Cisco SCMS SM CNR LEG

Reference Guide

Version 3.0
OL-7201-02

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Customer Order Number: DOC-720102=
Text Part Number: OL-7201-02

Printed in the USA on recycled paper containing 10% postconsumer waste.

Cisco SCMS SM CNR LEG *Reference Guide*

CONTENTS

Preface

This document explains how to install and configure the Cisco Network Registrar (CNR) Login Event Generator (LEG) on the Solaris and Windows NT/2000 platforms.

Document Revision History

Cisco Service Center Release	Part Number	Publication Date
Release 3.0	OL-7201-02	December, 2005
	Description of Changes	
	Reorganization of documentation. No major changes or new features were added to this revision.	
Release 2.5.7	OL-7201-01	May, 2005

Audience

This document is intended for System Administrators and Integrators who are responsible for the installation, configuration, and maintenance of the CNR LEG component. The administrator or system integrator should be familiar with the CNR extensions concept and with Cisco Service Control Subscriber Management and Subscriber Integration concepts.

Organization

This guide covers the following topics:

Chapter	Title	Description
Chapter 1	*About the CNR LEG* (on page 1-1)	Describes the Subscriber Manager CNR LEG software module and the terms and concepts used in this guide.
Chapter 2	*Getting Started* (on page 2-1)	Provides the package contents list and prerequisites for installing the CNR LEG.
Chapter 3	*Installing the CNR LEG* (on page 3-1)	Details the CNR LEG installation procedures for both Widows and Solaris platforms. It also describes the uninstall procedure.
Chapter 4	*Configuring the CNR LEG and the SM* (on page 4-1)	Describes the configuration for the CNR LEG and the Subscriber Manager using the CNR LEG.
Appendix A	*CNR LEG Functional Specification* (on page A-1)	Describes the CNR LEG design, logging, tracing, and operations performed by the CNR LEG.

Related Documentation

This ***Cisco SCMS SM CNR LEG*** Reference Guide should be used in conjunction with the following Cisco documentation:

- *SCMS Subscriber Manager User Guide*
- *Service Control Application for Broadband User Guide*

Conventions

This document uses the following conventions:

Convention	Description
boldface font	Commands and keywords are in **boldface**.
italic font	Arguments for which you supply values are in i*talics*.
[ ]	Elements in square brackets are optional.
{x | y | z}	Alternative keywords are grouped in braces and separated by vertical bars.
[x | y | z]	Optional alternative keywords are grouped in brackets and separated by vertical bars.
string	A nonquoted set of characters. Do not use quotation marks around the string, or the string will include the quotation marks.

`screen` font	Terminal sessions and information the system displays are in `screen` font.
`boldface screen` font	Information you must enter is in **`boldface screen`** font.
`italic screen` font	Arguments for which you supply values are in *`italic screen`* font.
→	This pointer highlights an important line of text in an example.
^	The symbol ^ represents the key labeled **Control**—for example, the key combination **^D** in a screen display means hold down the **Control** key while you press the **D** key.
< >	Non printing characters, such as passwords, are in angle brackets.
[ ]	Default responses to system prompts are in square brackets.
!, #	An exclamation point (!) or a pound sign (#) at the beginning of a line of code indicates a comment line.

Notes use the following conventions:

Note Means *reader take note*. Notes contain helpful suggestions or references to materials not contained in this manual.

Cautions use the following conventions:

Caution Means *reader be careful*. You are capable of doing something that might result in equipment damage or loss of data.

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  http://www.cisco.com/pcgi-bin/marketplace/welcome.pl

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We appreciate your comments.

Obtaining Technical Assistance

Cisco provides *Cisco.com* (on page vii) as a starting point for all technical assistance. Customers and partners can obtain documentation., troubleshooting tips, and sample configurations from online tools. For Cisco.com registered users, additional troubleshooting tools are available from the TAC website.

Cisco.com

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If you have a priority level 3 (P3) or priority level 4 (P4) problem, contact TAC by going to the TAC website:

http://www.cisco.com/tac

P3 and P4 level problems are defined as follows:

- P3—Your network is degraded. Network functionality is noticeably impaired, but most business operations continue.
- P4—You need information or assistance on Cisco product capabilities, product installation, or basic product configuration.

