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802.1X Deployment Guide

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CHAPTER 1

Introduction

The need for secure network access has never been greater. In today's diverse workplaces, consultants, contractors, and even guests require access to network resources over the same LAN connections as regular employees. As data networks become increasingly indispensable in day-to-day business operations, the possibility that unauthorized people will gain access to controlled or confidential information also increases.

One of the most vulnerable points of the network is the access edge. The access layer is where end users connect to the network. In the past, corporations have largely relied on physical security to protect this part of the network. Unauthorized users were not allowed to enter a secure building where they could plug into the network. Today, contractors and consultants regularly have access to secure areas. Once inside, there is nothing to prevent a contractor from plugging into a wall jack and gaining access to the corporate network. There is no need to enter an employee cube to do this. Conference rooms frequently offer network access through wall jacks or even desktop switches. Once connected to the network, everyone (employees, contractors, consultants, guests, and malicious users) has access to all the resources on the network.

The best and most secure solution to vulnerability at the access edge is to leverage the intelligence of the network. Cisco IOS software enables standards-based network access control at the access layer by using the 802.1X protocol to secure the physical ports where end users connect. 802.1X is an IEEE standard for media-level (Layer 2) access control, offering the capability to permit or deny network connectivity based on the identity of the end user or device. 802.1X is well-known as a way to secure wireless network access. It is equally essential in securing wired network access.

This configuration guide describes the basic deployment of an identity-based network access control system for wired networks using IEEE 802.1X. This system is implemented with the Cisco Catalyst family of switches and the Cisco Secure Access Control Server (ACS). Additional components of the system include an IEEE 802.1X compliant client, such as Cisco Secure Service Client (CSSC), and an optional X.509 Public Key Infrastructure (PKI) certificate architecture.

Beyond basic network access control, this 802.1X-based access control system offers the following services:

- Dynamic, user-specific policy-based authorization
- Policy enforcement at the port level
- Support for IP Telephony
- Support for non-802.1X-capable devices

These services are addressed in subsequent chapters.

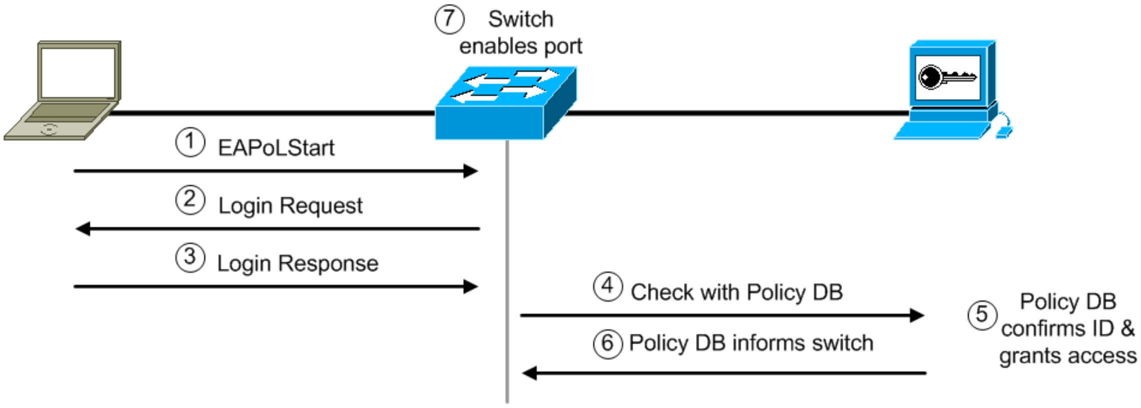
What is 802.1X?

The IEEE 802.1X protocol allows Cisco Catalyst switches to offer network access control at the port level. Every port on the switch is individually enabled or disabled based on the identity of the user or device connecting to it.

When 802.1X is first enabled on a port, the switch automatically drops all traffic received on that port. There is one exception to this rule. The only traffic a switch will accept is a request to start 802.1X authentication. Only after the 802.1X authentication has successfully completed will the switch accept any other kind of traffic on the port.

