# Configure ISE 2.1 Guest Portal with PingFederate SAML SSO

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## Introduction

This document describes how to configure Cisco Identity Services Engine (ISE) version 2.1 Single Sign On(SSO) capabilities for guest portal Security Assertion Markup Language (SAML).

# Prerequisites

## Requirements

Cisco recommends that you have knowledge of these topics:

- Cisco Identity Services Engine guest services.
- Basic knowledge about SAML SSO.

## **Components Used**

The information in this document is based on these software and hardware versions:

- Cisco Identity Services Engine version 2.1
- PingFederate 8.1.3.0 server from Ping Identity as SAML Identity Provider(IdP)

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, ensure that you understand the potential impact of any command.

# **Flow Overview**

SAML is an XML-based standard for exchanging authentication and authorization data between security domains.

SAML specification defines three roles: the Principal (Guest User), the Identity Provider [IdP] (IPing Federate server), and the Service Provider [SP] (ISE).

In a typical SAML SSO flow, the SP requests and obtains an identity assertion from the IdP. Based on this result, ISE can perform policy decisions as the IdP can include configurable attributes that ISE can use ( i.e. Group and email address associated to the AD object).

## **Expected Flow for this Use Case**

1. Wireless LAN Controller (WLC) or Access switch is configured for a typical Central Web Authentication (CWA) flow.

**Tip**: Find the configuration examples for CWA flows in the Related Information Section at the bottom of the article.

2. The client connects and the session gets authenticated against ISE. The Network Access Device(NAD) applies the redirect attributes value pairs (AVPs) returned by ISE(url-redirect-acl and url-redirect).

3. The client opens the browser, generates HTTP or HTTPS traffic, and gets redirected to ISE's Guest Portal.

4. Once in the portal the client will be able to enter previously assigned guest credentials (**Sponsor Created**) and self-provision a new guest account or use its AD credentials to log in (**Employee Login**) which will provide Single Sign On capabilities through SAML.

5. Once the user selects the option of "Employee Login", the ISE verifies if there is an active assertion associated to this client's browser session against the IdP. If there are no active sessions, the IdP will enforce the user login. At this step the user will be prompted to enter AD credentials in the IdP portal directly.

6. The IdP authenticates the user via LDAP and it creates a new Assertion that will stay alive for a configurable time.

**Note**: Ping Federate by default applies a **Session Timeout** of 60 minutes (this means that if there are no SSO login requests from ISE in 60 minutes after initial authentication the session is deleted) and a **Session Max Timeout** of 480 minutes (even if the IdP has received constant SSO login requests from ISE for this user the session will expire in 8 hours).

As long as the Assertion session is still active, the Employee will experience SSO when he uses the Guest Portal. Once the session times out , a new User authentication will be enforced by the IdP.

# Configure

This section discusses the configuration steps to integrate ISE with Ping Federate and how to enable Browser SSO for the Guest Portal.

**Note**:Although various options and possibilities exist when you authenticate Guest users, not all combinations are described in this document. However, this example provides you with the information necessary to understand how to modify the example to the precise configuration you want to achieve.

## Step 1. Prepare ISE to Use an External SAML Identity Provider

- 1. On the Cisco ISE, choose Administration > Identity Management > External Identity Sources > SAML Id Providers.
- 2. Click Add.

SAML Id Providers

3. Under **Genaral** Tab, enter an **Id Provider Name**. Click **Save**. The rest of the configuration in this section depends on the metadata that needs to be imported from the IdP in later steps.



## Step 2. Configure the Guest portal to use an external Identity Provider

- 1. Choose Work Centers > Guest Access > Configure > Guest Portals.
- 2. Create a new portal and choose Self-Registered Guest Portal.

**Note**: This will not be the main portal that the user experience but a subportal that will interact with the IdP in order to verify session status. This portal is called SSOSubPortal.

3. Expand Portal Settings and choose PingFederate for Authentication Method.

4. From **Identity Source Sequence**, choose the External SAML IdP previously defined(PingFederate).

#### Portals Settings and Customization

Portal Name: *		Description:				
SSOSubPortal		SubPortal that will connect to the SAML IdP		Portal test URL		
A strategy and	DiseEederate		m.			
Authentication	Prigrederate	<u> </u>	w			
method: *	Configure authority	entication methods at:				

# 5. Expand the Acceptable Use Policy( AUP) and Post-Login Banner Page Settings sections and disable both.

Portal flow is:



6. Save the changes.

7. Go back to Guest Portals and create a new one with the Self-Registered Guest Portal option.

**Note**: This will be the Primary portal visible to the client. The primary portal will use the SSOSubportal as an interface between ISE and the IdP. This portal is called PrimaryPortal.

