



Cisco SCMS SM C/C++ API Programmer Guide

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Cisco SCMS SM C/C++ API Programmer Guide

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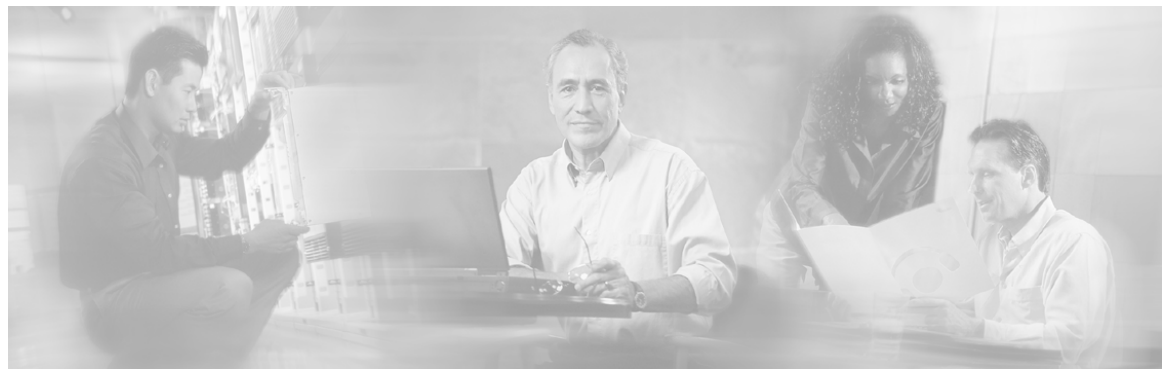
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Preface

This document explains the SCMS SM C/C++ API and how to install, compile, and run the API.

The SCMS SM C/C++ API is used for updating, querying, and configuring the Subscriber Manager (SM). It consists of two parts, which may be used separately or together without restriction.

- **SM Non-blocking C/C++ API**—A high-performance API with low visibility to errors and other operation results. Supports automatic integrations with OSS/AAA systems.
- **SM Blocking C/C++ API**—A more user-friendly API. Supports user interface applications for accessing and managing the SM.



Note

A set of APIs with exactly the same functionality is also available for the Java environment.

Document Revision History

Cisco Service Center Release	Part Number	Publication Date
Release 3.0.3	OL-7203-03	May, 2006
Description of Changes		
Updated documentation for Release 3.0.3. No major changes or new features were added to this release.		
Release 3.0	OL-7203-02	December, 2005

Audience

This guide is for the networking or computer technician responsible for configuring the Subscriber Manager. It is also intended for the operator who manages the SCE platforms.

Organization

This Programmer Guide contains the following topics:

Chapter	Title	Description
Chapter 1	<i>Getting Started</i> (on page 1-1)	Describes the platforms on which the C/C++ API can be used, how to install, compile, and start running the C/C++ API component.
Chapter 2	<i>General API Concepts</i> (on page 2-1)	Provides a description of the various concepts that are used when working with the SM C/C++ API.
Chapter 3	<i>Blocking API</i> (on page 3-1)	Describes the features and operations of the Blocking API and provides code examples.
Chapter 4	<i>Non-blocking API</i> (on page 4-1)	Describes the features and operations of the Non-blocking API and provides code examples.
Appendix A	<i>List of Error Codes</i> (on page A-1)	Provides a list of error codes that are used in the C/C++ API.

Related Documentation

This API Programmer Guide should be used in conjunction with all of the SCMS Subscriber Manager User, API, and Reference Guides.

Conventions

This document uses the following conventions:

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

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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The following sections provide sources for obtaining documentation from Cisco Systems.

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You can access the most current Cisco documentation on the World Wide Web at the following sites:

- <http://www.cisco.com>
- <http://www-china.cisco.com>
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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

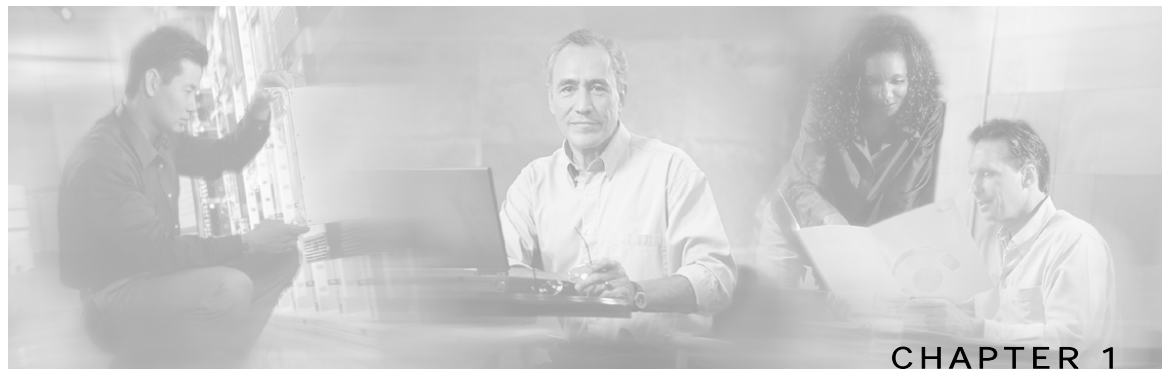
If you have a priority level 1 (P1) or priority level 2 (P2) problem, contact TAC by telephone and immediately open a case. To obtain a directory of toll-free numbers for your country, go to the following website:

<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 section describes the platforms on which the SM C/C++ API can be used and how to install, compile, and start running the SM C/C++ API.

This chapter contains the following sections:

- [Platforms and Compilers](#) 1-1
- [Installation](#) 1-1
- [Compiling and Running](#) 1-3

Platforms and Compilers

The SCMS SM C/C++ API was developed and tested on Windows, Solaris, and Linux platforms. It was compiled on Windows using Microsoft Visual C++ 6 compiler, on Solaris using the GCC 2.95.3 compiler, and on Linux using GCC 3.2.3 compiler.

Installation

Extracting the Package

The SCMS SM C/C++ API distribution is provided as part of the SCMS SM-LEG distribution file and is located in the `sm_api` directory. The SCMS SM C/C++ 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 C/C++ SM API distribution tar `sm-c-api-dist.tar` file
- Step 2** Extract the C/C++ SM API package tar:
- ```
#> tar -xvf sm-c-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 `sm-c-api-vvv.bb` is referred to as `<installdir>`.



### Note

The abbreviations **vvv** and **bb** stand for the SCMS SM C/C++ API version and build number

The `<installdir>/winnt` folder contains the `smapi.dll` file, which is the Windows API Executable. It also contains additional DLL and LIB files necessary for the Windows API operation.

The `<installdir>/solaris` folder contains the `libsmapi.so` file, which is the Solaris API Executable.

The `<installdir>/linux` folder contains the `libsmapi.so` file, which is the Linux API Executable.

The `<installdir>/include` folder contains the API C/C++ header files.

The `<installdir>/include/system` folder contains the C++ API internal header files.

Table 1-1 Layout of Installation Directory

| Folder                          | Subfolder (as applicable) | File Name                  |
|---------------------------------|---------------------------|----------------------------|
| <code>&lt;installdir&gt;</code> |                           | README.csmapi              |
|                                 | Include                   | BasicTypes.h               |
|                                 |                           | Common.h                   |
|                                 |                           | GeneralDefs.h              |
|                                 |                           | Logger.h                   |
|                                 |                           | PrintLogger.h              |
|                                 |                           | SmApiBlocking.h            |
|                                 |                           | SmApiBlocking_c.h          |
|                                 |                           | SmApiNonBlocking.h         |
|                                 |                           | SmApiNonBlocking_c.h       |
|                                 | Include/System            | OperationHandleInterface.h |
|                                 |                           | OperationResultInterface.h |

| Folder | Subfolder (as applicable) | File Name   |
|--------|---------------------------|-------------|
|        | Linux                     | libsmapi.so |
|        | Solaris                   | libsmapi.so |
|        | Winnt                     | asn1ber.dll |
|        |                           | asn1ber.lib |
|        |                           | asn1rt.dll  |
|        |                           | asn1rt.lib  |
|        |                           | SmApi.dll   |
|        |                           | SmApi.lib   |

## Compiling and Running

### Windows

To compile and run a program that uses the SCMS SM C/C++ API :

---

**Step 1** Ensure that `smapi.dll` and the other DLL files are in your path or in the directory of your executable.

**Step 2** Ensure that the `include` folder is in your include path of the compilation.

**Example using Microsoft Visual C++ 6:**

Enter the project settings, click the **C++** tab, and then choose the **Preprocessor** category. Add the include directory path in the **Additional Include directories** line.

**Step 3** Ensure that the `smapi.lib` file is in your linkage path.

**Example using Microsoft Visual C++ 6:**

Enter the project settings and click the **Link** tab. Add **smapi.lib** to the **Object/Library modules** line.

**Step 4** Include the relevant API header file in your source code, and compile your code.

---

## Solaris

To compile and run a program that uses the SM C/C++ API:

---

**Step 1** Ensure that `libsmapi.so` is in your `LD_LIBRARY_PATH`.

For example, when using the **Bash** shell type, use the following command line:

```
bash-2.03$ export set LD_LIBRARY_PATH=$LD
LIBRARY_PATH:the-libsmapi.so-folder
```

**Step 2** Ensure that the `include` folder is in your include path of the compilation.

For example, when using the **GCC**, add the include folder after the `-I` option flag, as follows:

```
> gcc -c -o TestSmApi.o -Ism-api-header-file-folder
-Ism-api-header-file-folder/system/ TestSmApi.cpp
```

**Step 3** Ensure that the `libsmapi.so` file is in your linkage line or load it dynamically.

Link your object file to the `pthread` and `socket` library, as follows:

```
> gcc -o testSmApi TestSmApi.o -lsmapi -lpthread -lsocket
```

---

## Linux (Red Hat)

To compile and run a program that uses the SM C/C++ API:

---

**Step 1** Ensure that `libsmapi.so` is in your `LD_LIBRARY_PATH`.

For example, when using the **Bash** shell type, use the following command line:

```
bash-2.03$ export set LD_LIBRARY_PATH=$LD
LIBRARY_PATH:the-libsmapi.so-folder
```

**Step 2** Ensure that the `include` folder is in your include path of the compilation.

For example, when using the **GCC**, add the include folder after the `-I` option flag, as follows:

```
> gcc -c -o TestSmApi.o -Ism-api-header-file-folder
-Ism-api-header-file-folder/system/ TestSmApi.cpp
```

**Step 3** Ensure that the `libsmapi.so` file is in your linkage line or load it dynamically. Specify the location of `libsmapi.so` using the `-L` option flag. Link your object *file* to the `pthread` and `stdc++` libraries, as follows:

