CISCO SERVICE CONTROL SOLUTION GUIDE

Cisco Service Control Online Advertising Solution Guide: Behavioral Profile Creation Using RDRs, Release 4.1.x

Revised: December 23, 2013, OL-30596-01

Note This document supports all 4.1.x releases.

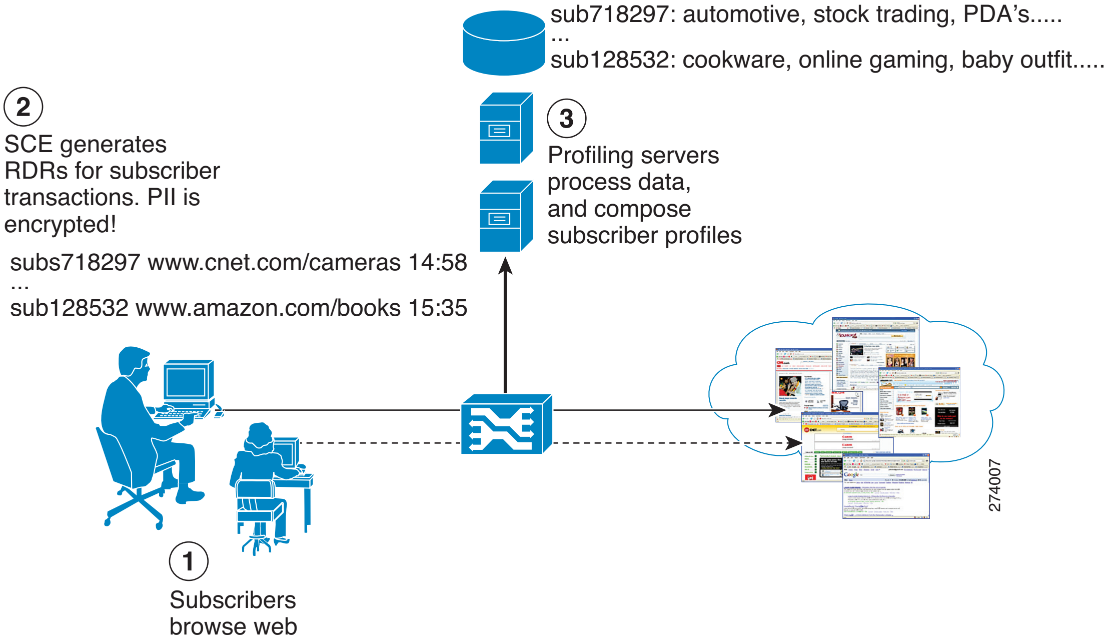
1 Overview

Online Behavioral Targeting is an online advertising approach that involves presenting users with advertisements based on their interests, as deduced by monitoring their web browsing preferences. The Cisco Service Control Engine (Cisco SCE) platform can enable online behavioral targeting based on an analysis of subscriber online usage patterns.

Such behavioral targeting does not require the analysis of each and every HTTP request on the line, because such analysis would result in numerous excess information. The Cisco SCE platform performs the first level of analysis in the behavioral targeting chain by inspecting the user browsing sessions, detecting the particular requests that are triggered by the actual user browsing (these events are termed ClickStream), and generating Raw Data Records (RDRs) that contain a digest of these events. To avoid compromising subscriber privacy, the RDRs can be configured to not include any Personally Identifiable Information (PII), in which case all elements containing PII are hashed. The RDRs are typically received by an entity that analyzes the nature of usage and creates a profile of the subscriber to be used later for targeting. The way the greater solution works is outside the scope of this document.

Figure 1 illustrates the high-level overview of an RDR-based behavioral targeting solution.

Figure 1 High Level Overview of an RDR-based Behavioral Targeting Solution


sub718297: automotive, stock trading, PDA's.....
...
sub128532: cookware, online gaming, baby outfit.....
2
SCE generates RDRs for subscriber transactions. PII is encrypted!
subs718297 www.cnet.com/cameras 14:58
...
sub128532 www.amazon.com/books 15:35
3
Profiling servers process data, and compose subscriber profiles
1
Subscribers browse web
274007

ClickStream detection is a fundamental capability of the solution, because it can detect which specific requests, out of the enormous number of HTTP requests generated throughout the subscriber web activity, were actually triggered by the subscriber browsing the web. When a subscriber clicks a link, or enters a URL in the browser address bar, an HTTP request is generated to fetch this URL. Typically, an HTML page is returned, which constitutes the outline of the contents requested. For the browser to be able to render this page, it must download multiple objects (tens or sometimes around a hundred for a single page viewed), which in turn results in multiple HTTP requests for obtaining these objects.

To carry out behavioral targeting, it is sufficient to understand what the user was trying to do (represented by the initial request, such as biz.publisher.com/ap/081120/world_markets.html > global markets), rather than looking at each object downloaded as a secondary result of such a request (such as: http://ads.adnetwork.com/a/a/in/interbroke/300x250_yah.jpg > broker advertisement).

ClickStream detection makes exactly this distinction, allowing the number of requests to be analyzed to be greatly reduced, which is necessary to enable a scalable analysis solution.

The information that is collected per such transaction is exported from the Cisco SCE using Extended Transaction Usage RDRs, which includes information on the transaction that has been performed, in addition to information on the subscriber that performed the transaction.

PII, such as subscriber ID and IP address, is protected by hashing this information with the use of preconfigured "salt". In this way, the subscriber record can be matched only by another system configured with the same salt, in which case it has the original PII to match against. Salt is configurable to the Cisco SCE platform.