In each of the above cases, use the Cisco TAC website to quickly find answers to your questions.

To register for *Cisco.com* (on page vii), go to the following website:

http://tools.cisco.com/RPF/register/register.do

If you cannot resolve your technical issue by using the TAC online resources, Cisco.com registered users can open a case online by using the TAC Case Open tool at the following website:

http://www.cisco.com/tac/caseopen

Contacting TAC by Telephone

If you have a priority level 1 (P1) or priority level 2 (P2) problem, contact TAC by telephone and immediately open a case. To obtain a directory of toll-free numbers for your country, go to the following website:

http://www.cisco.com/warp/public/687/Directory/DirTAC.shtml

P1 and P2 level problems are defined as follows:

- P1—Your production network is down, causing a critical impact to business operations if service is not restored quickly. No workaround is available.
- P2—Your production network is severely degraded, affecting significant aspects of your business operations. No workaround is available.

CHAPTER 1

About the CNR LEG

The Cisco Network Registrar (CNR) Login Event Generator (LEG) is a software module that forwards login and logout events from the CNR to the Cisco Service Control Management Suite Subscriber Manager (SCMS SM). The CNR LEG is actually a CNR extension developed in C++. The extension points used by CNR LEG are:

- `init-entry`
- `post-send-packet`
- `post-packet-decode`

This chapter contains the following sections:

The CNR LEG Module

The CNR LEG module requires the use of option 82 sub-option 2 (Relay-Agent-Information Option with the Remote-Id sub-option), which contains the CM-MAC, in all DHCP requests. If option 82 does not exist in a renewal transaction, an attempt to extend the lease based solely on the IP address is performed. This will succeed only if the IP address was previously logged in to the Subscriber Manager (SM) by the LEG, in the event of a full DHCP transaction, or via other interfaces to the SM.

The CNR LEG protects the SM and the connection to the SM from any DHCP Denial of Service (DoS) attacks, which are performed on the CNR. To reduce the login rate to the SM, the LEG ignores identical DHCP requests that are approved by the CNR. The requests are sent to the CNR in short time intervals.

For additional information about extending the CNR functionality using extension points, see the *CNR CLI Reference Guide*.

The CNR LEG was carefully developed and thoroughly tested on Solaris and Windows platforms for both functional correctness and robustness. It does not jeopardize the stability or the reliability of the CNR.

Terms and Concepts

This section defines terms and concepts that are necessary for understanding the CNR LEG and Subscriber Manager (SM) configuration and operation. More information about all items can be found in the *SCMS Subscriber Manager User Guide*.

Subscriber Mappings

The main function of the CNR LEG is to provide the SM with network-ID-to-subscriber mappings in real time.

The SCE platform requires mappings between the network IDs (IP addresses) of the flows it encounters and the subscriber IDs. The SM database contains the network IDs that map to the subscriber IDs. The SCE network-ID-to-subscriber mappings are constantly updated from the SM database.

For information about the SCE platforms, see the *SCE 1000* and *SCE 2000 User Guides*.

Subscriber Domain

The SM provides the option of partitioning SCE platforms and subscribers into subscriber domains. A subscriber domain is a group of SCE platforms that share a group of subscribers. Subscriber domains can be configured using the SM configuration file and can be viewed using the SM Command-Line Utility (CLU).

It is also possible to configure domain aliases. A domain alias is a synonym for the actual domain name in the SM. Domain aliases are configured in the SM configuration file.

For additional information about domains and domain aliases, see *Chapter 5* and *Appendix A* of the *SCMS Subscriber Manager User Guide*.

RPC Protocol (PRPC)

The CNR LEG communicates with the SM using a proprietary RPC (PRPC) protocol developed by Cisco. PRPC is also used by the SM Java, C, and C++ APIs. The CNR LEG uses the C++ API as its communication layer.

Subscriber Mode

The Subscriber Mode defines which entity is referred to as the subscriber in the LEG and in the SM.