```
> gcc -o testSmApi TestSmApi.o -lsmapi -lpthread -lstdc++ -L<lib
path>
```

---



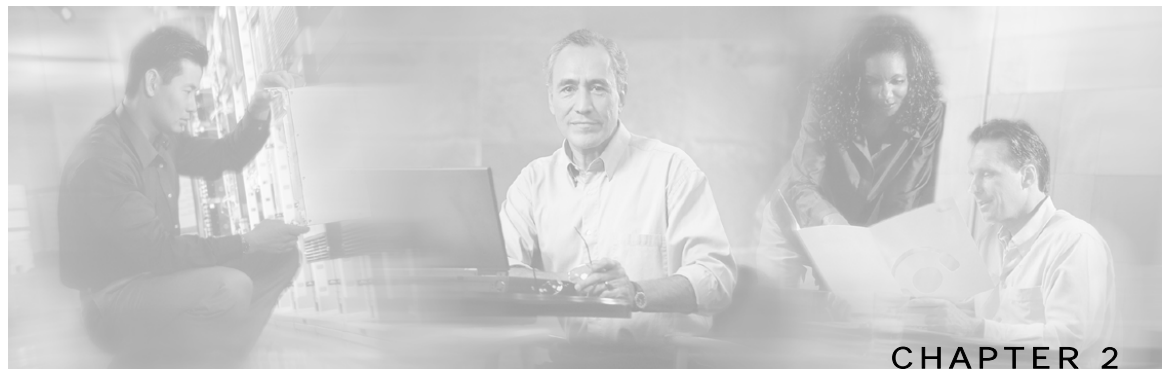
## SM Setup

The API connects to the PRPC server on the SM. For the API to work, the following conditions must be met:

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

The PRPC server is a proprietary RPC protocol designed by Cisco. For additional information, see the *SCMS Subscriber Manager User Guide*.





# General API Concepts

---

This chapter describes various concepts that are used when working with the SCMS SM C/C++ API .

This chapter contains the following sections:

- [Blocking API/Non-blocking API](#) 2-2
- [Reliability](#) 2-2
- [C vs. C++ API](#) 2-2
- [API Initialization](#) 2-4
- [API Finalization](#) 2-5
- [Return Code Structure](#) 2-6
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- [Subscriber Name Format](#) 2-7
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- [Signal Handling](#) 2-11
- [Practical Tips](#) 2-11

## Blocking API/Non-blocking API

This section describes the differences between the Blocking API and Non-blocking API operations.

### Blocking API

In a Blocking API operation, which is the common type, every method returns *after* its operation has been performed.

The SM Blocking C/C++ API provides a wide range of operations and is a *superset* of the Non-blocking API functionality.

### Non-blocking API

In a Non-blocking API operation, every method returns *immediately*, even before its operation has been completed. The operation results are either returned to a set of user defined callbacks or not returned at all.

The Non-blocking 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 SM Non-blocking C/C++ API contains a small number of Non-blocking operations. The API supports retrieval of operation results using result callbacks.

## Reliability

The SCMS SM C/C++ API is reliable in the sense that the operations performed on the API are kept until their associated results are returned from the SM. If the connection to the SM is lost, operations that were not sent to the SM and operations whose results did not yet return from the SM are sent to the SM immediately on reconnection. The order of operation invocation is maintained at all times.

## C vs. C++ API

The C and C++ APIs are essentially the same. The C API is actually a thin wrapper over the C++ API, with method prototype and signature changes imposed by the constraint of C not being an object-oriented programming language.

The following sections describe the C/C++ API differences and provide some examples.

### Method Names

The method names of the C API are the same as in the C++ API, except that the C API method names have an identifying prefix:

- The Blocking C API method names are prefixed with `SMB_`.
- The Non-blocking C API methods are prefixed with `SMNB_`.

**Note**

The documentation of methods in this guide uses the name and signature of the C++ API methods.

**Example**

Both the Blocking and Non-blocking C++ APIs provide a `login` method. The method in the Blocking C API is called `SMB_login` and the method in the Non-blocking C API is called `SMNB_login`.

**Handle Pointers**

The Blocking and Non-blocking APIs are C++ Objects. Several API instances can co-exist in a single process, each having its own socket and state. To provide the same functionality in the C API, the *handle* concept is introduced. Each C API method accepts a handle as its first argument. The handle is used to identify the C API instance on which the caller wants to operate. Calling the `SMB_init` or `SMNB_init` method creates a new C API instance; the handle to the instance is provided by the return value of these methods. For more information, see *API Initialization* (on page 2-4).

**Blocking API Example**

The following C++ Blocking API `logoutByName` method signature:

```
ReturnCode* logoutByName(char* argName,
 char** argMappings,
 MappingType* argMappingTypes,
 int argMappingsSize)
```

is translated into C Blocking API as:

```
ReturnCode* SMB_logoutByName(SMB_HANDLE argApiHandle,
 char* argName,
 char** argMappings,
 MappingType* argMappingTypes,
 int argMappingsSize);
```

**Non-Blocking API example**

The following C++ Non-blocking API `logoutByName` method signature:

```
int logoutByName(char* argName,
 char** argMappings,
 MappingType* argMappingTypes,
 int argMappingsSize);
```

is translated into C Non-blocking API as:

```
int SMNB_logoutByName(SMNB_HANDLE argApiHandle,
 char* argName,
 char** argMappings,
 MappingType* argMappingTypes,
 int argMappingsSize);
```

# API Initialization

To initialize the API:

- 
- Step 1** Construct the API using one of its two constructors.
  - Step 2** Perform API-specific setup operations.
  - Step 3** Connect the API to the SM.
- 

These three steps are described in the following sections.

Initialization examples can be found in the code examples sections under each API.

## API Construction

Both C and C++ Blocking and Non-blocking APIs must construct and initialize the API. Be sure to check that the initialization has succeeded before proceeding.

To construct and initialize the API:

- 
- Step 1** For the C++ API, construct an API object and call the `init` function. For example:

```
SmApiNonBlocking nbapi;
If (!nbapi.init(0,2000000,10,30)) {
 exit(1);
}
```

- Step 2** For the C API, call the `init` function, which allocates and initializes the API. For example:

```
SMNB_HANDLE nbapi = SMNB_init(0,2000000,10,30);
if (nbapi == NULL) {
 exit(1);
}
```

---

## Setting the LEG Name

Set the Login Event Generator (LEG) name if you intend to turn on the SM-LEG failure handling options in the SM. For more information about LEGs and SM-LEG failure handling, see the *SCMS Subscriber Manager User Guide*.

To set the LEG name, call the relevant `setName` function in the API. The LEG name will be used by the SM when recovering from a connection failure. A constant string that identifies the API will be appended to the LEG name as follows:

- For Blocking API: `.B.SM-API.C`
- For Non-blocking API: `.NB.SM-API.C`

### Example (Blocking API)

If the provided LEG name is `my-leg.10.1.12.45-version-1.0`, the actual LEG name will be `my-leg.10.1.12.45-version-1.0.B.SM-API.C`

If no name is set, the LEG uses the hostname of the machine as the prefix of the name.

For additional information about SM-LEG failure handling, see *Appendix A* of the *SCMS Subscriber Manager User Guide*.

## Setup Operations

The setup operations for the two APIs differ. Both APIs support setting a disconnect listener, which is described in the *Disconnect Callback Listener* (on page 2-10) section.

The following sections describe the setup operations for the Blocking API and the Non-blocking API.

### Blocking API setup

To set up the Blocking API, you must set an operation timeout value. For more information, see *Blocking API* (on page 3-1).

### Non-blocking API setup

To set up the Non-blocking API you are required to set a disconnect callback, see *Non-blocking API* (on page 4-1).

## Connecting to the SM

To connect to the SM, use one of the following connect methods:

- 
- The following example shows how to connect when using the C++ APIs:  
`connect(char* host, Uint16 argPort = 14374)`
  - The following example shows how to connect when using the C Blocking API:  
`SMB_connect(SMB_HANDLE argApiHandle, char* host, Uint16 argPort)`
  - The following example shows how to connect when using the C Non-blocking API:  
`SMNB_connect(SMNB_HANDLE argApiHandle, char* host, Uint16 argPort)`
- 

The `argHostName` parameter can be either an IP address or a reachable hostname. At any time during the API operation, you can check if the API is connected by using one of the variants of the function `isConnected`.

## API Finalization

Both C and C++ Blocking and Non-blocking APIs must disconnect from the SM and free the memory of the API:

- For the C++ APIs, call the `disconnect` method and free the API object.

- For the C APIs, call the appropriate `disconnect` function and then free the API using the appropriate `release` function.

## Return Code Structure

The results of the API operations are returned using a generic structure called `ReturnCode`. The `ReturnCode` structure contains several parameters:

- `u`—a union of all of variables and pointers to variables that are the actual returned value.
- `type`—a return code type parameter (`ReturnCodeType` enumeration) that defines the type of the value (`u`) that the `ReturnCode` structure holds.
- `size`—the number of elements in the value. If `size` equals `1` then there is one element in the value, such as a scalar, character string, void, or error. If `size` is greater than `1` then there are several elements in the array, and the type should be one of the array types.

The return code structure is allocated by the API and must be freed by the user of the API. The `freeReturnCode` utility function can be used to safely free the structure.

Additional return code structure utility functions are:

- `printReturnCode`—prints the `ReturnCode` structure value to the `stdout`
- `isReturnCodeError`—checks whether the `ReturnCode` structure is an error

## Definitions

From `GeneralDefs.h` header file:

```
OSAL_DllExport typedef struct ReturnCode_t
{
 ReturnCodeType type;
 int size; /* number of elements in the union element (for
example:
stringVal will have size=1) */
 union { /* use union value according to the type value
*/
 bool boolVal;
 short shortVal;
 int intVal;
 long longVal;
 char* stringVal;
 bool* boolArrayVal;
 short* shortArrayVal;
 int* intArrayVal;
 long* longArrayVal;
 char** stringArrayVal;
 ErrorCode* errorCode;
 struct ReturnCode_t** objectArray;
 } u;
}ReturnCode;
```



## Example

In the following example, the subscriber data of *subscriber1* is retrieved and displayed. The returned structure contains an array of `ReturnCode` structures held by the `objectArray` union value. Each structure contains a different value type. For additional information, see the explanation of the [getSubscriber](#) (on page 3-23) method. This example code uses the `isReturnCodeError` and `freeReturnCode` methods.

```
ReturnCode* subFields = bapi.getSubscriber("subscriber1");
if (isReturnCodeError(subFields) == false)
{
 printf("\tname:\t\t%s\n", subFields->u.objectArray[0]->u.stringVal);
 printf("\tmapping:\t\t%s\n",
 subFields->u.objectArray[1]->u.stringArrayVal[0]);
 printf("\tdomain:\t\t%s\n", subFields->u.objectArray[3]->u.stringVal);
 printf("\tautologout:\t\t%d\n", subFields->u.objectArray[8]->u.intVal);
}
else
{
 printf("error in subscriber retrieval\n");
}
freeReturnCode(subFields);
```

## Error Code Structure

The `ErrorCode` structure can be one of the values of the return code structure. This structure describes the error that occurred. The structure consists of the following parameters:

- `type`—an `ErrorCodeType` enumeration that describes the error. See the `GeneralDefs.h` file for additional information
- `message`—a specific error code
- `name`—currently not used

## Definition

From `GeneralDefs.h` header file:

```
OSAL_DllExport typedef struct ErrorCode_t
{
 ErrorCodeType type; /* type of the error see enumeration */
 char* name; /* currently not used */
 char* message; /* error message */
}ErrorCode;
```

## Subscriber Name Format

Most methods of both APIs require the subscriber name as an input parameter. This section lists the formatting rules of a subscriber name.

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

|                          |                  |                   |                |
|--------------------------|------------------|-------------------|----------------|
| alphanumerics            | \$ (dollar sign) | . (period or dot) | _ (underscore) |
| - (minus sign or hyphen) | % (percent sign) | / (slash)         | ~ (tilde)      |

|                      |                  |             |                |
|----------------------|------------------|-------------|----------------|
| ! (exclamation mark) | & (ampersand)    | :           | ' (apostrophe) |
| # (number sign)      | () (parentheses) | @ (at sign) |                |

## Network ID Mappings

A network ID mapping is a network identifier that the SCE device can relate to a specific subscriber record. A typical example of a network ID mapping (or simply mapping) is an IP address. For additional information, see the *SCMS Subscriber Manager User Guide*. Currently, the Cisco Service Control Solution supports IP address, IP range, and VLAN mappings.

Both Blocking and Non-blocking APIs contain operations that accept mappings as a parameter. Examples are:

- the `addSubscriber` operation (Blocking APIs)
- the `login` method (Blocking or Non-blocking APIs)

When passing mappings to an API method, the caller is requested to provide two parameters:

- A character string (`char*`) mapping identifiers or array of character strings (`char**`) mappings.
- A `MappingType` enumeration or array of `MappingType` variables.

When passing arrays, the `MappingType` variables array must contain the same number of elements as the mappings array.

The API supports the following subscriber mapping types (defined by the `MappingType` enumeration):

- IP addresses or IP ranges
- VLAN tags

## 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 `GeneralDefs.h` header file:

- `IP_RANGE` specifies IP mapping (IP-Address or IP-Range that matches the mapping identifier with the same index in the mapping identifier array).

## 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 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: `VLAN-tag = 0-4095`.

The string is a decimal in the specified range.

The mapping type is also provided in the `GeneralDefs.h` header file:

`VLAN` specifies a VLAN mapping that matches the mapping identifier with the same index in the mapping identifier array.

## Subscriber Domains

The domain concept is explained in detail in the *SCMS Subscriber Manager User Guide*. Briefly, a domain is an identifier that tells the SM which SCE devices should be updated with the subscriber record.

A domain name is of type (`char*`). During system installation, the network administrator determines the system domain names, which therefore vary between installations. The APIs include methods that specify to which domain a subscriber belongs and allow queries about the system's domain names. If an API operation specifies a domain name that does not exist in the SM domain repository, it is considered an error and an `ERROR_CODE_DOMAIN_NOT_FOUND` error `ReturnCode` will be returned.

## Subscriber Properties

Several operations manipulate subscriber properties. A subscriber property 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 *SCMS Subscriber Manager User Guide* and in the *Service Control Application for Broadband (SCA BB) User Guide*. The application user guide provides application-specific information. It lists the subscriber properties that exist in the application running on your system, the allowed value set, and the significance of each property value.

To format subscriber properties for C/C++ API operations, use the String arrays (`char**`) `propertyKeys` and `propertyValues`.

**Note**

The arrays must be of the *same length*, and NULL entries are forbidden. Each key in the keys array has a matching entry in the values array. The value for `propertyKeys[j]` resides in `propertyValues[j]`.

**EXAMPLE:**

If the property keys array is {`"name"`, `"color"`, `"shape"`} and the property values array is {`"john"`, `"red"`, `"circle"`}, the properties will be `name=john`, `color=red`, `shape=circle`.

## Custom Properties

Some operations manipulate custom properties. Custom properties are similar to subscriber properties, but do not affect how the SCE analyzes and manipulates the subscriber's traffic. The application management modules use custom properties to store additional information for each subscriber.

To format custom properties, use the string (`char**`) arrays `customPropertyKeys` and `customPropertyValues`, the same as used in formatting *Subscriber Properties* (on page 2-9).

## Logging Capabilities

The API package contains a `Logger` abstract class that can be inherited and used to integrate the SM API with the host application log. The `Logger` class exposes four basic levels of logging: error messages, warning messages, informative messages, and several levels of trace messages. Both the Blocking and Non-blocking API have this capability. The `Logger` class is provided in the `Logger.h` header file.

The API user should implement a logger by inheriting from the `Logger` class. To have the API use this logger, the code should call the API's `setLogger` method of the C++ implementation of the API.

For testing and for simple LEG implementations, the API package provides the `PrintLogger` class, which is a simple implementation of the `Logger` class that prints the log messages to the standard error (STDERR). An API user can initiate the `PrintLogger` object, set its logging level using the `setLoggingLevels` method of the `PrintLogger` class, and pass the logger object to the API using the API `setLogger` method. The `PrintLogger` class is provided in the `PrintLogger.h` header file.

## Disconnect Callback Listener

Both Blocking and Non-blocking APIs allow setting a disconnect callback listener to be notified when the API is disconnected from the SM. The disconnect callback is defined as follows:

```
typedef void (*ConnectionIsDownCallbackFunc)();
```

To set the disconnect listener, use the `setDisconnectListener` method.

## Example

The following example is a simple implementation of a disconnect callback listener that prints a message to `stdout` and exits:

```
#include "GeneralDefs.h

void connectionIsDown(){
 printf("Message: connection is down.");
 exit(0);
}
```

## Signal Handling

The SCMS SM C/C++ API as a networking module might handle sockets that are closed by the SM, for example, if the SM is restarted, which may cause “Broken Pipe” signals. It is especially advisable for the UNIX environment to handle this signal.

To ignore the signal, add the following call:

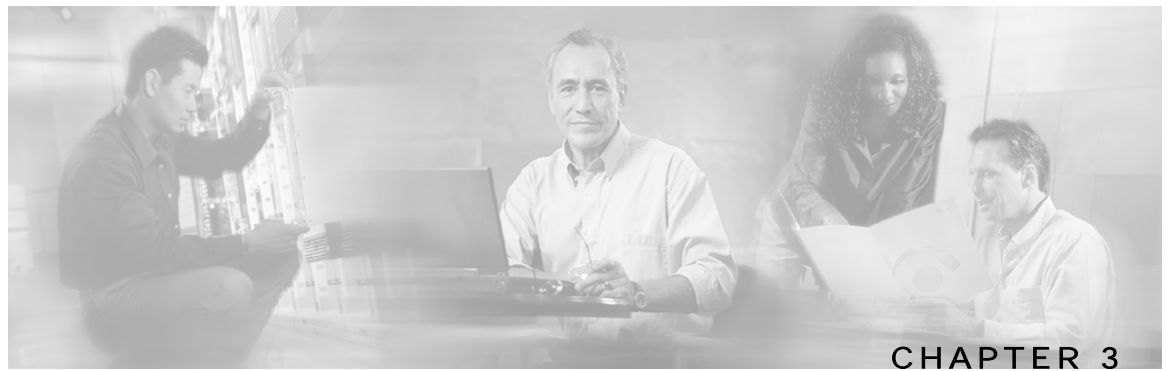
```
sigignore(SIGPIPE);
```

## Practical Tips

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

- Connect to the SM once and maintain an open API connection to the SM at all times, using the API many times. Establishing a connection is a timely procedure, which allocates resources on the SM side and the API client side.
- Share the API connection between your threads. It is better to have one connection per LEG. Multiple connections require more resources on the SM and client side.
- Do not implement synchronization of the calls to the API. The client automatically synchronizes calls to the API.
- It is recommended to place the API clients (LEGs) in the same order of the SM machine processor number.
- If the LEG application has bursts of logon operations, enlarge the internal buffer size accordingly to hold these bursts (Non-Blocking flavor).
- During the integration, set the SM `logon_logging_enabled` configuration parameter to view the API operations in the SM log to troubleshoot the integration, if any problems arise.
- Use the debug mode for the LEG application that logs/prints the return values of the non-blocking operations.
- Use the automatic reconnect feature to improve the resiliency of the connection to the SM.
- In cluster setups, connect the API using the virtual IP address of the cluster and not the management IP address of one of the machines.





## Blocking API

---

This chapter introduces the Reply Timeout, a feature unique to the Blocking API. It also lists all operations of the Blocking API, and provides code examples.



---

**Note**

If you only need to develop an *automatic integration*, skip this chapter and go directly to the *Non-blocking API* (on page 4-1) chapter.

---

This chapter contains the following sections:

- [Multi-threading Support](#) 3-1
- [Operation Timeout Error Code](#) 3-2
- [Blocking API Methods](#) 3-2
- [Blocking API C++ Code Examples](#) 3-44
- [Blocking API C Code Examples](#) 3-47

## Multi-threading Support

The Blocking API supports a configurable number of threads calling its methods simultaneously. For more information about configuring the number of threads, see the `init` ("C++ [init Method](#)" on page 3-37) method.



---

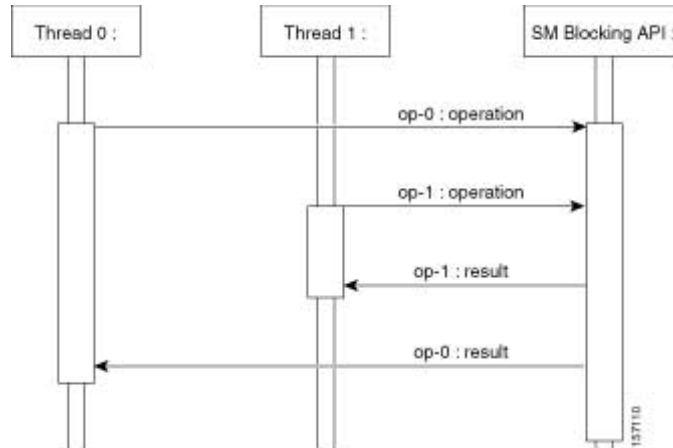
**Note**

In a multi-threaded scenario for the Blocking API, the order of invocation is **not** guaranteed.

---

## Example

Thread-0 calls operation-0 at time-0, and thread-1 calls operation-1 at time-1, where time-1 is later than time-0. In this example, it is possible that operation-1 may be performed **before** operation-0, as shown in the following diagram (the vertical scale is time):



The SM allocates five threads to handle each API instance. It is recommended to develop a multi-threaded application that uses the API with a number of threads in the order of the five threads. Implementing with more threads might result in longer delays for the calling threads.

## Operation Timeout Error Code

A Blocking operation returns only when the operation result has been retrieved from the SM. If a networking malfunction or other error prevents the operation result from being retrieved, the caller will wait indefinitely. The SM API provides means of working around this situation.

The reply timeout feature, the `setReplyTimeout` method, lets the caller set a timeout. It will return a `ReturnCode` with the `ERROR_CODE_CLIENT_OPERATION_TIMEOUT` error when a reply does not return within the timeout period.

Calling the `setReplyTimeout` function with an `int` value sets a reply timeout. The reply timeout is interpreted in milliseconds. A zero value indicates that the operation should wait (freeze, hang) until a result arrives - or indefinitely, if no result arrives.

## Blocking API Methods

This section lists the methods of the Blocking API. The syntax of each method is followed by a description of its input parameters and return values.

The Blocking API is a superset of the Non-blocking API. Except for differences in return values and result handling, identical operations in both APIs have the same functions and syntax structure.

The C/C++ API share the same function signature, except for the `SMB_` prefix for all function names of the Blocking C APIs, and the API handle of type `SMB_HANDLE` as the first parameter in all functions. Any other differences between the APIs are explained in the function description.



The Blocking API subscriber management methods can be classified into the following categories:

- **Dynamic IP and property allocation**—For using the SM API for integration with an AAA system, the following methods are relevant:
  - *login* (on page 3-5)
  - *logoutByName* (on page 3-8)
  - *logoutByNameFromDomain* (on page 3-10)
  - *logoutByMapping* (on page 3-12)
  - *loginCable* (on page 3-13)
  - *logoutCable* (on page 3-15)

**Note**

These methods are not designed to add or remove subscribers from the database, but to modify dynamic parameters (such as IP addresses) of existing subscribers.

- **Static/Manual Subscriber configuration**—For example for GUI usage, the following methods are relevant:
  - *addSubscriber* (on page 3-16)
  - *removeSubscriber* (on page 3-19)
  - *removeAllSubscribers* (on page 3-20)
  - *setPropertyToDefault* (on page 3-34)
  - *removeCustomProperties* (on page 3-35)
- For simple read-only operations performed independently in subscriber awareness mode, the following methods are relevant:
  - *getNumberOfSubscribers* (on page 3-21)
  - *getNumberOfSubscribersInDomain* (on page 3-22)
  - *getSubscriber* (on page 3-23)
  - *subscriberExists* (on page 3-25)
  - *subscriberLoggedIn* (on page 3-26)
  - *getSubscriberNameByMapping* (on page 3-27)
  - *getSubscriberNames* (on page 3-28)
  - *getSubscriberNamesInDomain* (on page 3-30)
  - *getSubscriberNamesWithPrefix* (on page 3-31)
  - *getSubscriberNamesWithSuffix* (on page 3-32)
  - *getDomains* (on page 3-33)

It is possible to combine methods from different categories in a single application. The classification is presented for clarification purposes only.

- **Methods used for API maintenance - initialization, connection, disconnect:**

- *C++ setLogger method* (on page 3-36)
- *C++ init method* (on page 3-37)
- *C SMB\_init function* (on page 3-38)
- *C SMB\_release function* (on page 3-39)
- *setName* (on page 3-40)
- *connect* (on page 3-41)
- *disconnect* (on page 3-42)
- *isConnected* (on page 3-43)



---

**Note**

The examples that appear at the end of the described methods are in C++. Every example described at the end of the methods should be preceded by the sample code below:

---

```
SmApiBlocking bapi;
// Init with default parameters
bapi.init();
// Connect to the SM
bapi.connect((char*)"1.1.1.1");
```

## login

**Syntax**

```
ReturnCode* login(char* argName,
 char** argMappings,
 MappingType* argMappingTypes,
 int argMappingsSize,
 char** argPropertyKeys,
 char** argPropertyValues,
 int argPropertySize,
 char* argDomain,
 bool argIsAdditive,
 int argAutoLogoutTime)
```

**Description**

The `login` method adds or modifies a domain, mappings, and properties of a subscriber that already exists in the SM database. It can be called with partial data, for example, with only mappings or only properties provided and NULL put in the unchanged fields.

If another subscriber with the same (or colliding) mappings already exists in the same domain, the colliding mappings will be removed from the other subscriber and assigned to the new subscriber.

If the subscriber does not exist in the SM database, it will be created with the data provided.

**Parameters**

`argName`: See explanation of *subscriber name format* (on page 2-7).

`argMappings`: See explanation of mappings and *mapping types* ("Network ID Mappings" on page 2-8).

If no mappings are specified, and the `argIsAdditive` flag is TRUE, the previous mappings will be retained. If no such mappings exist, the operation will fail.

`argMappingTypes`: See explanation of mappings and *mapping types* ("Network ID Mappings" on page 2-8).

`argMappingsSize`: the size of the `argMappings` and `argMappingTypes` arrays.

`argPropertyKeys`: See explanation of property keys and values in the *General API Concepts* (on page 2-1) chapter.

`argPropertyValues`: See explanation of property keys and values in the *General API Concepts* (on page 2-1) chapter.

`argPropertySize`: the size of the `argPropertyKeys` and `argPropertyValues` arrays.

`argDomain`: See explanation of *domains* ("Subscriber Domains" on page 2-9).

If domain is NULL, but the subscriber already has a domain, the existing domain will be retained.

`ArgIsAdditive`: Refers to the mappings parameters.

- TRUE—adds the mappings provided by this call to the subscriber record.
- FALSE—overrides the mappings that already exist in the subscriber record with the mappings provided by this call.

`argAutoLogoutTime`: Applies only to mappings provided as arguments to this method.

- Positive value (N): automatically logs out the mappings (similar to a logout method being called) after N seconds.
- 0 value: maintains current expiration time for the given mappings.
- Negative value: disables any expiration time that might have been set for the mappings given.

## Return Value

A pointer to a `ReturnCode` structure with a void type, unless an error has occurred.

## Error Codes

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

- `ERROR_CODE_ILLEGAL_SUBSCRIBER_NAME`
- `ERROR_CODE_BAD_SUBSCRIBER_MAPPING`
- `ERROR_CODE_SUBSCRIBER_DOMAIN_ASSOCIATION`
- `ERROR_CODE_DATABASE_EXCEPTION`
- `ERROR_CODE_UNKNOWN`

This error can be caused by the following:

- NULL value for the `domain` parameter for the subscriber that does not exist/does not have a domain
- Invalid values for the `propertyValues` parameter

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

## Example

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