The high-level message exchange in Figure 1-1 illustrates how port-based access control works within an identity-based system. First, a client, such as a laptop equipped with an 802.1X supplicant, connects to an IEEE 802.1X-enabled network and sends a start message to the LAN switch (the *authenticator*). Once the start message is received, the LAN switch sends a login request to the client and the client replies with a login response. The switch forwards the response to the policy database (the *authentication server*) which authenticates the user. After the user identity is confirmed, the policy database authorizes network access for the user and informs the LAN switch. The LAN switch then enables the port connected to the client.

Figure 1-1 Port-based Access Control



User or device credentials are processed by AAA server. The AAA server is able to reference user or device policy profile information either internally, using the integrated user database, or externally, using database sources such as Microsoft Active Directory, LDAP, Novell NDS or Oracle databases. This enables the integration of the system into exiting user management structures and schemes, thereby simplifying overall deployment.

802.1X and EAP

When authenticating users for the purposes of network access control, the system must provide user and/or device identification using strong authentication technologies known to be secure and reliable. IEEE 802.1X does not by itself dictate how this is achieved. Rather, the 802.1X protocol defines an encapsulation for the transport of the Extensible Authentication Protocol (EAP) from the client to the switch. The 802.1X encapsulation is sometimes referred to as EAP over LAN (EAPoL). The switch in turn relays the EAP information to the authentication server using the RADIUS protocol (EAP over RADIUS).

EAP, which is defined by RFC 3748, is itself a framework—not a specific authentication method. EAP provides a way for the client and the authentication server to negotiate an authentication method that they both support. There are many EAP methods but the ones used more frequently for 802.1X wired authentication include EAP-TLS, EAP-PEAP, and EAP-FAST. These EAP methods are discussed in more detail later in this document.

How 802.1X Impacts the Network

Before enabling 802.1X in the network, it is essential to review the default security posture of a port enabled for 802.1X authentication: all traffic is dropped except 802.1X EAPoL packets. This is a fundamental change from the traditional model in which the port is enabled and all traffic is allowed from the moment that a device plugs into the port. Ports that were traditionally open will now be closed by default. This is one of the cornerstones of the strong security and network access control provided by 802.1X. However, this change in the default network access model can have a profound impact on network devices and applications. Understanding and providing for the impacts of this change will make for a smooth deployment of 802.1X network access control.

Non 802.1X-Enabled Devices

802.1X must be enabled on both the host device and on the switch to which the device connects. If a device without an 802.1X supplicant attempts to connect to a port that is enabled for 802.1X, it will be subjected to the default security policy. The default security policy says that 802.1X authentication must succeed before access to the network is granted. Therefore, by default, non-802.1X-capable devices cannot get access to an 802.1X-protected network.

Although many devices increasingly support 802.1X, there will always be devices that require network connectivity but do not and/or cannot support 802.1X. Examples of such devices include network printers, badge readers, legacy servers, and PXE boot machines. Some provision must be made for these devices.

Cisco provides two features to accommodate non-802.1X devices. These are MAC Authentication Bypass (MAB) and the Guest VLAN. These features provide fallback mechanisms when there is no 802.1X supplicant. After 802.1X times out on a port, the port can move to an open state if MAB succeeds or if the Guest VLAN is configured. Judicious application of either or both of these features will be required for a successful 802.1X deployment.

Note Network-specific testing will be required to determine the optimal values for 802.1X timers to accommodate the various non-802.1X-capable devices on your network. See the *Baseline Identity Design Overview Guide* for more details on optimizing 802.1X timers for non-802.1X-enabled devices such as PXE-boot.

Wake-on-LAN (WoL) devices also require special handling in an 802.1X-enabled environment. WoL is an industry standard that defines a power management wake-up event. Many network interface cards (NICs) in the industry today support WoL. After a machine goes into low-energy suspend mode, it can be automatically reactivated when a "magic packet" is received by the NIC. This capability can be used to wake up a mail server machine to deliver mail, for software management pushes, to deploy patches overnight to desktops, and so on. By default, 802.1X controls traffic in both directions, which would prevent the magic packet from getting to a sleeping WoL device. To enable WoL to interoperate with 802.1X, Cisco provides the option of configuring unidirectional control on an 802.1X port.