Portal Name: *	Description:
PrimaryPortal	Portal visible to the client during CWA flow.

8. Expand the Login Page Settings and choose the SSOSubPortal previously created under "Allow the following identity-provider guest portal to be used for login".

✓	Allow the following identity-provider guest portal to be $\mathfrak{g}$	used for
	SSOSubPortal	•

9. Expand the **Acceptable Use Policy AUP and Post-login Banner Page Settings** and uncheck them.

At this point the portal flow must look like this:

Guest Flow (Based on setting	s)	
Self Registration	LOGIN Max Devices Reached Success	Alternate Login Portal See the selected identity-provider portal for the guest flow details.

10. Choose **Portal Customization > Pages > Login**. You must now have the option to customize the **Alternative Login Options** (Icon, text, and so on).

Alternative login:	You can also login with	(static text)
Alternative login access portal:		
	Use this text:	
	Alternative Login Portal	as link
	as icon tooltip	
	lcon	⊗ •)

**Note**: Notice that on the right side, under the portal preview, the additional login option is visible.



11. Click Save.

Now both portals appear under the Guest Portal List.

PrimaryPortal Portal visible to the client during CWA flow. Oused in 1 rules in the Authorization policy	Allow login using : SSOSubPortal
SSOSubPortal SubPortal that will connect to the SAML IdP SubPortal by another portal for alternate login	Used as alternate login option by : PrimaryPortal

# Step 3. Configure PingFederate to act as an Identity Provider for ISE Guest Portal

- 1. In ISE, choose Administration > Identity Management > External identity Sources > SAML Id Providers > PingFederate and click the Service Provider Info.
- 2. Under Export Service Provider Info, click Export.

### SAML Identity Provider

General	Identity Provider Config.	Service Provider Info.
Service	Provider Information	
🗌 Load	d balancer	۲
Export S	ervice Provider Info. Export	Ð

**3.** Save and extract the zip file generated. The XML file contained here is used to create the profile in PingFederate in later steps.

### SSOSubPortal.xml

**Note**: From this point on, this document covers the PingFederate configuration. This configuration is same for multiple solutions like Sponsor portal, MyDevices, and BYOD portals. (Those solutions are not covered in this article).

4. Open the PingFederate admin portal (typically https://ip:9999/pingfederate/app).

### 5. Under the **IdP Configuration** tab > **SP Connections** section choose **Create New**.

### IdP Configuration

APPLICATION INTEGRATION	SP CONNECTIONS			
Adapters Default URL	Manage All	Create New	Import	
Application Endpoints		L]		

### AUTHENTICATION POLICIES

6. Under Connection Type, click Next.

## SP Connection



7. Under Connection Options, click Next.



8. Under **Import Metadata**, click the **File** radio button, click **Chose file** and choose the XML file previously exported from ISE.

SP Connection



9.Under Metadata Summary, click Next.

10.On the General Info page, under Connection Name, enter a name ( such as ISEGuestWebAuth) and click **Next**.



11. Under **Browser SSO**, click **Configure Browser SSO** and under **SAML Profiles** check the options and click **Next**.



### 12.On Assertion lifetime click Next.

13.On Assertion Creation click Configure Assertion Creation.

14.Under Identity Mapping choose Standard and click Next.



# 15. On Attribute Contract > Extend Contract enter the attributes mail and memberOf and click add. Click Next.

SP Connection   Browser SSO   Assertion Creation					
Identity Mapping	Attribute Contract	Authentication Source Mapping	Summary		
An Attribute Contract is	a set of user attributes t	hat this server will send in the assertio	n.		
Attribute Contract	Subject N	ame Format			
SAML_SUBJECT	urrcoasis	names:tc:SAML:1.tnameid-format:unsp	secified	~	
Extend the Contract Attribute Name Format Action					
mail	umoasisma	mestc:SAML:2.0:attrname-format:basi	ic		
memberOf	umoasisma	mestc:SAML:2.0:attmame-format:basi	ic .		

