



Cisco SCMS SCE Subscriber API Programmer Guide

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Cisco SCMS SCE Subscriber API Programmer Guide

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Preface

The *Cisco SCMS SCE Subscriber API* is used for integrations that require direct access to the SCE platform for subscriber provisioning purposes.

Document Revision History

Cisco Service Center Release	Part Number	Publication Date
Release 3.0.3	OL-8236-02	May, 2006
Description of Changes		
Updated API code examples. See API Code Examples (on page 5-33).		
Release 3.0	OL-8236-01	December, 2005

Audience

This guide is intended for the networking or computer technician responsible for integrations involving policy servers that perform subscriber provisioning with the SCE platform.

Organization

This guide covers the following topics:

Chapter	Title	Description
Chapter 1	Getting Started (on page 1-1)	This chapter discusses the platforms on which the SCE Subscriber API can be used, and how to install, compile, and start running the API.
Chapter 2	Concepts and Terms (on page 2-1)	This chapter describes various terms and concepts that are utilized when working with the <i>SCMS SCE Subscriber API</i> .
Chapter 3	API Events (on page 3-1)	This chapter describes various events accessed by the <i>SCMS SCE Subscriber API</i> .

Chapter	Title	Description
Chapter 4	<i>Getting Familiar with the API Data Types</i> (on page 4-1)	This chapter describes the various API data types.
Chapter 5	<i>Programming with the SCE Subscriber API</i> (on page 5-1)	This chapter provides a detailed description of the API programming structure, classes, methods, and interfaces.
Chapter 6	<i>Troubleshooting</i> (on page 6-1)	This chapter describes the usage of the API logging abilities for troubleshooting the integration with the API. API logging enables the user to monitor the operations being called including the received parameters both at the API client and at the SCE side.
Appendix A	<i>List of Error Codes</i> (on page A-1)	This appendix lists the error codes that are returned by the API.

Related Publications

This API Guide should be used in conjunction with the following Cisco documentation:

- *SCMS Subscriber Manager User Guide*
- *Service Control Application for Broadband User Guide*
- *SCE 1000 or SCE 2000 User Guides*

Conventions

This document uses the following conventions:

Convention	Description
boldface font	Commands and keywords are in boldface .
<i>italic</i> font	Arguments for which you supply values are in <i>italics</i> .
[]	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.
<i>italic screen</i> font	Arguments for which you supply values are in <i>italic screen</i> font.

Convention	Description
→	This pointer highlights an important line of text in an example.
<>	Nonprinting 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.

Warnings use the following conventions:



Warning

Means *reader be warned*. You are capable of doing something that might result in bodily injury.

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Cisco provides [Cisco.com](http://www.cisco.com) (on page ix) 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.

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Technical Assistance Center

The Cisco TAC website is available to all customers who need technical assistance with a Cisco product or technology that is under warranty or covered by a maintenance contract.

Contacting TAC by Using the Cisco TAC Website

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 ix), 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.

Disclaimer: The code in this document can be used as a guideline for your site installation. However, any code that has been implemented using this document is not supported by TAC.



Getting Started

This chapter discusses the platforms on which the SCE Subscriber API can be used, and how to install, compile, and start running it.

This chapter contains the following sections:

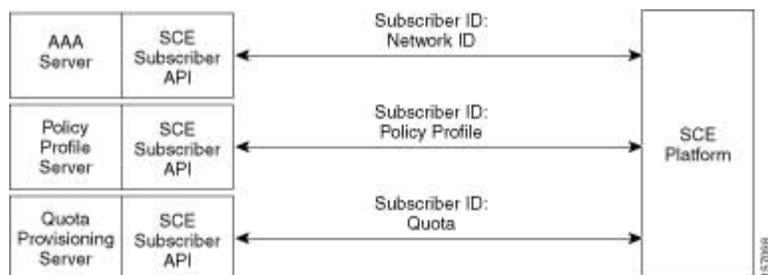
- [Introduction](#) 1-1
- [Platforms](#) 1-2
- [Installation](#) 1-2
- [Compiling and Running](#) 1-3
- [SCE platform setup](#) 1-4

Introduction

The *SCMS SCE Subscriber API* provides the ability to external applications (policy servers) to directly connect to the SCE for subscriber provisioning purposes.

Subscriber provisioning is a process of updating the *Network IDs*, *Policy Profile* and *Quota* characteristics of the subscriber using the Subscriber ID as the correlation. For more information about the characteristics of the subscriber in the Service Control Application for Broadband (SCABB), see the *Subscriber Characteristics* (on page 2-1) section.

The API can be installed and used concurrently on several policy servers and each of them can perform different parts of the subscriber provisioning process as shown in the following diagram:



The API uses the PRPC (Proprietary Remote Procedure Call) protocol as a transport for the connection to the SCE. The PRPC is a proprietary RPC protocol designed by Cisco.

**Note**

The API provides a connection to one SCE platform for each API instance

Platforms

The *SCMS SCE Subscriber API* is operable on any platform that supports Java version 1.4.

Installation

Extracting the Package

The *SCMS SCE Subscriber API* distribution is provided as part of the SCMS SM-LEG distribution file and is located in the *sce_api* directory.

The *SCMS SCE Subscriber API* is packaged in a UNIX tar file that can be extracted using the UNIX tar utility or most Windows compression utilities.

To install the distribution on a UNIX platform:

-
- Step 1** Extract the SCMS SM-LEG distribution file and locate the SCE Subscriber API distribution tar *sce-java-api-dist.tar.gz*
 - Step 2** Unzip the distribution file:

```
#> gunzip sce-java-api-dist.tar.gz
```
 - Step 3** Extract the the SCE Subscriber API package tar:

```
#> tar -xvf sce-java-api-dist.tar
```
-

To install the distribution on a Windows platform:

Use a zip extractor (such as WinZip).

Package Content

For brevity, the installation directory *sce-java-api-vvv.bb* is referred to as *<installdir>*.

**Note**

The abbreviations *vvv* and *bb* stand for the SCE Subscriber Java API version and build number.

The `<installdir>/javadoc` folder contains the SCE Subscriber API JAVADOC documentation.

The `<installdir>/lib` folder contains the `sceapi.jar` file, which is the API Executable. It also contains additional jar files necessary for the API operation.

Table 1-1 Layout of Installation Directory

Path	Name	Description
<installdir>		
	README	API readme file
<installdir>/Javadoc		
	index.html	Index of all API specifications
	(API specification files, etc.)	API specification documents
<installdir>/Lib		
	sceapi.jar	SCE Subscriber API executable
	asn1rt.jar	Utility jar used by the API
	log4j.jar	Utility jar used by the API
	log4j.properties	Property file needed for the logging functionalities
	jdmkrt.jar	Utility jar used by the API

Compiling and Running

To compile and run a program that uses the *SCMS SCE Subscriber API*, the following files must be in CLASSPATH:

- `sceapi.jar`
- `asn1rt.jar`
- `log4j.jar`
- `log4j.properties` - for more information about the file format, see the [API Client Logging](#) (on page 6-5) section.
- `jdmkrt.jar`

The SCE Subscriber API provides internal logging interface using the log4j logging functionalities. In order to function correctly `log4j.jar` and `log4j.properties` must be in a CLASSPATH when running a program.

For example, if the program source is in *SCEApiProgram.java*, use the following command-line to compile:

```
#> javac -classpath sceapi.jar SCEApiProgram.java
```

Afterward, use the following command-line to run the program:

```
#> java -cp .;<installdir>/lib/asn1rt.jar;
<installdir>/lib/log4j.jar;<installdir>/log4j.properties;<install
dir>/lib/sceapi.jar SCEApiProgram
```

SCE platform setup

The following sections describe the configuration that is performed on the SCE platform to allow correct API functioning.

PRPC Server

The API connects to the PRPC server on the SCE platform. The PRPC server is a server running a proprietary RPC protocol designed by Cisco. For more information, see the *SCE User Guide*.

Before using the API, ensure that:

- The SCE must be up and running, and reachable from the machine that hosts the API.
- The PRPC server on the SCE must be started.

Configuring the SCE in Pull Mode

To enable the SCE platform to issue a request for subscriber information when running in a Pull Model (see *Pull Model* (on page 2-2)), the following should be configured using the SCE platform Command-Line Interface (CLI):

To configure the SCE in Pull Model:

Step 1 Configure the subscriber templates (optional):

```
(config if)#>subscriber template import <CSV file>
```

For more information about the templates and the format of the CSV file, see the *Service Control Application for Broadband User Guide*.

Step 2 Configure the unmapped-subscriber groups ranges.

a) Use the following CLI to import anonymous groups from a file:

```
(config if)#>subscriber anonymous group import <CSV file>
```

b) Alternatively, use the following CLI to manually define the anonymous group:

```
(config if)#>subscriber anonymous group name <NAME> IP-range
<IP RANGE>
```

For more information about configuring the SCE platform, see the *SCE 1000 or SCE 2000 User Guides*.

RDR Formatter Configuration

To enable the RDR formatter to issue quota-related indications, the RDR formatter on the SCE platform should be configured as follows:

```
#>RDR-formatter destination 127.0.0.1 port 33001 category number  
3 priority 100
```

By default, Quota RDRs tags are mapped to category 4. If another category is required, use the following CLI command :

```
#>RDR-formatter rdr-mapping add tag-ID <tag number> category-  
number <number>
```



Note

For Quota RDR tag IDs, see the *Cisco Service Control Application for Broadband User Guide*.



Note

To enable the application to issue quota-related indications, it should be enabled in the *Cisco Service Control Application for Broadband GUI*. See the *Cisco Service Control Application for Broadband User Guide* for configuration description.

Configuring API Disconnection Timeout

The SCE platform allows setting the timeout for the API to reconnect to the SCE platform after it was disconnected. During this timeout, the SCE will not free the resources and no data will be lost. After the timeout has elapsed and the API did not reconnect, the SCE considers the API disconnected and frees all the resources. The default timeout value is 5 minutes.

Use the following CLI command to configure the timeout:

```
(config)# management-agent sce-api timeout <timeout-in-sec>
```

Use the following CLI command to reset the timeout to the default value:

```
(config)# default management-agent sce-api timeout
```

Use the following CLI command to view the timeout value:

```
# show management-agent sce-api
```




Concepts and Terms

This chapter describes various terms and concepts that are utilized when working with the *SCMS SCE Subscriber API*.

This chapter contains the following sections:

- [Subscriber Characteristics](#) 2-1
- [Subscriber Integration Models](#) 2-2
- [Non-blocking Model](#) 2-3
- [Indications Listeners](#) 2-3
- [Supported Topologies](#) 2-4
- [Multi-threading Support](#) 2-5
- [Auto-reconnect Support](#) 2-6
- [Reliability Support](#) 2-6
- [High Availability Support](#) 2-6
- [Synchronization](#) 2-6
- [Practical Tips](#) 2-7

Subscriber Characteristics

One of the fundamental entities in the Service Control Application for Broadband (SCA BB) solution is a *subscriber*. A subscriber is the entity that the SCA BB solution individually monitors, accounts, and enforces a service configuration. The following sections briefly describe the characteristics of the subscriber in the SCA BB. For more information about the format and usage of the subscriber's characteristics, see the [Getting Familiar with the API Data Types](#) (on page 4-1) section.

Subscriber ID

Subscriber ID is a subscriber unique identifier, for example, a user name, IMSI (International Mobile Subscriber Identity), or other codes that uniquely identify a subscriber.

Anonymous Subscriber ID

When working in the Pull Model integration, the SCE assigns each unknown subscriber IP address with a temporary Subscriber ID, Anonymous Subscriber ID, until it receives the real Subscriber ID from the Policy Server.

For more information on the Pull Model integration, see the [Subscriber Integration Models](#) (on page 2-2) section.

Network ID

The SCE correlates a certain traffic flow to a subscriber by mapping a network identifier, for example, IP address, IP range, or VLAN, to the subscriber entity.

Policy Profile

A Policy Profile includes a set of parameters used by the SCA BB solution to define what policy is enforced on the subscriber.

Quota

A quota includes the quota-bucket values of the service quota or quotas available for the usage of the subscriber.

Subscriber Integration Models

The following terms describe two models of a dynamic subscriber integration that are supported by the SCE platform.

Push Model

In **push model** integration, an external server introduces (pushes) the subscribers to the SCE platform. This is performed whenever a new subscriber logs in to the network or the external server presumes to know all subscribers and introduces them to the SCE box when they connect.



Pull Model

In **pull model** integration, the SCE platform requests subscriber data from the external entity when it encounters traffic of an unknown subscriber, known as an anonymous subscriber. The external entity retrieves the required subscriber information and sends it back to the SCE platform.



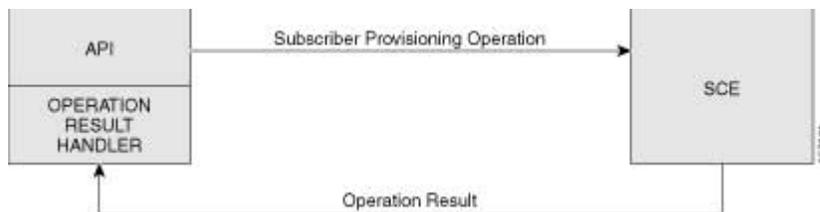
Non-blocking Model

The SCE Subscriber API is implemented using a non-blocking model. Non-blocking methods return immediately, even before a subscriber provisioning operation has been completed. The Non-blocking Model method is advantageous when the operation is lengthy and involves I/O. Performing the operation in a separate thread allows the caller to continue doing other tasks and it improves overall system performance.

The operation results are either returned to an Observer object (Listener) or not may be returned at all.

The API supports retrieval of operation results using an operation result handler described in the [Result Handling](#) (on page 5-13) section.

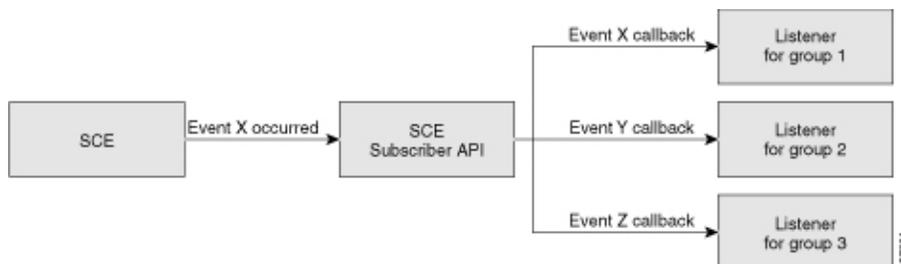
The following diagram illustrates the Non-blocking Model method during a subscriber provisioning operation:



Operation results can be used for operation result error logging or for inspection of the parameters used by the operation.

Indications Listeners

The API provides the user with the ability to receive an indication when certain events occur on the SCE platform. The API dispatches the indications received from the SCE to the interested entities, called *listeners*, by activating the relevant Listener's callback methods. The indications are separated into several logical groups when only **one** listener can be defined for each group of indications.



To receive certain indications, a listener needs to be registered to the API that implements the required callback functions. After the listener is registered, the API can dispatch the required indications to the listener. The *SCMS SCE Subscriber API* provides 3 types of indications when separate listeners are registered to the following types of the indications:

- Login-pull indications
- Logout indications

- Quota indications

For more information about listener indications, see the [API Events](#) (on page 3-1) chapter.