Cable providers usually prefer using the Cable Modem (CM) as the subscriber entity to be assigned multiple IP addresses (one per Customer Premises Equipment (CPE)).

The CNR LEG supports the *CPE as Subscriber* and *CM as Subscriber* (the default) modes, as defined by the configuration.

The CNR LEG works with the SM cable support module when operating in the “CPE as Subscriber” mode. For additional information about cable environment subscriber modes, see *Appendix C* of the *SCMS Subscriber Manager User Guide*.

DHCP DoS Attack Filter

The connection between the CNR LEG and the SM is a resource that should be protected against DHCP Denial of Service attacks. Such attacks are dispatched by sending a high rate of DHCP requests from a certain subscriber, which can cause the connection to overflow because of too many logon messages in a short period of time. The CNR LEG enables the administrator to use the filter that identifies such events of multiple identical DHCP requests and filters them to reduce the rate of logon messages to a predefined rate. The filter does not protect the CNR against attacks, but rather protects the connection to the SM.

SM Cable Support Module

The cable support module is an SM component that executes an API friendly to cable environment integrations. The cable support module translates between the cable subscriber terminology (CPE, CM, CMTS) and the generic subscriber terms used by the Cisco Service Control Management system. The CNR LEG uses PRPC to invoke the `cableLogin` and `cableLogout` operations that are performed by the cable support module API.

The SM cable support module is used only in the *CPE as Subscriber* mode.

For additional information about the cable support module, see *Appendix C* of the *SCMS Subscriber Manager User Guide*.

SM C++ API

The SM C++ API exposes a set of operations designed to enable subscriber integration with the Cisco system. The CNR LEG uses the SM C++ API as its basic communication layer.

For additional information about the C++ API, see the *SCMS SM C/C++ API Programmer's Guide*.

Communication Link Failure Handling

A keep-alive mechanism periodically checks the communication link (socket) between the CNR LEG and the SM. The communication link fails when the socket is closed or a keep-alive timeout occurs. The keep-alive timeout can be configured in the SM configuration file.

In cases where LEG-SM link fails, the SM can be configured to clear the mappings of all the subscribers that are updated by the failed LEG.

To learn more about communication link failure handling, see *Appendix A* of the *SCMS Subscriber Manager User Guide*.

Subscriber Auto-logout

The SM supports the configuration of an auto-logout timer (lease-time) for each subscriber. The timer is set when a subscriber `cableLogin\login` operation is performed. The CNR LEG extracts and sets an auto-logout value from the DHCP IP lease expiration time option.

CHAPTER 2

Getting Started

This chapter contains the following sections:

Prerequisites

CNR LEG is operable with any CNR version 5.0 or later.

The platform requirements (OS/CPU/RAM/disk) are the same as the CNR requirements for both Windows and Solaris. See the *Cisco Network Registrar (CNR) Installation Guide* for platform requirements details.

Package Contents

The CNR LEG distribution is provided as part of the SCMS-SM LEG distribution file and is located in the CNR_LEG directory. The contents of the CNR LEG distribution package supplied by Cisco are described in the following table.

Table 2-1 File layout of CNR LEG distribution package

Root	Folder (under root)	File name	Notes
`pkg-ext-dir`			
		readme.cnrleg	Short description of CD content
	doc		
		cnrleg.cfg	Sample configuration file
	solaris		
		libcnrleg.so	Solaris distribution in a single library file
	winnt		
		asn1ber.dll	

Root	Folder (under root)	File name	Notes
		asn1rt.dll	
		cnrleg.dll	

CHAPTER 3

Installing the CNR LEG

This chapter describes the procedures for installing the CNR LEG on both Windows x86 and Solaris 8 SPARC platforms. It also describes the uninstall procedure.

Note The directory in which the CNR is installed is referred to as `cnr-inst-dir`.

This chapter contains the following sections:

Installing the CNR LEG on Windows

To install the CNR LEG on Windows:

Step 1 Extract the SM LEG distribution file and locate the CNR LEG distribution tar file under the CNR LEG directory.

