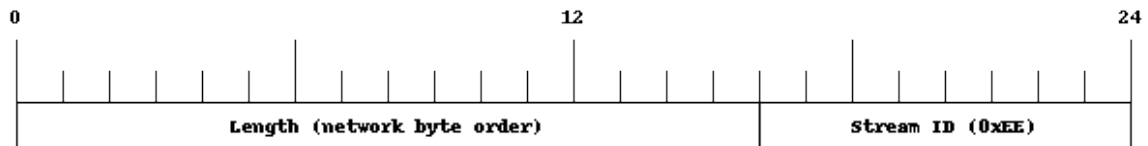


Figure 1: IPA header for control protocol

Inside the IPA header is a single byte of extension header with protocol ID 0x00 which indicates the control interface.

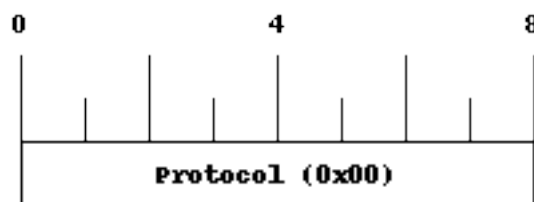


Figure 2: IPA extension header for control protocol

After the concatenation of the two above headers, the plain-text payload message starts. The format of that plain text is illustrated for each operation in the respective message sequence chart in the chapters below.

The fields specified below follow the following meaning:

<id>

A numeric identifier, uniquely identifying this particular operation. 0 is not allowed. It will be echoed back in any response to a particular request.

<var>

The name of the variable / field affected by the GET / SET / TRAP operation. Which variables/fields are available is dependent on the specific application under control.

<val>

The value of the variable / field

<reason>

A text formatted, human-readable reason why the operation resulted in an error.

9.1.1 GET operation

The GET operation is performed by an external application to get a certain value from inside the Osmocom application.

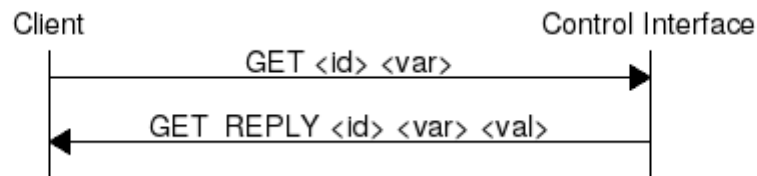


Figure 3: Control Interface GET operation (successful outcome)

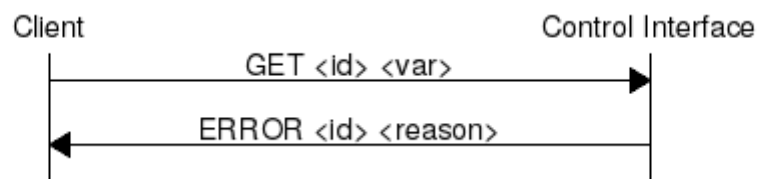


Figure 4: Control Interface GET operation (unsuccessful outcome)

9.1.2 SET operation

The SET operation is performed by an external application to set a value inside the Osmocom application.

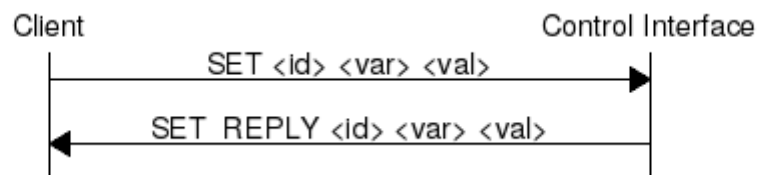


Figure 5: Control Interface SET operation (successful outcome)

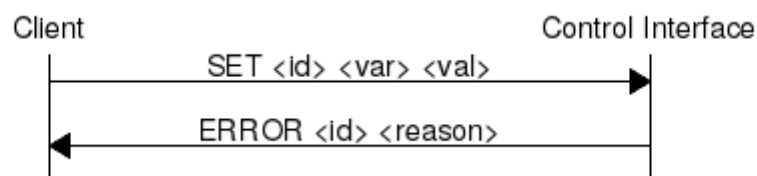


Figure 6: Control Interface SET operation (unsuccessful outcome)

9.1.3 TRAP operation

The program can at any time issue a trap. The term is used in the spirit of SNMP.