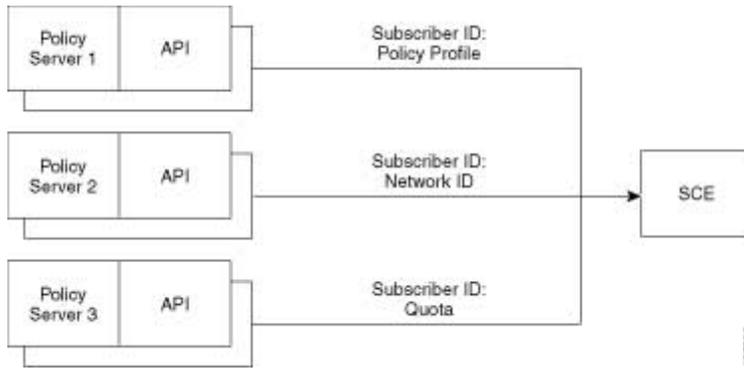
Supported Topologies

The following topologies are recommended to use with the *SCMS SCE Subscriber API*:

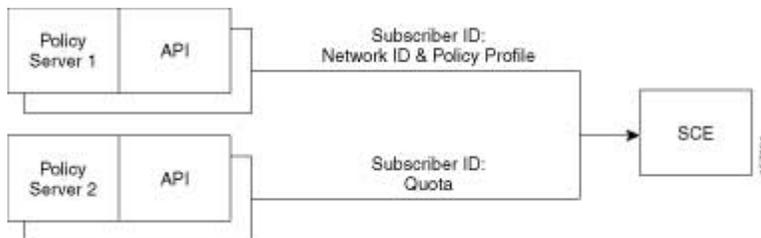
- One policy server (or two-node cluster) that is responsible for all aspects of the subscriber provisioning process:



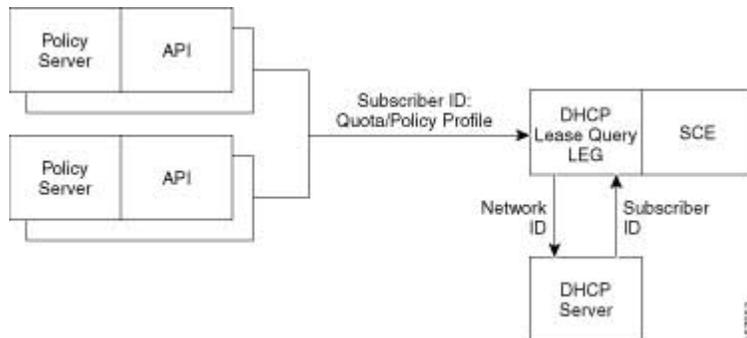
- Three policy servers (or three two-node clusters) – every server is responsible for a different aspect of the subscriber provisioning process:



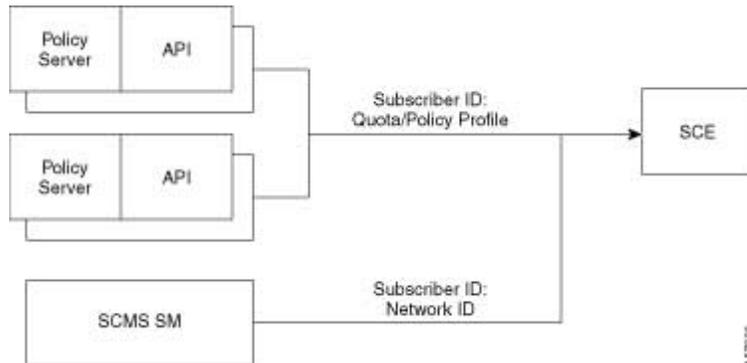
- Two policy servers (or two two-node clusters) when one of the servers is responsible for two aspects of the subscriber provisioning and the other server is responsible for one aspect only (any combination is allowed). For example:



- DHCP Lease Query LEG, which is responsible for mapping a Network ID to a Subscriber ID, with one or more policy servers as described in the three policy server diagram above. The following diagram shows the DHCP Lease Query LEG:



- SCMS SM, which is responsible for mapping Network ID to Subscriber ID, with one or more policy servers. The number of policy servers depends on whether the SM is used for policy profile provisioning in addition to the network ID:



Note

The API itself does not limit the use of any topology however the SCE platform does not correlate between all the entries (Policy Servers) that perform subscriber provisioning. Therefore the user should be **extremely** careful when using more than one Policy Server for the **same provisioning purpose** (for example Network ID/Subscriber ID correlation) so that not to cause a situation where the SCE platform receives different information for the same subscriber from the two policy servers responsible for the same aspect of the subscriber provisioning as this may cause loss of the synchronization with at least one policy server. For example, using two policy servers that are responsible for providing Subscriber ID/Network ID correlation for the same subscriber will produce the situation where the SCE is always synchronized with the policy server that performed the last update for this subscriber.

Multi-threading Support

The API supports an unlimited number (limited by the available memory) of threads calling its methods simultaneously.

**Note**

In a multi-threaded scenario the order of invocation is **guaranteed**: the API performs operations in the same chronological order that they were called.

Auto-reconnect Support

The API supports auto-reconnection to the SCE in case of connection failure. When this option is activated, the API can determine when the connection to the SCE is lost. When the connection is lost, the API activates a reconnection task that tries to reconnect to the SCE again in a configurable interval time until reconnection is successful.

Reliability Support

The *SCMS SCE Subscriber API* is implemented as a *reliable* API. The API ensures that no requests to the SCE are lost and no indication from the SCE is lost. The API maintains an internal storage for all API requests that were sent to the SCE. Only after receiving an acknowledgement from the SCE that the request was handled, it considers the request as **committed** and the API can remove the request from its internal storage. If a connection failure occurs between the API and the SCE, the API accumulates all requests in its internal storage until the connection to the SCE is reestablished. On reconnection, the API resends all **non-committed** requests to the SCE, ensuring that no requests are lost.

**Note**

The order of resending requests is **guaranteed**: the API resends the requests in the same chronological order that they were called.

High Availability Support

High availability support is provided by the API. It assumes that the high availability scheme of the policy server is a two-node cluster type where only one server is active at any given time. The other server, in standby, is not connected to the SCE. For more information, see the [Implementing High Availability](#) (on page 5-32) section.

Synchronization

The SCE and Policy Server must be kept synchronized concerning the subscribers that the SCE is handling their internal parameters. Otherwise, the SCE might confuse one of the subscriber's traffic to another subscriber, or the subscriber's SLA (Service Level Agreement) will not be enforced because of a change in the policy that did not reach the SCE. For more information read [SCE-API Synchronization](#) (on page 5-28) section.

Practical Tips

When implementing the code that integrates the API with your application you should consider the following practical tips:

- Connect once to the SCE and maintain an open API connection to the SCE at all times, using the API many times. Establishing a connection is a timely procedure, which allocates resources on the SCE side and the API client side.
- Share the API connection between your threads - it is better to have one connection per Policy Server. Multiple connections require more resources on the SCE and client side.
- Do not implement synchronization of the calls to the API. The client automatically synchronizes calls to the API.
- If the Policy Server application has bursts of logon operations, enlarge the internal buffer size accordingly to hold these bursts (Non-Blocking flavor).
- During the integration, use the logging capabilities that are described in the *SCE Logging* (on page 6-1) and the *API Client Logging* (on page 6-5) sections in the *Troubleshooting* (on page 6-1) chapter to view the API operations in the SCE's ad client logs and to troubleshoot problems during the integration, if any.
- Use the debug mode for the Policy Server application that logs/prints the return values of the operations.
- Use the automatic reconnect feature to improve the resiliency of the connection to the SCE.



API Events

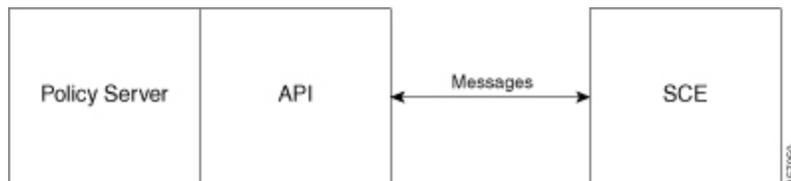
This chapter describes various events accessed by the *SCMS SCE Subscriber API*.

This chapter contains the following sections:

- [Overview 3-1](#)

Overview

The API accesses a set of **events** that are a pre-defined set of messages passed back and forth between the Policy Server and the SCE platform:



Every message can be assigned a type according to the purpose of the message:

- *Request*—Requests information or an action to be performed. A request is not necessarily followed by a response.
- *Response*—Answers a previous request
- *Indication*—Indicates the other side that an event has occurred

Most of the events may be used for both **push** and **pull** models. See the [Subscriber Integration Models](#) (on page 2-2) section.

The events may be divided into the following Subscriber Provisioning process groups:

- *Network ID management events*—includes events relating to the modification of the subscriber Network ID mapping
- *Policy Profile management events*—includes events relating to modification of the subscriber Policy Profile parameters
- *Quota management events*—includes events relating to the management of subscriber quota
- *SCE Synchronization management events*—includes events relating to the management of the SCE synchronization process

You can perform bulk operations, which are basically bundling many triggers for the same event on many subscribers to one global event.

The following sections provide a general description of each type of the events.

Network ID Management Events

Login Events

Login events occur when the subscriber connects to the network and vary for pull and push models.

Push Model

The push integration model assumes that the Policy Server triggers the subscriber introduction to the SCE. For example, the server receives a subscriber login indication from an external entity such as AAA (Authorization, Authentication, and Accounting), extracts the required subscriber attributes and "pushes" the information to the SCE platform:



The subscriber login operation may cause either the creation of a new subscriber record in the SCE or update an existing subscriber. For example, for cable modem networks the subscriber is a cable modem and the CPEs connected to this cable modem are configured as a list of IP addresses (potentially ranges). In this case, the login of the new CPE connected to the same modem causes the CPE IP address to be added to the subscriber's Network ID list.

Pull Model

The pull integration model assumes that the SCE discovers a new subscriber from the incoming data traffic. The new subscriber is entered in the system as an **anonymous** subscriber and is assigned one of the default policies. The SCE initiates a request to the external system (a login-pull request) that may either provide the subscriber login information (a login-pull reply) or is omitted, if no information exists for this IP. The login information provided to the SCE replaces the **anonymous** subscriber with the actual subscriber and enforces the correct policy.

If the login is rejected by the external system and the traffic keeps coming from the **anonymous** subscriber, the pull request will be retried.



**Note**

Despite being classified as “Network-ID Management Event”, LOGIN-REQUEST event and LOGIN-PULL-RESPONSE event are optimized to allow sending all subscriber information to the SCE. It is recommended to use these events for Policy Profile and Quota updates when all parts of the subscriber provisioning is performed by a single Policy Server. For multiple Policy Servers topologies, use separate events for updating Policy Profile and Quota information described in the following sections. For more information about topologies, see the [Supported Topologies](#) (on page 2-4) section.

Logout Events

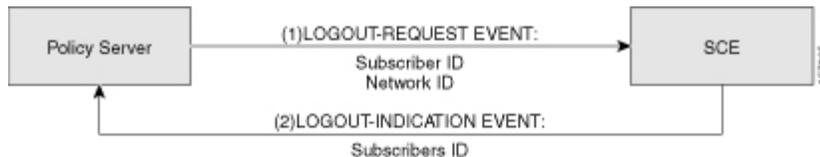
The logout event indicates that a certain network ID is no longer used by the subscriber. A logout event is not necessarily followed by the removal of the subscriber record from the SCE. For example, in cable modem networks, when there are more than one CPE connected to the same modem, the logout of one CPE may not lead to the removal of a subscriber if another CPE remains connected. The actual removal of the subscriber occurs when all of the CPEs (Subscriber's network-IDs) are disconnected.



The logout event in the **pull** model may occur, for example, when the SCE identifies that the subscriber is not active for a specific time interval. The SCE “logs out” the subscriber and sends a LOGOUT-INDICATION event.



The LOGOUT-INDICATION event may also follow the Logout operation. This occurs once a subscriber is actually removed, for example, when no more valid network mappings (IP) are associated with this subscriber.



Network ID Update Event

This event is a REQUEST from the Policy Server to the SCE to update the network ID of the subscriber that already exists in the SCE platform. This event does not require any RESPONSE.



Policy Profile Management Events

Profile Update Event

This event is a REQUEST from the Policy Server to the SCE to update the policy profile of the subscriber that already exists in the SCE platform. This event does not require any RESPONSE.



Note As described above, the LOGIN-REQUEST event and LOGIN-PULL-RESPONSE event can also update the policy profile.

Quota Management Events

Quota Update Event

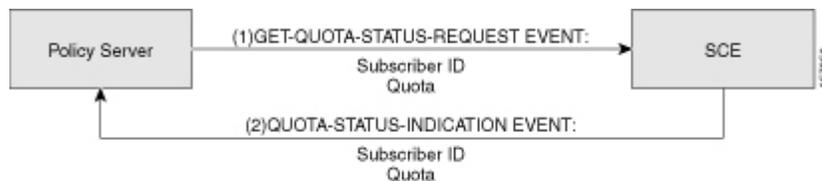
The Quota Update Event is a REQUEST from the Policy Server to the SCE to update the quota of the subscriber that already exists in the SCE platform. This event does not require any RESPONSE event.



Note As described above, the LOGIN-REQUEST event and LOGIN-PULL-RESPONSE event can also update the quota.

Get Quota Status Event

The Get Quota Status Event is a REQUEST from the Policy Server to the SCE to report the quota information of the subscriber that already exists in the SCE platform. This event will be followed by the QUOTA-STATUS-INDICATION event.



**Note**

A QUOTA-STATUS-INDICATION event maybe issued periodically by the SCE without a specific request from the Policy Server. See the next section.

Quota Status Event

The Quota Status INDICATION event is used by the SCE to notify the Policy Server about the remaining quota. This event is invoked periodically in a preconfigured time interval.



Quota Below Threshold Event

The Quota Below Threshold INDICATION event is used by the SCE to notify the Policy Server that the remaining quota for certain services of the specific subscriber is below the preconfigured threshold. This event may be followed by the UPDATE-QUOTA-REQUEST event from the Policy Server to the SCE, but it is not mandatory.



Quota Depleted Event

The Quota Depleted INDICATION event is used by the SCE to notify the Policy Server that the quota for certain services of the specific subscriber is depleted. This event may be followed by the UPDATE-QUOTA-REQUEST event from the Policy Server to the SCE.



SCE Synchronization Procedure Events

Start Synchronization Event

This REQUEST event it is used to notify the SCE that the synchronization process is about to start. The SCE uses this REQUEST to perform internal operations that are required for synchronization process preparation. This event has a push and a pull component.



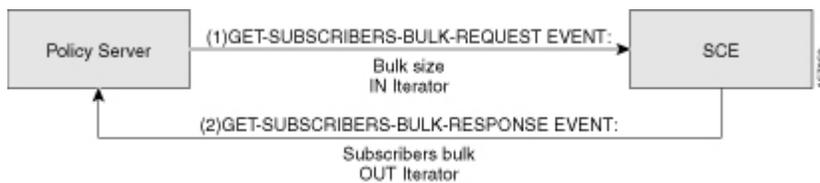
End Synchronization Event

The End Synchronization REQUEST event is used to notify the SCE that the synchronization process has ended. This event has a push and a pull component.



Get Subscribers Events

During the SCE's **Pull** Model synchronization process, the Policy Server is required to retrieve ALL subscribers that the SCE is currently handling. The GET-SUBSCRIBERS-BULK-REQUEST event is a request from the Policy Server to the SCE to retrieve the next bulk of subscribers that the SCE is currently handling. Upon receiving this request, the SCE responds with the GET-SUBSCRIBERS-BULKRESPONSE event that supplies the subscriber names and Network-IDs.



For more information, see the [Pull Mode](#) ("Pull Model" on page 2-2) section and the [Pull Model Synchronization Procedure](#) (on page 5-29) section.



Getting Familiar with the API Data Types

This chapter describes the various API data types used in the *SCMS SCE Subscriber API*.

This chapter contains the following sections:

- [Subscriber ID](#) 4-1
- [Network ID Mappings](#) 4-1
- [SCA BB Subscriber Policy Profile](#) 4-3
- [Subscriber Quota](#) 4-4
- [Bulk Operations Data Types](#) 4-6

Subscriber ID

Most methods of the SCE Subscriber APIs require the subscriber ID to be used as an input parameter. The Subscriber ID is a string which represents a subscriber name, or a CM MAC address. This section lists the formatting rules of a subscriber ID.

The subscriber name is *case-sensitive*. It may contain up to 40 characters. The following characters may be used:

Alphanumerics	\$ (dollar sign)	. (period or dot)	_ (underscore)
- (minus sign or hyphen)	% (percent sign)	/ (slash)	~ (tilde)
! (exclamation mark)	& (ampersand)	: (colon)	' (apostrophe)
# (number sign)	() (parentheses)	@ (at sign)	

For example:

```
String subID1="john";  
String subID2="john@yahoo.com";
```

Network ID Mappings

A network ID is a network identifier that the SCE device relates to a specific subscriber record. A typical example of a network ID mapping is an IP address. Currently, the Cisco Service Control Engine (SCE) supports IP address, IP range, and VLAN types of mappings.

The NetworkID class represents various types of subscriber network identification.

The API supports the following subscriber mapping types:

- IP addresses or IP ranges
- VLAN tags


Note

Mixing IP addresses/IP ranges with VLAN tags for the same subscriber is not supported.