Step 2 Extract the CNR LEG distribution and copy the files:

a) Unzip the CNR Package to `pkg-ext-dir`.

b) Copy all files under `pkg-ext-dir\winnt` to <`cnr-inst-dir`>`\Extensions\DHCP\Dex\`.

c) Copy the sample configuration file from `pkg-ext-dir\doc` to a directory of your choice, hereafter referred to as `cfg-dir`.

Step 3 Configure the CNR LEG using the sample configuration file:

See *Configuring the CNR LEG* (on page 4-1).

Step 4 Configure the SM:

See *Configuring the SM* (on page 4-3).

Step 5 Register the CNR LEG with the CNR:

a) Run the CNR `<cnr-inst-dir>/bin/nrcmd` command-line utility.

b) Log in to the CNR nrcmd CLU. To log in, type the following command:

`nrcmd [-C <cluster>] [-N <user>] [-P <password>]`.

c) Configure the following:

```
nrcmd> extension smleg create dex cnrleg.dll cnrLegPostSendPacket
nrcmd> extension smleg set init-entry=cnrLegInitEntry
nrcmd> extension smleg set init-args=cfg-dir/cnrleg.cfg
nrcmd> dhcp attachExtension post-send-packet smleg 1[1]
nrcmd> extension smlegext create dex cnrleg.dll cnrLegPostPacketDecode
nrcmd> dhcp attachExtension post-packet-decode smlegext 1[2]
nrcmd> save
nrcmd> server DHCP reload
```

Note You must use the `cfg-dir` full path in the `init-args` argument.

Note You must use a slash (“/”) and not a back-slash (“\”) as the path separator.

[1] Any sequence number can be used for this command
[2] Any sequence number can be used for this command

Installing the CNR LEG on Solaris

To install the CNR LEG on Solaris:

Step 1 Extract the SM LEG distribution file and locate the CNR LEG distribution tar file under the CNR LEG directory.

Step 2 Extract the CNR LEG distribution and copy the files:

a) Extract the CNR Package to `pkg-ext-dir`.

For example: `#> tar xvf cnr-leg-dist.tar`

b) Copy *`libcnrleg.so`* under `pkg-ext-dir/solaris` to `<cnr-inst-dir>/extensions/dhcp/dex`.

c) Copy the sample configuration file from `pkg-ext-dir/doc` to a directory of your choice, hereafter referred to as `cfg-dir`.

Step 3 Configure the CNR LEG using the sample configuration file:

See *Configuring the CNR LEG* (on page 4-1).

Step 4 Configure the SM:

See *Configuring the SM* (on page 4-3).

Step 5 Register the CNR LEG with CNR:

a) Run the CNR `<cnr-inst-dir>/bin/nrcmd` command-line utility.

b) Log in to the CNR nrcmd CLU. To log in, type the following command:

`nrcmd [-C <cluster>] [-N <user>] [-P <password>]`.

c) Configure the following:

```
nrcmd> extension smleg create dex libcnrleg.so cnrLegPostSendPacket
nrcmd> extension smleg set init-entry=cnrLegInitEntry
nrcmd> extension smleg set init-args=cfg-dir/cnrleg.cfg
nrcmd> dhcp attachExtension post-send-packet smleg 1[3]
nrcmd> extension smlegext create dex libcnrleg.so cnrLegPostPacketDecode
nrcmd> dhcp attachExtension post-packet-decode smlegext 1[4]
nrcmd> save
nrcmd> server DHCP reload
```

Note You must use the `cfg-dir` full path in the `init-args` argument.

[3] Any sequence number can be used for this command
[4] Any sequence number can be used for this command

Note You must use a slash (“/”) and not a back-slash (“\”) as the path separator.

Uninstalling the CNR LEG

This section explains how to uninstall the CNR LEG. The uninstall procedure is applicable for both Windows and Solaris platforms.