2 Configuring Behavioral Targeting Support: Highlights

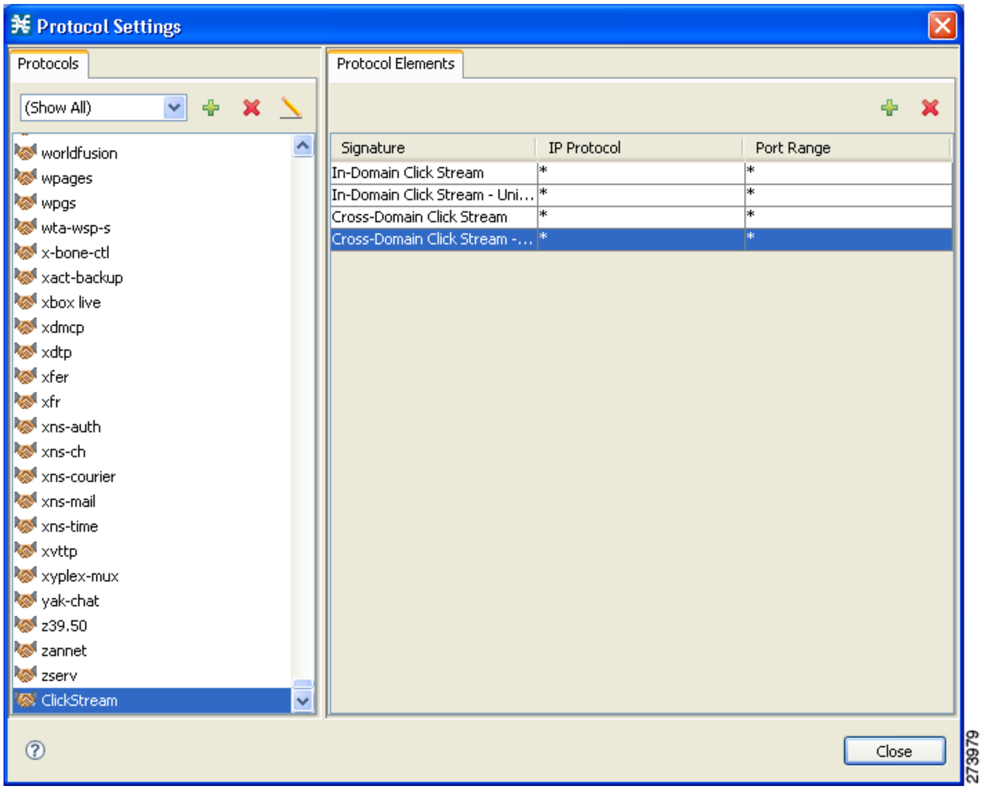
This section provides the highlights of configuring the main components of behavioral targeting on the Cisco SCE platform. For configuration details, see the "Configuring a Cisco SCE Platform for Exporting Behavioral Targeting Information" section on page 6.

Creating a ClickStream Service

ClickStream signatures are mapped by default to the HTTP Browsing protocol and consequently to the browsing service. To be able to act on them separately, first move them to a protocol of their own, then assign this protocol to a service of its own.

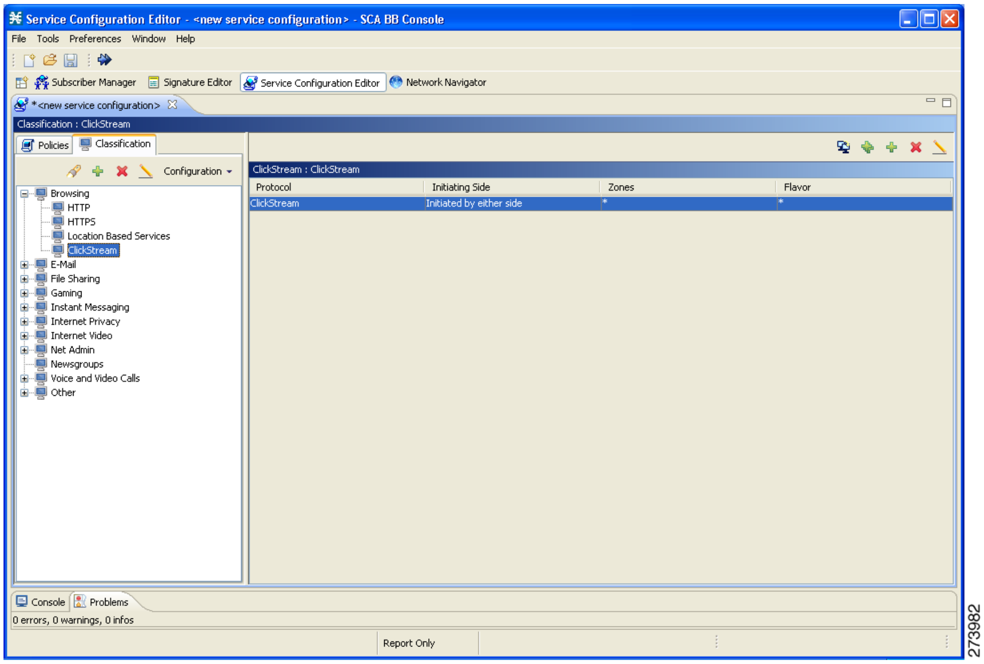
Figure 2 and Figure 3 illustrate configuring the ClickStream protocol and service.

Figure 2 Configuring the ClickStream Protocol



Signature	IP Protocol	Port Range
In-Domain Click Stream	*	*
In-Domain Click Stream - Uni…	*	*
Cross-Domain Click Stream	*	*
Cross-Domain Click Stream -…	*	*

Figure 3 Configuring the ClickStream Service



Protocol	Initiating Side	Zones	Flavor
ClickStream	Initiated by either side	*	*

0 errors, 0 warnings, 0 infos

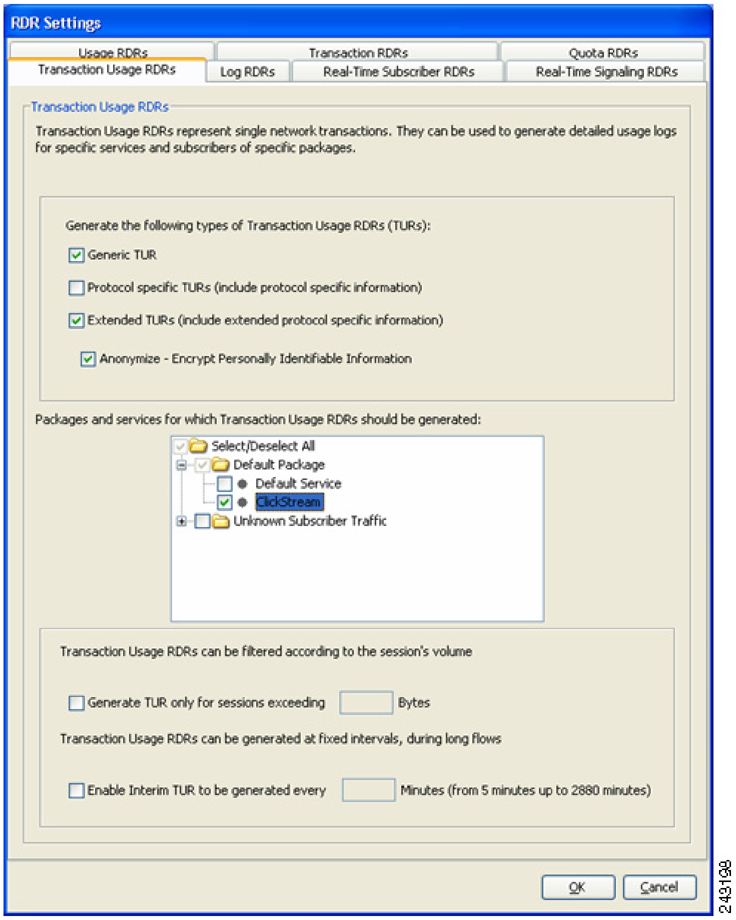
Configuring Extended Transaction Usage RDRs

Extended Transaction Usage RDRs (TURs) contain extra protocol-specific information (see the "Anonymized HTTP Transaction Usage RDR" section on page 14). These RDRs are configured from the **Transaction Usage RDRs** tab of the RDR Settings dialog box of the Cisco Service Control Application for Broadband (Cisco SCA BB) console.