Unidirectional control allows data packets (such as a magic packet) to leave the port while still denying all non-EAPoL traffic from coming into the port. Once the WoL device has been activated by the magic packet, it can complete an 802.1X authentication and gain full access to the network.

Note Since unidirectional port control represents a weaker deployment of 802.1X, best practice is to enable WoL only on the ports where it is needed.

802.1X Devices with Invalid Credentials

802.1X protects the network by preventing users and devices without valid credentials from gaining access to the access port. However, there may be situations where legitimate users do not have valid credentials. For example, an employee's certificate might expire while the employee is on leave. When the employee plugs back into the network, 802.1X authentication will fail and the port will remain closed. However, to get a new certificate, the employee must have network access. This is a chicken-and-egg problem. In a different scenario, a partner might attempt to connect to the network for guest access. The partner's laptop is configured for 802.1X, but the partner's credentials are only valid on the partner's home network. 802.1X authentication fails, preventing the partner from gaining guest access.

To provide for situations such as these, Cisco offers the Auth-Fail VLAN feature. When 802.1X authentication fails (as opposed to timing out because there is no supplicant on the host), the port is moved to a configurable VLAN where restricted access can be enforced. Using the Auth Fail VLAN, network administrators can tailor network access for devices without valid credentials. For example, the Auth-Fail VLAN may be configured to permit access the Internet only or to a Certificate Authority for certificate renewal.

Note The Auth-Fail VLAN should always be deployed in accordance with an organization's security policy.

For more information on using the Auth-Fail VLAN, see the *802.1X VLAN Authorization Deployment Guide*.

802.1X in Microsoft Environments

Many customers use the Microsoft Windows system (mostly Windows 2000, Windows XP, Windows Server 2003, and Windows Vista) as their core computing system. Windows environments are heavily dependent on network access for many basic functions. Understanding this dependency and how to design 802.1X environments accordingly is required for successful 802.1X deployments.

Windows Group Policy Object (GPO)

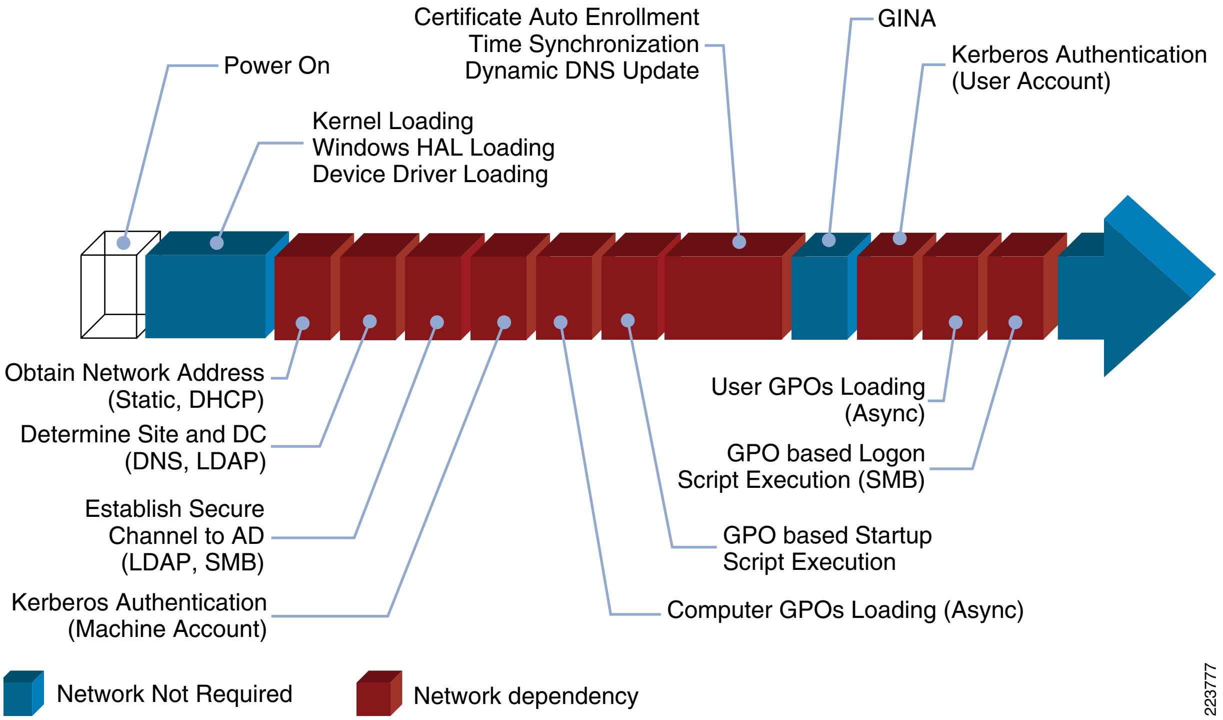
In a Microsoft Active Directory environment, Group Policy Objects (GPO) are widely used to apply Windows' configuration or policy settings to a group of users and/or computers in the domain. GPOs can be used to deploy startup or logoff scripts, change registry values, install software packages, set security options, redirect folders, and many other tasks.