Configuration of this option allows the Identity Provider to pass the **MemberOf** and **Email** attributes provided by Active Directory to ISE, which ISE can use later as a condition during policy decision.

### 16.Under Authentication Source Mapping click Map New Adapter Instance.

### 17.On Adapter Instance choose HTML Form Adapter. Click Next

SP Connection   Brow	vser SSO   Assertion Crea
Adapter Instance Mappi	Attribute Contract Full
Select an IdP adapter instance th partner.	at may be used to authenticate users fo
ADAPTER INSTANCE	HTML Form Adapter
Adapter Contract	
givenName	
mail	
memberOf	
objectGUID	
sn	
username	
userPrincipalName	
OVERRIDE INSTANCE SET	TINGS

### 18. Under Mapping methods choose the second option down and click Next.

	RETRIEVE ADDITIONAL ATTRIBUTES FROM MULTIPLE DATA STORES USING ONE MAPPING
	RETRIEVE ADDITIONAL ATTRIBUTES FROM A DATA STORE INCLUDES OPTIONS
-	TO USE ALTERNATE DATA STORES AND/OR A FAILSAFE MAPPING
	USE ONLY THE ADAPTER CONTRACT VALUES IN THE SAML ASSERTION

### 19. On Attribute Sources & User Lookup click Add Attribute Source box.

20. Under **Data Store** enter a description, and choose LDAP conection instance from **Active Data Store** and define what type of Directory Service this is. If there are no **Data Stores** configured yet click **Manage Data Stores** in order to add the new instance.

## SP Connection | Browser SSO | Assertion Creation | IdP Adapter Mapping

Data Store	LDAP Directory Search	LDAP Filter	Attribute Contract Fulfillment	Summary
This server uses	local data stores to retrieve s	upplemental attrib	outes to be sent in an assertion. S	pecify an Attribute S
ATTRIBUTE SOL	URCE DESCRIPTION		et	
ACTIVE DATA S	TORE		et	
DATA STORE TY	(PE	LDAP		
Manage Dat	a Stores			

21. Under LDAP Directory Search define the Base DN for LDAP user Lookup in the domain and click Next.

Data Otara			Attailuate Contract Fulfillmont	<b>C</b>	
SP Connec	ction   Browser SSC	D   Assertio	on Creation   IdP Adapt	er Mappin	g

Please configure your directory search. This information, along with the attributes supplied in the contract, will be used



**Note**: This is important as it will define the base DN during the LDAP user lookup. An incorrectly defined Base DN will result in Object Not found in LDAP schema.

22.Under LDAP Filter add the string sAMAccountName=\${username} and click Next.

# SP Connection | Browser SSO | Assertior



23. Under Attribute Contract Fulfillment choose the given options and click Next.

SP Connection	Browser SSO	Assertion Creation	IdP Adapter	Mapping	Attribu

	Data Store	LDAP Directory Search	LDAP Filter	Attribute Contract Fulfillment	Summary
--	------------	-----------------------	-------------	--------------------------------	---------

Fulfill your Attribute Contract with values from the authentication adapter, dynamic text values, or from a data store lookup.

Attribute Contract	Source		Value	
SAML_SUBJECT	Adapter	~	username	~
mail	Adapter	~	mail	*
memberOf	Adapter	~	memberOf	~

- 24. Verify the configuration at the summary section and click **Done**.
- 25. Back in Attribute Sources & User lookup click Next.
- 26. Under Failsafe Attribute Source click Next.
- 27. Under Attribute Contract Fulfillment choose these options and click Next.

Attribute Contract	Source		Value	
SAML_SUBJECT	Adapter	~	username	~
mail	Text	~	no email address	
memberOf	Text	~	no group found	

- 28. Verify the configuration in Summary Section and click **Done**.
- 29. Back on Authentication Source Mapping click Next.
- 30. Once configuration has been verified under Summary page click Done.
- 31. Back on Assertion Creation click Next.

32. Under **Protocol Settings**, click **Configure Protocol Settings**. At this point there must be two entries already populated. Click **Next**.