Enable these RDRs explicitly by checking the appropriate check boxes, and choosing the packages you want them generated for (you only need to enable these RDRs for the ClickStream service in each package).

Optionally, these RDRs can be anonymized, in which case all PII in the RDR is hashed using Message Digest 5 (MD5). Hashing is done using the "salt" configured on the SCE platform. For GUI options on anonymizing the RDRs, see Transaction Usage RDR Settings (Figure 4).

Figure 4 Transaction Usage RDR Settings



Transaction Usage RDRs

Transaction Usage RDRs represent single network transactions. They can be used to generate detailed usage logs for specific services and subscribers of specific packages.

Generate the following types of Transaction Usage RDRs (TURs):

☑ Generic TUR

□ Protocol specific TURs (include protocol specific information)

☑ Extended TURs (include extended protocol specific information)

☑ Anonymize - Encrypt Personally Identifiable Information

Packages and services for which Transaction Usage RDRs should be generated:

- ☑ Select/Deselect All
  - ☑ Default Package
    - □ ● Default Service
    - ☑ ● ClickStream
  - □ Unknown Subscriber Traffic

Transaction Usage RDRs can be filtered according to the session's volume

□ Generate TUR only for sessions exceeding ____ Bytes

Transaction Usage RDRs can be generated at fixed intervals, during long flows

□ Enable Interim TUR to be generated every ____ Minutes (from 5 minutes up to 2880 minutes)

Enabling Deep HTTP Inspection

To ensure comprehensive detection of the ClickStream events in the traffic stream, it is important to enable deep inspection of HTTP, which configures the Cisco SCE platform to analyze and classify all HTTP requests within a single flow.

Some browsers, in conjunction with some web server implementations, use the same TCP flow to carry multiple requests triggered by clicks that target the same host. Such events are not detected if the classification is done only at the beginning of the flow (which is the default for Cisco SCA BB).

To enable deep HTTP inspection, in the Cisco SCA BB Console Service Configuration Editor, choose **Configuration** > **System Settings** > **Advanced Options** > **Advanced Service Configuration Options...**

Note Enabling deep HTTP inspection is expected to impact the Cisco SCE performance because of the excessive processing associated with it, the actual figure depending on the amount and on the nature of HTTP traffic. We recommend that you monitor SCE platform performance when enabling this capability.

Configuring MD5 Salt to the SCE Platform

When the **Anonymize** option is selected, Extended TURs are generated with all personally identifying fields (subscriber ID and subscriber IP address) hashed using MD5.

The Cisco SCE platform applies a “salt” to the personally identifying field before hashing it. The salt is 128 bits (16 bytes) long, and it is configured to the SCE platform in four separate 4-byte arguments represented in HEX. The default value of the salt is 0x12345678 0x12345678 0x12345678 0x12345678.

The salt is configured to the SCE by using these CLI commands with four 4-byte arguments in HEX:

```
SCE# config
SCE# interface linecard 0
SCE(config if)# salt 0x12345678 0x00004321 0xfafafafa 0xafafafaf
```

To return the salt to the default value use these CLI commands:

```
SCE# config
SCE# interface linecard 0
SCE(config if)# default salt
```

Save the running configuration by using this command:

```
SCE# copy running-config startup-config
```

Configuring RDR Routing to the Profiling Server

Ensure that only ClickStream RDRs are sent to the designated server, even if other RDRs are enabled on the system. This is done by directing the extended HTTP TUR to a separate category, and routing this category to a dedicated server.

This is accomplished in two steps:

1. Direct the HTTP Extended TUR to an exclusive RDR category.

   Map the Extended TUR for HTTP (tag 0xF0F0F53C / 4042323260) to RDR category 2 by using this CLI command:

   ```
   SCE(config)# RDR-formatter rdr-mapping tag-ID 0xF0F0F53C category-number 2
   ```

2. Send the RDRs in this category to the designated server.

   Configure RDR category 2 to the desired destination by using this CLI command:

   ```
   SCE(config)# RDR-formatter destination 10.10.10.10 port 33000 category number 2 priority 100
   ```

You can configure a second destination for the category 2 RDRs to function as a backup destination.

3. Configure a secondary destination for backup as needed.

   Configure RDR category 2 to a secondary destination by using this CLI command:

   ```
   SCE(config)# RDR-formatter destination 10.10.10.11 port 33000 category number 2 priority 90
   ```

4. Save the running configuration by using this CLI command:

   ```
   SCE# copy running-config startup-config
   ```

3 Configuring a Cisco SCE Platform for Exporting Behavioral Targeting Information

This section explains in detail how to configure an Cisco SCE to generate ClickStream RDRs.