```
MappingType map_type = IP_RANGE;
char* ip_address = "192.168.12.5";

bapi.login(
 "john", // subscriber name
 &ip_address,
 &map_type,
 1, // one mapping
 NULL, NULL, 0, // no properties
 "subscribers", // domain
 true, // isMappingAdditive is true
 -1); // autoLogoutTime set to infinite
```

To add the IP address 192.168.12.5 overriding previous mappings:

```

MappingType map_type = IP_RANGE;
char* ip_address = "192.168.12.5";

bapi.login(
 "john", // subscriber name
 &ip_address,
 &map_type,
 1,
 NULL, NULL, 0,
 "subscribers", // domain
 false, // isMappingAdditive is false
 -1); // autoLogoutTime set to infinite

```

To extend the auto logout time of 192.168.12.5 that was previously assigned to *john*:

```

MappingType map_type = IP_RANGE;
char* ip_address = "192.168.12.5";

bapi.login(
 "john", // subscriber name
 &ip_address,
 &map_type,
 1,
 NULL, NULL, 0,
 "subscribers", // domain
 false, // isMappingAdditive is false
 300); // autoLogoutTime set to 300 seconds

```

To modify a dynamic property of *john* (e.g. package ID):

```

char* prop_name = "packageID";
char* prop_value = "10";

bapi.login(
 "john",
 NULL, NULL, 0,
 &prop_name, // property key
 &prop_value, // property value
 1, // one property
 "subscribers", // domain
 false,
 -1);

```

To add the IP address 192.168.12.5 to an existing subscriber named *john* without affecting existing mappings and modify a dynamic property of *john* (e.g. package ID):

```

MappingType map_type = IP_RANGE;
char* ip_address = "192.168.12.5";

char* prop_name = "packageID";
char* prop_value = "10";

bapi.login(
 "john",
 &ip_address,
 &map_type,
 1,
 &prop_name, // property key
 &prop_value, // property value
 1,
 "subscribers", // domain
 true, // isMappingAdditive is set to true
 -1);

```

## logoutByName

### Syntax

```
ReturnCode* logoutByName(char* argName,
 char** argMappings,
 MappingType* argMappingTypes,
 int argMappingsSize)
```

### Description

Locates the subscriber in the database and removes mappings from the subscriber.

### Parameters

`argName`: See explanation of [subscriber name format](#) (on page 2-7).

`argMappings`: See explanation of mappings and [mapping types](#) ("Network ID Mappings" on page 2-8).

If no mappings are specified, all the subscriber mappings will be removed.

`argMappingTypes`: See explanation of mappings and [mapping types](#) ("Network ID Mappings" on page 2-8).

`argMappingsSize`: The size of the `argMappings` and `argMappingTypes` arrays.

### Return Value

A pointer to a `ReturnCode` structure with a Boolean type:

- TRUE—if the subscriber was found and the subscriber mappings were removed from the subscriber database.
- FALSE—if the subscriber was not found in the subscriber database.

### Error Codes

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

- ERROR\_CODE\_SUBSCRIBER\_DOES\_NOT\_EXIST
- ERROR\_CODE\_BAD\_SUBSCRIBER\_MAPPING
- ERROR\_CODE\_SUBSCRIBER\_DOMAIN\_ASSOCIATION
- ERROR\_CODE\_DOMAIN\_NOT\_FOUND
- ERROR\_CODE\_NOT\_A\_SUBSCRIBER\_DOMAIN
- ERROR\_CODE\_DATABASE\_EXCEPTION

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

## Example

To remove IP address 192.168.12.5 from subscriber *john*:

```
MappingType map_type = IP_RANGE;
char* ip_address = "192.168.12.5";
```

```
bapi.logoutByName(
 "john",
 &ip_address,
 &map_type,
 1);
```

To remove all IP addresses from subscriber *john*:

```
bapi.logoutByName("john", NULL, NULL, 0);
```

## logoutByNameFromDomain

### Syntax

```
ReturnCode* logoutByNameFromDomain (char* argName,
 char** argMappings,
 MappingType* argMappingTypes,
 int argMappingsSize,
 char* argDomain)
```

### Description

Locates the subscriber in the database according to the specified domain and removes mappings from the subscriber.

### Parameters

`argName`: See explanation of *subscriber name format* (on page 2-7) in the *General API Concepts* chapter.

`argMappings`: See explanation of mappings and *mapping types* ("Network ID Mappings" on page 2-8) in the *General API Concepts* chapter.

If no mappings are specified, all the subscriber mappings will be removed.

`argMappingTypes`: See explanation of mappings and *mapping types* ("Network ID Mappings" on page 2-8) in the *General API Concepts* chapter.

`argMappingsSize`: The size of the `argMappings` and `argMappingTypes` arrays.

`argDomain`: See explanation of *domains* ("Subscriber Domains" on page 2-9) in the *General API Concepts* chapter.

The operation will fail if *either* of the following conditions exists:

- The domain is null, but the subscriber exists in the database and belongs to a domain.
- The domain specified is incorrect.

### Return Value

A pointer to a `ReturnCode` structure with a Boolean type:

- TRUE—if the subscriber was found and the subscriber mappings were removed from the subscriber database.
- FALSE—if the subscriber was not found in the subscriber database.

### Error Codes

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

- `ERROR_CODE_SUBSCRIBER_DOES_NOT_EXIST`
- `ERROR_CODE_BAD_SUBSCRIBER_MAPPING`
- `ERROR_CODE_SUBSCRIBER_DOMAIN_ASSOCIATION`



- ERROR\_CODE\_DOMAIN\_NOT\_FOUND
- ERROR\_CODE\_NOT\_A\_SUBSCRIBER\_DOMAIN
- ERROR\_CODE\_DATABASE\_EXCEPTION

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

## Example

To remove IP address 192.168.12.5 of subscriber *john* from domain *subscribers*:

```
MappingType map_type = IP_RANGE;
char* ip_address = "192.168.12.5";
```

```
bapi.logoutByNameFromDomain(
 "john",
 &ip_address,
 &map_type,
 1,
 "subscribers");
```

To remove all IP addresses of subscriber *john* from domain *subscribers*:

```
bapi.logoutByNameFromDomain(
 "john",
 NULL,
 NULL,
 0,
 "subscribers");
```

## logoutByMapping

### Syntax

```
ReturnCode* logoutByMapping(char* argMapping,
 MappingType argMappingType,
 char* argDomain)
```

### Description

Locates a subscriber based on domain and mapping, and removes the subscriber mappings. The subscriber remains in the database.

### Parameters

`argMapping`: See explanation of mappings and *mapping types* ("Network ID Mappings" on page 2-8).

`argMappingType`: See explanation of mappings and *mapping types* ("Network ID Mappings" on page 2-8).

`argDomain`: See description in `logoutByNameFromDomain` operation.

### Return Value

A pointer to a `ReturnCode` structure with a Boolean type:

- TRUE—if the subscriber was found and removed from the subscriber database.
- FALSE—if the subscriber was not found in the subscriber database.

### Error Codes

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

- ERROR\_CODE\_SUBSCRIBER\_DOES\_NOT\_EXIST
- ERROR\_CODE\_BAD\_SUBSCRIBER\_MAPPING
- ERROR\_CODE\_SUBSCRIBER\_DOMAIN\_ASSOCIATION
- ERROR\_CODE\_DOMAIN\_NOT\_FOUND
- ERROR\_CODE\_NOT\_A\_SUBSCRIBER\_DOMAIN
- ERROR\_CODE\_DATABASE\_EXCEPTION

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

### Example

To remove IP address 192.168.12.5 from domain *subscribers*:

```
bapi.logoutByMapping(
 "192.168.12.5",
 IP_RANGE,
 "subscribers");
```

## loginCable

### Syntax

```
ReturnCode* loginCable(char* argCpe,
 char* argCm,
 char* argIp,
 int argLease,
 char* argDomain,
 char** argPropertyKeys,
 char** argPropertyValues,
 int argPropertySize)
```

### Description

A login method adapted for the cable environment, which calls the cable support module in the SM. This method is designed to log in CPEs to the SM. To log in a CM, specify the CM MAC address in both CPE and CM arguments. For additional information, see the *Cable Environment Appendix* of the *SCMS Subscriber Manager User Guide*.



#### Note

The name of the CPE in the SM database is the concatenation of the CPE and CM values with **two** underscore ["\_"] characters between them. The caller must make sure that the lengths of CPE and CM add up to no more than **38** characters.

### Parameters

`argCpe`: A unique identifier of the CPE (usually a MAC address).

`argCm`: A unique identifier of the cable modem (usually a MAC address).

`argIp`: the CPE IP address.

`argLease`: the CPE lease time.

`argDomain`: See explanation of *domains* ("[Subscriber Domains](#)" on page 2-9). The domain will usually be CMTS IP.



#### Note

Domain aliases must be set on the SM in order for the CMTS IP to be correctly interpreted as a domain name. For information regarding aliases configuration, see the *Configuring Domains* section of *SCMS Subscriber Manager User Guide*.

`argPropertyKeys`: See explanation of the keys and values of the *Subscriber Properties* (on page 2-9).

If the CPE is provided with partial or no application properties, the values for the missing application properties will be copied from the application properties of the CM to which this CPE belongs. Each CM application property thus serves as a default for the CPE under it.

`argPropertyValues`: See explanation of the keys and values of the *Subscriber Properties* (on page 2-9).

`argPropertySize`: The size of the `argPropertyKeys` and `argPropertyValues` arrays.

## Return Value

A pointer to a `ReturnCode` structure with a void type.

## Error Codes

None

## Examples

To add the IP address 192.168.12.5 to a CM called *CM1* with 2 hours lease time:

```
bapi.loginCable(
 "CM1",
 "CM1",
 "192.168.12.5",
 7200, // lease time in seconds
 "subscribers",
 NULL, NULL, 0); // no properties
```

To add the IP address 192.168.12.50 to a CPE called *CPE1* behind *CM1* with a lease time of 1 hour:

```
bapi.loginCable(
 "CPE1",
 "CM1",
 "192.168.12.50",
 3600, // lease time in seconds
 "subscribers",
 NULL, NULL, 0);
```

## logoutCable

### Syntax

```
ReturnCode* logoutCable(char* argCpe,
 char* argCm,
 char* argIp,
 char* argDomain)
```

### Description

Indicates a logout (CPE becoming offline) event to the SM cable support module.

### Parameters

*argCpe*: See description in the [loginCable](#) (on page 3-13) method.

*argCm*: See description in the [loginCable](#) (on page 3-13) method.

*argIp*: See description in the [loginCable](#) (on page 3-13) method.

*argDomain*: See description in the [loginCable](#) (on page 3-13) method.

### Return Value

A pointer to a `ReturnCode` structure with a Boolean type:

- TRUE—if the CPE was found and removed from the subscriber database.
- FALSE—if the CPE was not found in the subscriber database.

### Error Codes

None

### Examples

To remove the IP address 192.168.12.5 from *CPE1*, which is behind *CM1*:

```
bool isExist = bapi.logoutCable(
 "CPE1",
 "CM1",
 "192.168.12.5",
 "subscribers");
```

## addSubscriber

### Syntax