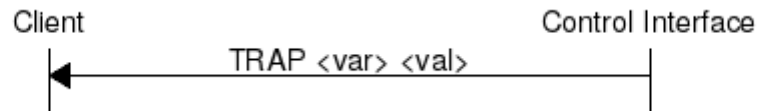


Figure 7: Control Interface TRAP operation

9.2 Common variables

There are several variables which are common to all the programs using control interface. They are described in the following table.

Table 2: Variables available over control interface

Name	Access	Value	Comment
counter.*	RO		Get counter value.
rate_ctr.*	RO		Get rate counter value.

Those read-only variables allow to get value of arbitrary counter or rate counter using its name e. g. "counter.net.sms.submitted" or "rate_ctr.per_hour.nat.bsc.sccp.conn". Of course for that to work the program in question have to register corresponding counter names using libosmocore functions. Note the difference between counter and rate_ctr access format: in case of rate_ctr the counter name have to be prefixed with interval specification which can be any of "per_sec", "per_min", "per_hour", "per_day" or "abs" for absolute value.

9.3 Control Interface python example: `bsc_control.py`

In the `openbsc.git` repository, there is an example python script called `openbsc/contrib/bsc_control.py` which implements the Osmocom control interface protocol.

You can use this tool either stand-alone to perform control interface operations against an Osmocom program, or you can use it as a reference for developing your own python software talking to the control interface.

9.3.1 Setting a value

Example: Use `bsc_control.py` to set the short network name of OsmoNITB

```
$ ./bsc_control.py -d localhost -s short-name 32C3
Got message: SET_REPLY 1 short-name 32C3
```

9.3.2 Getting a value

Example: Use `bsc_control.py` to get the mnc of OsmoNITB

```
$ ./bsc_control.py -d localhost -g mnc
Got message: GET_REPLY 1 mnc 262
```

9.3.3 Listening for traps

You can use `bsc_control.py` to listen for traps the following way:

Example: Using `bsc_control.py` to listen for traps:

```
$ ./bsc_control.py -d localhost -m
```

- ❶ the command will not return and wait for any TRAP messages to arrive

10 Glossary

2FF

2nd Generation Form Factor; the so-called plug-in SIM form factor

3FF

3rd Generation Form Factor; the so-called microSIM form factor

3GPP

3rd Generation Partnership Project

4FF

4th Generation Form Factor; the so-called nanoSIM form factor

A Interface

Interface between BTS and BSC, traditionally over E1 (*3GPP TS 48.008* [[3gpp-ts-48-008](#)])

A3/A8

Algorithm 3 and 8; Authentication and key generation algorithm in GSM and GPRS, typically COMP128v1/v2/v3 or MILENAGE are typically used

A5

Algorithm 5; Air-interface encryption of GSM; currently only A5/0 (no encryption), A5/1 and A5/3 are in use

Abis Interface

Interface between BTS and BSC, traditionally over E1 (*3GPP TS 48.058* [[3gpp-ts-48-058](#)] and *3GPP TS 52.021* [[3gpp-ts-52-021](#)])

ACC

Access Control Class; every BTS broadcasts a bit-mask of permitted ACC, and only subscribers with a SIM of matching ACC are permitted to use that BTS

AGCH

Access Grant Channel on Um interface; used to assign a dedicated channel in response to RACH request

AGPL

GNU Affero General Public License, a copyleft-style Free Software License

ARFCN

Absolute Radio Frequency Channel Number; specifies a tuple of uplink and downlink frequencies

AUC

Authentication Center; central database of authentication key material for each subscriber

BCCH

Broadcast Control Channel on Um interface; used to broadcast information about Cell and its neighbors