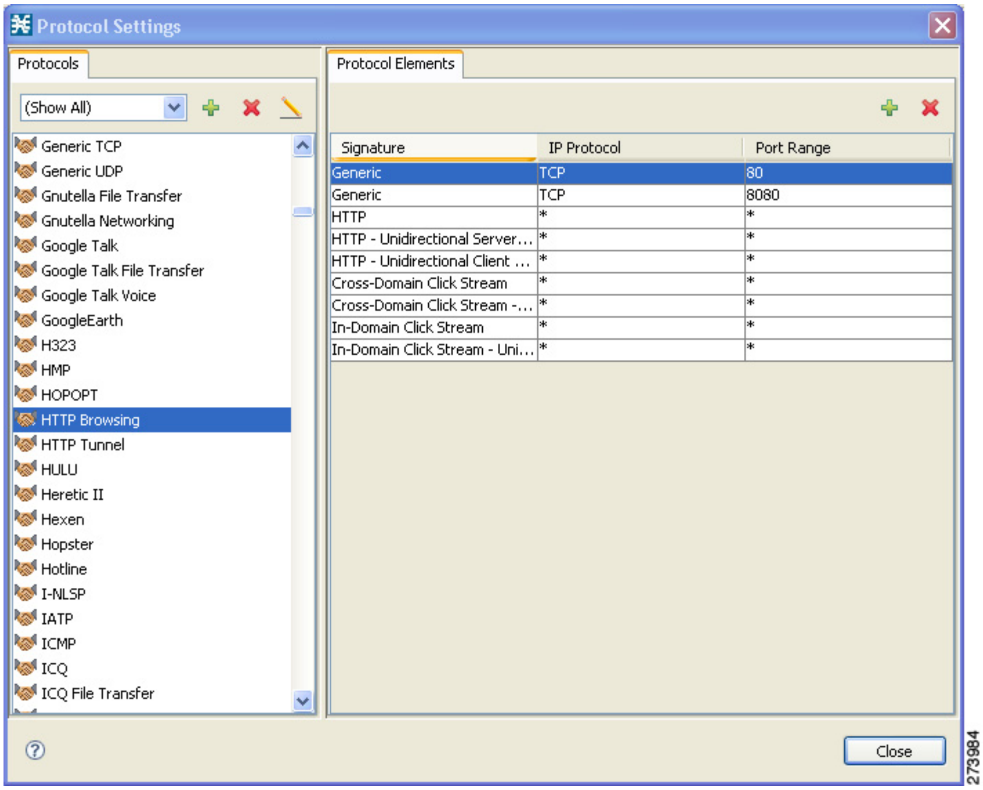
Step 1 In the Cisco SCA BB Policy Editor, click the **Classification** tab (left pane), click **Configuration,** and select **Protocols**.

Step 2 In the Protocol Settings window (see Figure 5), select the **HTTP Browsing** service.

Step 3 On the **Protocol Elements** tab, remove the ClickStream-related protocol elements:

- In-Domain ClickStream
- In-Domain ClickStream - Unidirectional Client Request
- Cross-Domain ClickStream
- Cross-Domain ClickStream - Unidirectional Client Request

Figure 5 Protocol Settings



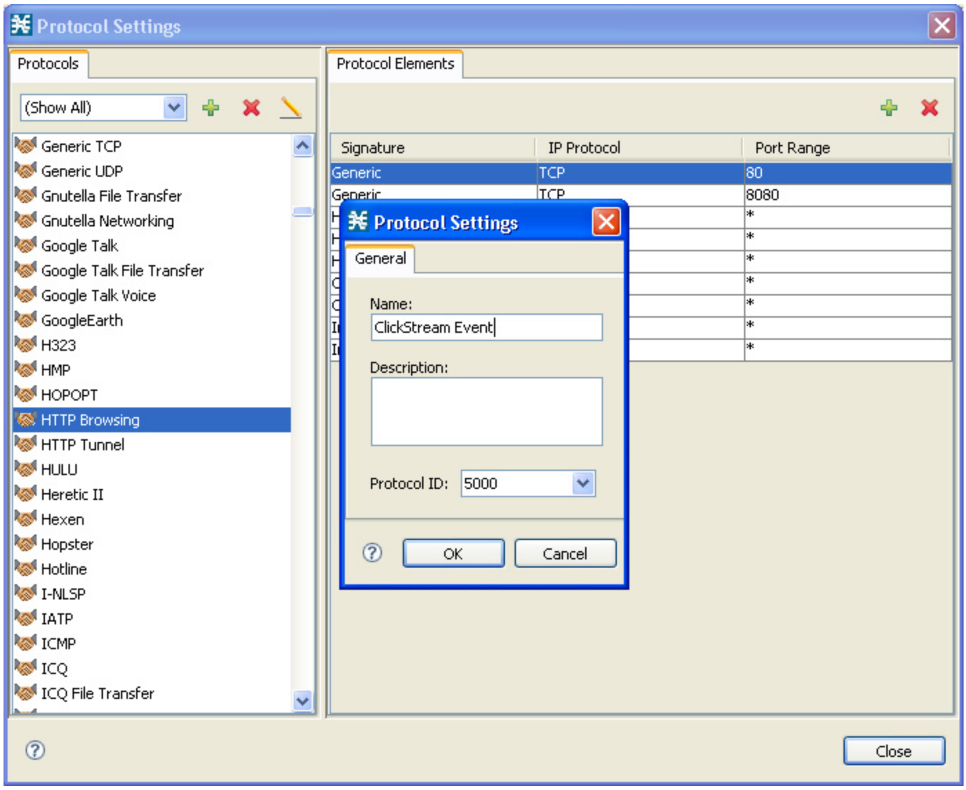
Generic TCP
Generic UDP
Gnutella File Transfer
Gnutella Networking
Google Talk
Google Talk File Transfer
Google Talk Voice
GoogleEarth
H323
HMP
HOPOPT
HTTP Browsing
HTTP Tunnel
HULU
Heretic II
Hexen
Hopster
Hotline
I-NLSP
IATP
ICMP
ICQ
ICQ File Transfer

Signature	IP Protocol	Port Range
Generic	TCP	80
Generic	TCP	8080
HTTP	*	*
HTTP - Unidirectional Server…	*	*
HTTP - Unidirectional Client …	*	*
Cross-Domain Click Stream	*	*
Cross-Domain Click Stream -…	*	*
In-Domain Click Stream	*	*
In-Domain Click Stream - Uni…	*	*

Step 4 In the Protocol Settings window, on the Protocols tab, click the Add (**+**) icon to add a new protocol.

Step 5 Enter a name for the new protocol **ClickStream Event,** and click **OK** (**see** Figure 6).

Figure 6 Protocol Settings—Name



Signature	IP Protocol	Port Range
Generic	TCP	80
Generic	TCP	8080
H		*
H		*
H		*
C		*
I		*
I		*
I		*

Protocol Settings — General

Name: ClickStream Event

Description:

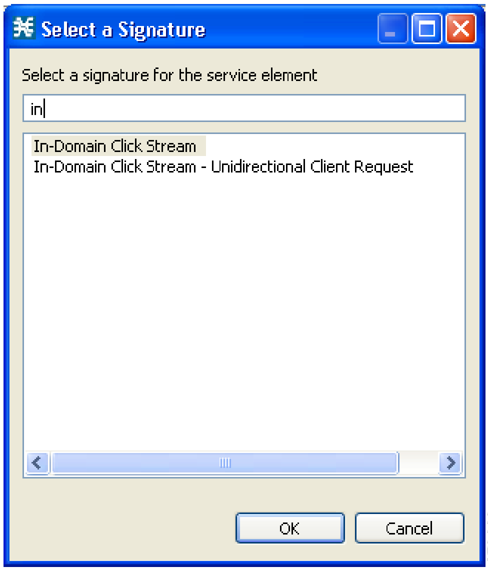
Protocol ID: 5000

Step 6 On the Protocol Elements tab, click the Add (+) icon to add protocol elements to the ClickStream Protocol.