```
ReturnCode* addSubscriber(
 char* argName,
 char** argMappings,
 MappingType* argMappingTypes,
 int argMappingsSize,
 char** argPropertyKeys,
 char** argPropertyValues,
 int argPropertySize,
 char** argCustomPropertyKeys,
 char** argCustomPropertyValues,
 int argCustomPropertySize,
 char* argDomain)
```

### Description

Creates a new subscriber record according to the given data and adds it to the SM database. If a subscriber by this name already exists, it will be removed before the new one is added. In contrast to `login`, which modifies fields passed to it and leaves unspecified fields unchanged, `addSubscriber` sets the subscriber exactly as specified by the parameters passed to it.



#### Note

It is recommended to call the `login` method for existing subscribers, instead of `addSubscriber`. Dynamic mappings and properties should be set by using `login`. Static mappings and properties should be set at the first time the subscriber is created by using `addSubscriber`.



#### Note

With `addSubscriber` the auto-logout feature is always disabled. To enable auto-logout, use `login`.

#### EXAMPLE:

Subscriber *AB*, already set up in the subscriber database, has a single IP mapping of *IP1*.

If an `addSubscriber` operation for *AB* is called with no mappings specified (NULL in both the *mappings* and *mappingTypes* fields), *AB* will be left with no mappings.

However, calling a `login` operation with these NULL-value parameters will not change *AB*'s mappings; *AB* will be left with its previous IP mapping of *IP1*.

### Parameters

`argName`: See explanation of *subscriber name format* (on page 2-7).

`argMappings`: See explanation of mappings and *mapping types* ("Network ID Mappings" on page 2-8).

`argMappingTypes`: See explanation of mappings and mapping types in the *General API Concepts* chapter.

`argMappingsSize`: The size of the `argMappings` and `argMappingTypes` arrays.

`argPropertyKeys`: See explanation of property keys and values in the *General API Concepts* chapter.

`argPropertyValues`: See explanation of property keys and values in the *General API Concepts* chapter.

`argPropertySize`: The size of the `argPropertyKeys` and `argPropertyValues` arrays.

`argCustomPropertyKeys`: See explanation of custom property keys and values in the *General API Concepts* chapter.

`argCustomPropertyValues`: See explanation of custom property keys and values in the *General API Concepts* chapter.

`argPropertySize`: The size of the `argCustomPropertyKeys` and `argCustomPropertyValues` arrays.

`argDomain`: See explanation of *domains* ("[Subscriber Domains](#)" on page 2-9). A NULL value indicates that the subscriber is domain-less.

## Return Value

A pointer to a `ReturnCode` structure with a void type.

## Error Codes

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

- `ERROR_CODE_ILLEGAL_SUBSCRIBER_NAME`
- `ERROR_CODE_BAD_SUBSCRIBER_MAPPING`
- `ERROR_CODE_DOMAIN_NOT_FOUND`
- `ERROR_CODE_SUBSCRIBER_ALREADY_EXISTS`
- `ERROR_CODE_SUBSCRIBER_DOMAIN_ASSOCIATION`
- `ERROR_CODE_DATABASE_EXCEPTION`
- `ERROR_CODE_UNKNOWN`

This error code indicates that invalid values were supplied for the `propertyValues` parameter.

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

## Examples

To add a new subscriber, *john*, with custom properties:

```
char* propKeys[] = { "work_phone", "home_phone" };
char *propValues[] = { "123456", "898765" };

bapi.addSubscriber(
 "john",
 NULL, NULL, 0, // dynamic mappings will be set by
login
 NULL, NULL, 0, // dynamic properties will be set by
login
 propKeys, propValues, 2, // 2 custom properties
 "subscribers"); // default domain
```



## removeSubscriber

### Syntax

```
ReturnCode* removeSubscriber(char* argName)
```

### Description

Removes a subscriber completely from the SM database.

### Parameters

`argName`: See explanation of [Subscriber Name Format](#) (on page 2-7).

### Return Value

A pointer to a `ReturnCode` structure with a Boolean type:

- TRUE—if the subscriber was found in the database and successfully removed.
- FALSE—if the conditions for TRUE were not met - the subscriber was not found in the database, or the subscriber was found but was not successfully removed.

### Error Codes

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

- `ERROR_CODE_ILLEGAL_SUBSCRIBER_NAME`
- `ERROR_CODE_SUBSCRIBER_DOES_NOT_EXIST`
- `ERROR_CODE_DATABASE_EXCEPTION`

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

### Example

To remove subscriber *john* entirely from the database:

```
bapi.removeSubscriber("john");
```

## removeAllSubscribers

### Syntax

```
ReturnCode* removeAllSubscribers()
```

### Description

Removes all subscribers from the SM, leaving the database with no subscribers.



---

**Note**

This method might take time to execute. To avoid operation timeout exceptions, set a high operation timeout (up to 5 minutes) before calling this method.

---

### Return Value

A pointer to a ReturnCode structure with a void type.

### Error Codes

None.

## getNumberOfSubscribers

### Syntax

```
ReturnCode* getNumberOfSubscribers()
```

### Description

Retrieves the total number of subscribers in the SM database.

### Return Value

A pointer to a `ReturnCode` structure holding an integer describing the number of subscribers in the SM.

### Error Codes

None

## getNumberOfSubscribersInDomain

### Syntax

```
ReturnCode* getNumberOfSubscribersInDomain(char* argDomain)
```

### Description

Retrieves the number of subscribers in a subscriber domain.

### Parameters

`argDomain`: A name of a subscriber domain that exists in the SM's domain repository.

### Return Value

A pointer to a `ReturnCode` structure holding an integer describing the number of subscribers in the domain provided.

### Error Codes

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

- `ERROR_CODE_NOT_A_SUBSCRIBER_DOMAIN`
- `ERROR_CODE_DOMAIN_NOT_FOUND`

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

## getSubscriber

### Syntax

```
ReturnCode* getSubscriber(char* argName)
```

### Description

Retrieves a subscriber record. Each field is formatted as an integer, string, or string array, as described in the Return Value section for this method. If the subscriber does not exist in the SM database, an exception will be thrown.

### Parameters

`argName`: See explanation of [subscriber name format](#) (on page 2-7).

### Return Value

A pointer to a ReturnCode structure holding an array of ReturnCode structures with nine elements. No array element is NULL.

The following list is the element values and their meanings:

|         |                                                                                                                     |
|---------|---------------------------------------------------------------------------------------------------------------------|
| Index 0 | subscriber name (char*)                                                                                             |
| Index 1 | array of mappings (char**)                                                                                          |
| Index 2 | array of mapping types (short*)                                                                                     |
| Index 3 | Domain name (char*)                                                                                                 |
| Index 4 | array of property names (char**)                                                                                    |
| Index 5 | array of property values (char**)                                                                                   |
| Index 6 | array of custom property names (char**)                                                                             |
| Index 7 | array of custom property values (char**)                                                                            |
| Index 8 | array of auto-logout time, as seconds from now, or value of <b>-1</b> if not set (long l*) one per mapping (index1) |

### Error Codes

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

- ERROR\_CODE\_SUBSCRIBER\_DOES\_NOT\_EXIST
- ERROR\_CODE\_DATABASE\_EXCEPTION

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

## Example

To retrieve the subscriber record of *john*:

```
ReturnCode* sub = bapi.getSubscriber("john");
// sub name
char* name = sub->u.objectArray[0]->u.stringVal;

// sub mapping
char** mappings = sub->u.objectArray[1]->u.stringArrayVal;

// mappings types
short* types = sub->u.objectArray[2]->u.shortArrayVal;

char* domainName = (char*)sub->u.objectArray[3]->u.stringVal;

char** propertyNames = (char**)sub->u.objectArray[4]->u.stringArrayVal;

char** propertyValues = (char**)sub->u.objectArray[5]->u.stringArrayVal;

char** customPropertyName = (char**)sub->u.objectArray[6]-
>u.stringArrayVal;

char** customPropertyValues = (char**)sub->u.objectArray[7]-
>u.stringArrayVal;

long* autoLogoutTime = sub->u.objectArray[8]->u.longArrayVal;
```

## subscriberExists

### Syntax

```
ReturnCode* subscriberExists(char* argName)
```

### Description

Verifies that a subscriber exists in the SM database.

### Parameters

`argName`: See explanation of *subscriber name format* (on page 2-7).

### Return Value

A pointer to a `ReturnCode` structure with a Boolean type:

- TRUE—if the subscriber was found in the SM database.
- FALSE—if the subscriber could not be found.

### Error Codes

None.

## subscriberLoggedIn

### Syntax

```
ReturnCode* subscriberLoggedIn(char* argName)
```

### Description

Checks whether a subscriber that already exists in the SM database is logged in, that is, if the subscriber also exists in an SCE database.

When the SM is configured to work in *Pull mode*, a TRUE value returned by this method does **not** guarantee that the subscriber actually exists in an SCE database, but rather that the subscriber is available to be pulled by an SCE if needed.

If the subscriber does not exist in the SM database, an exception will be thrown.

### Parameters

`argName`: See explanation of [subscriber name format](#) (on page 2-7).

### Return Value

A pointer to a `ReturnCode` structure with a Boolean type:

- TRUE—if the subscriber is logged in.
- FALSE—if the subscriber is not logged in.

### Error Codes

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

- `ERROR_CODE_ILLEGAL_SUBSCRIBER_NAME`
- `ERROR_CODE_DATABASE_EXCEPTION`

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



## getSubscriberNameByMapping

### Syntax

```
ReturnCode* getSubscriberNameByMapping(char* argMapping,
MappingType argMappingType,
char* argDomain)
```

### Description

Finds a subscriber name according to a mapping and a domain.

### Parameters

`argMapping`: See explanation of mappings and *mapping types* ("Network ID Mappings" on page 2-8).

`argMappingType`: See explanation of mappings and *mapping types* ("Network ID Mappings" on page 2-8).

`argDomain`: The name of the domain to which the subscriber belongs to. The operation will fail if *either* of the following conditions exists:

- The domain is null, but the subscriber exists in the database and belongs to a domain.
- The specified domain is incorrect.

### Return Value

A pointer to a `ReturnCode` structure with a `String (char*)` type:

- Subscriber name—if a subscriber record was found.
- NULL—if no subscriber record with the supplied mapping could be found in the SM database.

### Error Codes

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

- `ERROR_CODE_DOMAIN_NOT_FOUND`
- `ERROR_CODE_BAD_SUBSCRIBER_MAPPING`
- `ERROR_CODE_NOT_A_SUBSCRIBER_DOMAIN`
- `ERROR_CODE_DATABASE_EXCEPTION`

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

## getSubscriberNames

### Syntax

```
ReturnCode* getSubscriberNames(char* argFirstName,
 int argAmount)
```

### Description

Gets a bulk of subscriber names from the SM database, starting with `argFirstName` followed by the next `argAmount` subscribers (in alphabetical order).

If `argFirstName` is NULL, the (alphabetically) first subscriber name that exists in the SM database will be used.



#### Note

There is **no** guarantee that the total number of subscribers (in all bulks) will equal the value returned from `getNumOfSubscribers` at any time. They may differ, for example, if some subscribers are added or removed while bulks are being retrieved.

### Parameters

`argFirstName`: Last subscriber name from last bulk (first name to look for). Use NULL to start with the first (alphabetic) subscriber.

`argAmount`: Limit on number of subscribers that will be returned. If this value is higher than the SM limit (1000), the SM limit will be used.



#### Note

Values higher than 500 to this parameter is **not** recommended.

### Return Value

A pointer to a `ReturnCode` structure with a String Array (`char**`) holding a list of subscriber names ordered alphabetically.

The method will return as many subscribers that are found in the SM database, starting at the requested subscriber. The array size is limited by the minimum between `argAmount` and the SM limit (1000).

### Error Codes

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

- `ERROR_CODE_ILLEGAL_SUBSCRIBER_NAME`
- `ERROR_CODE_DATABASE_EXCEPTION`

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

## Example

To receive an alphabetical list of subscriber names:

```
bool hasMoreSubscribers;
char* lastBulkEnd = NULL;
char tmpName[50];
int bulkSize = 100;

do
{
 ReturnCode* subscribers =
 smApi.getSubscriberNames(lastBulkEnd,bulkSize);

 hasMoreSubscribers = false;

 if ((isReturnCodeError(subscribers) == false) &&
 (subscribers->type == STRING_ARRAY_T) &&
 (subscribers->u.stringArrayVal != NULL))
 {
 for (int i = 0; i < subscribers->size; i++)
 {
 // do something with subscribers->u.stringArrayVal[i]
 }

 if (subscribers->size == bulkSize)
 {
 hasMoreSubscribers = true;
 strcpy (tmpName, subscribers->u.stringArrayVal[bulkSize - 1]);
 lastBulkEnd = tmpName;
 }
 }
 freeReturnCode(subscribers);
} while (hasMoreSubscribers);
```

## getSubscriberNamesInDomain

### Syntax

```
ReturnCode* getSubscriberNamesInDomain(char* argFirstName,
 int argAmount,
 char* argDomain)
```

### Description

Retrieves subscribers from the SM database that are associated with the specified domain.

The function of this operation is the same as the "[getSubscriberNames](#)" (on page 3-28) operation.

### Parameters

`argFirstName`: See description in "[getSubscriberNames](#)" (on page 3-28) operation.

`argAmount`: See description in "[getSubscriberNames](#)" (on page 3-28) operation.

`argDomain`: The name of a subscriber domain that exists in the SM domain repository.

### Return Value

An alphabetically ordered array of subscriber names that belong to the specified domain.

See the [Return Value](#) (on page 3-28) section of the `getSubscriberNames` ("[getSubscriberNames](#)" on page 3-28) operation for more information.

### Error Codes

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

- `ERROR_CODE_ILLEGAL_SUBSCRIBER_NAME`
- `ERROR_CODE_DOMAIN_NOT_FOUND`
- `ERROR_CODE_DATABASE_EXCEPTION`

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

## getSubscriberNamesWithPrefix

### Syntax