BCC

Base Station Color Code; short identifier of BTS, lower part of BSIC

BTS

Base Transceiver Station

BSC

Base Station Controller

BSIC

Base Station Identity Code; 16bit identifier of BTS within location area

BSSGP

Base Station Subsystem Gateway Protocol (*3GPP TS 48.018* [[3gpp-ts-48-018](#)])

BVCI

BSSGP Virtual Circuit Identifier

CBCH

Cell Broadcast Channel; used to transmit Cell Broadcast SMS (SMS-CB)

CC

Call Control; Part of the GSM Layer 3 Protocol

CCCH

Common Control Channel on Um interface; consists of RACH (uplink), BCCH, PCH, AGCH (all downlink)

Cell

A cell in a cellular network, served by a BTS

CEPT

Conférence européenne des administrations des postes et des télécommunications; European Conference of Postal and Telecommunications Administrations.

CGI

Cell Global Identifier comprised of MCC, MNC, LAC and BSIC

dB

deci-Bel; relative logarithmic unit

dBm

deci-Bel (milliwatt); unit of measurement for signal strength of radio signals

DHCP

Dynamic Host Configuration Protocol (*IETF RFC 2131* [[ietf-rfc2131](#)])

downlink

Direction of messages / signals from the network core towards the mobile phone

DSP

Digital Signal Processor

dnvixload

Tool to program UBL and the Bootloader on a sysmoBTS

EDGE

Enhanced Data rates for GPRS Evolution; Higher-speed improvement of GPRS; introduces 8PSK

EGPRS

Enhanced GPRS; the part of EDGE relating to GPRS services

ESME

External SMS Entity; an external application interfacing with a SMSC over SMPP

ETSI

European Telecommunications Standardization Institute

FPGA

Field Programmable Gate Array; programmable digital logic hardware

Gb

Interface between PCU and SGSN in GPRS/EDGE network; uses NS, BSSGP, LLC

GERAN

GPRS/EDGE Radio Access Network

GGSN

GPRS Gateway Support Node; gateway between GPRS and external (IP) network

GMSK

Gaussian Minimum Shift Keying; modulation used for GSM and GPRS

GPL

GNU General Public License, a copyleft-style Free Software License

Gp

Gp interface between SGSN and GGSN; uses GTP protocol

GPS

Global Positioning System; provides a highly accurate clock reference besides the global position

GSM

Global System for Mobile Communications. ETSI/3GPP Standard of a 2G digital cellular network

GSMTAP

GSM tap; pseudo standard for encapsulating GSM protocol layers over UDP/IP for analysis

GTP

GPRS Tunnel Protocol; used between SGSN and GGSN

HLR

Home Location Register; central subscriber database of a GSM network

HPLMN

Home PLMN; the network that has issued the subscriber SIM and has his record in HLR

IE

Information Element

IMEI

International Mobile Equipment Identity; unique identifier for the mobile phone

IMSI

International Mobile Subscriber Identity; 15-digit unique identifier for the subscriber/SIM; starts with MCC/MNC of issuing operator

IP

Internet Protocol (*IETF RFC 791* [?])

IPA

ip.access GSM over IP protocol; used to multiplex a single TCP connection

LAC

Location Area Code; 16bit identifier of Location Area within network

LAPD

Link Access Protocol, D-Channel (*ITU-T Q.921* [[itu-t-q921](#)])

LAPDm

Link Access Protocol Mobile (*3GPP TS 44.006* [[3gpp-ts-44-006](#)])

LLC

Logical Link Control; GPRS protocol between MS and SGSN (*3GPP TS 44.064* [[3gpp-ts-44-064](#)])

Location Area

Location Area; a geographic area containing multiple BTS

MCC

Mobile Country Code; unique identifier of a country, e.g. 262 for Germany

MMF

Machine-to-Machine Form Factor; a SIM chip package that is soldered permanently onto M2M device circuit boards.