To uninstall the CNR LEG:

Step 1 Un-register CNR LEG from CNR:

a) Run the CNR `<cnr-inst-dir>/bin/nrcmd` command-line utility.

b) Log in to the CNR nrcmd CLU. To log in, type the following command:

`nrcmd [-C <cluster>] [-N <user>] [-P <password>]`.

c) Configure the following:

```
nrcmd> dhcp detachExtension post-send-packet 1
nrcmd> extension smleg delete
nrcmd> dhcp detachExtension post-packet-decode 1
nrcmd> extension smlegext delete
nrcmd> save
nrcmd> server DHCP reload
```

Step 2 Delete the LEG distribution files:

This part of the uninstall procedure is optional.

a) Delete all files copied to `<cnr-inst-dir>/extensions/dhcp/dex`

b) Delete the configuration file (`cfg-dir/cnrleg.cfg`).

Configuring the CNR LEG and the SM

This chapter explains how to configure the CNR LEG and to configure the Subscriber Manager to use the CNR LEG module.

This chapter contains the following sections:

Configuring the CNR LEG

The CNR configuration file offers the following configuration options to the user:

- SM IP address—the IP address of the SM
- SM port—the TCP port on which the SM PRPC server listens
- Subscriber mode—the subscriber entity to be used by the LEG: CM as subscriber (default) or CPE as subscriber
- Lease time option—the DHCP option number from which to extract the lease expiration time that is to be sent to the SM
- Attack filter parameters—defines whether the DHCP DoS attack protection is on and defines how the filtering is performed

Setting the SM IP Address and Port

You must set the SM IP address correctly in order for the LEG to operate.

The default PRPC TCP port number generally does not need to be changed.

The SM port default is TCP 14374. The SM PRPC port can be retrieved from the SM configuration file. For additional information, see *Appendix A* of the *SCMS Subscriber Manager User Guide*.

SM IP Address and Port Example

The following example is a portion of a sample CNR configuration file showing how to configure the SM IP address and port:

```
[sm]
# SM IP address
ip_address= 216.239.37.99
# SM PRPC Server port. default 14374
#port=14374
```

Setting the Subscriber Mode

The LEG can operate in one of two modes:

- CM as Subscriber - each CPE login/logout/lease extension triggers a logon operation to the SM using the corresponding CM MAC as the subscriber ID.
- CPE as Subscriber - each CPE is a separate subscriber entity. Each CPE login/logout/lease extension triggers a logon operation to the SM using both the CPE MAC and the CM MAC as the subscriber ID.

Subscriber Mode Example

The following example is a portion of a sample CNR configuration file showing how to configure the Subscriber Mode:

- CM as Subscriber:

```
[general]
# defines who is the subscriber to refer to the CM or the CPE.
# default: cm_as_subscriber optional  values: cm_as_subscriber \
# cpe_as_subscriber
subscriber_mode=cm_as_subscriber
```

- CPE as Subscriber:

```
[general]
# defines who is the subscriber to refer to the CM or the CPE.
# default: cm_as_subscriber optional  values: cm_as_subscriber \
# cpe_as_subscriber
subscriber_mode=cpe_as_subscriber
```

Setting the Lease Time Option

To enable subscriber auto-logout at lease time expiration on the SM, the `lease_time` option must be set. The CNR LEG can extract the IP address lease expiration from one of the following DHCP option numbers:

- 51 (default)
- 58
- 59

For additional information about the auto-logout mechanism see *Configuring Auto-logout* (on page 4-6).

Lease Time Option Example

The following example is a portion of a sample CNR configuration file showing how to configure the lease time option:

```
lease_time_option=51
```

Setting the Attack Filter Parameters

To enable the DHCP Denial of Service (DDoS) attack protection, the `enabled` option must be set. The attack filter has two parameters that define its operation:

- The `timeout` parameter defines the minimal interval in seconds between identical DHCP requests (login/renew transactions). If two identical requests reach the CNR within the time interval specified in this parameter, the second request is ignored by the LEG. The CNR does not trigger the second login to the SM.
- The `num_of_entries` parameter defines the number of DHCP transaction information entries that the attack filter can hold at any given time. This parameter affects the amount of memory allocated by the LEG for the DDoS attack protection filter. This parameter should be changed only if the LEG supports a high transaction rate.