When using subscriber operations that involve network ID the caller is requested to provide a NetworkID parameter.

NetworkID class constructors are defined as follows:

```
public NetworkID(String mapping,short mappingType) throws Exception
public NetworkID(String[] mappings,short[] mappingTypes) throws Exception
```

Parameters of the NetworkID constructors are:

- a `java.lang.String` mapping identifier or array of mapping identifiers
- a short mapping type or array of mapping types

When passing arrays, the `mappingTypes` array must contain either the same number of elements as the `mappings` array, or a single element.

- Use `NetworkID.TYPE_IP` or `NetworkID.TYPE_VLAN` constants if the array contains more than one element
- Use `NetworkID.ALL_IP_MAPPINGS` or `NetworkID.ALL_VLAN_MAPPINGS` constants when a single array element is used

Specifying IP Address Mapping

The string format of an IP address is the commonly used decimal notation:

IP-Address=[0-255].[0-255].[0-255].[0-255]

Example:

- 216.109.118.66

The mapping type of an IP address is provided in the class `NetworkID`:

```
com.scms.common.NetworkID.TYPE_IP:
```

`com.scms.common.NetworkID.ALL_IP_MAPPINGS` specifies that all the entries in the mapping identifiers array are IP mappings.

Specifying IP Range Mapping

The string format of an IP range is an IP address in decimal notation and a decimal specifying the number of 1s in a bit mask: IP-Range=[0-255].[0-255].[0-255].[0-255]/[0-32].

Examples:

- 10.1.1.10/32 is an IP range with a full mask, that is, a regular IP address.
- 10.1.1.0/24 is an IP range with a 24-bit mask, that is, all of the addresses ranging between 10.1.1.0 and 10.1.1.255.



Note The mapping type of an IP Range is identical to the mapping type of the IP address.

Specifying VLAN Tag Mapping

The string format for VLAN tag mapping is a decimal number in the following range: [2-2046]

VLAN mapping type is provided in class `com.scms.common.NetworkID`:

- The mapping type of an IP address is provided in the class `NetworkID`:
`com.scms.common.NetworkID.TYPE_VLAN`:
- `com.scms.common.NetworkID.ALL_VLAN_MAPPINGS` specifies that all the entries in the mapping identifiers array are VLAN mappings.

Network ID Mappings Examples

Construct `NetworkID` with a single IP address:

```
NetworkID nid = new NetworkID("1.1.1.1", NetworkID.TYPE_IP)
```

Construct `NetworkID` with a range of IP addresses:

```
NetworkID nid = new NetworkID("1.1.1.1/24", NetworkID.TYPE_IP)
```

Construct `NetworkID` with multiple IP addresses:

```
NetworkID nid = new NetworkID(new String[]{"1.1.1.1", "2.2.2.2", "3.3.3.3"},  
NetworkID.ALL_IP_MAPPINGS)
```

Construct `NetworkID` with a single VLAN address:

```
NetworkID nid = new NetworkID("23", NetworkID.TYPE_VLAN)
```

SCA BB Subscriber Policy Profile

The Policy Profile describes the subscriber policy information. A policy profile is generally comprised of two main parts including a statically defined policy that is identified by the policy package and a set of subscriber policy properties that might have a dynamic nature. The policy package is identified by the package ID. Most of the rules enforced on the subscriber traffic are derived from the package ID.

Subscriber policy property in the SCA BB is a **key-value** pair that affects the way the SCE analyzes and reacts to network traffic generated by the subscriber.

More information about properties can be found in the *Service Control Application Suite for Broadband User Guide*.

SCA BB version 3.0 contains the following properties:

- `packageId`—defines the package ID of the subscriber

- **monitor**—indicates whether to issue an Raw Data Record (RDR) for each transaction of this subscriber

PolicyProfile Class

The API provides a `PolicyProfile` class to format subscriber policy profiles required for the API operations.

The following method constructs the `PolicyProfile` class based on the array of policy properties:

```
public PolicyProfile(String[] policy)
```



Note

The encoding of each string within the array **must** be as follows: “property_name=property_value”.

The following method allows adding a policy property to the profile according to the format described above:

```
public void addPolicyProperty(String policyProperty)
```



Note

This method is not optimized for performance. For best performance results, use the `PolicyProfile` constructor.

EXAMPLE:

```
PolicyProfile pp = new PolicyProfile(new String[]{"packageId=22",
                                                "monitor=1"})
```

Subscriber Quota

The quota provisioning in SCA BB is prepared using subscriber quota buckets. Each subscriber has 16 buckets, and each bucket can be defined for volume or sessions. When a subscriber uses a particular service, the amount of consumed volume or number of sessions is subtracted from one of the buckets. The service configuration, which is defined in the general policy definition by using the SCA BB GUI, determines which bucket to use for each service. Consumption for the volume buckets is counted in units of L3 kilobytes and consumption for the session buckets is the number of sessions. For example, it is possible to define that the Browsing and E-mail services consume quota from Bucket #1, P2P service consumes quota from Bucket #2, and that all other services are not bound to any particular bucket.

Quota bucket comprises from the following components:

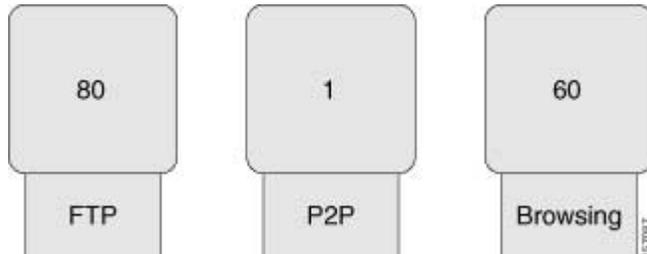
- **Bucket ID**—unique identifier of the bucket (`String`) as defined in the predefined policy. Valid values are numbers in range [1-16]
- **Bucket value**—quota bucket value (`long`)

Quota Operation is defined to dynamically modify subscriber's quota buckets. There are 2 types of quota operations:

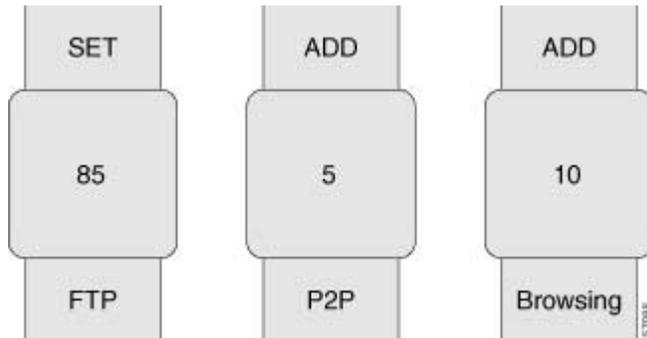
- **ADD_QUOTA_OPERATION**—adds the new quota value to the current value of the bucket residing on the SCE platform
- **SET_QUOTA_OPERATION**—replaces the value of the quota bucket residing on the SCE platform with the new value

EXAMPLES

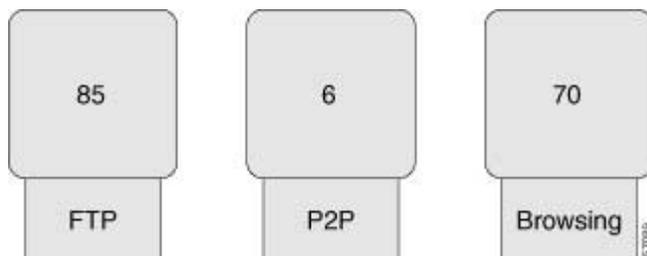
Current values of the subscriber A's quota at the SCE is as follows:



We want to apply the following actions to the existing quota:



After the quota actions are performed the result is:



For additional information about Subscriber Quota, see the *Service Control Application for Broadband User Guide*.

The following sections describe the classes the API provides for operations that include the subscriber quota management operations.

SCAS_BB_Quota

The `SCAS_BB_Quota` class implements the `Quota` interface, which is used in all callback functions of the [QuotaListener](#) (on page 5-10) interface.

The following method constructs the `SCAS_BB_Quota` based on the array of IDs and values:

```
public SCAS_BB_Quota (String[] bucketIDs, long[] bucketValues)
```

The following method allows retrieving of the quota buckets IDs:

```
public String[] getBucketIDs()
```

The following method allows retrieving of the quota buckets values:

```
public long[] getBucketValues()
```

SCAS_BB_QuotaOperation

The SCAS_BB_QuotaOperation class implements the QuotaOperation interface, which is used for Subscriber Provisioning operations that include the subscriber's quota such as login operation (see the [login operation](#) (on page 5-17) section) and update quota operation (see the [quotaUpdate operation](#) (on page 5-25)).

The following method constructs the SCAS_BB_QuotaOperation based on the array of IDs, values and actions:

```
public SCAS_BB_QuotaOperation (String[] IDs,
                               long[] values,
                               short[] actions)
```

The following method allows retrieving of the quota buckets' IDs:

```
public String[] getBucketIDs()
```

The following method allows retrieving of the quota buckets' values:

```
public long[] getBucketValues()
```

The following method allows retrieving of the quota buckets' actions:

```
public short[] getBucketActions()
```

Bulk Operations Data Types

Bulk classes and operations should be used when performing the same method for many subscribers each with its own parameters. The bulk classes are provided by the API for result handling of bulk operations and for bulk indications from the SCE. The bulk classes are passed to the bulk methods such as loginBulk and logoutBulk.

The following is a list of considerations when using the bulk operations:

- All bulk classes are inherited from the common BulkBase class.
- Due to the memory constraints of the SCE the bulk size is limited to a maximum of 100 entries.

Bulk Iterator

The BulkBase class provides an iterator to view the data contained in the bulk.

The following is the syntax for the Bulk Iterator:

```
Iterator getIterator()
```

This iterator can be used for iteration over the bulks received from the SCE in various indications (for example, logoutBulkIndication, loginPullBulkResponseIndication, and so forth) or for inspecting the data you provided to various operations in case an operation has failed.

The iterator provides the following methods for data retrieval:

```
public Object next()
public boolean hasNext()
```

The next() method returns a `SubscriberData` object.

The [SubscriberData](#) (on page 4-7) class is used for retrieving the information of a single subscriber contained within the bulk.

SubscriberData

The `SubscriberData` class represents all of the operations that can be performed on a specific subscriber. The following utility methods are supplied by the `SubscriberData` class for information retrieval:

```
public String getSubscriberID()
public String getAnonymousID()
public String[] getMappings()
public short[] getTypes()
public boolean getAdditiveFlag()
public String[] getPolicyStrings()
public String[] getQuotaStrings()
public String[] getQuotaOperationStrings()
```

The following sections describe various bulk data types that are available for different API operations.

Login_BULK Class

This class represents bulk of subscribers and it includes all data required for the `loginBulk` operation.

Constructor

To construct the `Login_BULK` filled with the data use the following constructor:

```
public Login_BULK(String[] subscriberIDs,
                 NetworkID[] networkIDs,
                 boolean[] networkIDsAdditive,
                 PolicyProfile[] policy,
                 QuotaOperation[] quota)
```

Parameters

`subscriberID` - the unique ID of the subscriber. See the [Subscriber ID](#) (on page 4-1) section for the subscriber ID format description.

`networkID` - the network identifier of the subscriber. See the [Network ID Mappings](#) (on page 4-1) section for more information.

`networkIDAdditive` - If this flag is set to `TRUE`, the supplied `NetworkID` is added to the existing `networkIDs` of the subscriber. Otherwise, the supplied `networkID` replaces the existing `networkIDs`.

`policy` - policy profile of the subscriber. See the [SCA BB Subscriber Policy Profile](#) (on page 4-3) section for more information.

quota - quota of the subscriber. See the [Subscriber Quota](#) (on page 4-4) section for more information.

To construct an empty Login_BULK, use the following method:

```
public Login_BULK()
```

addBulkEntry Method

Use the following method to add entries to the bulk:

```
public void addBulkEntry(String subscriberID,
                        NetworkID networkID,
                        boolean networkIdsAdditive,
                        PolicyProfile policy,
                        QuotaOperation quota)
```

Parameters

subscriberID - the unique ID of the subscriber. See the [Subscriber ID](#) (on page 4-1) section for the subscriber ID format description.

networkID - the network identifier of the subscriber. See the [Network ID Mappings](#) (on page 4-1) section for more information.

networkIDAdditive - If this flag is set to TRUE, the supplied NetworkID is added to the existing networkIDs of the subscriber. Otherwise, the supplied networkID replaces the existing networkIDs.

policy - policy profile of the subscriber. See the [SCA BB Subscriber Policy Profile](#) (on page 4-3) section for more information.

quota - quota of the subscriber. See the [Subscriber Quota](#) (on page 4-4) section for more information.

Examples

The following example demonstrates the usage of the Login_BULK object:

```
// Prepare all data for the bulk construction
String[] names = new String[5];
NetworkID[] mappings = new NetworkID[5];
boolean[] additive = new boolean[5];
PolicyProfile[] policy = new PolicyProfile[5];

for (int i=0; i< 5; i++)
{
    names[i]="sub_"+i;
    mappings[i] = new NetworkID("1.1.1."+i,NetworkID.TYPE_IP);
    additive[i] = true;
    policy[i] = new PolicyProfile(new String[]{"packageId="+i});
}

// construct the bulk object
Login_BULK bulk = new Login_BULK(names,mappings,additive,policy,null);
// Now it can be used in loginBulk operation
sceApi.loginBulk(bulk,null);
```

An alternative way of manipulating Login_BULK:

```
// Construct the empty bulk
Login_BULK bulk = new Login_BULK ();

// Fill the bulk using addBulkEntry method:
for (int i=0; i<20; i++)
{
    String name ="sub_"+i;
    NetworkID mappings = new NetworkID(i+1);
    boolean additive = true;
    PolicyProfile policy = new PolicyProfile(
        new String[]{"packageId="+i+1});
    QuotaOperation quota = new new SCAS_BB_QuotaOperation(
        new String[]{"1","2","3"},
        new long[]{80,80,0}
        new short[]{SCAS_BB_QuotaOperation.ADD_QUOTA_OPERATION,
            SCAS_BB_QuotaOperation.ADD_QUOTA_OPERATION,
            SCAS_BB_QuotaOperation.SET_QUOTA_OPERATION});

    bulk.addBulkEntry(name,mappings,additive,policy,quota);
}
// Now it can be used in loginBulk operation
sceApi.loginBulk(bulk,null);
```

SubscriberID_BULK Class

The SubscriberID_BULK class is used in the `logoutBulkIndication` callback function that requires only subscriber IDs to be entered. (See [logoutBulkIndication callback method](#) (on page 5-10).)

Constructors

To construct the SubscriberID_BULK with Subscriber IDs data, use the following constructor:

```
public SubscriberID_BULK(String[] subscriberIDs)
```

To construct an empty SubscriberID_BULK, use the following method:

```
public SubscriberID_BULK()
```

Parameters

`subscriberID` - the unique ID of the subscriber. See the [Subscriber ID](#) (on page 4-1) section for the subscriber ID format description.

addBulkEntry Method

Use the following method to add entries to the SubscriberID bulk:

```
addBulkEntry(String subscriberID)
```

Parameters

`subscriberID` - the unique ID of the subscriber. See the [Subscriber ID](#) (on page 4-1) section for the subscriber ID format description.

NetworkAndSubscriberID_BULK Class

The `NetworkAndSubscriberID_BULK` class is used in bulk operations that require Subscriber IDs and NetworkIDs in the following operations:

- `getSubscribersBulkResponse` callback (see the [LoginPullListener](#) (on page 5-7) section)
- `logoutBulk` operation (see the [logoutBulk operation](#) (on page 5-21) section)
- `networkIDUpdateBulk` operation (see the [networkIDUpdateBulk operation](#) (on page 5-23) section)

Constructors

To construct the `NetworkAndSubscriberID_BULK` with the SubscriberID and NetworkID data, use the following constructor:

```
public NetworkAndSubscriberID_BULK(String[] subscriberIDs,
                                   NetworkID[] networkIDs,
                                   boolean[] netIdAdditive)
```

To construct an empty `NetworkAndSubscriberID_BULK`, use the following method:

```
public NetworkAndSubscriberID_BULK()
```

Parameters

`subscriberID` - the unique ID of the subscriber. See the [Subscriber ID](#) (on page 4-1) section for more information.