GPOs are defined on an Active Directory (AD) Domain Controller (DC). Computers and users download GPOs when logging into the domain. A computer logs into the domain when it is first booted. A user logs onto the domain by pressing **Ctrl-Alt-Delete** and entering an appropriate username and password at the login screen (sometimes referred to as the GINA, after the Microsoft library that controls the interactive login process). If GPOs cannot be downloaded at login time because the network is unavailable, the Windows networking environment cannot function properly.

Windows Logon

The key elements of the Windows Startup process are shown in Figure 1-2.

Figure 1-2 Windows Startup Process



Clearly, large portions of the Windows logon process depend on network connectivity. The following network functions and protocols are all required for successful Windows logon and GPO downloading:

- Addressing (DHCP)
- Site and Domain Determination (DNS, LDAP)
- Secure Channel Establishment to AD (SMB)
- Authentication (Kerberos)
- Time Synchronization (NTP)
- Policy Application (LDAP, SMB)

Because the default security status of an 802.1X port is closed to all traffic except EAPoL until after authentication, 802.1X might, when deployed improperly, break the Windows login process.

Machine Authentication

A successful 802.1X authentication will open the port and allow the Windows device to log in to the domain. However, in Figure 1-3, it is clear that the user login screen (the GINA) appears relatively late in the Windows login process. If the 802.1X supplicant waits for the user to enter a username and password at the GINA before initiating authentication, then all the networking protocols and network-based processes that come before the GINA will be blocked and Windows policies will not be properly applied.

To prevent this problem, the 802.1X system supports *machine authentication*. Machine authentication allows the machine itself to authenticate via 802.1X before the user logs in. Machine authentication is exactly the same as user authentication. The 802.1X supplicant uses special machine credentials (a machine-specific password or certificate) to complete the authentication. This allows the machine to have network access and download its GPOs before the user logs on to the machine.