Attack Filter Example

The following example is a portion of a sample CNR configuration file showing how to configure the attack filter parameters:

```
[attack filter]
# enable or disable the attack filtering mechanism in the LEG
# can be set to true or false. default true.
enabled=true
# minimum time in seconds between DHCP login/renew transactions of
# the same subscriber with the same IP. default = 10 seconds
timeout=10
# the number of attack transactions detected on this user that
# should generate a log message. setting 0 disables this logging.
# note: the first attack detection is always logged (unless
# logging is disabled)
# default: log every 100 attack transactions.
log_interval=100
```

Configuring the SM

The Subscriber Manager is configured using the SM configuration file. For additional information, see *Appendix A* of the *SCMS Subscriber Manager User Guide*.

Configuring SM-LEG Failure Handling

Note It is **important** to properly configure SM-LEG failure handling on the SM before continuing with the CNR LEG configuration. For information about configuring the SM, See *Appendix A* of the *SCMS Subscriber Manager User Guide*.

To configure the failure handling, you must do the following in the configuration file:

Step 1 Activate SM-LEG Failure Handling

Step 2 Set LEG-Domains associations

Activating SM-LEG Failure Handling

By default, SM-LEG failure handling is **not** activated.

To activate SM-LEG failure handling:

Step 1 Set the `clear_all_mappings` parameter to true.

Step 2 Change the `timeout` value *(optional)*.

SM-LEG Failure Handling Example

The following example is a portion of a sample `p3sm.cfg` configuration file showing how to configure SM-LEG failure handling:

```
[SM-LEG Failure Handling]
# The following parameter defines the behavior of the SM in case of
# LEG-SM connection failure.
# This parameter is relevant only for cases SM and LEG are running
# on different machines.
# Note that this parameter defines a behavior that is similar for
# ALL connected LEGs. If the parameter is set to true then in case
# of LEG-SM connection failure that is not recovered within the
# defined timeout, the mappings of all subscribers in the domains
# defined in the 'LEG-Domains Association' section for the LEG
# that was disconnected, will be removed.
#
# IMPORTANT: LEG Domains must be defined in the following section
# in case this parameter is set to 'true'.
#
# Optional values: [true/false]. Default: false.

clear_all_mappings=true

# The following parameter defines the time in seconds from a LEG-SM
# connection failure until clearing the mappings in the SM database.
# Default value: 60.

timeout=60
```

Setting LEG-Domains Associations

You must set LEG-Domains associations in order for the SM-LEG failure handling to work. The CNR-LEG name to be used in this section is a concatenation of the hostname of the machine on which the LEG is installed and the suffix `".CNR.LEG"`.

An alternate way to retrieve the CNR-LEG name is by using the **p3rpc** utility. This utility displays all clients currently connected to the PRPC server, including the CNR.

To retrieve the CNR-LEG name using the p3rpc utility:

- At the prompt, type:

  `> p3rpc -show-client-names`

LEG-Domains Association Example

If the hostname of the machine on which the LEG is installed is `netserv5`, the LEG name to be used in the configuration file is `"netserv5.CNR.LEG"`. The following example assumes that the subscriber domain associated with the CNR LEG is named `subscribers`.

The following example is a portion of a sample `p3sm.cfg` configuration file showing how to set LEG-Domains associations.

```
[LEG-Domains Association]
# The following parameter defines domains that the mapping of all
# subscribers that belong to them will be cleared on LEG-SM
# connection failure. The key is the LEG NAME and the value is a
# comma separated list of domain names.
# A value of * in domain names stands for all the subscriber domains
# in the system.
# A value of * in LEG name means all the LEGs that are connected to
# the SM.
# LEG NAME1 = domain_name1,domain_name2
# LEG NAME2 = domain_name2,domain_name3

netserv5.CNR.LEG=subscribers
```

Setting Domain Aliases

You must set domain aliases in order for the CNR LEG to operate correctly.

The CNR LEG uses the CMTS IP for the subscriber domain name. You should make sure that all the CMTS IP addresses appear as an alias to exactly one subscriber domain. Domain aliases are configured in the SM configuration file.

Note You do **not** have to configure domain aliases in those cases where each CMTS updates a single subscriber domain *and* you have configured the subscriber domain names in the SM to be the IP address of the matching CMTS.