Step 7 For the new protocol element created, click the "..." button in the Signature column.

Step 8 In the Select a Signature dialog box (see Figure 7), add the **In-Domain Click Stream** signature, and click **OK**.

Figure 7 Select a Signature



Select a signature for the service element

in

In-Domain Click Stream
In-Domain Click Stream - Unidirectional Client Request

Step 9 Repeat Step 6 through Step 8 for the rest of the ClickStream signatures:

- In-Domain Click Stream - Unidirectional Client Request
- Cross-Domain Click Stream

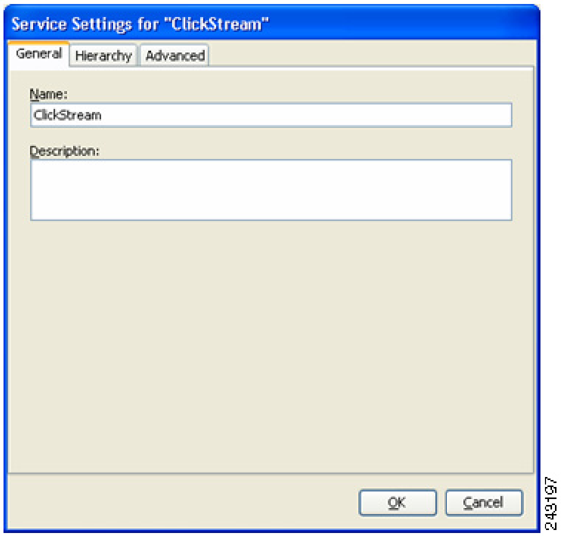
- Cross-Domain Click Stream - Unidirectional Client Request

Step 10 In the Cisco SCA BB Policy Editor, click the **Classification** tab (left pane), and highlight the **Browsing** service.

Step 11 Click the Add (**+**) icon to add a new service under the Browsing service.

Step 12 Name the service **ClickStream** (or any other name you choose) (see Figure 8).

Figure 8 Service Settings



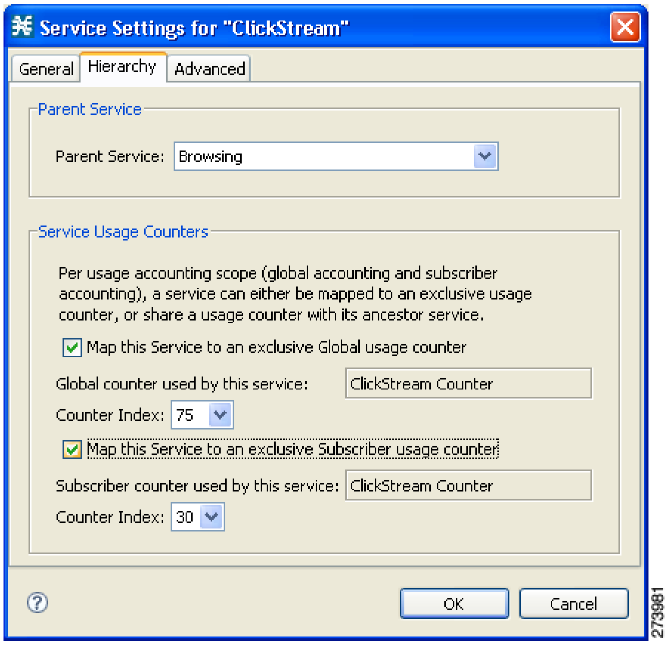
Service Settings for "ClickStream"

Name: ClickStream

Description:

Step 13 Click the **Hierarchy** tab (see Figure 9) and check the two check boxes to add a dedicated service counter to the ClickStream Service. (This is useful if you want to generate reports on the global and per-subscriber ClickStream activity.)

Figure 9 Hierarchy



Service Settings for "ClickStream"

Parent Service

Parent Service: Browsing

Service Usage Counters

Per usage accounting scope (global accounting and subscriber accounting), a service can either be mapped to an exclusive usage counter, or share a usage counter with its ancestor service.

☑ Map this Service to an exclusive Global usage counter

Global counter used by this service: ClickStream Counter

Counter Index: 75

☑ Map this Service to an exclusive Subscriber usage counter

Subscriber counter used by this service: ClickStream Counter

Counter Index: 30

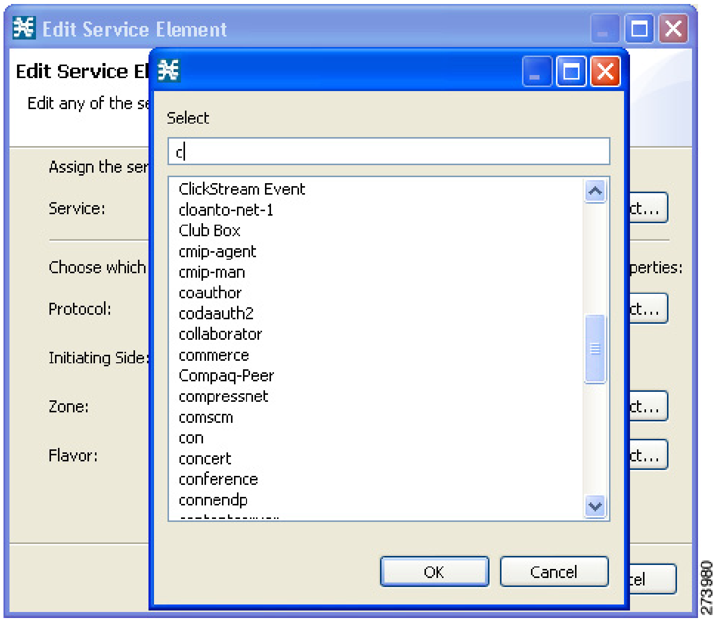
Step 14 Click **OK**.

Step 15 In the right pane, click the Add (**+**) icon to add a service element.

Step 16 In the dialog box that opens, click **Select** next to the Protocol field and select the **ClickStream Event** protocol (or whatever you named your ClickStream protocol) from the list (see Figure 10).

Step 17 Click **OK**.