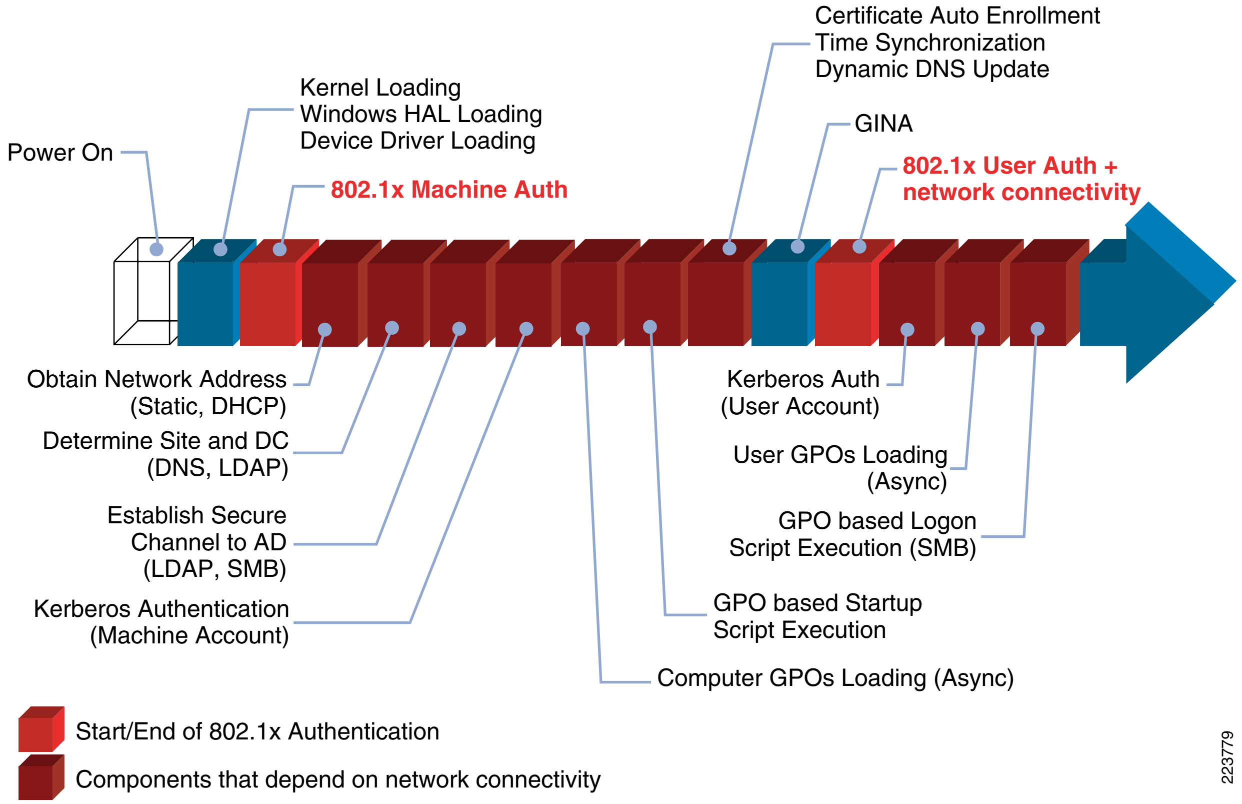
To ensure successful Windows login, 802.1X machine authentication should adhere to these conditions:

- Machine authentication should always start as soon as device drivers are initialized and be completed before GINA is displayed to user.
- IP connectivity (DHCP, RARP) should always be established right after successful authentication.
- Logon process (Domain lookup, SChannel, Kerberos Auth, etc.) should be postponed until network connectivity is established and completed before GINA is displayed to user.

Machine authentication can be used by itself or in combination with user authentication. Machine authentication by itself is an excellent way to ensure that every device connecting to the network is a corporate asset (since only machines that have joined the Windows domain will have the appropriate credentials for successful machine authentication). Combining user authentication with machine authentication preserves the Windows machine login process while also enabling user-specific network access. User authentication, however, should not be deployed without machine authentication in Windows environments. If user authentication is deployed without machine authentication, then the Windows machine login process will break. We recommend always enabling machine authentication in Windows networking environments.

When machine and user authentication are both enabled and functioning properly, the Windows login sequence proceeds normally as shown in Figure 1-3.

Figure 1-3 802.1X and Logon Serialization



Note that Figure 1-3 represents an idealized view of machine and user authentication in a Microsoft environment. Whether or not this actually is realized in practice depends on specifics of the OS and the 802.1X supplicant. For more information, see the *Windows Interoperability Document*.

Need the actual title of document to cross-reference.

Planning for 802.1X Deployment

Deploying 802.1X will fundamentally change how users and devices gain access to the network. By shifting from an open model of connectivity to a *closed-until-authorized* model, network administrators can leverage the intelligence of the network to secure the access edge. Understanding and planning for the impact of this shift is essential. During the planning process, it is important to recognize that every network is unique. To tune the system for optimal security with optimal access, some network-specific testing will be required.