SP Connection   Browser SSO   Protocol Settings						
Assertion Consumer Service	URL Allowable SAML Bindings	Signature Policy	Encryption Policy	Summary		
As the IdP, you send SAML asse	tions to the SP's Assertion Consumer !	Service. The SP may req	uest that the SAML asse	ertion be sent to	one of several URLs, via different bindings. Please provide the possibl	
Default	Index	Binding			Endpoint URL	
default	0	POST			https://14.36.157.210.8443/portal/SSOLoginResponse.action	
	1	POST			https://torise21a.rtpaaa.net/8443/portal/SSOLoginResponse.action	

#### 33. Under SLO Service URLs click Next.

34. On Allowable SAML Bindings, uncheck the options ARTIFACT and SOAP and click Next.

Assertion Consumer Service URL	SLO Service URLs	Allowable SAML Bindings

When the SP sends messages, what SAML bindings do you want to allow?

	ARTIFACT
~	POST
~	REDIRECT
	SOAP

- 35. Under Signature Policy click Next.
- 36. Under Encryption Policy click Next.

37. Review the configuration in the Summary page and click **Done**.

38. Back on Browser SSO > Protocol settings click **Next**, validate the configuration, and click **Done**.

39. The browser SSO tab appears. Click Next.

### SP Connection



40. Under **Credentials** click **Configure Credentials** and choose the signing certificate to be used during IdP to ISE communication and check the option **Include the certificate in the signature**. Then click **Next**.

## SP Connection | Credentials

Digital Signature Settings	Signature Verification Settings	Summary
You may need to digitally sign S	AML messages or security tokens to	protect against tampering. Please select a key/c
SIGNING CERTIFICATE	01:55:31:36:ED:D8 (cn=	47:1) ~
	INCLUDE THE CERTIFICATE	E IN THE SIGNATURE <keyinfo> ELEMENT.</keyinfo>
	INCLUDE THE RAW KE	Y IN THE SIGNATURE <keyvalue> ELEMENT.</keyvalue>
SIGNING ALGORITHM	RSA SHA256 V	

**Note**: If there are no certificates configured click **Manage Certificates** and follow the prompts in order to generate a **Self-signed certificate** to be used to sign IdP to ISE communications.

- 41. Validate the configuration under the summary page and click **Done**.
- 42. Back on the **Credentials** tab click **Next**.

43. Under Activation & Summary choose Connection Status ACTIVE, validate the rest of the configuration, and click Done.

SP Connection						
Connection Type	Connection Options	Metadata URL	General Info	Browser SSO	Credentials	Activation & Summary
Summary information for	or your SP connection. Click	k a heading in a sect	ion to edit a particu	ular configuration se	etting.	
Connection Status	ACTIVE					

## Step 4. Import IdP Metadata into ISE External SAML IdP Provider Profile

- Under the PingFederate management console, choose Server Configuration > Administrative Functions > Metadata Export. If the server has been configured for multiple roles( IdP and SP), choose the option I am the Identity Provider(IdP). Click Next.
- 2. Under Metadata mode select "Select Information to Include In Metadata Manually". Click Next .



- 3. Under Protocol click Next.
- 4. On Attribute Contract click Next.

5. Under **Signing Key** choose the certificate previously configured on the connection profile. Click **Next**.





The metadata may contain a public key that this system uses for digital signatures. If you wish to inclu



6. Under **Metadata Signing** choose the signing certificate and check **Include this certificate's public key in the key info element.** Click **Next**.

SIGNING CERTIFICATE	01:55:31:36:ED:D8 (cn=14.36.147.1) ~
	INCLUDE THIS CERTIFICATE'S PUBLIC KEY CERTIFICATE IN THE <keyinfo> ELEMENT.</keyinfo>
SIGNING ALGORITHM	RSA SHA256 V

7. Under XML encryption certificate click Next.

Note: The option to enforce encryption here is up to the Network Admin.