Figure 10 Edit Service Element

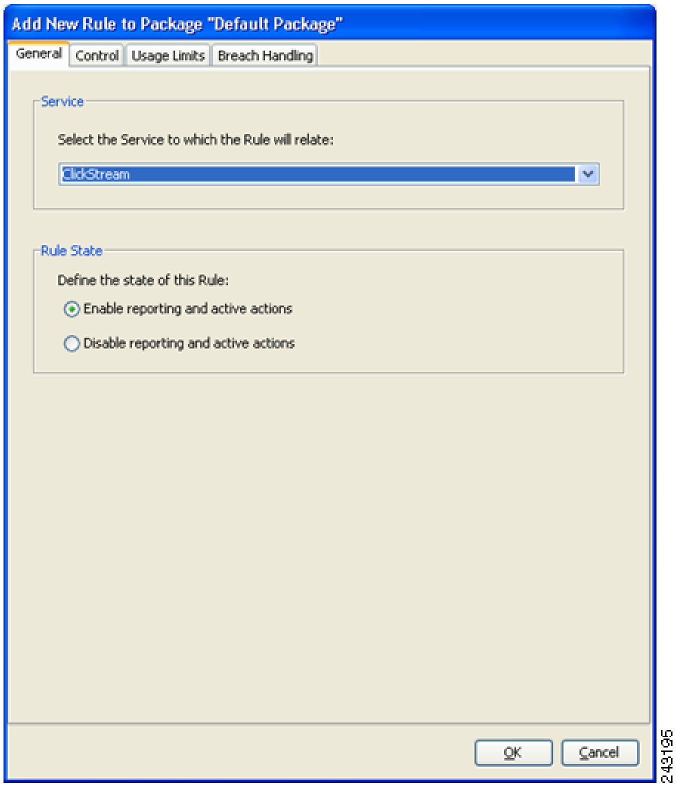


Step 18 In the Cisco SCA BB Policy Editor, click the **Policies** tab (left pane), and then select the package for which to generate the ClickStream RDRs.

Step 19 In the right pane, click the Add (**+**) icon to add the ClickStream service.

Step 20 In the window that opens (see Figure 11), select **ClickStream** from the drop-down list.

Figure 11 Add New Rule to Package



Add New Rule to Package "Default Package"

Service

Select the Service to which the Rule will relate:

ClickStream

Rule State

Define the state of this Rule:

● Enable reporting and active actions

○ Disable reporting and active actions

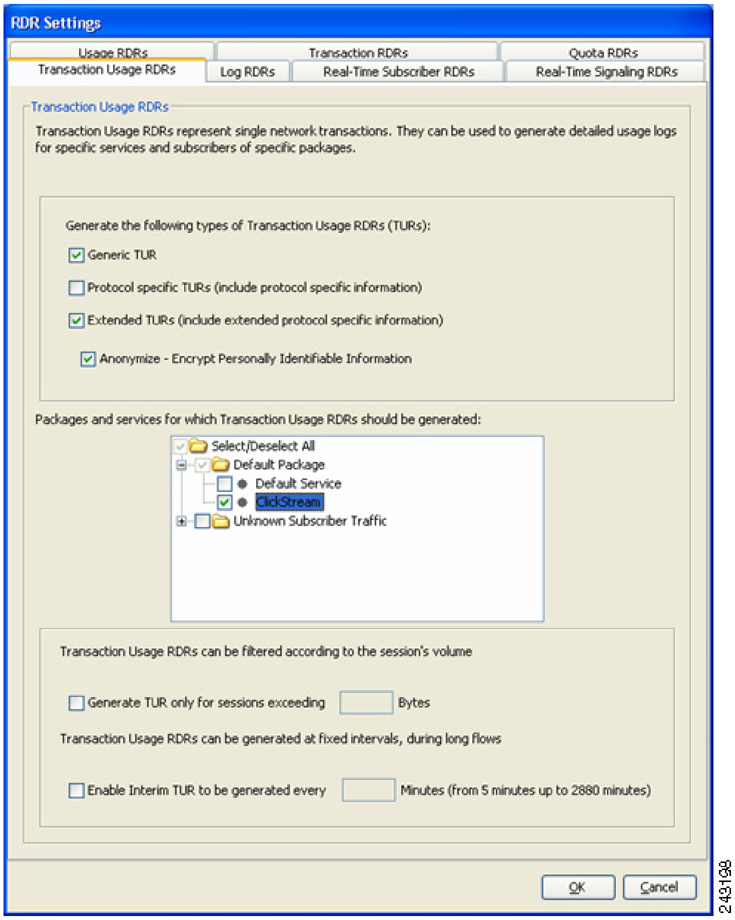
Step 21 Click **OK**.

Step 22 In the Cisco SCA BB Policy Editor, repeat Step 18 through Step 21 for every package for which you want to enable ClickStream RDRs.

Step 23 In the right pane, click **Configuration** and choose **Classification** > **RDR Settings**.

Step 24 Click the **Transaction Usage RDRs** tab (see Figure 12).

Figure 12 RDR Settings—Transaction Usage RDRs



Transaction Usage RDRs

Transaction Usage RDRs represent single network transactions. They can be used to generate detailed usage logs for specific services and subscribers of specific packages.

Generate the following types of Transaction Usage RDRs (TURs):

☑ Generic TUR

□ Protocol specific TURs (include protocol specific information)

☑ Extended TURs (include extended protocol specific information)

☑ Anonymize - Encrypt Personally Identifiable Information

Packages and services for which Transaction Usage RDRs should be generated:

- ☑ Select/Deselect All
  - ☑ Default Package
    - □ ● Default Service
    - ☑ ● ClickStream
  - □ Unknown Subscriber Traffic

Transaction Usage RDRs can be filtered according to the session's volume

□ Generate TUR only for sessions exceeding ____ Bytes

Transaction Usage RDRs can be generated at fixed intervals, during long flows

□ Enable Interim TUR to be generated every ____ Minutes (from 5 minutes up to 2880 minutes)

Step 25 Enable Extended TURs by checking the relevant check box.