Domain Aliases Example

In this example, the SM is configured with the following:

- A single subscriber domain named `subscribers`

- Four CMTS devices with the following IP addresses:
  - 209.247.228.201
  - 209.247.228.202
  - 69.42.72.147
  - 69.42.72.148

The following example is a portion of a sample p3sm.cfg configuration file showing how to configure the domain aliases.

```
[Domain.subscribers]

# The following parameter defines domain aliases. When subscriber
# information is received from the LEG with certain alias the
# information will be distributed to the domain that matches this
# alias - domain that contains this alias in its aliases list.
#
# A typical alias could be a network device IP address. For example,
# each string in the values can be the IP address of a NAS or a
# CMTS.
#
# In order to distribute all subscriber operations on all unmapped
# domains to a certain domain use aliases=*. Note that only one
# domain section may include this alias.

aliases=209.247.228.201,209.247.228.202,69.42.72.147,69.42.72.148
```

Configuring Auto-logout

To automatically log out subscribers when their lease time expires, you must configure the SM auto-logout interval. After every **auto-logout interval** time, the SM checks which subscriber IP addresses have a lease time that has expired and begins to automatically remove these IP addresses from the system.

Lease time is the timeout defined by the LEG during the login operation of each IP address, based on the lease-time option. All subscriber login events will start a timer of lease_time seconds. When the timer expires and the grace_period, which is another configuration parameter, has also passed, the subscriber's IP addresses are removed causing the subscriber to be removed from the SCE platform database. If the subscriber logs on with an existing IP address during the countdown period, the timer is reset and the countdown period restarts.

If the auto-logout value is set to zero (0), the SM's auto-logout mechanism is disabled.

If the auto-logout interval is set to a value greater than zero, the SM's auto-logout mechanism is enabled.

Note The subscriber record (with no mappings) remains in the SM database, preserving the subscriber state.

Auto-logout Example

The following example is a portion of a sample `p3sm.cfg` configuration file showing how to configure the auto-logout interval to 6 minutes:

```
[Auto Logout]

# The following parameter configures the time between each run of
# the auto-logout mechanism. After every “auto-logout” time
# interval, the SM checks which subscriber IP addresses have a lease
# time that has expired, and begins to automatically remove these IP
# addresses from the system (causing it to be removed from the SCE
# platform's database).

# Auto-logout should be activated when the LEG/API can't provide
# logout indications.

auto_logout_interval=360

# The following parameter defines the grace period in seconds for
# subscriber auto logout. A subscriber will be logged out only after
# timeout period + grace period seconds.

grace_period=10

# The following parameter defines the maximum rate (logouts per
# second) that the auto-logout task will perform logouts from the
# system. This enables to spread the load of the logout operations
# over time, and reduce the performance impact on other operations.
# the value should be calculated so it spreads the logouts over at
# least half of 'auto_logout_interval' time. (default 50)

max_rate=50
```

Configuring the PRPC Server

To enable the CNR LEG to communicate with the SM, the PRPC server must be up and running. The RPC server is started by default, therefore it does not require special configuration.

The following example is a portion of a sample `p3sm.cfg` configuration file showing the PRPC server configuration:

```
[RPC.Server]
# RPC server port (default 14374)

port=14374
```

To view the status of the PRPC server in the SM:

- At the prompt, type:

  `> p3rpc --show`

APPENDIX A

CNR LEG Functional Specification

This appendix describes the CNR LEG design, logging, and tracing, and the operations performed by the LEG in each extension point. The purpose of this appendix is to provide insight into the CNR LEG operation and integration with CNR.