8. Under **Summary** section click **Export**. Save the Metadata file generated and then click **Done**.

Export Metadata	
Metadata Role Metadata Mode Protocol Attribute Contract Signing Key Metadata Signing XML Encryption Certificate E	xport & Summary
Click the Export button to export this metadata to the file system.	
Export Metadata	
Metadata Role	
Metadata role	Identity Provider
Metadata Mode	
Metadata mode	Select information manually
Use the secondary port for SOAP channel	falso
Protocol	
Protocol	SAML20
Attribute Contract	
Attribute	None defined
Signing Key	
Signing Key	CNI14.36.473, OUITAC, OICisco, LIRTP, CIUS
Metadata Signing	
Signing Certificate	CN=14.36.1473, OU=TAC, O=Cisco, L=RTP, C=US
Include Certificate in KeyInfo	falso
Include Rew Key in KeyValue	falso
Selected Signing Algorithm	RSA SHA256
XML Encryption Certificate	
Encryption Keys/Certs	NONE
Export	Cancel Previous Done

9. Under ISE, choose to Administration > Identity Management > External Identity Sources > SAML Id Providers > PingFederate.

10. Click **Identity Provider Config > Browse** and proceed to import the metadata saved from PingFederate Metadata Export operation.

## SAML Identity Provider



# 11. Choose **Groups** Tab, under **Group Membership Attribute** add **memberOf** and then click **Add**

Under the **Name in Assertion** add the Distinguished Name that the **IdP** must return when **memberOf** attribute is retrieved form LADP authentication. In this case the group configured is linked to the sponsor group of TOR and the DN for this group is as follows:

### SAML Identity Provider

General	Identity Provider Config.	Service Provider Info.	Groups	Attributes	Advanced Settings	
Groups						
Group Me	embership Attribute	nemberOf				0
-Add	🖉 Edit 🗙 Delete					
Nar	me in Assertion				Name in ISE	
CN CN	=TOR,DC=met			84	TOR I Cancel	
				0.	ine i Gailleor	

Once you add the DN and "Name in ISE" description click OK.

12. Choose Attributes tab and click Add.

At this step, add the attribute "mail" that is contained in the SAML token passed from the IdP that based on Ping's query over LDAP, it must contain the email attribute for that object.

Add Attribute		х
*Name in Assertion	mail	
Туре	STRING	
Default value		
"Name in ISE	mail	(i)
	OK Cancel	

**Note**: Steps 11 and 12 ensure that ISE receives the AD object Email and MemberOf attributes through the IdP login action.

## Verify

 Launch the Guest Portal using the Portal Test URL or by following the CWA flow. The user will have the options to enter guest credentials, create their own account, and Employee Login.

### Sign On

Welcome to the Guest Portal. Sign on with the username and password provided to you.

Username:		
Password:		
	Sign On	
	Don't have an account?	
	You can also login with	

2. Click **Employee Login**. Since there are no Active Sessions the user will be redirected to the IdP login portal.

Sign On	
Disease size as and we'll and you sight sizes	
Please sign on and we'll send you right along.	
USERNAME	
PASSWORD	
Sign On	

- 3. Enter AD credentials and click Sign On.
- 4. IdP logon screen will redirect the user to the Guest Portal Success Page.

111111 Sponsored Guest Portal

Success

You now have Internet access through this network.

5. At this point, every time the user comes back to the Guest Portal and choose "Employee Login" they will be allowed in the network as long as the Session is still active in the IdP.

## **Troubleshoot**

CISCO

Any SAML authentication issue will be logged under ise-psc.log. There is a dedicated component (SAML) under Administration > Logging > Debug log Configuration > Select the node in **question >** Set SAML component to **debug** level.