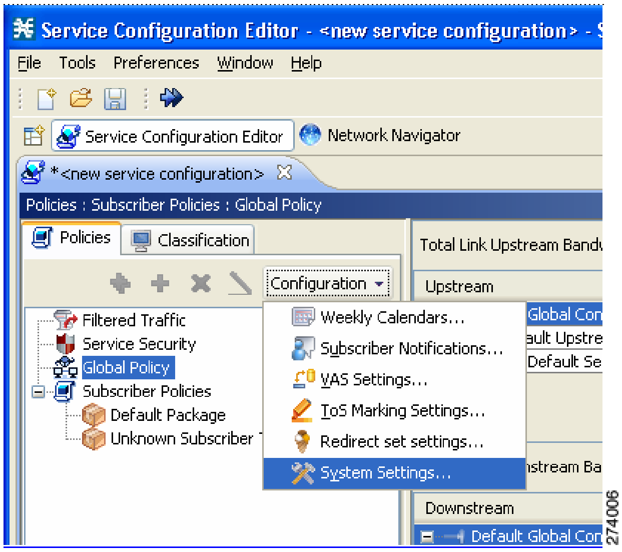
Step 26 (Optional) Enable the anonymize option as needed, by checking **Anonymize - Encrypt Personally Identifiable Information**.

Step 27 Check the ClickStream service on all relevant packages, to enable generating RDRs for this service. Uncheck any other service for which you do not want Transaction Usage RDRs (extended or regular) generated.

Note Make sure that you have already created a specific rule for ClickStream on all relevant packages.

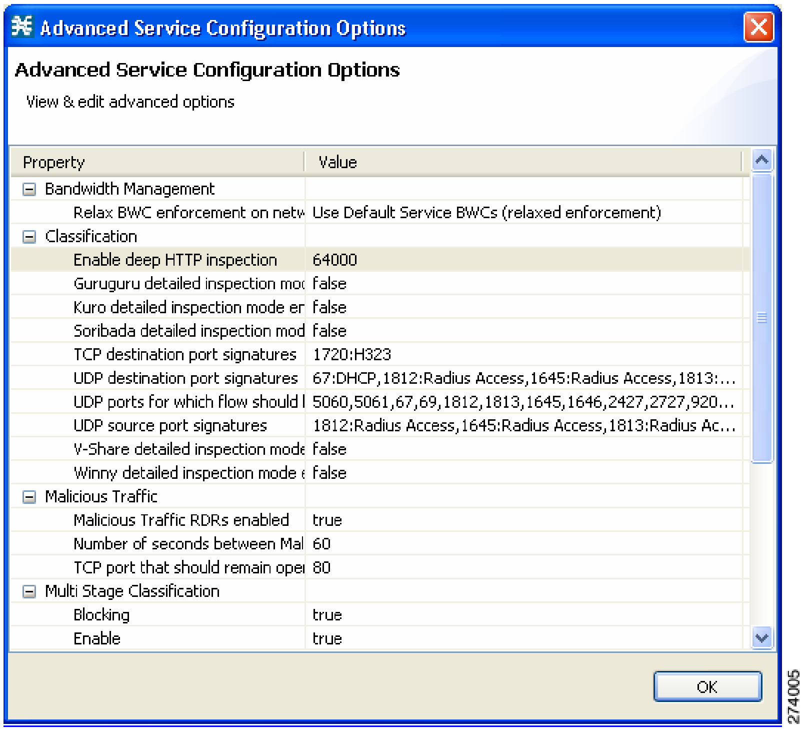
Step 28 Choose **Policies** > **Configuration** > **System Settings** (see Figure 13).

Figure 13 Service Configuration Editor—Policies > Configuration > System Settings



Step 29 On the Advanced Options tab, click **Advanced Service Configuration Options** (see Figure 14) to enable deep inspection of HTTP flows (beyond the first transaction) by setting the highlighted value to **64000.** This enables the analysis of multiple transactions within a single HTTP flow, which is important for comprehensive detection of ClickStream events.

Figure 14 Advanced Service Configuration Options



Advanced Service Configuration Options

View & edit advanced options

Property	Value
⊟ Bandwidth Management	
Relax BWC enforcement on netw	Use Default Service BWCs (relaxed enforcement)
⊟ Classification	
Enable deep HTTP inspection	64000
Guruguru detailed inspection moc	false
Kuro detailed inspection mode er	false
Soribada detailed inspection mod	false
TCP destination port signatures	1720:H323
UDP destination port signatures	67:DHCP,1812:Radius Access,1645:Radius Access,1813:...
UDP ports for which flow should I	5060,5061,67,69,1812,1813,1645,1646,2427,2727,920...
UDP source port signatures	1812:Radius Access,1645:Radius Access,1813:Radius Ac...
V-Share detailed inspection mode	false
Winny detailed inspection mode (	false
⊟ Malicious Traffic	
Malicious Traffic RDRs enabled	true
Number of seconds between Mal	60
TCP port that should remain opei	80
⊟ Multi Stage Classification	
Blocking	true
Enable	true

Step 30 Apply the Service Configuration to the SCE platform.

Step 31 (Optional) If the anonymize option is enabled, configure MD5 salt to the SCE platform (use a 128-bit salt value of your choice) by using this command:

```
SCE(config if)# salt 0xfafafafa 0xfafafafa 0xfafafafa 0xfafafafa
```

Step 32 Map the Extended TUR for HTTP (tag 0xF0F0F53C / 4042323260) to RDR category 2 by using this command:

```
SCE(config)# RDR-formatter rdr-mapping tag-ID 0xF0F0F53C category-number 2
```

Step 33 Direct category 2 to your server of choice by using this command:

```
SCE(config)# RDR-formatter destination 10.10.10.10 port 33000 category number 2 priority 99
```

Step 34 Save the configuration by using this command:

```
SCE# copy running-config-all startup-config-all
```

4 Anonymized HTTP Transaction Usage RDR

The RDR tag of the Anonymized HTTP Transaction Usage RDR is **F0 F0 F5 3C / 4042323260.**

Table 1 lists the RDR fields and their descriptions.