```
ReturnCode* getSubscriberNamesWithPrefix(char* argFirstName,
 int argAmount,
 char* argPrefix)
```

### Description

Retrieves subscribers from the SM database whose names begin with a specified prefix.

The function of this operation is the same as the "[getSubscriberNames](#)" (on page 3-28) operation.

### Parameters

`argFirstName`: See description in "[getSubscriberNames](#)" (on page 3-28) operation.

`argAmount`: See description in "[getSubscriberNames](#)" (on page 3-28) operation.

`argPrefix`: A case-sensitive string that marks the prefix of the required subscriber names.

### Return Value

An alphabetically ordered array of subscriber names that start with the prefix required.

See the *Return Value* (on page 3-28) section of the `getSubscriberNames` ("[getSubscriberNames](#)" on page 3-28) operation.

### Error Codes

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

- `ERROR_CODE_ILLEGAL_SUBSCRIBER_NAME`
- `ERROR_CODE_DATABASE_EXCEPTION`

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

## getSubscriberNamesWithSuffix

### Syntax

```
ReturnCode* getSubscriberNamesWithSuffix(char* argFirstName,
 int argAmount,
 char* argSuffix)
```

### Description

Retrieves subscribers from the SM database whose names end with the specified suffix.

The functions of this operation are the same as the "[getSubscriberNames](#)" (on page 3-28) operation.

### Parameters

`argFirstName`: See description in "[getSubscriberNames](#)" (on page 3-28) operation.

`argAmount`: See description in "[getSubscriberNames](#)" (on page 3-28) operation.

`argSuffix`: A case-sensitive string that marks the suffix of the required subscriber names.

### Return Value

An alphabetically ordered array of subscriber names that end with the suffix required.

See the [Return Value](#) (on page 3-28) section of the [getSubscriberNames](#) (on page 3-28) operation.

### Error Codes

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

- `ERROR_CODE_ILLEGAL_SUBSCRIBER_NAME`
- `ERROR_CODE_DATABASE_EXCEPTION`

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

## getDomains

### Syntax

```
ReturnCode* getDomains()
```

### Description

Provides a list of current subscriber domains in the SM domain repository.

### Return Value

A pointer to a `ReturnCode` structure with a `String Array (char**)` holding a complete list of subscriber domain names in the SM.

### Error Codes

None

## setPropertiesToDefault

### Syntax

```
ReturnCode* setPropertiesToDefault(char* argName,
char** argPropertyKeys,
int argPropertySize)
```

### Description

Resets the specified application properties of a subscriber. If an application is installed, the relevant application properties will be set to the default value of the properties according to the currently loaded application information. If an application is not installed, an `ERROR_CODE_ILLEGAL_STATE` error code is returned.

### Parameters

`argName`: See explanation of subscriber name format in the *General API Concepts* (on page 2-1) chapter.

`argPropertyKeys`: See explanation of property keys and values in the *General API Concepts* (on page 2-1) chapter.

`argPropertySize`: The size of the `argPropertyKeys` array.

### Return Value

A pointer to a `ReturnCode` structure with a void type.

### Error Codes

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

- `ERROR_CODE_ILLEGAL_SUBSCRIBER_NAME`
- `ERROR_CODE_BAD_SUBSCRIBER_MAPPING`
- `ERROR_CODE_DOMAIN_NOT_FOUND`
- `ERROR_CODE_SUBSCRIBER_DOES_NOT_EXIST`
- `ERROR_CODE_NOT_A_SUBSCRIBER_DOMAIN`
- `ERROR_CODE_DATABASE_EXCEPTION`

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



## removeCustomProperties

### Syntax

```
ReturnCode* removeCustomProperties(char* argName,
 char** argCustomPropertyKeys,
 int argCustomPropertySize)
```

### Description

Resets the specified custom properties of a subscriber.

### Parameters

`argName`: See explanation of subscriber name format in the *General API Concepts* (on page 2-1) chapter.

`argCustomPropertyKeys`: See explanation of custom property keys and values in *the General API Concepts* (on page 2-1) chapter.

`argCustomPropertySize`: The size of the `argCustomPropertyKeys` array.

### Return Value

A pointer to a `ReturnCode` structure with a void type.

### Error Codes

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

- `ERROR_CODE_ILLEGAL_SUBSCRIBER_NAME`
- `ERROR_CODE_SUBSCRIBER_DOES_NOT_EXIST`
- `ERROR_CODE_DATABASE_EXCEPTION`

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

## C++ setLogger Method

### Syntax

```
void setLogger(Logger *argLogger)
```

### Description

Sets an implementation of the abstract Logger class. This method should be used for integrating the SM API log messages with the host application log.

### Parameters

`argLogger`: an implementation of the abstract Logger class.

### Return Value

None.

## C++ init Method

### Syntax

```
Bool init(int argSupportedThreads,
 int argThreadPriority,
 Uint32 argBufferSize,
 Uint32 argKeepAliveDuration,
 Uint32 argConnectionTimeout)
```

### Description

Configures and initializes the API.

**Note**

---

This method must be called before performing any operation of the C++ API.

---

### Parameters

`argSupportedThreads`: The number of threads the API should support.

`argThreadPriority`: The priority for the PRPC protocol network thread.

`argBufferSize`: The internal buffer size (for default use 2000000 (2,000,000) bytes).

`argKeepAliveDuration`: A hint regarding the wanted delay between PRPC protocol keep-alive messages (default use 10 seconds).

`argConnectionTimeout`: A hint regarding the wanted timeout on a non-responding PRPC protocol connection (for default use 20 seconds).

### Return Value

Boolean value:

- TRUE—success
- FALSE—fail

### Example

```
SmBlockingApi bapi;
bool success = bapi.init(10,
 0,
 2000000, //default
 10, // default
```

## C SMB\_init Function

### Syntax

```
SMB_HANDLE SMB_init (int argSupportedThreads,
 int argThreadPriority,
 Uint32 argBufferSize,
 Uint32 argKeepAliveDuration,
 Uint32 argConnectionTimeout)
```

### Description

Allocates, configures, and initializes the API.



#### Note

This method must be called before performing any operation of the C API.

### Parameters

`argSupportedThreads`: The number of threads the API should support.

`argThreadPriority`: The priority for the PRPC protocol network thread.

`argBufferSize`: The internal buffer size (default use 2000000 (2,000,000) bytes).

`argKeepAliveDuration`: A hint regarding the wanted delay between PRPC protocol keep-alive messages (default use 10 seconds).

`argConnectionTimeout`: A hint regarding the wanted timeout on a non-responding PRPC protocol connection (for default use 20 seconds).

### Return Value

SMB\_HANDLE handle to the API. If the handle equals NULL, the initialization failed. Otherwise a non-NULL value is returned.

### Example

```
SMB_HANDLE api;
// initialize an API
api = SMB_init(10, // 10 threads
 0,
 300000, // 3,000,000 bytes
 10, // default
 30); // 30 sec connection timeout
```

## C SMB\_release Function

### Syntax

```
void SMB_release(SMB_HANDLE argApiHandle)
```

### Description

Releases the resources used by the API. This function must be called at the end of the use of the API.

### Parameters

`argApiHandle`: the API handle received using the `SMB_init` function.

### Return Value

None.

## setName

### Syntax

```
void setName(char *argName)
```

### Description

Sets the name of the API, which serves as a unique identifier for the API-SM connection. The setName function should be called before calling the connect method.

### Parameters

argName: the API name.

### Return Value

None.

## connect

### Syntax

```
bool connect(char* argHostName, Uint16 argPort = 14374)
```

### Description

Attempts to establish a PRPC protocol connection to the SM.

### Parameters

`argHostName`: The SM IP-Address or hostname.

`argPort`: TCP port to connect the SM on (default is 14374).

### Return Value

Boolean value:

- TRUE—success
- FALSE—fail

## disconnect

### Syntax

```
bool disconnect()
```

### Description

Attempts to terminate the PRPC protocol connection to the SM.

### Return Value

Boolean value:

- TRUE—success
- FALSE—fail



## isConnected

### Syntax

```
bool isConnected();
```

### Description

Checks whether the PRPC protocol connection to the SM is up and running.

### Return Value

Boolean value:

- TRUE—The connection is up.
- FALSE—The connection is down.

## Blocking API C++ Code Examples

This section provides two code examples:

- Getting number of subscribers
- Adding subscriber, printing subscriber information, removing subscriber

### Getting Number of Subscribers

The following example prints to `stdout` the total number of subscribers in the SM database and the number of subscribers in each subscriber domain.

```
#include "SmApiBlocking.h"
#include <stdio.h>

int main(int argc, char* argv[])
{
 SmApiBlocking bapi;
 //initiation
 bapi.init();
 bapi.setReplyTimeout(300000); //set timeout for 5 minutes
 bapi.connect(argv[1]); // connect to the SM
 //operations
 ReturnCode* domains = bapi.getDomains();
 ReturnCode* totalSubscribers=bapi.getNumberOfSubscribers();
 if ((isReturnCodeError(domains) == false) &&
 (isReturnCodeError(totalSubscribers) == false))
 {
 printf(
 "number of susbcribers in the database:\t\t %d\n",
 totalSubscribers->u.intVal);
 for (int i=0; i<domains->size; i++)
 {
 ReturnCode* numberOfSusbcribersInDomain=
 bapi.getNumberOfSubscribersInDomain(
 domains->u.stringArrayVal[i]);
 if (isReturnCodeError(numberOfSusbcribersInDomain)
 == false)
 {
 printf(
 "number of susbcribers domain %s:\t\t%d\n",
 domains->u.stringArrayVal[i],
 numberOfSusbcribersInDomain->u.intVal);
 }
 freeReturnCode (numberOfSusbcribersInDomain);
 }
 }
 freeReturnCode (domains);
 freeReturnCode (totalSubscribers);
 //finalization
 bapi.disconnect();
 return 0;
}
```

## Adding a Subscriber, Printing Information, Removing a Subscriber

The following program adds a subscriber to the subscriber database, retrieves the subscriber information, prints it to `stdout`, and removes the subscriber from the subscriber database.

```
#include "SmApiBlocking.h"
#include <stdio.h>

int main(int argc, char* argv[])
{
 checkArguments(argc,argv);
 SmApiBlocking bapi;
 //initiation
 bapi.init();
 bapi.setReplyTimeout(10000); //set timeout for 10 seconds
 bapi.connect(argv[1]); // connect to the SM
 //add subscriber
 printf("adding subscriber to SM\n");
 MappingType type = IP_RANGE;
 char* customKey = "custom-key";
 char* customVal = "custom-value";
 ReturnCode* ret = bapi.addSubscriber(
 argv[2], // name
 &(argv[3]), // mapping`
 &type, // mapping type
 1, // one mapping
 &(argv[4]), // property key
 &(argv[5]), // property value
 1, // number of properties
 &customKey, //custom property key
 &customVal, //custom property value
 1, // number of custom properties
 argv[6]); //domain

 freeReturnCode (ret);

 //Print subscriber
 printf("Printing subscriber:\n");
 ReturnCode* subfields = bapi.getSubscriber(argv[1]);
 if (isReturnCodeError(subfields) == false)
 {
 printf("\tname:\t\t%s\n",
 subfields->u.objectArray[0]->u.stringVal);
 printf("\tmapping:\t\t%s\n",
 subfields->u.objectArray[1]->u.stringArrayVal[0]);
 printf("\tdomain:\t\t%s\n",
 subfields->u.objectArray[3]->u.stringVal);
 printf("\tautologout:\t\t%d\n",
 subfields->u.objectArray[8]->u.intVal);
 // Remove subscriber
 printf("removing subscriber from SM\n");
 bapi.removeSubscriber(argv[1]);
 }
 else
 {
 printf("error in subscriber retrieval\n");
 }
 freeReturnCode(subfields);
 //finalization
 bapi.disconnect();
 return 0;
}
```

```
void checkArguments(int argc, char* argv[])
{
if (argc != 7)
{
printf("usage: AddPrintRemove <SM-address> <subscriber-name> "
"<IP mapping> <property-key> <property-value> <domain>");
exit(1);
}
}
```

## Blocking API C Code Examples

This section provides two code examples:

- Getting number of subscribers
- Adding subscriber, printing subscriber information, removing subscriber

### Getting Number of Subscribers

The following example prints to `stdout` the total number of subscribers in the SM database and the number of subscribers in each subscriber domain.