You can access ISE through CLI and enter the command **show logging application ise-psc.log** tail and monitor the SAML events, or you can download ise-psc.log for further analysis under Operations > Troubleshoot > Download Logs > Select the ISE node > Debug Logs tab > click ise-psc.log to download the logs.

```
2016-06-27 16:15:39,366 DEBUG [http-bio-10.36.157.210-8443-exec-3][]
cpm.saml.framework.impl.SAMLFacadeImpl -::::- SAMLUtils::isOracle() - checking whether IDP URL
indicates that its OAM. IDP URL: https://10.36.147.1:9031/idp/sso.saml2
2016-06-27 16:15:39,366 DEBUG [http-bio-10.36.157.210-8443-exec-3][]
cpm.saml.framework.impl.SAMLFacadeImpl -::::- SPProviderId for PingFederate is: http://CiscoISE
/5b4c0780-2da2-11e6-a5e2-005056a15f11
2016-06-27 16:15:39,366 DEBUG [http-bio-10.36.157.210-8443-exec-3][]
cpm.saml.framework.impl.SAMLFacadeImpl -::::- ResponseValidationContext:
       IdP URI: PingFederate
       SP URI: http://CiscoISE/5b4c0780-2da2-11e6-a5e2-005056a15f11
       Assertion Consumer URL: https://10.36.157.210:8443/portal/SSOLoginResponse.action
       Request Id: _5b4c0780-2da2-11e6-a5e2-005056a15f11_DELIMITERportalId_EQUALS5b4c0780-2da2-
11e6-a5e2-005056a15f11 SEMIportalSessionId EQUALS309f733a-99d0-4c83-8
b99-2ef6b76c1d4b_SEMI_DELIMITER10.36.157.210
       Client Address: 10.0.25.62
       Load Balancer: null
2016-06-27 16:15:39,366 DEBUG [http-bio-10.36.157.210-8443-exec-3][]
cpm.saml.framework.validators.BaseSignatureValidator -::::- Determine the signing certificate
2016-06-27 16:15:39,366 DEBUG [http-bio-10.36.157.210-8443-exec-3][]
cpm.saml.framework.validators.BaseSignatureValidator -::::- Validate signature to SAML standard
with cert:CN=10.36.147.1, OU=TAC, O=Cisco, L=RTP, C=US serial:1465409531352
2016-06-27 16:15:39,367 DEBUG [http-bio-10.36.157.210-8443-exec-3][]
org.opensaml.xml.signature.SignatureValidator -::::- Creating XMLSignature object
2016-06-27 16:15:39,367 DEBUG [http-bio-10.36.157.210-8443-exec-3][]
org.opensaml.xml.signature.SignatureValidator -::::- Validating signature with signature
algorithm URI: http://www.w3.org/2001/04/xmldsig-more#rsa-sha256
2016-06-27 16:15:39,368 DEBUG [http-bio-10.36.157.210-8443-exec-3][]
cpm.saml.framework.validators.SAMLSignatureValidator -::::- Assertion signature validated
succesfully
2016-06-27 16:15:39,368 DEBUG [http-bio-10.36.157.210-8443-exec-3][]
cpm.saml.framework.validators.WebSSOResponseValidator -::::- Validating response
2016-06-27 16:15:39,368 DEBUG [http-bio-10.36.157.210-8443-exec-3][]
cpm.saml.framework.validators.WebSSOResponseValidator -::::- Validating assertion
```

```
2016-06-27 16:15:39,368 DEBUG [http-bio-10.36.157.210-8443-exec-3][]
cpm.saml.framework.validators.AssertionValidator -::::- Assertion issuer succesfully validated
2016-06-27 16:15:39,368 DEBUG [http-bio-10.36.157.210-8443-exec-3][]
cpm.saml.framework.validators.AssertionValidator -::::- Subject succesfully validated
2016-06-27 16:15:39,368 DEBUG [http-bio-10.36.157.210-8443-exec-3][]
cpm.saml.framework.validators.AssertionValidator -::::- Conditions succesfully validated
2016-06-27 16:15:39,368 DEBUG [http-bio-10.36.157.210-8443-exec-3][]
cpm.saml.framework.impl.SAMLFacadeImpl -::::- SAML Response: validation succeeded for quest
IDPResponse
:
       IdP ID: PingFederate
       Subject: guest
       SAML Status Code:urn:oasis:names:tc:SAML:2.0:status:Success
       SAML Success:true
       SAML Status Message:null
       SAML email:guest@example
       SAML Exception:null
2016-06-27 16:15:39,368 DEBUG [http-bio-10.36.157.210-8443-exec-3][]
cpm.saml.framework.impl.SAMLFacadeImpl -::::- AuthenticatePortalUser - about to call
authenticateSAMLUser messageCode:null subject:guest
2016-06-27 16:15:39,375 DEBUG [http-bio-10.36.157.210-8443-exec-3][]
cpm.saml.framework.impl.SAMLFacadeImpl -::::- Authenticate SAML User - result:PASSED
```

## **Related Information**

- <u>Central Web Authentication with Cisco WLC and ISE configuration example.</u>
- <u>Central Web Authentication with a Switch and Identity Services Engine Configuration</u>
   <u>Example</u>.
- <u>Release Notes for Cisco Identity Services Engine, Release 2.1</u>
- <u>Cisco Identity Services Engine Administrator Guide, Release 2.1</u>