`networkID` - the network identifier of the subscriber. See the [Network ID Mappings](#) (on page 4-1) section for more information.

`networkIDAdditive` - If this flag is set to `TRUE`, the supplied NetworkID is added to the existing networkIDs of the subscriber. Otherwise, the supplied networkID replaces the existing networkIDs.

addBulkEntry Method

Use the following method to add entries to the bulk:

```
addBulkEntry(String subscriberID,
              NetworkID networkID,
              boolean netIdAdditive)
```

Parameters

`subscriberID` - the unique ID of the subscriber. See the [Subscriber ID](#) (on page 4-1) section for more information.

`networkID` - the network identifier of the subscriber. See the [Network ID Mappings](#) (on page 4-1) section for more information.

`networkIDAdditive` - If this flag is set to `TRUE`, the supplied NetworkID is added to the existing networkIDs of the subscriber. Otherwise, the supplied networkID replaces the existing networkIDs.

LoginPullResponse_BULK Class

This class represents a bulk of subscribers and includes all data required for the `loginPullResponseBulk` method.

Constructors

To construct the `LoginPullResponse_BULK` containing the relevant data, use the following constructor:

```
public LoginPullResponse_BULK(String[] anonymousSubscriberIDs,
                             String[] subscriberIDs,
                             NetworkID[] networkIDs,
                             boolean[] networkIdsAdditive,
                             PolicyProfile[] policy,
                             QuotaOperation[] quota)
```

To construct an empty `LoginPullResponse_BULK`, use the following method:

```
public LoginPullResponse_BULK()
```

Parameters

`anonymousSubscriberID` - the identifier of the anonymous subscriber. This is sent by the SCE within the [loginPullRequest/loginPullBulkRequest](#) (on page 5-7) indication. See the [Anonymous Subscriber ID](#) ("Subscriber Integration Models" on page 2-2) section for more information.

`subscriberID` - the unique ID of the subscriber. See the [Subscriber ID](#) (on page 4-1) section for more information.

`networkID` - the network identifier of the subscriber. See the [Network ID Mappings](#) (on page 4-1) section for more information.

`networkIDAdditive` - If this flag is set to TRUE, the supplied NetworkID is added to the existing networkIDs of the subscriber. Otherwise, the supplied networkID replaces the existing networkIDs.

`policy` - the policy profile of the subscriber. See the [SCA BB Subscriber Policy Profile](#) (on page 4-3) section for more information.

`quota` - the quota of the subscriber. See the [Subscriber Quota](#) (on page 4-4) section for more information.

addBulkEntry Method

Use the following method to add entries to the bulk:

```
public addBulkEntry(String anonymousSubscriberID,
                   String subscriberID,
                   NetworkID networkID,
                   boolean networkIdAdditive,
                   PolicyProfile policy,
                   QuotaOperation quota)
```

Parameters

`anonymousSubscriberID` - the identifier of the anonymous subscriber. This is sent by the SCE within the [loginPullRequest/loginPullBulkRequest](#) (on page 5-7) indication. See the [Anonymous Subscriber ID](#) ("Subscriber Integration Models" on page 2-2) section for more information.

`subscriberID` - the unique ID of the subscriber. See the [Subscriber ID](#) (on page 4-1) section for more information.

`networkID` - the network identifier of the subscriber. See the [Network ID Mappings](#) (on page 4-1) section for more information.

`networkIDAdditive` - If this flag is set to TRUE, the supplied NetworkID is added to the existing networkIDs of the subscriber. Otherwise, the supplied networkID replaces the existing networkIDs.

`policy` - the policy profile of the subscriber. See the [SCA BB Subscriber Policy Profile](#) (on page 4-3) section for more information.

`quota` - the quota of the subscriber. See the [Subscriber Quota](#) (on page 4-4) section for more information.

PolicyProfile_BULK Class

This class represents a bulk of subscriber IDs and subscriber policy profiles that is used in the `updatePolicyProfileBulk` operation.

Constructors

To construct the `PolicyProfile_BULK` containing the relevant data, use the following constructor:

```
public PolicyProfile_BULK(String[] subscriberIDs, PolicyProfile[] policy)
```

To construct an empty `PolicyProfile_BULK`, use the following method:

```
public PolicyProfile_BULK()
```

Parameters

`subscriberID` - the unique ID of the subscriber. See the [Subscriber ID](#) (on page 4-1) section for more information.

`policy` - the policy profile of the subscriber. See the [SCA BB Subscriber Policy Profile](#) (on page 4-3) section for more information.

addBulkEntry Method

Use the following method to add entries to the bulk:

```
public addBulkEntry(String subscriberID, PolicyProfile policy)
```

Parameters

`subscriberID` - the unique ID of the subscriber. See the [Subscriber ID](#) (on page 4-1) section for more information.

`policy` - the policy profile of the subscriber. See the [SCA BB Subscriber Policy Profile](#) (on page 4-3) section for more information.

Quota_BULK Class

This class represents a bulk of subscribers IDs and subscriber quota buckets that is used in the following operations:

- getQuotaStatusBulk operation (only the bucket IDs are to be provided)
- quotaStatusBulkIndication callback method
- quotaDepletedBulkIndication callback method
- quotaBelowThresholdIndication callback method

Constructors

To construct the Quota_BULK containing the relevant data, use the following constructor:

```
public Quota_BULK(String[] subscriberIDs, Quota[] subscribersQuota)
```

To construct an empty Quota_BULK, use the following method:

```
public Quota_BULK()
```

Parameters

subscriberID - the unique ID of the subscriber. See the [Subscriber ID](#) (on page 4-1) section for more information.

quota - the quota of the subscriber. See the [Subscriber Quota](#) (on page 4-4) section for more information.

addBulkEntry Method

Use the following method to add entries to the bulk:

```
public addBulkEntry(String subscriberID, Quota quota)
```

Parameters

subscriberID - the unique ID of the subscriber. See the [Subscriber ID](#) (on page 4-1) section for more information.

quota - the quota of the subscriber. See the [Subscriber Quota](#) (on page 4-4) section for more information.

QuotaOperation_BULK Class

This class represents a bulk of subscribers IDs and subscriber Quota operations that is used in the QuotaUpdateBulk operation and in the login operation.

Constructors

To construct the QuotaOperation_BULK containing the relevant data, use the following constructor:

```
public QuotaOperation_BULK(String[] subscriberIDs,  
                           QuotaOperation[] quotaOperations)
```

To construct an empty `QuotaOperation_BULK`, use the following method:

```
public QuotaOperation_BULK()
```

Parameters

`subscriberID` - the unique ID of the subscriber. See the [Subscriber ID](#) (on page 4-1) section for more information.

`quotaOperation` - the quota operation to perform on the quota of the subscriber. See the [Subscriber Quota](#) (on page 4-4) section for more information.

addBulkEntry Method

Use the following method to add entries to the bulk:

```
addBulkEntry(String subscriberID, QuotaOperation quotaOperation)
```

Parameters

`subscriberID` - the unique ID of the subscriber. See the [Subscriber ID](#) (on page 4-1) section for more information.

`quotaOperation` - the quota operation to perform on the quota of the subscriber. See the [Subscriber Quota](#) (on page 4-4) section for more information.



Programming with the SCE Subscriber API

This chapter provides a detailed description of the API programming structure, classes, methods, and interfaces.

This chapter contains the following sections:

- [API classes summary](#) 5-1
- [Programming Guidelines](#) 5-2
- [PRPC_SCESubscriberApi class](#) 5-3
- [Indications Listeners](#) 5-7
- [Connection Monitoring](#) 5-12
- [Result Handling](#) 5-13
- [Subscriber Provisioning Operations](#) 5-16
- [SCE-API Synchronization](#) 5-28
- [Advanced API Programming](#) 5-32
- [API Code Examples](#) 5-33

API classes summary

The following list maps the classes provided by the API.

Package `com.scms.api.sce.prpc`

- [PRPC_SCESubscriberApi](#) (on page 5-3) - main API class.

Package `com.scms.api.sce`

Indications Listeners

- [LoginPullListener Interface Class](#) (on page 5-7) (interface)
- [LogoutListener Interface Class](#) (on page 5-9) (interface)
- [QuotaListener Interface Class](#) (on page 5-10) (interface)

Connection Monitoring

- *ConnectionListener* (on page 5-12) (interface)

Operations Result Handling

- *OperationException* (on page 5-16) (class)
- SCESubscriberApi (interface) - contains error codes constants that can be received inside OperationException
- *OperationArguments* (on page 5-14) (class)
- *OperationResultHandler* (on page 5-13) (interface)

Package com.scms.common

com.scms.common package contains all data types used by the API.

- *Login_BULK* (on page 4-7) (class)
- *LoginPullResponse_BULK* (on page 4-11) (class)
- *NetworkAndSubscriberID_BULK* (on page 4-10) (class)
- *PolicyProfile_BULK* (on page 4-4) (class)
- *SubscriberID_BULK* (on page 4-9) (class)
- *SubscriberData* (on page 4-7) (class)
- *SCAS_BB_Quota* (on page 4-5) (class)
- *SCAS_BB_QuotaOperation* (on page 4-6) (class)
- *NetworkID* (on page 4-1) (class)
- *PolicyProfile* (on page 4-4) (class)

Programming Guidelines

Programming with callback methods

As described in previous sections, many of the API operations are based on callback methods. The user provides a “listener”, which is called when certain events occur. The following warning defines the main guideline for programming with callback methods.



Caution

Do not perform long operations within the thread of the callback method. Long operations should be performed from a **separate thread**. Moreover, not following this recommendation might result in resource leakage on the client's side.

This caution applies to the following operations:

- LoginPullListener callback methods

- LogoutListener callback methods
- QuotaListener callback methods
- ConnectionListener callback methods

PRPC_SCESubscriberApi class

The PRPC_SCESubscriberAPI class (resides in a com.scms.sce.api.prpc package) is the main API class that provides the following functionality:

- Constructing the API
- Connecting the API to exactly one SCE (configuring the connection attributes)
- Registering/unregistering indications listeners
- Setting the connection listener
- Performing Subscriber Provisioning operations
- Disconnecting from the SCE

API Construction

The PRPC_SCESubscriberAPI provides the following constructors:

Syntax:

```
public PRPC_SCESubscriberApi(String apiName, String sceHost)
                                throws UnknownHostException

public PRPC_SCESubscriberApi(String apiName,
                               String sceHost,
                               long autoReconnectInterval)
                                throws UnknownHostException

public PRPC_SCESubscriberApi(String apiName,
                               String sceHost,
                               int scePort,
                               long autoReconnectInterval)
                                throws UnknownHostException
```

Parameters:

The following is a description of the constructor arguments for the API constructors:

apiName - Specifies an API name .



Note

The API name should be unique per SCE. Constructing more than one API with the same name connected to a single SCE will be handled by the SCE platform as one API client. This feature should be used only when high-availability is supported. For more information about high availability, see the High Availability section.

sceHost - can be either an IP address or a reachable hostname.

`scePort` - PRPC protocol TCP port to connect to the SCE (default value is 14374)

`autoReconnectInterval` - Defines the interval (in milliseconds) for attempting reconnection by the reconnection task, as follows:

- If the value is 0 or less, the reconnection task is not activated (no auto-reconnect is attempted).
- If the value is greater than 0 and a connection failure exists, the reconnection task will be activated every `<autoReconnectInterval>` milliseconds.
- Default value: -1 (no auto-reconnect is attempted)



Note

To enable the auto-reconnect support, the `connect` method of the API **must** be called at least once.

Examples:

The following code constructs an API with an auto-reconnection interval of 10 seconds:

```
PRPC_SCESuscriberAPI sceApi = new PRPC_SCESuscriberAPI("MyApi",
                                                       "10.1.1.1",
                                                       10000);
sceApi.connect();
```

The following code constructs an API without auto-reconnection support:

```
PRPC_SCESuscriberAPI sceApi = new PRPC_SCESuscriberAPI("MyApi",
                                                       "10.1.1.1");
sceApi.connect();
```

Listeners Setup Operations

After initializing the API it should be set-up with the utilized listeners based on the type of application using the API, and the topology used. For more information about topologies, see the [Supported Topologies](#) (on page 2-4) sections.

The listeners setup operations may include:

- Setting a connection listener, described in more detail in the [ConnectionListener Interface](#) (on page 5-12) section:

```
public void setConnectionListener(ConnectionListener listener)
```

- Setting a login-pull listener, described in more detail in the [LoginPullListener Interface](#) (on page 5-7) section:

```
public void registerLoginPullListener(LoginPullListener listener)
```

- Setting a logout listener, described in more detail in the [LogoutListener Interface](#) (on page 5-9) section.

```
public void registerLogoutListener(LogoutListener listener)
```

- Setting a quota listener, described in more detail in the [QuotaListener Interface](#) (on page 5-10) section.

```
public void registerQuotaListener(QuotaListener listener)
```

**Note**

The listener registration to the API causes resource allocations in the SCE to support reliable delivery of messages to the listener. Even if the application that uses the API crashes and restarts after a short time the messages are kept and sent to the SCE when the API reconnects.

Advanced Setup Operations

The API enables initializing certain internal properties for API customization. The initialization is done using the API `init` method.

**Note**

For settings to take effect, the `init` method **must** be called before the `connect` method.

The following properties can be set:

- Output queue size—the internal buffer size defining the maximum number of requests that can be accumulated by the API until they are sent to the SCE (Default: 1024)
- Operation timeout—a suggested time interval about the desired timeout (in milliseconds) on a non-responding PRPC protocol connection (Default: 45 seconds)

Syntax

The syntax for the `init` method is as follows:

```
public void init(Properties properties)
```

Parameters

- `properties` (`java.util.Properties`)

Enables setting the properties described above:

- To set the output queue size, use `prpc.client.output.machinemode.recordnum` as a property key
- To set the operation timeout, use `com.scms.api.sce.prpc.regularInvocationTimeout` or `com.scms.api.sce.prpc.listenerInvocationTimeout` as a property key

**Note**

`com.scms.api.sce.prpc.listenerInvocationTimeout` is used for operations that may be invoked from listener callback. This timeout should be shorter than `com.scms.api.sce.prpc.regularInvocationTimeout` to avoid deadlocks.

Example

The following code shows how to customize properties during initialization:

```
// API construction
PRPC_SCESubscriberAPI sceApi = new PRPC_SCESubscriberAPI("MyApi",
                                                         "10.1.1.1",10000);

// API initialization
java.util.Properties p = new java.util.Properties();
p.setProperty("prpc.client.output.machinemode.recordnum", 2048+"");

api.init(p);

// connect to the API
sceApi.connect();
```

**Note**

The `init` method is called **before** the `connect` method.

Connecting to the SCE

After setting up the API, you should attempt to connect to the SCE. If the auto-reconnect feature is activated, the API will handle any disconnection from this point on.

To connect to the SCE, use the following methods:

```
public void connect() throws Exception
```

At any time during the API operation, you can check if the API is connected to the SCE by using the method `isConnected()`:

```
public boolean isConnected()
```

**Note**

Every API instance supports a connection to exactly one SCE platform.

getApiVersion

Syntax

```
public String getApiVersion()
```

Description

This method queries the API version. Version is a string formatted as <Major Version.Minor Version>.

API Finalization

To free the resources of both server and client, call the `disconnect` method:

```
public void disconnect()
```

The call to the `disconnect` method frees the resources in the SCE that manages the reliability of the connection from the SCE to the API. If the application is restarting and you do not want to lose any messages, do not use the `disconnect` method.

It is recommended that you use a `finally` statement in your main class. For example:

```
public static void main(String [] args) throws Exception
{
    PRPC_SCESubscriberApi sceapi = new PRPC_SCE_SubscriberApi ("myApi",
                                                             "sceHost");

    try
    {
        ...
        // Your code goes here
    }
    finally
    {
        sceapi.disconnect();
    }
}
```

Indications Listeners

The SCE platform issues several types of indications when certain events occur. There are three types of indications:

- Login-pull indications
- Logout indications
- Quota indications

The indications are sent only if there are listeners that are registered to listen to those indications. For every type of indications, a separate listener may be registered. For descriptions about the events that trigger these indications, see the [API Events](#) (on page 3-1) chapter.

LoginPullListener Interface Class

The `LoginPullListener` interface defines a set of callback functions that are used only in the **pull** model.

Policy Servers that are responsible for the Network ID management part of the Subscriber Provisioning process and intend to work in the pull model should register a `LoginPullListener` to enable to respond to the login-pull requests from the SCE and to synchronize the SCE platform.