CNR LEG High Level Design

The CNR LEG uses extension points:

- `init-entry`
- `post-packet-decode`
- `post-send-packet`

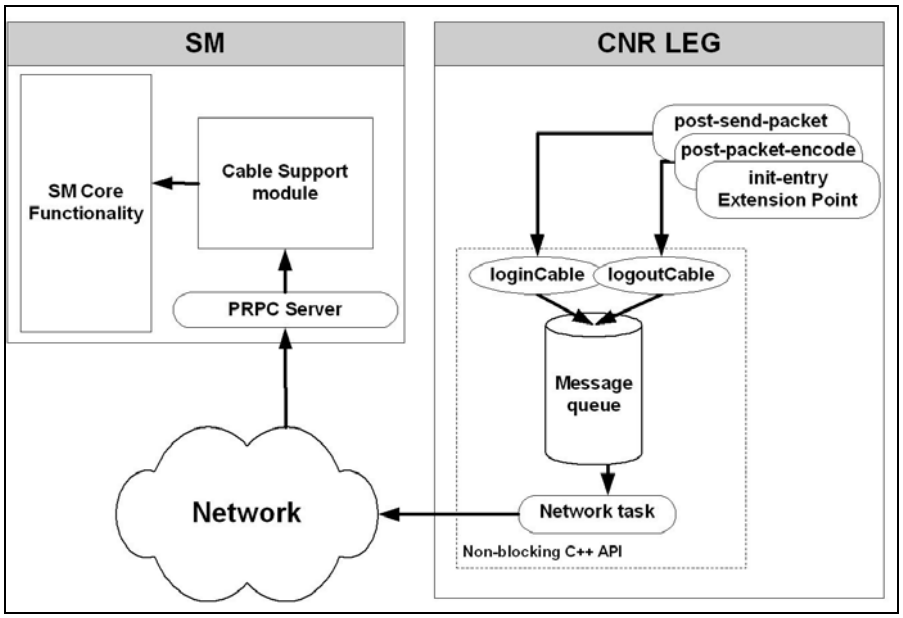
When an extension point hook is called, the following sequence of events takes place:

Step 1 The extension point hook performs the minimal computation necessary to extract all the required data and calls a Non-blocking C++ API operation.

Step 2 The Non-blocking operation encodes a message and places it in a queue.

Step 3 The Non-blocking C++ API network task reads messages from the message buffer and sends them over the network to the PRPC Server on the SM.

Step 4 The PRPC Server decodes the message and passes it to the cable support module, which sets up the subscribers in the SM database using the SM core functionality.



The only operations performed in the context of the CNR extension dispatching thread are message creation and placement in a message queue. The heavy network operations are performed in a separate thread. Note that if for some reason the message queue is full, the message will be dropped to avoid the risk of creating a delay, which would damage CNR performance.

Logging and Tracing

By default, the CNR LEG logs its messages to the CNR log. The LEG supports a debug mode and several trace levels. Logging and tracing are controlled from the LEG configuration file.

Note Changes made to the LEG configuration file become effective only when the LEG is restarted.

Extensions Point Operation

This section briefly describes the operations performed by the CNR LEG at each extension point.

init-entry

The extension point `init-entry` is used for initializing or terminating the CNR LEG.

During initialization, the CNR LEG performs the following operations:

- Reading the configuration file
- Initializing the LEG logging and tracing
- Creating a Non-blocking C++ API instance and connecting it to the SM

- Starting the C++ API network-task thread

During termination, the CNR LEG performs the following operations:

- Stopping and freeing the Non-blocking C++ API instance
- Stopping the C++ API network-task thread

post-send-packet

The extension point `post-send-packet` is used for sending the following `cableLogin` operations to the SM:

- Verifying that the request-dictionary is for DHCP REQUEST and the response dictionary is for DHCP ACK
- Extracting CM-MAC, CPE-MAC, and CMTS-IP from the request dictionary
- Extracting the assigned CPE-IP and lease time from the response dictionary
- In CM as Subscriber mode CM requests are ignored
- Calling the Non-blocking C++ API `cableLogin\login` operation with the parameters extracted
- If no CM-MAC (option 82) is found, an attempt to extend the lease based solely on the IP address is performed

post-packet-decode

The extension point `post-packet-decode` is used for sending the following `cableLogout\logout` operations to the SM:

- Verifying that the request dictionary is for either DHCP RELEASE or DHCP DECLINE
- Extracting CM-MAC, CPE-MAC, CPE-IP, and CMTS-IP from the request dictionary
- Calling the Non-blocking C++ API `cableLogout\logout` operation with the parameters extracted

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