MGW

Media Gateway

MM

Mobility Management; part of the GSM Layer 3 Protocol

MNC

Mobile Network Code; identifies network within a country; assigned by national regulator

MNO

Mobile Network Operator; operator with physical radio network under his MCC/MNC

MS

Mobile Station; a mobile phone / GSM Modem

MSC

Mobile Switching Center; network element in the circuit-switched core network

MSISDN

Mobile Subscriber ISDN Number; telephone number of the subscriber

MVNO

Mobile Virtual Network Operator; Operator without physical radio network

NCC

Network Color Code; assigned by national regulator

NITB

Network In The Box; combines functionality traditionally provided by BSC, MSC, VLR, HLR, SMSC functions; see OsmoNITB

NSEI

NS Entity Identifier

NVCI

NS Virtual Circuit Identifier

NWL

Network Listen; ability of some BTS to receive downlink from other BTSs

NS

Network Service; protocol on Gb interface (*3GPP TS 48.016* [[3gpp-ts-48-016](#)])

OCXO

Oven Controlled Crystal Oscillator; very high precision oscillator, superior to a VCTCXO

OML

Operation & Maintenance Link (*ETSI/3GPP TS 52.021* [[3gpp-ts-52-021](#)])

OpenBSC

Open Source implementation of GSM network elements, specifically OsmoBSC, OsmoNITB, OsmoSGSN

OpenGGSN

Open Source implementation of a GPRS Packet Control Unit

OpenVPN

Open-Source Virtual Private Network; software employed to establish encrypted private networks over untrusted public networks

Osmocom

Open Source MOBILE COMMUNICATIONS; collaborative community for implementing communications protocols and systems, including GSM, GPRS, TETRA, DECT, GMR and others

OsmoBSC

Open Source implementation of a GSM Base Station Controller

OsmoNITB

Open Source implementation of a GSM Network In The Box, combines functionality traditionally provided by BSC, MSC, VLR, HLR, AUC, SMSC

OsmoSGSN

Open Source implementation of a Serving GPRS Support Node

OsmoPCU

Open Source implementation of a GPRS Packet Control Unit

OTA

Over-The-Air; Capability of operators to remotely reconfigure/reprogram ISM/USIM cards

PCH

Paging Channel on downlink Um interface; used by network to page an MS

PCU

Packet Control Unit; used to manage Layer 2 of the GPRS radio interface

PDCH

Packet Data Channel on Um interface; used for GPRS/EDGE signalling + user data

PIN

Personal Identification Number; a number by which the user authenticates to a SIM/USIM or other smart card

PLMN

Public Land Mobile Network; specification language for a single GSM network

PUK

PIN Unblocking Code; used to unblock a blocked PIN (after too many wrong PIN attempts)

RAC

Routing Area Code; 16bit identifier for a Routing Area within a Location Area

RACH

Random Access Channel on uplink Um interface; used by MS to request establishment of a dedicated channel

RAM

Remote Application Management; Ability to remotely manage (install, remove) Java Applications on SIM/USIM Card

RF

Radio Frequency

RFM

Remote File Management; Ability to remotely manage (write, read) files on a SIM/USIM card

Roaming

Procedure in which a subscriber of one network is using the radio network of another network, often in different countries; in some countries national roaming exists

Routing Area

Routing Area; GPRS specific sub-division of Location Area

RR

Radio Resources; Part of the GSM Layer 3 Protocol

RSL

Radio Signalling Link (*3GPP TS 48.058* [[3gpp-ts-48-058](#)])

RTP

Real-Time Transport Protocol (*IETF RFC 3550* [[ietf-rfc3550](#)]); Used to transport audio/video streams over UDP/IP

SACCH

Slow Associate Control Channel on Um interface; bundled to a TCH or SDCCH, used for signalling in parallel to active dedicated channel

SDCCH

Slow Dedicated Control Channel on Um interface; used for signalling and SMS transport in GSM

SDK

Software Development Kit

SIM

Subscriber Identity Module; small chip card storing subscriber identity

Site

A site is a location where one or more BTSs are installed, typically three BTSs for three sectors

SMPP

Short Message Peer-to-Peer; TCP based protocol to interface external entities with an SMSC