To enable listening to those indications, the API allows a listener to be set for this type of indications:

```
public void registerLoginPullListener(LoginPullListener listener)
public void unregisterLoginPullListener(LoginPullListener listener)
```

**Note**

The API supports one LoginPullListener at a time. Furthermore, it is strongly recommended not to have more than one API that has registered a LoginPullListener as it can lead to non-synchronized SCE platforms, if both SCEs respond to the same login-pull request.

LoginPullListener is an interface that is implemented to enable to register a login-pull indications listener. It is defined as follows:

```
public interface LoginPullListener
{
    public void loginPullRequest (String anonymousSubscriberID,
                                  NetworkID networkID)

    public void loginPullRequestBulk(NetworkAndSubscriberID_BULK subs)

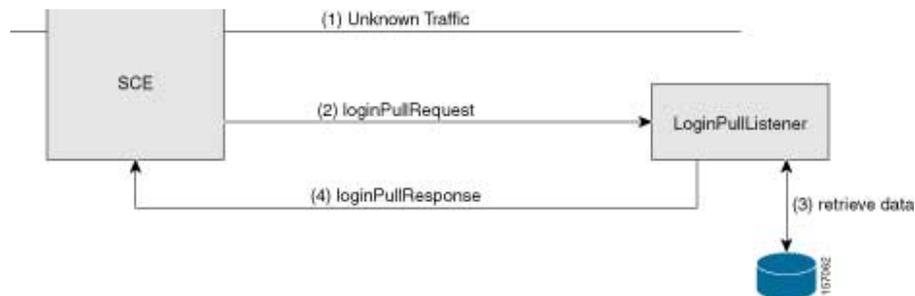
    public void getSubscribersBulkResponse(
        NetworkAndSubscriberID_BULK subs,
        SubscriberBulkResponseIterator iterator)
}
```

loginPullRequest callback method

When the SCE encounters an unknown IP address's subscriber-side traffic, it issues a request for the subscriber login information based on the IP address (see [Pull model](#) (on page 3-2) in API Events chapter). The SCE expects the policy server to respond with the configuration data of the subscriber data to which this IP was allocated.

This request is dispatched to the registered listener and triggers the loginPullRequest callback function. Upon this callback, the listener should retrieve the subscriber information of the subscriber matching this IP address and activate loginPullResponse to deliver the information to the SCE (see [loginPullResponse operation](#) (on page 5-19) section in Subscriber Provisioning Operations). If no information exists for this IP address, no response is issued.

The following diagram illustrates the loginPullRequest callback method:

**Parameters**

- anonymousSubscriberID - This anonymous subscriber ID **must** be supplied to the loginPullResponse operation (see the [loginPullResponse operation](#) (on page 5-19) section). Also see the [Anonymous Subscriber ID](#) ("Subscriber Integration Models" on page 2-2) section.

- `networkID` - networkID of the unknown subscriber. See the [NetworkID](#) ("[Subscriber Integration Models](#)" on page 2-2) section for more information.

loginPullRequestBulk callback method

This callback function is the bulk version of the `loginPullRequest` callback function that is described above.

Parameters

- `subs` - contains pairs of NetworkIDs and anonymous IDs of several subscribers. See the parameters description of the [loginPullRequest](#) ("[loginPullRequest callback method](#)" on page 5-8) callback method for more information.

The Policy Server can respond to this request by the [loginPullBulkResponse](#) (on page 5-20) method activation or by activating the [loginPullResponse](#) (on page 5-19) method for each NetworkID in the bulk. To iterate over the data contained in the `subs` parameter use the [next\(\)](#) ("[Bulk Iterator](#)" on page 4-6) iteration method provided by the bulk class.

GetSubscribersBulkResponse callback method

This callback method is used during the SCE synchronization process in the **pull** model. For a detailed description, see the [SCE-API Synchronization](#) (on page 5-28) section.

LogoutListener Interface Class

Policy Servers that are responsible for the Network ID management part of the Subscriber Provisioning process might want to register a `LogoutListener` to be notified when certain subscribers are actually removed from the SCE platform.

The API allows setting a `LogoutListener` to be able to receive logout indications.

```
public void registerLogoutListener(LogoutListener listener)
public void unregisterLogoutListener(LogoutListener listener)
```



Note The API supports one `LogoutListener` at a time.

The following sections describe callback functions of the `LogoutListener` interface.

logoutIndication callback method

When the SCE platform identifies the logout of the last Network-ID of the subscriber identified by the `subscriberID`, the logout indication is issued. This triggers a call to the `logoutIndication` callback function of all registered logout indications listeners.

```
public void logoutIndication(String subscriberID)
```

Parameters

- `subscriber ID` - a unique identifier of the subscriber. See [Subscriber ID](#) (on page 4-1) for more information. This subscriber ID is no longer handled by the SCE.

logoutBulkIndication callback method

When the SCE platform identifies the logout of the last NetworkID of the **group** of subscribers, the logout bulk indication is issued. This triggers a call to the `logoutBulkIndication` callback function of all registered logout indications listeners.

```
public void logoutBulkIndication(SubscriberID_BULK subs)
```

Parameters

- `subs` - contains subscriber IDs of the subscribers that were logged out. See the [SubscriberID_BULK](#) (on page 4-9) section for more information.

QuotaListener Interface Class

Policy Servers that are responsible for the Quota management operations in the Subscriber Provisioning Process should be able to receive quota-related indications issued by the SCE platform.

The API allows setting the `QuotaListener` to be able to receive quota indications.

```
public void registerQuotaListener(QuotaListener listener)
public void unregisterQuotaListener(QuotaListener listener)
```



Note

The API supports one `QuotaListener` at a time.

The following sections describe the callback functions of the `QuotaListener` interface.

quotaStatusIndication callback method

Quota status indication delivers the remaining value of the specified set of the quota buckets for a specific subscriber. This indication is issued by the SCE periodically or upon a call to the **getQuotaStatus** operation (see the [getQuotaStatus](#) (on page 5-26) section) and is distributed to the registered listener by activating a `quotaStatusIndication` callback function.

```
public void quotaStatusIndication(String subscriberID,
                                 Quota quota)
```

Parameters

- `subscriberID` - the unique ID of the subscriber. See the [Subscriber ID](#) (on page 4-1) section for more information.
- `quota` - quota of the subscriber. See [Subscriber Quota](#) (on page 4-4) section for more information.

quotaStatusBulkIndication callback method

Quota status bulk indication delivers the remaining value of the specified set of the quota buckets for a group of subscribers. This indication is issued by SCE periodically or upon a call to the `getQuotaStatusBulk` operation (see the [Get Quota Status Event](#) (on page 3-4) section) and is distributed to the registered listener by activating a `quotaStatusBulkIndication` callback function.

```
public void quotaStatusBulkIndication(Quota_BULK subs)
```

For periodically issued indications, the period can be configured. For more information, see the *Cisco Service Control Application for Broadband User Guide*.

Parameters

- `subs` - contains quota data of the bulk of the subscribers. See the [Quota_BULK](#) (on page 4-13) section for more information.

quotaBelowThresholdIndication callback method

When the quota of a subscriber drops below a pre-configured threshold, the SCE platform issues an indication which is distributed to the registered listener by activating a `quotaBelowThresholdIndication` callback function.

```
public void quotaBelowThresholdIndication(String subscriberID,
                                         Quota quota)
```

Parameters

- `subscriberID` - the unique ID of the subscriber. See the [Subscriber ID](#) (on page 4-1) section for more information.
- `quota` - quota of the subscriber. See the [Subscriber Quota](#) (on page 4-4) section for more information.

quotaBelowThresholdBulkIndication callback method

When the quota of a group of subscribers drops below a pre-configured threshold, the SCE platform issues an indication, which is distributed to the registered listener by activating a `quotaBelowThresholdBulkIndication` callback function.

```
public void quotaBelowThresholdBulkIndication(Quota_BULK subs)
```

Parameters

- `subs` - contains quota data of the bulk of the subscribers. See the [Quota_BULK](#) (on page 4-13) section for more information.

quotaDepletedIndication callback method

When the quota of a subscriber is depleted, the SCE platform issues an indication, which is distributed to the registered listener by activating a `quotaDepletedIndication` callback function.

```
public void quotaDepletedIndication(String subscriberID)
```

Parameters

- `subscriberID` - the unique ID of the subscriber. See [Subscriber ID](#) (on page 4-1) section for more information.

quotaDepletedBulkIndication callback method

When the quota of a group of subscribers is depleted, the SCE platform issues an indication, which is distributed to the registered listener by activating a `quotaDepletedBulkIndication` callback function.

```
public void quotaDepletedBulkIndication (SubscriberID_BULK subs)
```

Parameters

- `subs` - contains names of the subscribers that their quota was depleted. See the [SubscriberID_BULK](#) (on page 4-9) section for more information.

Connection Monitoring

The *SCMS SCE Subscriber API* monitors the connection to the SCE platform. A Policy Server requesting to perform certain operations on connection establishment or disconnection from the SCE can implement a `ConnectionListener` interface.

ConnectionListener Interface

The API allows to set a connection listener.

```
setConnectionListener(ConnectionListener listener)
```

The connection listener is an interface that is defined as follows:

```
public interface ConnectionListener {
    /**
     * called when the connection with the SCE is down.
     */
    public void connectionIsDown();

    /**
     * called when the connection with the SCE is established.
     */
    public void connectionEstablished();
}
```

The connection establishment callback is used to start the SCE synchronization. See the [SCE-API Synchronization](#) (on page 5-28) section for more information.

Example

The following example is a simple implementation of a disconnect listener that prints a message to `stdout` and returns.

```
import com.scms.api.sce.ConnectionListener;

public class MyConnectionListener implements ConnectionListener {

    public void connectionIsDown(){
        System.out.println("Message: connection is down.");
        return;
    }

    public void connectionEstablished(){
        System.out.println("Message: connection is established.");
        // activate thread that starts SCE synchronization
    }

}
```

Result Handling

The API enables setting a result handler for **every operation** allowing handling operations results in a different manner.

The `OperationResultHandler` interface's `handleOperationResult` callback is called when a result of an operation, which ran on the SCE, returns to the API.

If no result handling is required for a specific operation, insert **null** in the *handler* argument.



Note

The same operation result handler can be passed to all operations.

OperationResultHandler Interface

This interface is implemented to receive results of operations performed through the API.

The operation result handler is called with the following single method:

```
public interface OperationResultHandler {

    /**
     * handle a result
     */
    public void handleOperationResult(Object[] result,
                                     OperationArguments handback);

}
```

You should implement this interface if you want to be informed about the results of operations performed through the API.



Note

The `OperationResultHandler` interface is the only way to retrieve results. The results cannot be returned immediately after the API method has returned to the caller. To enable to receive operation results, set the result handler of each operation at the time of the operation call (as displayed in the examples).

The following is the data returned from the `OperationResultHandler` interface:

- **result**—The actual result of the operation - each entry within the array can be one of the following:
 - `NULL`—indicates success of the operation.
 - `OperationException`—indicates operation failure (see below).

For non-bulk operations, the result array will have only one entry. For bulk operations, each entry of the result array corresponds to the relevant entry in the bulk operation.

- **handback**—The API automatically provides this object to every operation call. It contains the information about the operation that was called, including all arguments that were passed at the time of the call. The input arguments of the operation are retrieved by the argument name in the API documentation. For example, this data can be used to inspect/output the parameters after the operation failed or to repeat the operation call.



Note

In operations involving bulk objects, even if the operation fails for any specific element in the bulk, the processing of the bulk will continue until the end of the bulk.

OperationArguments class

Use the following methods to retrieve the operation name:

```
public String getOperationName()
```

Use the following methods to retrieve the arguments names:

```
public String[] getArgumentNames()
```

Use the following method to retrieve the specific operation argument. Use the operation's arguments' names from the operation signature as an argument:

```
public Object getArgument(String name)
```

Examples

Sample implementation of the `OperationResultHandler` interface:

```
public class MyOperationHandler implements OperationResultHandler
{
    long successCounter = 0;
    long errorCounter = 0;

    public void handleOperationResult(Object[] result,
                                     OperationArguments handback)
    {
        for (int index=0; index < result.length; index++)
        {
            if (result[index]==null)
            {
                // success
                successCounter++;
            }
            else
            {
                // failure
                errorCounter++;

                // Extract error details
                OperationException ex = (OperationException)result[index];

                // Extract operation name
                String operationName = handback.getOperationName();

                // Print operation name and error message
                System.out.println("Error for operation "+
                                   operationName + ":" +
                                   ex.getErrorMessage());

                // Print operation arguments
                String[] argNames = handback.getArgumentNames();
                if (argNames!=null)
                {
                    for (int j=0; j<argNames.length; j++)
                    {
                        System.out.println(argNames[j]+ "="+
                                           handback.getArgument(argNames[j]));
                    }
                }
            }
        }
    }
}
```



Note The above sample implementation can be used for both regular and bulk operations.

The following example demonstrates login operation sample result handler:

```
public class LoginOperationHandler implements OperationResultHandler
{
    public void handleOperationResult(Object[] result,
                                     OperationArguments handback)
    {
        for (int index=0; index < result.length; index++)
        {
            if (result[index]!=null)
            {
                // failure

                // Extract error details
                OperationException ex =
                    (OperationException)result[index];

                // Print operation name and error message
                System.out.println("Error for login operation "+
                                   ":" + ex.getErrorMessage());

                // Print subscriber ID parameter value
                System.out.println("subscriberID"+
                                   handback.getArgument("subscriberID"));
            }
        }
    }
}
```

Operation Errors

OperationException Class

All functional errors of the *SCMS SCE Subscriber API* are provided by the same Java class, `com.scms.api.sce.OperationException`, which is contrary to the normal Java usage. This “contrary” approach was chosen because of the required “cross-language and cross-protocol” nature of the *SCMS SCE Subscriber API*, which should allow all future SCE API implementations to appear the same (Java, C, C++).

Each `OperationException` exception provides the following information:

- A unique error code (`long`)
- An informative message (`java.lang.String`)
- A server-side *stack trace* (`java.lang.String`)

See the [List of Error Codes](#) (on page A-1) for more details about error codes and their meaning.

Subscriber Provisioning Operations

This section lists the methods of the API that can be used for Subscriber Provisioning purposes. The signature of each method is followed by a description of its input parameters and its return values.

All the methods return a `java.lang.IllegalStateException` when called before a connection with the SCE is established.

login operation

Syntax

```
void login(String subscriberID,
           NetworkID networkID,
           boolean networkIdAdditive,
           PolicyProfile policy,
           QuotaOperation quotaOperation,
           OperationResultHandler handler) throws Exception
```

Description

This operation is used to add or update the subscriber to the SCE. The operation is performed according to the following algorithm:

- If the subscriber ID does not exist in the SCE, a new subscriber is added with all the data supplied
- If the subscriber ID exists:
 - If the **networkIdAdditive** flag is set to TRUE, the supplied NetworkID is added to the existing networkIDs of the subscriber. Otherwise, the supplied networkID replaces the existing networkIDs.
 - **policy**—policy is **updated** with the new policy values. Subscriber Policy entries that are not provided within the PolicyProfile remain unchanged or created with default values.
 - **quota**—the quota is **updated** according to the bucket values and the operations provided (see the [Subscriber Quota](#) (on page 4-4) section)
- If there is a networkID congestion with another subscriber, the networkID of the **other** subscriber is logged out implicitly and the new subscriber is logged in.

For relevant events description, see the [Push Model](#) (on page 3-2) section in the *API Events* chapter.

Parameters

`subscriberID` - the unique ID of the subscriber. See the [Subscriber ID](#) (on page 4-1) section for the subscriber ID format description.

`networkID` - the network identifier or identifiers of the subscriber. See the [Network ID Mappings](#) (on page 4-1) section for more information.

`networkIdAdditive` - If this flag is set to TRUE, the supplied NetworkID is added to the existing networkIDs of the subscriber. Otherwise, the supplied networkID replaces the existing networkIDs.

`policy` - policy profile of the subscriber. See the [SCA BB Subscriber Policy Profile](#) (on page 4-3) section for more information.

`quota` - quota of the subscriber. See the [Subscriber Quota](#) (on page 4-4) section for more information.

handler - result handler for this operation. See the [Result Handling](#) (on page 5-13) section for a description of the `OperationResultHandler` interface.