Consider the non-802.1X capable devices discussed in the "Non 802.1X-Enabled Devices" section on page 1-3. MAB or Guest VLAN can be used to allow these devices access to the network. However, MAB or Guest VLAN can only be used once 802.1X has timed out. By default, this timeout value is 90 seconds. If the device's PXE process times out or if DHCP gets deep into the exponential back-off process in those 90 seconds, the port may be open but the device will not know it. To the end user, it will appear as if network access has been denied. This problem can be alleviated by decreasing the 802.1X timeout. However, care must be exercised so that this timer is not set too low. If the port is put into the Guest VLAN or MAB-assigned VLAN too soon, an 802.1X capable device may not have enough time to start its supplicant. Since the optimal value for the timeout will depend on the specifics of your network, Cisco recommends that you use the 802.1X deployment planning phase to test whichever value you select for this timer.

Similarly, the specifics of an organization's Windows environment should be tested against 802.1X. For example, very large and complex Group Policies could introduce timing delays that would adversely affect the login process if not properly accounted for.

For an in-depth discussion of planning an 802.1X deployment, see the *Baseline Identity Design Overview Guide*.

802.1X Re-authentication

Since 802.1X is a port-based authentication technique, the physical status of the port directly impacts how long the authenticated session remains active. After a successful 802.1X authentication, the port remains open until the switch detects a physical link-down event (because the host unplugged from the port or the port was shutdown) or receives an explicit logoff notification indicating that the session should be terminated. Any device attempting to connect to the port after a link-down or a logoff will be required to authenticate again.

In the absence of link-down/logoff events, there is usually no need to re-authenticate a previously authenticated host that remains connected to the network. Since physical connectivity is continuously maintained, there is no question that the authenticated host remains connected to the port. Under these circumstances, re-interrogating the host's credentials would serve no purpose. In some situations, however, re-authentication can be used as a de facto 802.1X keepalive mechanism. For example, if a host is connected to the port via an IP phone or a hub, the switch might not have direct knowledge of link-down events. During re-authentication, the switch sends an EAP-Request to the host to initiate a new 802.1X authentication session, thus providing a mechanism by which the switch can confirm that the authenticated host is still connected.

Because authentication and authorization are tightly coupled in 802.1X, re-authentication can also be used as a de facto re-authorization technique. In the absence of explicit mechanisms to dynamically push policy updates to switches, re-authentication provides a mechanism by which the switch can pull the latest authorization policy (such as VLAN or ACL assignment) for authenticated hosts.

Before configuring periodic re-authentication, network administrators should carefully weigh the perceived benefits against the potential impact to the network. Depending on the length of the re-authentication timer, periodic re-authentication could considerably increase the authentication traffic load on the network infrastructure. In addition, in some configurations, re-authentication can temporarily disrupt network connectivity for authenticated hosts. Special care must be taken when configuring re-authentication with MAC Authentication Bypass (MAB) and in IP Telephony environments. Refer to the *MAC Authentication Bypass Deployment Guide* and the *VoIP and Identity Integration Guide* for more information on MAB and IP Telephony deployment considerations.

IP Telephony

As with PCs and laptops, IP phones connect to the network at the access edge. For a complete end-to-end security solution, IP phones must be able to function in an 802.1X environment. Moreover, IP phones typically have an extra Ethernet port to allow a PC to connect to the network via the phone, introducing one more avenue to network access that must also be secured. A complete 802.1X deployment must be able to grant secure access to IP phones and the devices that connect behind them.

The Cisco 802.1X solution offers several features that allow for the smooth operation of IP Telephony in 802.1x-enabled networks. In the past, Cisco IP Phones could be granted access to the network via CDP-based bypass. With this method, devices that had identified themselves as IP phones via the Cisco Discovery Protocol (CDP) would be allowed to bypass 802.1X authentication and send traffic on the Voice VLAN. Devices connected to the phone would have to authenticate via 802.1X or MAB in order to gain access to the Data VLAN. More recently, Cisco IOS introduced Multi-Domain Authentication (MDA) which enables a broader, more secure solution that forces both the phone and the device behind it to authenticate using 802.1X or MAB. In addition, Cisco supports features such as Proxy EAPoL Logoff and MAB Inactivity Timers to ensure that the network can keep tabs on the devices connected via phones, reducing opportunities for session-hijacking while enabling mobility in telephony environments.

For more information on these and other IP Telephony features, see the *VoIP and Identity Integration Guide*.

Components of the Overall Solution

IEEE 802.1X is not about a single product or feature. It is an end-to-end solution that relies upon the integration of multiple components. This section reviews those components and reviews common terminology.