SMSC

Short Message Service Center; store-and-forward relay for short messages

SSH

Secure Shell; *IETF RFC 4250* [[ietf-rfc4251](#)] to 4254

syslog

System logging service of UNIX-like operating systems

System Information

A set of downlink messages on the BCCH and SACCH of the Um interface describing properties of the cell and network

TCH

Traffic Channel; used for circuit-switched user traffic (mostly voice) in GSM

TCP

Transmission Control Protocol; (*IETF RFC 793* [[ietf-rfc793](#)])

TFTP

Trivial File Transfer Protocol; (*IETF RFC 1350* [[ietf-rfc1350](#)])

TRX

Transceiver; element of a BTS serving a single carrier

u-Boot

Boot loader used in various embedded systems

UBI

An MTD wear leveling system to deal with NAND flash in Linux

UBL

Initial bootloader loaded by the TI Davinci SoC

UDP

User Datagram Protocol (*IETF RFC 768* [[ietf-rfc768](#)])

UICC

Universal Integrated Chip Card; A smart card according to *ETSI TR 102 216* [[etsi-tr102216](#)]

Um interface

U mobile; Radio interface between MS and BTS

uplink

Direction of messages: Signals from the mobile phone towards the network

USIM

Universal Subscriber Identity Module; application running on a UICC to provide subscriber identity for UMTS and GSM networks

VCTCXO

Voltage Controlled, Temperature Compensated Crystal Oscillator; a precision oscillator, superior to a classic crystal oscillator, but inferior to an OCXO

VPLMN

Visited PLMN; the network in which the subscriber is currently registered; may differ from HPLMN when on roaming

VTY

Virtual Teletype; a textual command-line interface for configuration and introspection, e.g. the OsmoBSC configuration file as well as its telnet link on port 4242

A Osmocom TCP/UDP Port Numbers

The Osmocom GSM system utilizes a variety of TCP/IP based protocols. The table below provides a reference as to which port numbers are used by which protocol / interface.

Table 3: TCP/UDP port numbers

L4 Protocol	Port Number	Purpose	Software
UDP	2427	MGCP GW	osmo-bsc_mgcp
TCP	2775	SMPP (SMS interface for external programs)	osmo-nitb
TCP	3002	A-bis/IP OML	osmo-bts, osmo-bsc, osmo-nitb
TCP	3003	A-bis/IP RSL	osmo-bts, osmo-bsc, osmo-nitb
TCP	4239	telnet (VTY)	osmo-stp
TCP	4240	telnet (VTY)	osmo-pcu
TCP	4241	telnet (VTY)	osmo-bts
TCP	4242	telnet (VTY)	osmo-nitb, osmo-bsc, cellmgr-ng
TCP	4243	telnet (VTY)	osmo-bsc_mgcp
TCP	4244	telnet (VTY)	osmo-bsc_nat
TCP	4245	telnet (VTY)	osmo-sgsn
TCP	4246	telnet (VTY)	osmo-gbproxy
TCP	4247	telnet (VTY)	OsmocomBB
TCP	4249	Control Interface	osmo-nitb, osmo-bsc
TCP	4250	Control Interface	osmo-bsc_nat
TCP	4251	Control Interface	osmo-sgsn
TCP	4252	telnet (VTY)	sysmobts-mgr
TCP	4253	telnet (VTY)	osmo-gtphub
TCP	4254	telnet (VTY)	osmo-msc
TCP	4255	Control Interface	osmo-msc
TCP	4256	telnet (VTY)	osmo-sip-connector

Table 3: (continued)

L4 Protocol	Port Number	Purpose	Software
TCP	4257	Control Interface	ggsn (OpenGGSN)
TCP	4258	telnet (VTY)	osmo-hlr
TCP	4259	Control Interface	osmo-hlr
TCP	4260	telnet (VTY)	ggsn (OpenGGSN)
UDP	4729	GSMTAP	Almost every osmocom project
TCP	5000	A/IP	osmo-bsc, osmo-bsc_nat
UDP	2427	GSMTAP	osmo-pcu, osmo-bts
UDP	23000	GPRS-NS over IP default port	osmo-pcu, osmo-sgsn, osmo-gbproxy

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