Error Codes

The following is the list of error codes that might be returned by this method:

- `ERROR_CODE_FATAL_EXCEPTION`
- `ERROR_CODE_RESOURCE_SHORTAGE`
- `ERROR_CODE_OPERATION_ABORTED`
- `ERROR_CODE_INVALID_PARAMETER`
- `ERROR_CODE_NO_APPLICATION_INSTALLED`

For a description of error codes, see [List of Error Codes](#) (on page A-1).

Examples

To add the IP address 192.168.12.5 to an existing subscriber named *john* without affecting any existing mappings:

```
login(
    "john", // subscriber name
    new NetworkID(new String[]{"192.168.12.5"},
                  SCESubscriberApi.ALL_IP_MAPPINGS),
    true, // isMappingAdditive is true
    null, // no policy
    null); // no quota
```

To add the IP address 192.168.12.5 overriding previous mappings:

```
login(
    "john", // subscriber name
    new NetworkID(new String[]{"192.168.12.5"},
                  SCESubscriberApi.ALL_IP_MAPPINGS),
    false, // isMappingAdditive is false
    null, // no policy
    null); // no quota
```

For more examples, see the [Login and Logout](#) (on page 5-33) section.

loginBulk operation

Syntax

```
void loginBulk(Login_BULK subsBulk,
               OperationResultHandler handler) throws Exception
```

Description

This operation applies the logic described in the login operation for each subscriber in the bulk.

Parameters

subsBulk - See the [Login_BULK Class](#) (on page 4-7) section.

`handler` - result handler for this operation. See the [Result Handling](#) (on page 5-13) section for a description of the `OperationResultHandler` interface.

Error Codes

The following is the list of error codes that might be returned by this method:

- `ERROR_CODE_FATAL_EXCEPTION`
- `ERROR_CODE_RESOURCE_SHORTAGE`
- `ERROR_CODE_OPERATION_ABORTED`
- `ERROR_CODE_INVALID_PARAMETER`
- `ERROR_CODE_NO_APPLICATION_INSTALLED`

For a description of error codes, see [List of Error Codes](#) (on page A-1).

loginPullResponse operation

Syntax

```
void loginPullResponse(String anonymousSubscriberID,  
                      String subscriberID,  
                      NetworkID networkID,  
                      PolicyProfile policy,  
                      QuotaOperation quota,  
                      OperationResultHandler handler) throws Exception
```

Description

This operation sends subscriber login information to the SCE as a response to a `loginPullRequest` call from the SCE or a `loginPullBulkRequest`.

For relevant events description, see the [Pull model](#) (on page 3-2) section in the *API Events* chapter.

Parameters

`anonymousSubscriberID` - the identifier of the anonymous subscriber. This is sent by the SCE within the [loginPullRequest/loginPullBulkRequest](#) (on page 5-7) indication. See the [Anonymous Subscriber ID](#) ("Subscriber Integration Models" on page 2-2) section for more information.

`subscriberID` - the unique ID of the subscriber. See the [Subscriber ID](#) (on page 4-1) section for the subscriber ID format description.

`networkID` - the network identifier of the subscriber. See the [Network ID Mappings](#) (on page 4-1) section for more information. This must include the network ID received by the `loginPullRequest`. If this subscriber in the SCE already has other network IDs, this network ID is added to the existing ones.

`policy` - policy profile of the subscriber. See the [SCA BB Subscriber Policy Profile](#) (on page 4-3) section for more information.

`quota` - quota of the subscriber. See the [Subscriber Quota](#) (on page 4-4) section for more information.

handler - result handler for this operation. See the [Result Handling](#) (on page 5-13) section for a description of the *OperationResultHandler* interface.

Error Codes

The following is the list of error codes that might be returned by this method:

- ERROR_CODE_FATAL_EXCEPTION
- ERROR_CODE_RESOURCE_SHORTAGE
- ERROR_CODE_OPERATION_ABORTED
- ERROR_CODE_INVALID_PARAMETER
- ERROR_CODE_NO_APPLICATION_INSTALLED

For a description of error codes, see [List of Error Codes](#) (on page A-1).

loginPullResponseBulk operation

Syntax

```
void loginPullResponseBulk(LoginPullResponse_BULK subsBulk,
                           OperationResultHandler handler) throws Exception
```

Description

This operation applies the logic described in loginPullResponse operation for each subscriber in the bulk.

For relevant events description, see the [Pull model](#) (on page 3-2) section in the *API Events* chapter.

Parameters

subsBulk - see the [LoginPullResponse_BULK](#) (on page 4-11) section.

handler - result handler for this operation. See the [Result Handling](#) (on page 5-13) section for a description of the *OperationResultHandler* interface.

Error Codes

The following is the list of error codes that might be returned by this method:

- ERROR_CODE_FATAL_EXCEPTION
- ERROR_CODE_RESOURCE_SHORTAGE
- ERROR_CODE_OPERATION_ABORTED
- ERROR_CODE_INVALID_PARAMETER
- ERROR_CODE_NO_APPLICATION_INSTALLED

For a description of error codes, see [List of Error Codes](#) (on page A-1).

Logout operation

Syntax

```
void logout(String subscriberID,  
            NetworkID networkID,  
            OperationResultHandler handler) throws Exception
```

Description

This operation removes the specified networkID of the subscriber from the SCE. If this is the last networkID of the specified subscriber, the subscriber is removed from the SCE. If no subscriber ID is specified, the supplied network ID is removed from the SCE regardless to which subscriber this network ID belongs. If no network ID is supplied, all Network IDs of this subscriber are removed.

If the subscriber record is not in the SCE, the logout operation will succeed.

For relevant events description, see the [Logout Events](#) (on page 3-3) section in the *API Events* chapter.

Parameters

`subscriberID` - the unique ID of the subscriber. See the [Subscriber ID](#) (on page 4-1) section for the subscriber ID format description.

`networkID` - the network identifier of the subscriber. See the [Network ID Mappings](#) (on page 4-1) section for more information.

`handler` - result handler for this operation. See the [Result Handling](#) (on page 5-13) section for a description of the *OperationResultHandler* interface.

Error Codes

The following is the list of error codes that might be returned by this method:

- `ERROR_CODE_FATAL_EXCEPTION`
- `ERROR_CODE_OPERATION_ABORTED`

For a description of error codes, see [List of Error Codes](#) (on page A-1).

logoutBulk operation

Syntax

```
void logoutBulk(NetworkAndSubscriberID_BULK subsBulk,  
               OperationResultHandler handler) throws Exception
```

Description

This operation applies the logic described in logout operation for each subscriber in the bulk.

For relevant events description, see the [Logout Events](#) (on page 3-3) section in the *API Events* chapter.

Parameters

`subsBulk` - see the [NetworkAndsubscriberID_BULK](#) (on page 4-10) section.

`handler` - result handler for this operation. See the [Result Handling](#) (on page 5-13) section for a description of the `OperationResultHandler` interface.

Error codes

The Following is the list of error codes that might be returned by this method:

- `ERROR_CODE_FATAL_EXCEPTION`
- `ERROR_CODE_OPERATION_ABORTED`

For a description of error codes, see [List of Error Codes](#) (on page A-1).

networkIdUpdate operation

Syntax

```
void networkIDUpdate(String subscriberID,
                    NetworkID networkID,
                    boolean networkIdAdditive,
                    OperationResultHandler handler) throws Exception
```

Description

This operation adds or replaces an existing subscriber's network ID.



Note

This operation is effective only if the subscriber record exists in the SCE. Otherwise, the operation will fail.

For relevant events description see the [Network ID Update Event](#) (on page 3-3) section in the *API Events* chapter.

Parameters

`subscriberID` - the unique ID of the subscriber. See the [Subscriber ID](#) (on page 4-1) section for the subscriber ID format description.

`networkID` - the network identifier of the subscriber. See the [Network ID Mappings](#) (on page 4-1) section for more information.

`networkIDAdditive` - If this flag is set to `TRUE`, the supplied `NetworkID` is added to the existing `networkIDs` of the subscriber. Otherwise, the supplied `networkID` replaces the existing `networkIDs`.

Error Codes

The following is the list of error codes that might be returned by this method:

- `ERROR_CODE_SUBSCRIBER_NOT_EXIST`

- ERROR_CODE_FATAL_EXCEPTION
- ERROR_CODE_RESOURCE_SHORTAGE
- ERROR_CODE_OPERATION_ABORTED
- ERROR_CODE_INVALID_PARAMETER
- ERROR_CODE_NO_APPLICATION_INSTALLED

For a description of error codes, see [List of Error Codes](#) (on page A-1).

networkIdUpdateBulk operation

Syntax

```
void networkIDUpdateBulk(NetworkAndSubscriberID_BULK subsBulk,
                        OperationResultHandler handler) throws Exception
```

Description

This operation applies the logic described in networkIDUpdate operation for each subscriber in the bulk.

For relevant events description, see the [Network ID Update Event](#) (on page 3-3) section in the *API Events* chapter.

Parameters

subsBulk - see [NetworkAndSubscriberID_BULK](#) (on page 4-10) section.

handler - result handler for this operation. See the [Result Handling](#) (on page 5-13) section for a description of the *OperationResultHandler* interface.

Error Codes

The following is the list of error codes that may be returned by this method:

- ERROR_CODE_SUBSCRIBER_NOT_EXIST
- ERROR_CODE_FATAL_EXCEPTION
- ERROR_CODE_RESOURCE_SHORTAGE
- ERROR_CODE_OPERATION_ABORTED
- ERROR_CODE_INVALID_PARAMETER
- ERROR_CODE_NO_APPLICATION_INSTALLED

For a description of error codes, see [List of Error Codes](#) (on page A-1).

profileUpdate operation

Syntax

```
void profileUpdate(String subscriberID,
                  PolicyProfile policy,
                  OperationResultHandler handler) throws Exception
```

Description

This operation modifies an existing subscriber's policy profile. If the subscriber record does not exist in the SCE, this operation will fail.

For relevant events description, see the *Profile Update Event* (on page 3-4) in the *API Events* chapter.

Parameters

`subscriberID` - the unique ID of the subscriber. See the *Subscriber ID* (on page 4-1) section for the subscriber ID format description.

`policy` - policy profile of the subscriber. See the *SCA BB Subscriber Policy Profile* (on page 4-3) section for more information.

`handler` - result handler for this operation. See the *Result Handling* (on page 5-13) section for a description of the *OperationResultHandler* interface.

Error Codes

The following is the list of error codes that might be returned by this method:

- ERROR_CODE_SUBSCRIBER_NOT_EXIST
- ERROR_CODE_FATAL_EXCEPTION
- ERROR_CODE_OPERATION_ABORTED
- ERROR_CODE_INVALID_PARAMETER
- ERROR_CODE_NO_APPLICATION_INSTALLED

For a description of error codes, see *List of Error Codes* (on page A-1).

profileUpdateBulk operation

Syntax

```
void profileUpdateBulk(PolicyProfile_BULK subsBulk,
                      OperationResultHandler handler) throws Exception
```

Description

This operation applies the logic described in `profileUpdate` operation for each subscriber in the bulk.

For relevant events description, see the *Profile Update Event* (on page 3-4) in the *API Events* chapter.

Parameters

`subsBulk` - See the *PolicyProfile_BULK* ("PolicyProfile_BULK Class" on page 4-12) section.

`handler` - result handler for this operation. See the *Result Handling* (on page 5-13) section for a description of the *OperationResultHandler* interface.

Error Codes

The following is the list of error codes that might be returned by this method:

- ERROR_CODE_SUBSCRIBER_NOT_EXIST
- ERROR_CODE_FATAL_EXCEPTION
- ERROR_CODE_OPERATION_ABORTED
- ERROR_CODE_INVALID_PARAMETER
- ERROR_CODE_NO_APPLICATION_INSTALLED

For a description of error codes, see [List of Error Codes](#) (on page A-1).

quotaUpdate operation

Syntax

```
void quotaUpdate(String subscriberID,  
                 QuotaOperation quotaOperation,  
                 OperationResultHandler handler) throws Exception
```

Description

This operation performs an operation of updating the subscriber's quota.

For relevant event description, see [Quota Update Event](#) (on page 3-4) in the API Events section.

Parameters

`subscriberID` - the unique ID of the subscriber. See the [Subscriber ID](#) (on page 4-1) section for the subscriber ID format description.

`quotaOperations` - quota operation to perform on the quota of the subscriber. [See the Subscriber Quota](#) (on page 4-4) section for more information.

`handler` - result handler for this operation. See the [Result Handling](#) (on page 5-13) section for a description of the `OperationResultHandler` interface.

Error Codes

The following is the list of error codes that might be returned by this method:

- ERROR_CODE_SUBSCRIBER_NOT_EXIST
- ERROR_CODE_FATAL_EXCEPTION
- ERROR_CODE_OPERATION_ABORTED
- ERROR_CODE_INVALID_PARAMETER
- ERROR_CODE_NO_APPLICATION_INSTALLED

For a description of error codes, see [List of Error Codes](#) (on page A-1).

quotaUpdateBulk operation

Syntax

```
void quotaUpdateBulk(QuotaOperation_BULK subsBulk,
                    OperationResultHandler handler) throws Exception
```

Description

This operation applied the logic of the quotaUpdate operation on each subscriber in the bulk.

For relevant events description, see the [Quota Update Event](#) (on page 3-4) in the *API Events* section.

Parameters

`subsBulk` - see the [QuotaOperation_BULK](#) ("QuotaOperation_BULK Class" on page 4-13) section.

`handler` - result handler for this operation. See the [Result Handling](#) (on page 5-13) section for a description of the *OperationResultHandler* interface.

Error Codes

The following is the list of error codes that might be returned by this method:

- ERROR_CODE_SUBSCRIBER_NOT_EXIST
- ERROR_CODE_FATAL_EXCEPTION
- ERROR_CODE_OPERATION_ABORTED
- ERROR_CODE_INVALID_PARAMETER
- ERROR_CODE_NO_APPLICATION_INSTALLED

For a description of error codes, see [List of Error Codes](#) (on page A-1).

getQuotaStatus operation

Syntax

```
void getQuotaStatus(String subscriberID,
                   Quota quota,
                   OperationResultHandler handler) throws Exception
```

Description

This operation places the request to query the current remaining quota amount of the specified set of quota buckets. This request will be followed (**asynchronously**) by the [getQuotaStatusIndication](#) ("quotaStatusIndication callback method" on page 5-10) including the queried data.

For relevant events description, see the Get Quota Status Event section in the *API Events* section.

Parameters

`subscriberID` - the unique ID of the subscriber. See the [Subscriber ID](#) (on page 4-1) section for the subscriber ID format description.

`quota` - should include the list of the names (without values) of the quota buckets to retrieve. See the [Subscriber Quota](#) (on page 4-4) section for more information about how to construct quota with buckets' names only..

`handler` - result handler for this operation. See the [Result Handling](#) (on page 5-13) section for a description of the *OperationResultHandler* interface.

Error Codes

The following is the list of error codes that might be returned by this method:

- `ERROR_CODE_SUBSCRIBER_NOT_EXIST`
- `ERROR_CODE_FATAL_EXCEPTION`
- `ERROR_CODE_OPERATION_ABORTED`
- `ERROR_CODE_INVALID_PARAMETER`
- `ERROR_CODE_NO_APPLICATION_INSTALLED`

For a description of error codes, see [List of Error Codes](#) (on page A-1).

getQuotaStatusBulk operation

Syntax

```
void getQuotaStatusBulk(Quota_BULK subsBulk,  
                        OperationResultHandler handler) throws Exception
```

Description

This method is a bulk version of the `getQuotaStatus` method described above.

For relevant events description, see the `Get Quota Status Event` section in the *API Events* section.

Parameters

`subsBulk` - see the [Quota_BULK](#) (on page 4-13) section.

`handler` - result handler for this operation. See the [Result Handling](#) (on page 5-13) section for a description of the *OperationResultHandler* interface.

Error Codes

The following is the list of error codes that might be returned by this method:

- `ERROR_CODE_SUBSCRIBER_NOT_EXIST`
- `ERROR_CODE_FATAL_EXCEPTION`
- `ERROR_CODE_OPERATION_ABORTED`
- `ERROR_CODE_INVALID_PARAMETER`

- ERROR_CODE_NO_APPLICATION_INSTALLED

For a description of error codes, see [List of Error Codes](#) (on page A-1).