Supplicant

A *supplicant* is an 802.1X client that runs on an edge device (workstation, laptop, and the like). The job of the supplicant is to request access to the LAN and respond to requests from the authenticator (the switch). The supplicant communicates with the authenticator via 802.1X-encapsulated EAP packets. Examples of IEEE 802.1X-compliant supplicant software include the Cisco Secure Services Client (CSSC) or the native 802.1X client offered in the Microsoft Windows operating system.

Authenticator

The *authenticator* is a device (such as a Cisco Catalyst switch) that controls physical access to the network based on the authentication status of the supplicant. The authenticator acts as an intermediary (proxy) between the supplicant and the authentication server. The authenticator requests identity information from the supplicant via 802.1X, verifies that information with the authentication server via RADIUS, and then relays a response to the supplicant based on the response from the authentication server.

When the switch receives EAP over LAN (EAPoL) frames and relays them to the authentication server, the Ethernet header is stripped and the EAP frame is re-encapsulated into a RADIUS packet. The EAP frames are not modified or examined during RADIUS encapsulation. When the switch receives RADIUS packets from the authentication server, the RADIUS header is removed, leaving the EAP frame, which is then encapsulated in the IEEE 802.1X format and sent to the supplicant.

Authentication Server

The *authentication server* (such as Cisco ACS) performs the actual authentication of the supplicant. By examining the information in the encapsulated EAP messages relayed from the authenticator, the authentication server validates the identity of the supplicant and notifies the switch whether or not the supplicant is authorized to access the LAN.

While the 802.1X specification does not dictate the protocol that is used for communication between the authenticator and the authentication server, the industry has converged on RADIUS as the de facto standard. RADIUS uses a client-server model in which secure authentication is exchanged between the RADIUS server and one or more RADIUS clients. In the 802.1X case, the authentication server (such as a Cisco ACS) is the RADIUS server and the authenticator (the switch) is the RADIUS client.

User Database

The *user database* is where user credentials used in 802.1X authentications are stored. This function can be integrated into the authentication server or it can be an external server to which the authentication server has access. Cisco ACS supports both models for the user database. The ACS has an internal user database that can be populated with usernames and passwords. The ACS also supports a number of protocols that allow it to verify user credentials that are stored in other repositories such as Microsoft Active Directory, generic LDAP databases, ODBC databases, and others.

EAP

In 802.1X, EAP provides the glue that ties the components together. The supplicant uses EAP to inform the authenticator that it is ready to begin or end authentication. In addition, EAP frames are passed between the supplicant and the authentication server to negotiate the EAP authentication type and carry out the authentication.

An EAP exchange proceeds as a series of Request/Response message pairs. The authenticator (on behalf of the authentication server) will send a Request to the supplicant and the supplicant will send a Response. The first Request that initiates authentication is typically for the supplicant’s identity. Once the supplicant responds, a series of Requests and Response is used to negotiate an EAP method and transfer the information required by that method.

At the end of the authentication process, the authentication server will either send an EAP-Success or an EAP-Failure to inform the supplicant whether the authentication passed or failed. Some EAP methods, such as EAP-TLS, further define an Alert message that offers additional information about why the authentication failed (supplicants as well as authentication servers can send Alerts).

There are two special EAP messages that the supplicant can send to the authenticator: *EAPoL-Start* and *EAPoL-Logoff*. The authenticator processes these messages locally and does not relay them to the authentication server. An EAPoL-Start is sent to indicate that the supplicant is ready to begin authentication. This message allows the supplicant to initiate an authentication. Typically, the authenticator will send an EAP-Request to initiate authentication as soon as the link comes up. However, the supplicant may not be listening at this stage and may miss the Request. The authenticator will retry, but the interval between retries may be long. In addition, after some number of unanswered Requests, the authenticator might move the port permanently into a Guest VLAN or MAB-assigned VLAN and stop sending further Requests. In these situations, the EAPoL-Start message allows the supplicant to inform the authenticator that it is ready to begin authentication.