Table 1 Anonymized HTTP Transaction Usage RDR Fields

RDR Field Name	Type	Description
HASHED_SUBSCRIBER_ID	STRING	Subscriber identification string, passed through hashing algorithm as described in the "Hash Algorithm" section on page 16.
PACKAGE_ID	INT16	ID of the package assigned to the subscriber whose traffic is being reported.
SERVICE_ID	INT32	Service classification of the reported session.
PROTOCOL_ID	INT16	Unique ID of the protocol associated with the reported session.
SKIPPED_SESSIONS	UINT32	Always 1.
SERVER_IP	UINT32	Destination IP address of the reported session. The destination is defined as the server or the listener of the networking session. The IP address is in a 32-bit binary format, but the value is obtained in decimal format in RDR. For example, 3228978306. If this is the subscriber IP, this field contains the short-hash of the IP, as described in the "Hash Algorithm" section on page 16.
SERVER_PORT	UINT16	Destination port number of the networking session.
HOST	STRING	Host extracted from the HTTP transaction.
URL	STRING	URL extracted from the HTTP transaction.
CLIENT_IP	UINT32	IP address of the client side of the reported session. The client side is defined as the initiator of the networking session. The IP address is in a 32-bit binary format, but the value is obtained in decimal format in RDR. For example, 3228978306. If this is the subscriber IP, this field contains the short-hash of the IP, as described in the "Hash Algorithm" section on page 16.
CLIENT_PORT	UINT16	Port number of the client side (initiator) of the networking session.
INITIATING_SIDE	INT8	Side of the SCE platform on which the initiator of the transaction resides. • 0—Subscriber side • 1—Network side
REPORT_TIME	UINT32	Ending time stamp of this RDR.
MILLISEC_DURATION	UINT32	Duration, in milliseconds, of the transaction reported in this RDR.
TIME_FRAME	INT8	Time frame during which the RDR was generated. (The range is from 0 to 3.)

Table 1 Anonymized HTTP Transaction Usage RDR Fields (continued)

RDR Field Name	Type	Description
SESSION_UPSTREAM_ VOLUME	UINT32	Upstream volume of the transaction, in bytes. The volume refers to the aggregated upstream volume on both links of all the flows bundled in the transaction.
SESSION_DOWNSTREAM_ VOLUME	UINT32	Downstream volume of the transaction, in bytes. The volume refers to the aggregated stream volume on both links of all the flows bundled in the transaction.
SUBSCRIBER_COUNTER_ID	UINT16	Each service is mapped to a counter. There are 32 subscriber usage counters.
GLOBAL_COUNTER_ID	UINT16	Each service is mapped to a counter. There are 128 global usage counters.
PACKAGE_COUNTER_ID	UINT16	Each package is mapped to a counter. There are 1024 package usage counters.
IP_PROTOCOL	UINT8	IP protocol type.
PROTOCOL_SIGNATURE	UINT32	ID of the protocol signature associated with this session.
ZONE_ID	UINT32	ID of the zone associated with this session.
FLAVOR_ID	UINT32	For protocol signatures that have flavors, this field contains the ID of the flavor associated with this session.
FLOW_CLOSE_MODE	UINT8	Reason for the end of flow.
HASHED_SUBSCRIBER_IP	STRING	Subscriber IP, hashed as described in the "Hash Algorithm" section on page 16.
USER_AGENT	STRING	User agent field extracted from the HTTP transaction.
HTTP_REFERER	STRING	REFERER extracted from the HTTP transaction.
HTTP_COOKIE	STRING	Cookie extracted from the HTTP transaction.

Further elaboration on RDR fields:

- HASHED_SUBSCRIBER_ID—Subscriber identification string, introduced through the subscriber management interfaces, passed through hashing algorithm as described in the "Hash Algorithm" section on page 16.

  The field is a 32-byte-long string, containing a Hexadecimal notation of the 128-bit hash result.
- PACKAGE_ID—ID of the package assigned to the subscriber whose traffic is being reported. An assigned Package ID is an integer value between 0 and maximum_number_of_packages. The maximum_number_of_packages value is reserved for unknown subscribers.
- HASHED_SUBSCRBIER_IP—IP address of the subscriber side of the reported session, after passing through the hashing algorithm as described in the "Hash Algorithm" section on page 16.

  The field is a 32-byte-long string, containing a hexadecimal notation of the 128-bit hash result.
- CLIENT_PORT—For TCP/UDP-based sessions, the port number of the client side (initiator) of the networking session. For non-TCP/UDP sessions, this field has the value 0.
- CONFIGURED_DURATION—For periodic RDRs, the configured period, in seconds, between successive RDRs.
- END_TIME—Ending time stamp of this RDR. The field is in UNIX time_t format, which is the number of seconds since midnight of January 1, 1970.
- FLAVOR_ID—For protocol signatures that have flavors, this field contains the ID of the flavor associated with this session.
- PROTOCOL_ID—Contains the unique ID of the protocol associated with the reported session.

Note The PROTOCOL_ID is the Generic IP, Generic TCP, or Generic UDP protocol ID value, according to the specific transport protocol of the transaction, unless a more specific protocol definition (such as a signature-based protocol or a port-based protocol), which matches the reported session, is assigned to a service.

- PROTOCOL_SIGNATURE—Contains the ID of the protocol signature associated with this session.
- REPORT_TIME—Ending time stamp of this RDR. The field is in UNIX time_t format, which is the number of seconds since midnight of January 1, 1970.
- SERVER_IP—Contains the destination IP address of the reported session. (The destination is defined as the server or the listener of the networking session.) The IP address is in a 32-bit binary format.
- SERVER_PORT—For TCP/UDP-based sessions, this field contains the destination port number of the networking session. For non-TCP/UDP sessions, this field contains the IP protocol number of the session flow.
- SERVICE_ID—Indicates the service classification of the reported session. For example, in the Transaction RDR, this field indicates which service was accessed, and in the Breaching RDR, this field indicates which service was breached.
- TIME_FRAME—System supports time-dependent policies, by using different rules for different time frames. This field indicates the time frame during which the RDR was generated. The value can be in the range from 0 to 3, indicating which of the four time frames was used.
- ZONE_ID—Contains the ID of the zone associated with this session.

Note All volumes in RDRs are reported in Layer 3 bytes.

5 Hash Algorithm

Hashing is done using the MD5 hash function, using a “salt” prepended to the hashed value.

- “salt” means adding a predefined value before the to-be hashed fields, to avoid simple backtracking of the source argument. The salt currently used by the SCE platform is 128 bits long and is configured to the SCE in four separate 4-byte arguments represented in HEX.
- Setting the salt is done through CLI using a hexadecimal notation. It can be updated periodically. (By default, it set to 0x12345678 0x12345678 0x12345678 0x12345678.)
- Hash result is 128 bits long, and is represented in RDRs as a 32-byte string. Each byte represents 4 bits of the result. To make it printable, add 64. (for example, 0000 mapped to ASCII(64) = '@'; 1111 mapped to ASCII(127) = '_').
- Short-hash that appears in RDRs is composed of the lower 32 bits of the hash result.

Obtaining Documentation and Submitting a Service Request

For information on obtaining documentation, using the Cisco Bug Search Tool (BST), submitting a service request, and gathering additional information, see *What’s New in Cisco Product Documentation* at: http://www.cisco.com/en/US/docs/general/whatsnew/whatsnew.html.

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