SCE-API Synchronization

In cases when the SCE and the Policy Server have a conflict in the data about a subscriber because of disconnection, loss of logon messages, or reboot, several problems can arise. These problems can cause a misclassification of one the subscriber's traffic as if it was another subscriber, enforcement of the wrong service on the subscriber's traffic, or loss of resources.

Such conflicts can be prevented by keeping the communication channels as reliable as possible by performing synchronization of the subscribers' data between the SCE and the Policy Server using the API. The Policy Server, by using the API, is **always** the initiator of the synchronization.



Caution

Performing the synchronization process from several Policy Servers at the same time will cause the subscriber information in the SCE to be inconsistent with all servers.

The following list describes the synchronization guidelines the Policy Server must adhere while implementing synchronization:

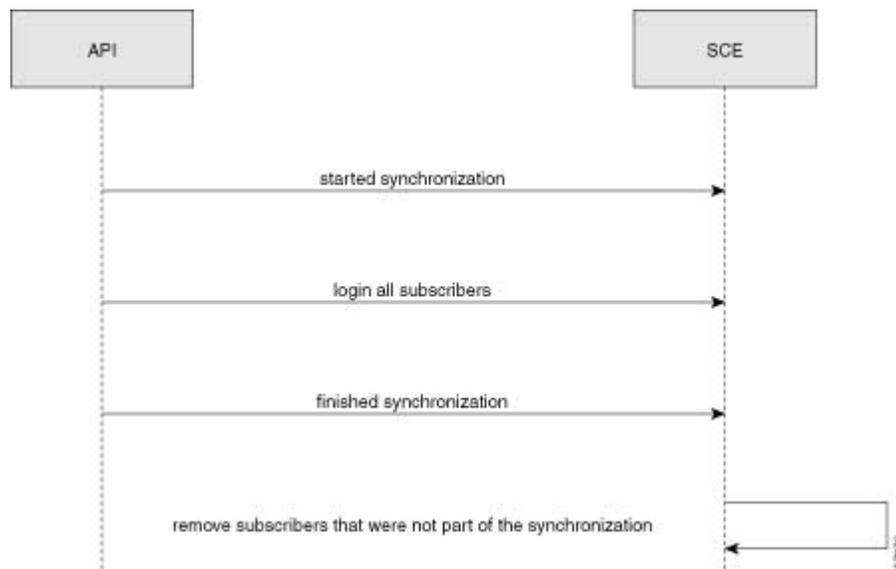
Push model synchronization procedure

Step 1: The Policy Server indicates to the SCE that it is starting to synchronize the SCE.

Step 2: The Policy Server logs-in all of the subscribers the SCE should handle. Preferably the login operations are performed in bulks.

Step 3: The Policy Server notifies the SCE that the synchronization has ended.

Step 4: The SCE removes all of the subscriber data that was not part of the synchronization process.





Note During the synchronization process, the regular logon operations can be performed.

The following sections describe the methods provided for use for the synchronization procedure in the *push* model.

SynchronizePushStart

Syntax

```
void synchronizePushStart(OperationResultHandler handler)
```

Description

This operation should be used in the push model only to signal the SCE that synchronization with the server is about to begin. The SCE marks all of the subscriber data with a “dirty-bit”, which is reset if this data is re-applied as part of the synchronization process. Every call to this method restarts the synchronization process.

Parameters

handler - result handler for this operation. See the [Result Handling](#) (on page 5-13) section for a description of the *OperationResultHandler* interface.

SynchronizePushEnd

Syntax

```
void synchronizePushEnd(boolean success, OperationResultHandler handler)
```

Description

This operation should be used in the *push* mode only to signal the SCE that synchronization with the server has ended. The SCE scans the entire subscriber database for data with the “dirty-bit” assigned at *SynchronizePushStart* and removes it.

Parameters

success - a flag indicating that the synchronization was successful to the SCE.

handler - result handler for this operation. See the [Result Handling](#) (on page 5-13) section for a description of the *OperationResultHandler* interface.

Pull Model Synchronization Procedure

Step 1: The Policy Server indicates to the SCE that it is starting to synchronize the SCE

Step 2: The Policy Server retrieves from the SCE all of the subscribers IDs and network-IDs it is currently handling

Step 3: The Policy Server fixes any miss-synchronization.

Algorithm:

The following algorithm template should be used when planning the synchronization procedure:

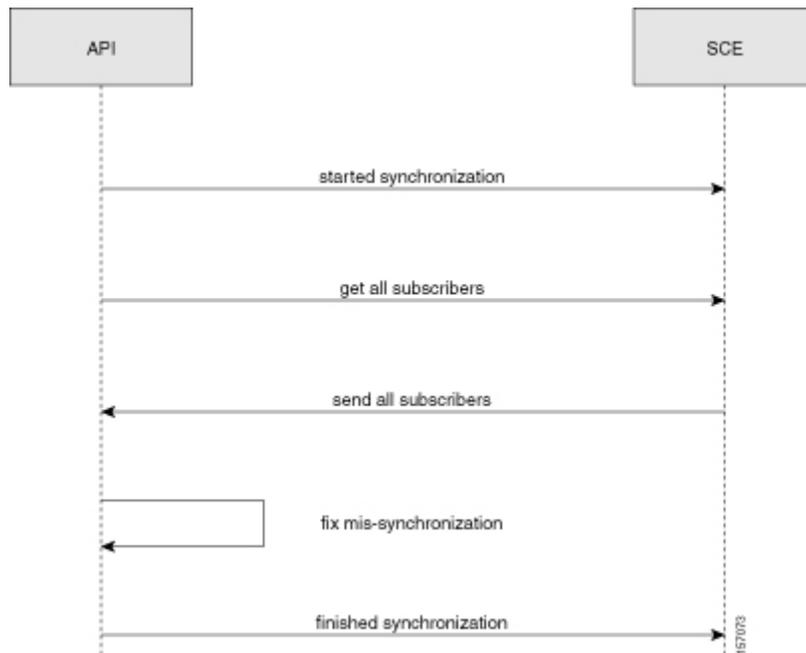
For each retrieved subscriber (<SubscriberID, IP address>):

- If < SubscriberID, IP address > exists in Policy Server database,
send a policy profile and networkID update to the SCE

Otherwise,

send a logout with the Subscriber IP to the SCE

Steps 2 and 3 are performed as a bulk at one time.

**Note**

During the synchronization process, the regular logon operations can be performed.

The following sections describe the methods provided for use for the synchronization procedure in the *pull* model.

SynchronizePullStart**Syntax**

```
void synchronizePullStart(OperationResultHandler handler)
```

Description

This operation should be used in the *pull* model only to signal the SCE that synchronization with the server should be started.

Parameters

`handler` - result handler for this operation. See the [Result Handling](#) (on page 5-13) section for a description of the `OperationResultHandler` interface.

SynchronizePullEnd

Syntax

```
void synchronizePullEnd(boolean success, OperationResultHandler
handler)
```

Description

This operation should be used in *pull* model only to signal the SCE that synchronization with the server has ended.

Parameters

`handler` - result handler for this operation. See the [Result Handling](#) (on page 5-13) section for a description of the `OperationResultHandler` interface.

`success` - a flag to the SCE indicating that the synchronization was successful.

GetSubscribersBulk

Syntax

```
void getSubscribersBulk(int bulkSize,
                        SubscribersBulkResponseIterator iterator,
                        OperationResultHandler handler)
```

Description

This operation should be used in the *pull* model synchronization process to retrieve a bulk of subscribers the SCE is currently handling (see [Pull Model Synchronization Procedure](#) (on page 5-29) section).

Upon receiving this request (`getSubscribersBulk`), the SCE issues asynchronously the `getSubscribersBulkResponse` indication containing subscriberIDs and corresponding NetworkIDs (see the [LoginPullListener Interface Class](#) (on page 5-7) section). This method supplies an iterator that is passed to the next call of `getSubscribersBulk`. To signal the end of iterations, the iterator of the last bulk is null.



Parameters

`bulkSize` - the size of the bulk to retrieve. Maximum bulk size is limited to 100 entries.

`iterator` - iterator of the subscribers at the SCE side. This iterator is received in `getSubscribersBulkResponseIndication` and it should be passed to the next call to `getSubscribersBulk` method. When calling first time to the `getSubscribersBulk` method - use `null` as an iterator (using `null` indicates that you want to start from the beginning).

`handler` - result handler for this operation. See the [Result Handling](#) (on page 5-13) section for a description of the `OperationResultHandler` interface.

Advanced API Programming

Implementing High Availability

High availability support provided by the API assumes that the high-availability scheme of the policy server is a type of two-node cluster where only one server is active at every given time. The other server (standby) is not connected to the SCE.

When the active server fails, it is the responsibility of the user's two-node cluster scheme to perform a fail-over to the standby server.



Note High-availability can be implemented separately for every policy server provisioning the SCE platform at the same time.

To implement high-availability with the *SCMS SCE Subscriber API*:

-
- Step 1** Setup a two-node cluster for two policy servers
 - Step 2** Construct two API instances **with the same API name** each one on the different server (node) within the cluster (For constructors description, see the API Construction section). During cluster runtime, only one API instance should be connected to the SCE platform. When a fail-over occurs, the failed server should disconnect from the SCE and the standby server should become active and re-connect to the SCE within the pre-defined timeout (see [the SCE Platform Setup \("Configuring API Disconnection Timeout"](#) on page 1-5) section). Because of identical API names, the SCE will behave as if the same API was re-connected and no information will be lost.
-



Caution

Do not call the `unregisterXXXListener` methods implicitly in the API used on the failed policy server as this will cause the loss of data. Calling the `disconnect()` method does not unregister the listeners.

API Code Examples

This section gives several code examples for the API usage:

Login and Logout

The following example logs in a predefined number of subscribers to the SCE, and then logs them out. This example uses auto-reconnect support therefore it does not define a connection listener.

The following code outline contains a sample implementation of a *result handler* that counts success and failure results:

```
// Class responsible for operations result handling
import com.scms.api.sce.OperationArguments;
import com.scms.api.sce.OperationException;
import com.scms.api.sce.OperationResultHandler;

public class MyOperationResultHandler implements OperationResultHandler
{
    long count = 0;

    public void handleOperationResult(Object[] result,
                                     OperationArguments handback)
    {
        for (int index=0; index < result.length; index++)
        {
            count++;
            if (result[index]==null)
            {
                //print success every 100 operations
                //if (++count%100 == 0)
                {
                    System.out.println("\tsuccess "+count);
                }
            }
            else // error - print every error
            {
                // failure
                count++;
                // Extract error details
                OperationException ex =
                    (OperationException)result[index];

                // Extract operation name
                String operationName = handback.getOperationName();

                // Print operation name and error message
                System.out.println("Error for operation "+
                                   operationName+": "+
                                   ex.getMessage());
            }
        }
    }
}
```

```

public synchronized void waitForLastResult(int lastResult)
{
    while (count<lastResult)
    {
        try
        {
            wait(100);
        }
        catch (InterruptedException ie)
        {
            ie.printStackTrace();
        }
    }
}

```

Class that contains simple LogoutListener implementation that counts the number of received logout indications:

```

import com.scms.api.sce.LogoutListener;
import com.scms.common.NetworkAndSubscriberID_BULK;
import com.scms.common.SubscriberID_BULK;

class MyLogoutListener implements LogoutListener
{
    long count = 0;

    public void logoutIndication(String subscriberID)
    {
        increaseCounter(1);
    }

    synchronized void increaseCounter(long value)
    {
        count = count + value;
    }

    synchronized long getCounter()
    {
        return count;
    }

    //waits for result number 'last result' to arrive
    public synchronized void waitForLastResult(int lastResult)
    {
        while (count<lastResult)
        {
            try
            {
                wait(100);
            }
            catch (InterruptedException ie)
            {
                ie.printStackTrace();
            }
        }
    }

    public void logoutBulkIndication(SubscriberID_BULK subs)
    {
        increaseCounter(subs.getSize());
    }
}

```

Class that contains the main method:

```
import com.scms.api.sce.prpc.PRPC_SCESubscriberApi;
import com.scms.common.*;

public class LogonPolicyServer {

    public static void main (String args[]) throws Exception
    {
        int numSubscribersToLogin = 500;

        //instantiate an API with reconnect interval of 5 seconds
        PRPC_SCESubscriberApi api = new PRPC_SCESubscriberApi(
            "myAPI",
            args[0], // IP of the SCE
            5000);

        try {
            // instantiate operation result handler
            // we will use one handler for all operations
            MyOperationResultHandler resultHandler =
                new MyOperationResultHandler();

            // instantiate logout listener
            MyLogoutListener listener = new MyLogoutListener();

            // register to logout indications
            api.registerLogoutListener(listener);

            // connect to the SCE
            api.connect();

            //login
            System.out.println("login of "+numSubscribersToLogin+
                " subscribers");

            PolicyProfile pp = new PolicyProfile(
                new String[]{"packageId=1",
                    "monitor=1"});

            for (int i=0; i<numSubscribersToLogin; i++)
            {
                api.login("sub"+i,
                    new NetworkID(getMappings(i), // generate ip
                        NetworkID.ALL_IP_MAPPINGS),
                    true, // additive flag
                    pp, // policy
                    null, // no quota
                    resultHandler);
            }
            // wait for subscribers to log in
            resultHandler.waitForLastResult(numSubscribersToLogin);

            //logout all subscribers
            System.out.println("logout of "+numSubscribersToLogin+
                " subscribers");

            for (int i=0; i<numSubscribersToLogin; i++)
            {
                NetworkID nid = new NetworkID(getMappings(i),
                    NetworkID.ALL_IP_MAPPINGS);

                api.logout("sub"+i,nid,resultHandler);
            }
        }
    }
}
```

```
        // wait for all subscribers to be logged out -
        //but this time use
        //logout listener to count the results
        listener.waitForLastResult(numSubscribersToLogin);
    }
    finally
    {
        api.unregisterLogoutListener
        api.disconnect();
    }
}

//'automatic' mapping generator for the sample program
private static String[] getMappings(int i) {
    return new String[]{ "10." + ((int)i/65536)%256 + "." +
        ((int)(i/256))%256 + "." + (i%256)};
}
}
```

Login-pull request and login-pull response

The following code fragment demonstrates a login-pull request and login-pull response manipulations:

This class is a sample implementation of the listener for the logout and login pull indications:

```
import java.util.Iterator;

// result handler from the previous example
import MyOperationResultHandler;

import com.scms.api.sce.*;
import com.scms.common.*;

class MyListener implements LoginPullListener, LogoutListener
{
    // indications counters
    long logoutCount = 0;
    long pullCount=0;

    // api instance - used to send login-pull responses to the SCE
    PRPC_SCESubscriberApi api = null;

    // construct operation handler -
    // from previous (Login and Logout) example
    MyOperationResultHandler h = new MyOperationResultHandler();

    public MyListener(PRPC_SCESubscriberApi api)
    {
        this.api = api;
    }

    // Increase logout counter
    public void logoutIndication(String subscriberID)
    {
        increaseLogoutCounter(1);
        System.out.println("Got logout notification " +
            getLogoutCounter());
    }

    // Increase logout counter
    public void logoutBulkIndication(SubscriberID BULK subs)
    {
        System.out.println("Got logout notification");
        increaseLogoutCounter(subs.getSize());
    }
}
```

```

public void loginPullRequest (String anonymousSubscriberID,
                             NetworkID networkID)
{
    try
    {
        increasePullCounter(1);
        System.out.println("Got pull request" + getPullCounter());

        // prepare policy
        PolicyProfile pp = new PolicyProfile(
                               new String[]{"packageId=1",
                                           "monitor=1"});

        // Answer with pull response
        // retrieve subscriber name - for example from your
        // policy server database
        // In this example we use fixed names based on the
        // subscribers counter
        api.loginPullResponse(anonymousSubscriberID,
                              "sub"+getPullCounter(),
                              networkID,
                              pp, // policy
                              null, // no quota
                              h); // handler from previous example
    }
    catch (Exception ex)
    {
        System.out.println(ex.getMessage());
    }
}

public void loginPullRequestBulk(NetworkAndSubscriberID BULK subs)
{
    try
    {
        increasePullCounter(subs.getSize());
        System.out.println("Got pull request" + getPullCounter());

        // Answer with pull response in bulk form
        PolicyProfile pp = new PolicyProfile(
                               new String[]{"packageId=1",
                                           "monitor=1"});

        LoginPullResponse_BULK responseBulk =
            new LoginPullResponse_BULK();

        Iterator subsIterator = subs.getIterator();

        // iterate of the received bulk (IPs and anonymous IDs)
        // and build a response bulk
        int count=0;
        while(subsIterator.hasNext())
        {
            // retrieve subscriber name - for example from your
            // policy server database
            // In this example we use fixed names based on the
            // subscribers counter
            String subName = "sub_"+count;

            SubscriberData sub = (SubscriberData)subsIterator.next();

            // Extract subscriber mappings from the bulk and