```
#include "SmApiBlocking_c.h"
#include <stdio.h>

int main(int argc, char* argv[])
{
 //initiation
 SMB_HANDLE bapi = SMB_init(10,0,2000000,10,20);
 if (bapi == NULL)
 {
 // init failure
 return -1;
 }
 SMB_setReplyTimeout(bapi,300000); //set timeout for 5 minutes
 SMB_connect(bapi,argv[1],14374); // connect to the SM
 //operations
 ReturnCode* domains = SMB_getDomains(bapi);
 ReturnCode* totalSubscribers= SMB_getNumberOfSubscribers(bapi);
 if ((isReturnCodeError(domains) == false) &&
 (isReturnCodeError(totalSubscribers) == false))
 {
 printf("number of susbcribers in the database:\t\t %d\n",
 totalSubscribers->u.intVal);
 for (int i=0; i<domains->size; i++)
 {
 ReturnCode* numberOfSubscribersInDomain=
 SMB_getNumberOfSubscribersInDomain(bapi,
 domains-
 >u.stringArrayVal[i]);
 if(isReturnCodeError(numberOfSubscribersInDomain) ==
 false)
 {
 printf(
 "number of susbcribers domain
 %s:\t\t%d\n",
 domains->u.stringArrayVal[i],
 numberOfSubscribersInDomain->u.intVal);
 }
 freeReturnCode (numberOfSubscribersInDomain);
 }
 freeReturnCode (domains);
 freeReturnCode (totalSubscribers);
 //finalization
 SMB_disconnect(bapi);
 SMB_release(bapi);
 return 0;
 }
}
```

## Adding a Subscriber, Printing Information, Removing a Subscriber

The following program adds a subscriber to the subscriber database, retrieves the subscriber information, prints it to `stdout`, and removes the subscriber from the subscriber database.

```
#include "SmApiBlocking_c.h"
#include <stdio.h>

int main(int argc, char* argv[])
{
 checkArguments(argc, argv);

 //initiation
 SMB_HANDLE bapi = SMB_init(10,0,2000000,10,20);
 if (bapi == NULL)
 {
 // init failure
 return -1;
 }
 SMB_setReplyTimeout(bapi,10000); //set timeout for 10 seconds
 SMB_connect(bapi,argv[1], 14374); // connect to the SM
 //add subscriber
 printf("adding subscriber to SM\n");
 MappingType type = IP_RANGE;
 char* customKey = "custom-key";
 char* customVal = "custom-value";
 ReturnCode* ret = SMB_addSubscriber(
 bapi, // handle
 argv[2], // name
 &(argv[3]), // mapping`
 &type, // mapping type
 1, // one mapping
 &(argv[4]), // property key
 &(argv[5]), // property value
 1, // number of properties
 &customKey, //custom property key
 &customVal, //custom property value
 1, // number of custom properties
 argv[6]); //domain

 freeReturnCode (ret);

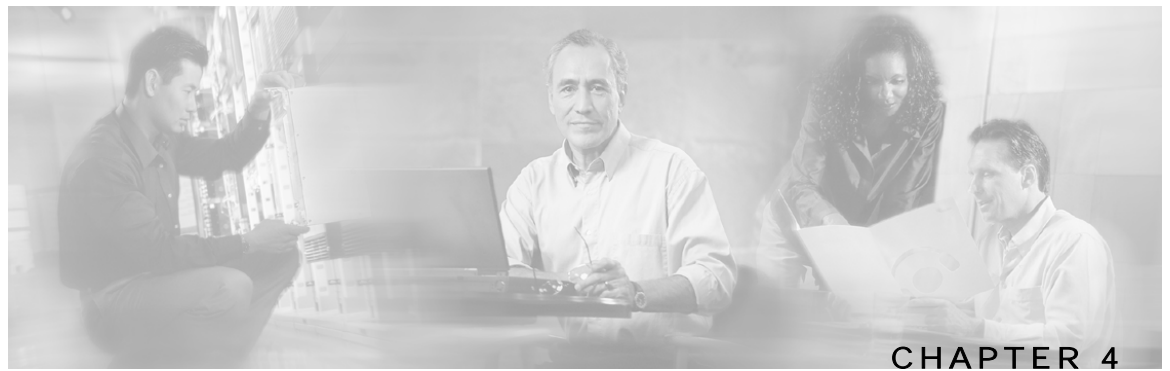
 //Print subscriber
 printf("Printing subscriber:\n");
 ReturnCode* subfields = SMB_getSubscriber(bapi,argv[2]);
 if (isReturnCodeError(subfields) == false)
 {
 printf("\tname:\t\t%s\n",
 subfields->u.objectArray[0]->u.stringVal);
 printf("\tmapping:\t%s\n",
 subfields->u.objectArray[1]->u.stringArrayVal[0]);
 printf("\tdomain:\t\t%s\n",
 subfields->u.objectArray[3]->u.stringVal);
 printf("\tautologout:\t%d\n",
 subfields->u.objectArray[8]->u.intVal);
 // Remove subscriber
 printf("removing subscriber from SM\n");
 SMB_removeSubscriber(bapi,argv[2]);
 }
}
```

```
else
{
 printf("error in subscriber retrieval\n");
}
freeReturnCode(subfields);
//finalization
SMB_disconnect(bapi);
SMB_release(bapi);
return 0;
}

void checkArguments(int argc, char* argv[])
{
 if (argc != 7)
 {
 printf(
 "usage: AddPrintRemove <SM-address> <subscriber-name> "
 "<IP mapping> <property-key> <property-value> <domain>");
 exit(1);
 }
}
```







# Non-blocking API

---

This chapter introduces the Result Handler Callbacks, a feature unique to the Non-blocking API. It also lists all methods of the Non-blocking API and provides code examples.

This chapter contains the following sections:

- [Multi-threading Support](#) 4-1
- [Result Handler Callbacks](#) 4-1
- [Non-blocking API Methods](#) 4-4
- [Non-blocking API C++ Code Examples](#) 4-9
- [Non-blocking API C Code Examples](#) 4-11

## Multi-threading Support

The Non-blocking API supports an unlimited number of threads calling its methods simultaneously.



### Note

---

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

---

## Result Handler Callbacks

The Non-blocking API enables setting result handler callbacks. The result handler callbacks are two functions for `handleSuccess` and `handleError`, as outlined in the following code.

```
/* operation failure callback specification */
typedef void (*OperationFailCallbackFunc)(Uint32 argHandle,
 ReturnCode *argReturnCode);

/* operation success callback specification */
typedef void (*OperationSuccessCallbackFunc)(Uint32 argHandle,
 ReturnCode *argReturnCode);
```

You should implement these callbacks if you want to be informed about the success or error results of operations performed through the API.

**Note**

This is the **only** interface for retrieving results; they **cannot** be returned immediately after the API method has returned to the caller.

Both `handleSuccess` and `handleError` callbacks accept two parameters:

- *Handle*—Each API operation's return-value is a handle of type `uint32`. This handle enables correlation between operation calls and their results. When a `handle...` operation is called with a handle of value **X**, the result will match the operation that returned the same handle value (**X**) to the caller.
- *Result*—The actual result of the operation returned as a pointer of type `ResultCode`.

## Example

The following example is a simple implementation of a result handler that counts the number of success/failure operations. This main method initiates the API and assigns a result handler.

For correct operation of the result handler, follow the code sequence given in the example.

**Note**

This example does **not** demonstrate the use of callback handles.

```
#include "GeneralDefs.h"
#include "SmApiNonBlocking.h"
#include <stdio.h>

int successCnt = 0;
int failCnt = 0;

void onOperationFail(UINT32 argHandle, ReturnCode* argReturnCode)
{
 failCnt++;
 if (argReturnCode != NULL)
 {
 freeReturnCode(argReturnCode);
 }
}

void onOperationSuccess(UINT32 argHandle, ReturnCode* argReturnCode)
{
 successCnt++;

 if (argReturnCode != NULL)
 {
 freeReturnCode(argReturnCode);
 }
}

int main(int argc, char* argv[])
{
 if (argc != 2)
 {
 printf("usage: ResultHandlerExample <sm-ip>");
 exit(1);
 }

 //note the order of operations!
 SmApiNonBlocking nbapi;
 nbapi.init();
 nbapi.connect(argv[1]);
 nbapi.setReplyFailCallBack(onOperationFail);
 nbapi.setReplySuccessCallBack(onOperationSuccess);
 nbapi.login(...);
 ...

 nbapi.disconnect();

 return 0;
}
```

## Non-blocking API Methods

This section lists the methods of the Non-blocking API.

Some of the methods return a non-negative `int` handle that may be used to correlate operation calls and their results (see the *Result Handler Callbacks* (on page 4-1) section). If an internal error had occurred a negative value is returned and the operation is not performed.

The operation results passed to the result handler callbacks are the same as the return values described in the same method in the *Blocking API* (on page 3-1), except that: return values of `void` are translated to `NULL`.



### Note

The error/fail callback will be handed with an error **only if** the matching operation in the Blocking API would return an error code with the same arguments according to the SM database state at the time of the call.

The C and C++ API share the same function signature, except for an `SMNB_` prefix for all Non-blocking C APIs function names, and an API handle of type `SMNB_HANDLE` as the first parameter in all functions. Other differences between the APIs are explained in the function description.

The following methods are described:

- *login* (on page 4-5)
- *logoutByName* (on page 4-5)
- *logoutByNameFromDomain* (on page 4-5)
- *logoutByMapping* (on page 4-5)
- *loginCable* (on page 4-6)
- *logoutCable* (on page 4-6)
- C++ *setLogger Method* (on page 4-6)
- C++ *init Method* (on page 4-6)
- C *SMNB\_init Function* (on page 4-7)
- C *SMNB\_release Function* (on page 4-7)
- *setName* (on page 4-7)
- *connect* (on page 4-7)
- *disconnect* (on page 4-7)
- *isConnected* (on page 4-8)

## login

### Syntax

```
int login(char* argName,
 char** argMappings,
 MappingType* argMappingTypes,
 int argMappingsSize,
 char** argPropertyKeys,
 char** argPropertyValues,
 int argPropertySize,
 char* argDomain,
 bool argIsAdditive,
 int argAutoLogoutTime)
```

The operation functionality is the same as the matching Blocking API operation. See [the login](#) (on page 3-5) operation in the Blocking API chapter for more information.

## logoutByName

### Syntax

```
int logoutByName(char* argName,
 char** argMappings,
 MappingType* argMappingTypes,
 int argMappingsSize)
```

The operation functionality is the same as matching Blocking API operation. See the [logoutByName](#) (on page 3-8) operation in the Blocking API chapter for more information.

## logoutByNameFromDomain

### Syntax

```
int logoutByNameFromDomain (char* argName,
 char** argMappings,
 MappingType* argMappingTypes,
 int argMappingsSize,
 char* argDomain)
```

The operation functionality is the same as matching Blocking API operation. See the [logoutByNameFromDomain](#) (on page 3-10) operation in the Blocking API chapter for more information.

## logoutByMapping

### Syntax

```
int logoutByMapping(char* argMapping,
 MappingType argMappingType,
 char* argDomain)
```

The operation functionality is the same as matching Blocking API operation. See the [logoutByMapping](#) (on page 3-12) operation for more information.

## loginCable

### Syntax

```
int loginCable(char* argCpe,
 char* argCm,
 char* argIp,
 int argLease,
 char* argDomain,
 char** argPropertyKeys,
 char** argPropertyValues,
 int argPropertySize)
```

The operation functionality is the same as matching Blocking API operation. See the [loginCable](#) (on page 3-13) operation for more information.

## logoutCable

### Syntax

```
int logoutCable(char* argCpe,
 char* argCm,
 char* argIp,
 char* argDomain)
```

The operation functionality is the same as matching Blocking API operation. See the [logoutCable](#) (on page 3-15) operation for more information.

## C++ setLogger Method

### Syntax

```
void setLogger(Logger *argLogger)
```

The operation functionality is the same as matching Blocking API operation. See the [C++ setLogger Method](#) (on page 3-36) operation for more information.

## C++ init Method

### Syntax

```
Bool init(int argThreadPriority = 0,
 Uint32 argBufferSize = DEFAULT_BUFFER_SIZE,
 Uint32 argKeepAliveDuration = DEFAULT_KEEP_ALIVE_DURATION,
 Uint32 argConnectionTimeout= DEFAULT_CONNECTION_TIMEOUT)
```

The operation functionality is the same as matching Blocking API operation. See the [C++ init Method](#) (on page 3-37) for more information.

## C SMNB\_init Function

### Syntax

```
SMNB_HANDLE SMNB_init(int argThreadPriority,
 Uint32 argBufferSize,
 Uint32 argKeepAliveDuration,
 Uint32 argConnectionTimeout)
```

The operation functionality is the same as matching Blocking API operation. See the [C SMB\\_init Function](#) (on page 3-38) operation for more information.

### Return Value

SMNB\_HANDLE handle to the API. If the handle equals NULL, the initialization failed. Otherwise a non-NULL value is returned.

## C SMNB\_release Function

### Syntax

```
void SMNB_release(SMNB_HANDLE argApiHandle)
```

The operation functionality is the same as matching Blocking API operation. See the [C SMB\\_release Function](#) (on page 3-39) operation for more information.

## setName

### Syntax

```
void setName(char *argName)
```

The operation functionality is the same as matching Blocking API operation. See the [setName](#) (on page 3-40) operation for more information.

## connect

### Syntax

```
bool connect(char* argHostName, Uint16 argPort = 14374)
```

The operation functionality is the same as matching Blocking API operation. See the [connect](#) (on page 3-41) operation for more information.

## disconnect

### Syntax

```
bool disconnect()
```

The operation functionality is the same as matching Blocking API operation. See the [disconnect](#) (on page 3-42) operation for more information.

## isConnected

### Syntax

```
bool isConnected();
```

The operation functionality is the same as matching Blocking API operation. See the [isConnected](#) (on page 3-43) operation for more information.



# Non-blocking API C++ Code Examples

This section provides a code example for logging in and logging out subscribers.

## Login and Logout

The following example logs in a predefined number of subscribers to the SM, and then logs them out. Note the implementation of a *disconnect listener* and a *result handler*.