```

```
        // construct a new NetworkID based on those mappings
        NetworkID subNetId = new NetworkID(sub.getMappings(),
                                           NetworkID.ALL_IP_MAPPINGS);

        responseBulk.addEntry(sub.getAnonymousSubscriberID(),
                              subName,
                              subNetId,
                              true,
                              pp,
                              null);

        count++;
    }

    //use the bulk constructed above in the bulk response
    //use handler from the previous example
    api.loginPullBulkResponse(responseBulk,h);
}
catch (Exception ex)
{
    System.out.println(ex.getMessage());
}
}

public void getSubscribersBulkResponse(
    NetworkAndSubscriberID BULK subs,
    SubscriberBulkResponseIterator iterator)
{
    // not implemented in this example
}

synchronized void increaseLogoutCounter(long value)
{
    logoutCount = logoutCount + value;
}

synchronized void increasePullCounter(long value)
{
    pullCount = pullCount + value;
}

synchronized long getPullCounter()
{
    return pullCount;
}

synchronized long getLogoutCounter()
{
    return logoutCount;
}
```

```
//waits for result number 'last result' to arrive
public synchronized void waitForPullResult(int lastResult) {
    while (pullCount<lastResult) {
        try {
            wait(100);
        } catch (InterruptedException ie) {
            ie.printStackTrace();
        }
    }
}

public synchronized void waitForLogoutResult(int lastResult) {
    while (logoutCount<lastResult) {
        try {
            wait(100);
        } catch (InterruptedException ie) {
            ie.printStackTrace();
        }
    }
}
}
```

Class that contains the main method:

```
import java.util.Iterator;

import com.scms.api.sce.*;
import com.scms.common.*;

public class LogonPolicyServer {
    static PRPC_SCESubscriberApi api = null;

    // This sample program waits for pull requests from the SCE
    // and answers to them with pull response
    // The program exists after all 500 were logged in
    public static void main (String args[]) throws Exception
    {
        int numSubscribersToLogin = 500;

        //instantiate an API with reconnect interval of 5 seconds
        api = new PRPC_SCESubscriberApi("myAPI","1.1.1.1",5000);

        // construct an operation result handler (from the
        // previous example
        MyOperationResultHandler handler =
            new MyOperationResultHandler();

        // instantiate logout and login-pull listener
        MyListener listener = new MyListener(api);

        try
        {
            // register to logout indications
            api.registerLogoutListener(listener);
            api.registerLoginPullListener(listener);

            // connect to the SCE
            api.connect();

            // wait for login-pull requests from the SCE
            // they will be issued if you have traffic for unknown
            // subscribers at the SCE

            System.out.println("Waiting for pull requests for "+
                numSubscribersToLogin+
                " subscribers");

            // wait for all subscribers to be logged in
            listener.waitForPullResult(numSubscribersToLogin);

            //logout all subscribers
            System.out.println("logout of "+numSubscribersToLogin+
                " subscribers");

            for (int i=0; i<numSubscribersToLogin; i++)
            {
                api.logout("sub"+i,null,handler);
            }

            // wait for all subscribers to be logged out
            listener.waitForLogoutResult(numSubscribersToLogin);
        }
        finally
        {
            api.unregisterLoginPullListener();
        }
    }
}
```

API Code Examples

```
        api.unregisterLogoutListener();  
        api.disconnect();  
    }  
}
```



Troubleshooting

This chapter describes the usage of the API logging abilities for troubleshooting the integration with the API. API logging enables the user to monitor the operations being called including the received parameters both at the API client and at the SCE side.

This chapter contains the following sections:

- [SCE Logging](#) 6-1
- [API Client Logging](#) 6-5

SCE Logging

The SCE platform provides the ability to log all of the operations called by the Policy Server into the SCE user-log file.

Default Log Messages

The following messages are issued by the SCE by default without any required configuration:

For connect operation:

```
<client-name> - connect operation was called, registered listeners: <type of the listeners that were registered>
```

For disconnect operation:

```
<client-name> - disconnected
```

For registerLoginPullListener operation:

```
<client-name> - registered a Login Pull Listener
```

For unregisterPullListener operation:

```
<client-name> - unregistered a Pull Listener
```

For registerLogoutListener operation:

```
<client-name> - registered a Logout Listener
```

For unregisterLogoutListener operation:

```
<client-name> - unregistered a Logout Listener
```

For registerQuotaListener operation:

```
<client-name> - registered Quota Listener
```

For unregisterQuotaListener operation:

```
<client-name> - unregister Quota Listener
```

For synchronizePushStart operation:

```
<client-name> - synchronize Push Start
```

For synchronizePushEnd operation:

```
<client-name> - synchronize Push End
```

For synchronizePullStart operation:

```
<client-name> - synchronize Pull Start
```

For synchronizePullEnd operation:

```
<client-name> - synchronize Pull End
```

Subscriber Operations Log messages

Subscriber operation log messages are activated by a special flag. To receive these messages, enable the flag.

To enable logging, use the following CLI at the SCE platform:

```
(config)# management-agent sce-api logging
```

To view the USERLOG file, use the following CLI at the SCE platform:

```
#>logger get user-log <FILE NAME>
```



Note

Enabling logging causes performance degradation. Therefore, it is advisable to only use logging for troubleshooting purposes.

To disable logging, use the following CLI at the SCE platform:

```
(config)#> no management-agent sce-api logging
```

To view whether the logging is enabled, use the following CLI at the SCE platform:

```
#> show management-agent sce-api
```

When the logging flag is enabled, the message below is issued for the following operations:

- Login operation
- networkIDUpdate operation
- logout operation
- quotaUpdate operation
- loginPullResponse operation
- profileUpdate operation
- getQuotaStatus operation

```
<operation name> operation was called with parameters: subscriberID -
<subscriber ID> anonymousSubscriberID - < anonymousSubscriberID > mappings
- <mappings list> mappings types - <mapping types list> policy - <policy
properties list> quota - <quota operation/quota buckets list>
```

For the following bulk operations:

- loginBulk operation
- networkIDUpdateBulk operation
- logoutBulk operation
- quotaUpdateBulk operation
- loginPullBulkResponse operation
- profileUpdateBulk operation
- getQuotaStatuBulkRequest operation
- getSubscribersBulk

The following message is issued:

```
<operation name> operation was called with parameters: bulk size - <bulk
size>
```

The following messages are issued for the LoginPullListener:

- **For loginPullRequest:**

```
loginPullRequest operation was called with parameters:
anonymousSubscriberID - <anonymous subscriber ID> mappings - <mappings
list> mapping types - <mapping types>
```

- **For loginPullRequestBulk:**

```
loginPullRequestBulk operation was called with parameters: bulk size -
<bulk size>
```

- **getSubscribersBulkResponse**

```
getSubscribersBulkResponse operation was called with parameters: bulk size
- <bulk size>
```

The following messages are issued for the LogoutListener:

- **For logoutIndication:**

```
logoutIndication operation was called with parameters: subscriberID -
<anonymous subscriber ID>
```

- **For logoutBulkIndication:**

```
logoutBulkIndication operation was called with parameters: bulk size -
<bulk size>
```

The following messages are issued for the QuotaListener:

- For `quotaStatusIndication`:

```
quotaStatusIndication operation was called with parameters:
```

- For `quotaBelowThresholdIndication`:

```
quotaBelowThresholdIndication operation was called with parameters:
```

- For `quotaDepletedIndication`:

```
quotaDepletedIndication operation was called with parameters: SubscriberID  
- <subscriber ID>
```

- For `quotaStatusBulkIndication`:

```
quotaStatusBulkIndication operation was called with parameters: bulk size  
- <bulk size>
```

- For `quotaBelowThresholdBulkIndication`:

```
quotaBelowThresholdBulkIndication operation was called with parameters:  
bulk size - <bulk size>
```

- For `quotaDepletedBulkIndication`:

```
quotaDepletedBulkIndication operation was called with parameters: bulk  
size - <bulk size>
```

API Client Logging

The API provides the ability to log every activated operation into the `apilog` file located under `${user.home}` directory. The logging parameters are configured using the Log4J properties files. To enable the logging make sure this file is in the application's CLASSPATH. This file is read at startup of the application so after changing it you must restart the application.

The following is the content of the `log4j.properties` file:

```
# default Log4j configuration for SCE Subscriber API
log4j.rootCategory=INFO, apiStdout

# In order to enable the logging to the file Replace the above
# line with the following:
# log4j.rootCategory=INFO, files

# stdout is set to be a ConsoleAppender.

log4j.appender.apiStdout=org.apache.log4j.ConsoleAppender
log4j.appender.apiStdout.layout=org.apache.log4j.PatternLayout
log4j.appender.apiStdout.layout.ConversionPattern=%d{dd-MMM
HH:mm:ss.SSS} [%t] %-5p %c%n%n

# files is set to be a RollingFileAppender.

#log4j.appender.files=org.apache.log4j.RollingFileAppender
#log4j.appender.files.layout=org.apache.log4j.PatternLayout
#log4j.appender.files.layout.ConversionPattern=%d{dd-MMM yyyy
HH:mm:ss.SSS} [%t] %-5p %c %x\n%n

#log4j.appender.files.File=${user.home}/apilog
#log4j.appender.files.Threshold=INFO
#log4j.appender.files.ImmediateFlush=true
#log4j.appender.files.MaxFileSize=1MB
#log4j.appender.files.MaxBackupIndex=4

# In order to enable debug logging uncomment the following line
#log4j.category.com.scms.api.sce.prpc=DEBUG
```

To enable the debug logging, uncomment the last line in the file. By default the logging is performed to the standard output. To direct the logging to the file, uncomment the `# log4j.rootCategory=INFO, files` line as explained in the file.

API Client Log messages

The following messages are issued by the API client after the `log4j.properties` file was properly configured:

- For API constructor:

```
"PRPC_SCESubscriberApi constructor was called with the following
parameters:
apiName - <apiName> host - <sceHost> port - <scePort> auto-reconnect -
<autoReconnectInterval>
```

- For init operation:

```
init operation was called with parameters <properties>
```

- For `setConnectionListener`:

```
setConnectionListener operation was called
```

- For `isConnected`:

```
isConnected operation was called
```

- For `getAPIVersion`:

```
getAPIVersion operation was called
```

For the following operations:

- Login operation
- `networkIDUpdate` operation
- logout operation
- `quotaUpdate` operation
- `loginPullResponse` operation
- `profileUpdate` operation
- `getQuotaStatus` operation

The following message is issued:

```
<operation name> operation was called with parameters: subscriberID -
<subscriber ID> anonymousSubscriberID - < anonymousSubscriberID > mappings
- <mappings list> mappings types - <mapping types list> policy - <policy
properties list> quota - <quota operation/quota buckets list>
```

For the following bulk operations:

- `loginBulk` operation
- `networkIDUpdateBulk` operation
- `logoutBulk` operation
- `quotaUpdateBulk` operation
- `loginPullBulkResponse` operation
- `profileUpdateBulk` operation
- `getQuotaStatuBulkRequest` operation
- `getSubscribersBulk` operation

The following message is issued:

```
<operation name> operation was called with parameters: bulk size - <bulk
size>
```

- For `connect` operation:

```
connect operation was called, registered listeners: <type of the listeners
that were registered>
```

- For `disconnect` operation:

```
disconnect operation was called
```

- For `registerLoginPullListener` operation:

```
registerLoginPullListener operation was called
```
- For `unregisterPullListener` operation:

```
unregisterPullListener operation was called
```
- For `registerLogoutListener` operation:

```
registerLogoutListener operation was called
```
- For `unregisterLogoutListener` operation:

```
unregisterLogoutListener operation was called
```
- For `registerQuotaListener` operation:

```
registerQuotaListener operation was called
```
- For `unregisterQuotaListener` operation:

```
unregisterQuotaListener operation was called
```
- For `synchronizePushStart` operation:

```
synchronizePushStart operation was called
```
- For `synchronizePushEnd` operation:

```
synchronizePushEnd operation was called
```
- For `synchronizePullStart` operation:

```
synchronizePullStart operation was called
```
- For `synchronizePullEnd` operation:

```
synchronizePullEnd operation was called
```

The following messages are issued for the `LoginPullListener` listener callback methods:

- For `loginPullRequest`:

```
loginPullRequest operation was called with parameters:  
anonymousSubscriberID - <anonymous subscriber ID> mappings - <mappings  
list> mapping types - <mapping types>
```
- For `loginPullRequestBulk`:

```
loginPullRequestBulk operation was called with parameters: bulk size -  
<bulk size>
```
- `getSubscribersBulkResponse`

```
getSubscribersBulkResponse operation was called with parameters: bulk size  
- <bulk size>
```

The following messages are issued for the `LogoutListener` listener callback methods:

- For `logoutIndication`:

```
logoutIndication operation was called with parameters: subscriberID -  
<anonymous subscriber ID>
```

- For `logoutBulkIndication`:

```
logoutBulkIndication operation was called with parameters: bulk size -  
<bulk size>
```

The following messages are issued for the `QuotaListener` listener callback methods:

- For `quotaStatusIndication`:

```
quotaStatusIndication operation was called with parameters:
```

- For `quotaBelowThresholdIndication`:

```
quotaBelowThresholdIndication operation was called with parameters:
```

- For `quotaDepletedIndication`:

```
quotaDepletedIndication operation was called with parameters: SubscriberID  
- <subscriber ID>
```

- For `quotaStatusBulkIndication`:

```
quotaStatusIndication operation was called with parameters: bulk size -  
<bulk size>
```

- For `quotaBelowThresholdBulkIndication`:

```
quotaBelowThresholdBulkIndication operation was called with parameters:  
bulk size - <bulk size>
```

- For `quotaDepletedBulkIndication`:

```
quotaDepletedBulkIndication operation was called with parameters: bulk  
size - <bulk size>  getAPIVersion operation was called
```



List of Error Codes

Error codes are used for interpreting the actual error for which an `OperationException` was returned. The error code is extracted using the `getErrorCode` method.

A list of the error codes and their description are given in the following table.

Table A-1 List of Error Codes

Error Code	Description
<code>ERROR_CODE_NO_APPLICATION_INSTALLED</code>	Application required for the operation execution is not installed
<code>ERROR_CODE_INVALID_PARAMETER</code>	One of the arguments provided to the method is illegal.
<code>ERROR_CODE_SUSBScriBER_ALREADY_EXISTS</code>	The subscriber on which the operation was performed already exists in the SCE.
<code>ERROR_CODE_SuBSCRIBER_DOES_NOT_EXIST</code>	The subscriber on which the operation is performed does not exist in the SCE .
<code>ERROR_CODE_FATAL_EXCEPTION</code>	Too many errors occurred at the SCE when trying to perform the operation
<code>ERROR_CODE_RESOURCE_SHORTAGE</code>	Internal error
<code>ERROR_CODE_OPERATION_ABORTED</code>	Internal error
<code>ERROR_CODE_ARRAY_ACCESS</code>	Internal error.
<code>ERROR_CODE_ATTRIBUTE_NOT_FOUND</code>	Internal error.
<code>ERROR_CODE_CLASS_CAST</code>	Internal error.
<code>ERROR_CODE_CLASS_NOT_FOUND</code>	Internal error.
<code>ERROR_CODE_CLIENT_INTERNAL_ERROR</code>	Internal error.
<code>ERROR_CODE_CLIENT_OUT_OF_THREADS</code>	Internal error.
<code>ERROR_CODE_ILLEGAL_STATE</code>	Internal error.
<code>ERROR_CODE_OBJECT_NOT_FOUND</code>	Internal error.
<code>ERROR_CODE_OPERATION_NOT_FOUND</code>	Internal error.
<code>ERROR_CODE_OUT_OF_MEMORY</code>	Internal error.
<code>ERROR_CODE_RUNTIME</code>	Internal error.

Error Code	Description
ERROR_CODE_NULL_POINTER	Internal error.
ERROR_CODE_UNKNOWN	Internal error.



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