```
#include "SmApiNonBlocking.h"
#include <stdio.h>

void connectionIsDown()
{
 printf("disconnect listener callback:: connection is down\n");
}

int count = 0;

//prints every error that occurs
void handleError(UINT32 argHandle, ReturnCode* argReturnCode)
{
 ++count;
 printf("\terror %d:\n",count);
 printReturnCode(argReturnCode);
 freeReturnCode(argReturnCode);
}

//prints a success result every 100 results
void handleSuccess(UINT32 argHandle, ReturnCode* argReturnCode)
{
 if (++count%100 == 0)
 {
 printf("\tresult %d:\n",count);
 printReturnCode(argReturnCode);
 }

 freeReturnCode(argReturnCode);
}

//waits for result number 'last result' to arrive
void waitForLastResult(int lastResult)
{
 while (count<lastResult)
 {
 ::Sleep(100);
 }
}

void checkTheArguments(int argc, char* argv[])
{
 if (argc != 4)
 {
 printf
 ("usage: LoginLogout <SM-address> <domain> <num-suscribers>");
 exit(1);
 }
}

void main (int argc, char* argv[])
```

```

{
 //check arguments
 checkTheArguments(argc, argv);
 int numSubscribersToLogin = atoi(argv[3]);

 //instantiation
 SmApiNonBlocking nbapi;
 //initiation
 nbapi.init();
 nbapi.setDisconnectListener(connectionIsDown);
 nbapi.connect(argv[1]);
 nbapi.setReplyFailCallBack(handleError);
 nbapi.setReplySuccessCallBack(handleSuccess);
 //login
 char name[10];
 char ipString[15];
 char* ip = &(ipString[0]);
 MappingType type = IP_RANGE;
 Uint32 ipVal = 0x0a000000;

 printf("login of %d subscribers\n",numSubscribersToLogin);
 for (int i=0; i<numSubscribersToLogin; i++)
 {
 sprintf((char*)name,"s%d",i);
 sprintf((char*)ip,"%d.%d.%d.%d",
 (int)((ipVal & 0xFF000000) >> 24),
 (int)((ipVal & 0x00FF0000) >> 16),
 (int)((ipVal & 0x0000FF00) >> 8),
 (int)(ipVal & 0x000000FF));
 ipVal++;

 nbapi.login(name, //subscriber name
 &ip, //a single ip mapping
 &type,
 1,
 NULL, //no properties
 NULL,
 0,
 argv[2], //domain
 false, //mappings are not additive
 -1); //disable auto-logout
 }
 waitForLastResult(numSubscribersToLogin);
 //logout
 printf("logout of %d subscribers",numSubscribersToLogin);
 ipVal = 0x0a000000;
 for (i=0; i<numSubscribersToLogin; i++)
 {
 sprintf((char*)ip,"%d.%d.%d.%d",
 (int)((ipVal & 0xFF000000) >> 24),
 (int)((ipVal & 0x00FF0000) >> 16),
 (int)((ipVal & 0x0000FF00) >> 8),
 (int)(ipVal & 0x000000FF));
 ipVal++;

 nbapi.logoutByMapping(ip,
 type,
 argv[2]);
 }
 waitForLastResult(numSubscribersToLogin*2);
 nbapi.disconnect();
}

```

# Non-blocking API C Code Examples

This section provides a code example for logging in and logging out subscribers.

## Login and Logout

The following example logs in a predefined number of subscribers to the SM, and then logs them out. Note the implementation of a *disconnect listener* and a *result handler*.

```
#include "SmApiNonBlocking_c.h"
#include <stdio.h>

void connectionIsDown()
{
 printf("disconnect listener callback:: connection is down\n");
}

int count = 0;

//prints every error that occurs
void handleError(Uint32 argHandle, ReturnCode* argReturnCode)
{
 ++count;
 printf("\terror %d:\n",count);
 printReturnCode(argReturnCode);
 freeReturnCode(argReturnCode);
}

//prints a success result every 100 results
void handleSuccess(Uint32 argHandle, ReturnCode* argReturnCode)
{
 if (++count%100 == 0)
 {
 printf("\tresult %d:\n",count);
 printReturnCode(argReturnCode);
 }

 freeReturnCode(argReturnCode);
}

//waits for result number 'last result' to arrive
void waitForLastResult(int lastResult)
{
 while (count<lastResult)
 {
 ::Sleep(100);
 }
}

void checkTheArguments(int argc, char* argv[])
{
 if (argc != 3)
 {
 printf
 ("usage: LoginLogout <SM-address> <domain> <num-suscribers>");
 exit(1);
 }
}
```

```

void main (int argc, char* argv[])
{
 //check arguments
 checkTheArguments(argc, argv);
 int numSubscribersToLogin = atoi(argv[3]);

 //instantiation
 SMNB_HANDLE nbapi = SMNB_init(0,2000000,10,30);
 if (nbapi == NULL)
 {
 exit(1);
 }

 SMNB_setDisconnectListener(nbapi,connectionIsDown);
 SMNB_connect(nbapi,argv[1],14374);
 SMNB_setReplyFailCallBack(nbapi,handleError);
 SMNB_setReplySuccessCallBack(nbapi,handleSuccess);
 //login
 char name[10];
 char ipString[15];
 char* ip = &(ipString[0]);
 MappingType type = IP_RANGE;
 Uint32 ipVal = 0x0a000000;

 printf("login of %d subscribers\n",numSubscribersToLogin);
 for (int i=0; i<numSubscribersToLogin; i++)
 {
 sprintf((char*)name,"s%d",i);
 sprintf((char*)ip,"%d.%d.%d.%d",
 (int)((ipVal & 0xFF000000) >> 24),
 (int)((ipVal & 0x00FF0000) >> 16),
 (int)((ipVal & 0x0000FF00) >> 8),
 (int)(ipVal & 0x000000FF));
 ipVal++;

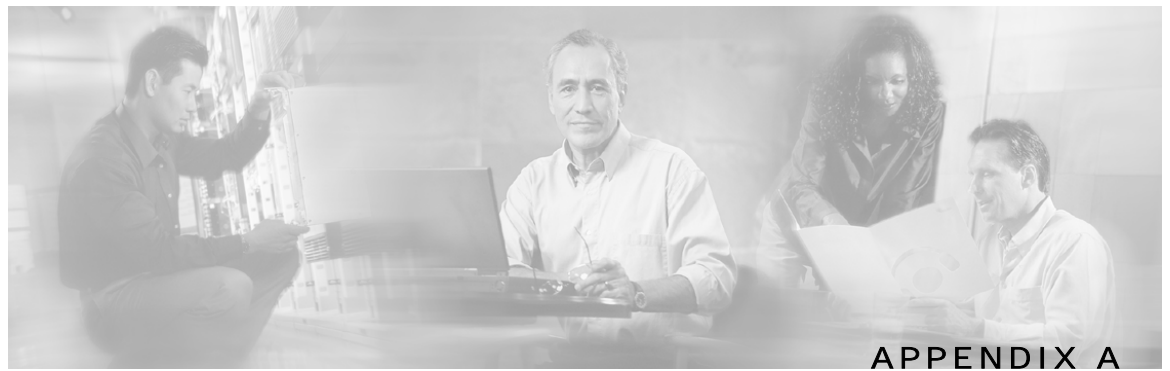
 SMNB_login(nbapi,
 name, //subscriber name
 &ip, //a single ip mapping
 &type,
 1,
 NULL, //no properties
 NULL,
 0,
 argv[2], //domain
 false, //mappings are not additive
 -1); //disable auto-logout
 }
 waitForLastResult(numSubscribersToLogin);
 //logout
 printf("logout of %d subscribers",numSubscribersToLogin);
 ipVal = 0x0a000000;
 for (i=0; i<numSubscribersToLogin; i++)
 {
 sprintf((char*)ip,"%d.%d.%d.%d",
 (int)((ipVal & 0xFF000000) >> 24),
 (int)((ipVal & 0x00FF0000) >> 16),
 (int)((ipVal & 0x0000FF00) >> 8),
 (int)(ipVal & 0x000000FF));
 ipVal++;

 SMNB_logoutByMapping(nbapi,

```

```
 ip,
 type,
 argv[1]);
 }
 waitForLastResult(numSubscribersToLogin*2);
 SMNB_disconnect(nbapi);
 SMNB_release(nbapi);
}
```





## List of Error Codes

Error codes are used for interpreting the actual error for which a `ReturnCode` (holding an `ErrorCode`) was returned.

The error code enumeration is given in the `GeneralDefs.h` header file. A list of the error codes and their description is given in the following table.

**Table A-1** List of Error Codes

| Error Code                                            | Description                                                                                                             |
|-------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <code>ERROR_CODE_BAD_SUBSCRIBER_MAPPING</code>        | A mapping was formatted badly or assigned to the subscriber illegally.                                                  |
| <code>ERROR_CODE_DOMAIN_NOT_FOUND</code>              | The domain provided to the operation does not exist in the SM domain repository.                                        |
| <code>ERROR_CODE_ILLEGAL_ARGUMENT</code>              | One of the arguments provided to the method is illegal.                                                                 |
| <code>ERROR_CODE_ILLEGAL_SUBSCRIBER_NAME</code>       | The subscriber name provided has more than 40 characters or has illegal characters.                                     |
| <code>ERROR_CODE_NOT_A_SUBSCRIBER_DOMAIN</code>       | The domain provided to the operation exists in the SM domain repository but is not a subscriber domain.                 |
| <code>ERROR_CODE_NUMBER_FORMAT</code>                 | A VLAN mapping string provided to the API does not represent a decimal number.                                          |
| <code>ERROR_CODE_SUBSCRIBER_DOES_NOT_EXIST</code>     | The subscriber on which the operation is performed does not exist in the SM database.                                   |
| <code>ERROR_CODE_SUBSCRIBER_DOMAIN_ASSOCIATION</code> | The subscriber exists in the SM database but is associated with a domain other than the one specified by the operation. |
| <code>ERROR_CODE_SUBSCRIBER_MAPPING_CONGESTION</code> | The mappings provided for the subscriber by the operation already belong to another subscriber.                         |
| <code>ERROR_CODE_SUBSCRIBER_ALREADY_EXISTS</code>     | The subscriber on which the operation was performed already exists in the SM database.                                  |
| <code>ERROR_CODE_DATABASE_EXCEPTION</code>            | Internal SM error – database error occurred during the operation.                                                       |
| <code>ERROR_CODE_ARRAY_ACCESS</code>                  | Internal SM error.                                                                                                      |

| <b>Error Code</b>                   | <b>Description</b>                                                           |
|-------------------------------------|------------------------------------------------------------------------------|
| ERROR_CODE_ATTRIBUTE_NOT_FOUND      | Internal SM error.                                                           |
| ERROR_CODE_CLASS_CAST               | Internal SM error.                                                           |
| ERROR_CODE_CLASS_NOT_FOUND          | Internal SM error.                                                           |
| ERROR_CODE_CLIENT_INTERNAL_ERROR    | Internal error.                                                              |
| ERROR_CODE_CLIENT_OUT_OF_THREADS    | Internal error.                                                              |
| ERROR_CODE_ILLEGAL_STATE            | Internal SM error.                                                           |
| ERROR_CODE_OBJECT_NOT_FOUND         | Internal SM error.                                                           |
| ERROR_CODE_OPERATION_NOT_FOUND      | Internal SM error.                                                           |
| ERROR_CODE_OUT_OF_MEMORY            | Internal SM error.                                                           |
| ERROR_CODE_RUNTIME                  | Internal SM error.                                                           |
| ERROR_CODE_NULL_POINTER             | Internal SM error.                                                           |
| ERROR_CODE_SE_ERROR                 | Internal SM error. The SM could not perform the operation on the SCE device. |
| ERROR_CODE_UNKNOWN                  | Internal SM or API error.                                                    |
| ERROR_CODE_CLIENT_OPERATION_TIMEOUT | Blocking API operation result did not return till the reply timeout expired. |





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