An EAPoL-Logoff can be sent by the supplicant to indicate that the 802.1X authentication should be terminated. It is not typically used except in IP Telephony deployments where it can be sent by the phone to the switch to indicate when an 802.1X-authenticated device behind the phone disconnects from the phone.

CHAPTER 2

Deploying 802.1X

Choosing an EAP Method

Inside the framework provided by 802.1X and EAP, the end device and/or user must authenticate to the authentication server using a secure and reliable EAP method. Commonly used EAP methods include EAP-PEAP, EAP-TLS and EAP-FAST. When deploying 802.1X, it is essential to choose an EAP method that meets your organization's security policy and that is supported by the available infrastructure.

Why it Matters

Choosing an EAP method is one of the most important decisions in deploying 802.1X. Different EAP methods offer differing levels of security and complexity. Moreover, the choice of EAP type will affect all the components in the network from the supplicant to the backend database.

Note Multiple EAP methods can be configured on both the supplicant and authentication server. As part of the EAP negotiation, both sides will select the first method that they both support. As a best practice, we recommend configuring a single EAP method if possible, since that offers a deterministic way to enforce the same EAP method for every user and device on the network.

Security Policy and EAP Method

Not every EAP method is suitable for every organization's security policy. Organizations with the highest security requirements might be required to implement EAP-TLS—which provides the strongest authentication method using client and server-side certificates. Other security policies might allow for the very good security offered by EAP-PEAP or EAP-FAST.

PKI and EAP Method

Each EAP method makes different demands on an organization's Public Key Infrastructure (PKI). PKI refers to the infrastructure that creates, maintains, and revokes X.509 certificates for devices and users in the network. An organization's ability to support PKI might influence the choice of an EAP method. Maintaining a PKI is a complex task and EAP methods with greater PKI requirements are typically more complex to deploy—especially if an organization is rolling out PKI for the sole purpose of supporting the 802.1X deployment.

The three most command EAP strategies generally differ in terms of complexity of PKI implementation as follows:

- EAP-TLS requires the most complex PKI
- EAP-PEAP requires moderately complex PKI
- EAP-FAST with autonomous provisioning requires no PKI

Note The most secure EAP method, EAP-TLS, is also the most complex to deploy. Finding the right balance between complexity and security is an important part of choosing an EAP method.

Supplicant and EAP Method

Not all supplicants support all EAP methods. When choosing a supplicant, be sure to verify that it supports the EAP method you wish to deploy.

Authentication Servers and EAP Method

Not all authentication servers support all EAP methods. When choosing an authentication server, be sure to verify that it supports the EAP method you wish to deploy.

Backend Data Storage and EAP Method

Not all backend data stores support all EAP methods. When choosing a backend data store, be sure to verify that it supports the EAP method you wish to deploy. Or, conversely, if you already have a backend data store, be sure to choose an EAP method that can leverage it. For example, an EAP type that uses MSCHAPv2 as the inner method (such as PEAP-MSCHAPv2) can use Active Directory as a backend database, but not a generic LDAP server.

EAP Methods

The following section gives a detailed technical overview of different EAP methods, starting with a description of the basic functionality and ending with specific deployment considerations and recommendations for each method. Summaries are provided for the following:

- EAP-TLS, page 2-2
- PEAP-MSCHAPv2, page 2-10
- EAP-FAST, page 2-13

For more information on design recommendations and how to choose an EAP type, see [insert reference to Jason's design paper].

Comment: Specific doc link/title needed for X-ref.

EAP-TLS

This section provides the following EAP-TLS descriptions:

- Basic Functionality (EAP-TLS), page 2-3
- Deployment Recommendations (EAP-TLS), page 2-4

Basic Functionality (EAP-TLS)

EAP-Transport Layer Security (EAP-TLS) is an IETF standard defined in RFC 2716. As discussed in Chapter 1, "Introduction," EAP-TLS addresses a number of weaknesses in other EAP protocols by using X.509 certificates for secure authentication. In addressing these weaknesses, however, EAP-TLS increases the complexity of deployment. Unlike PEAP-MSCHAPv2 (which requires only server-side certificates) and EAP-FAST (which requires no certificates), EAP-TLS requires client-side and server-side certificates for mutual authentication.

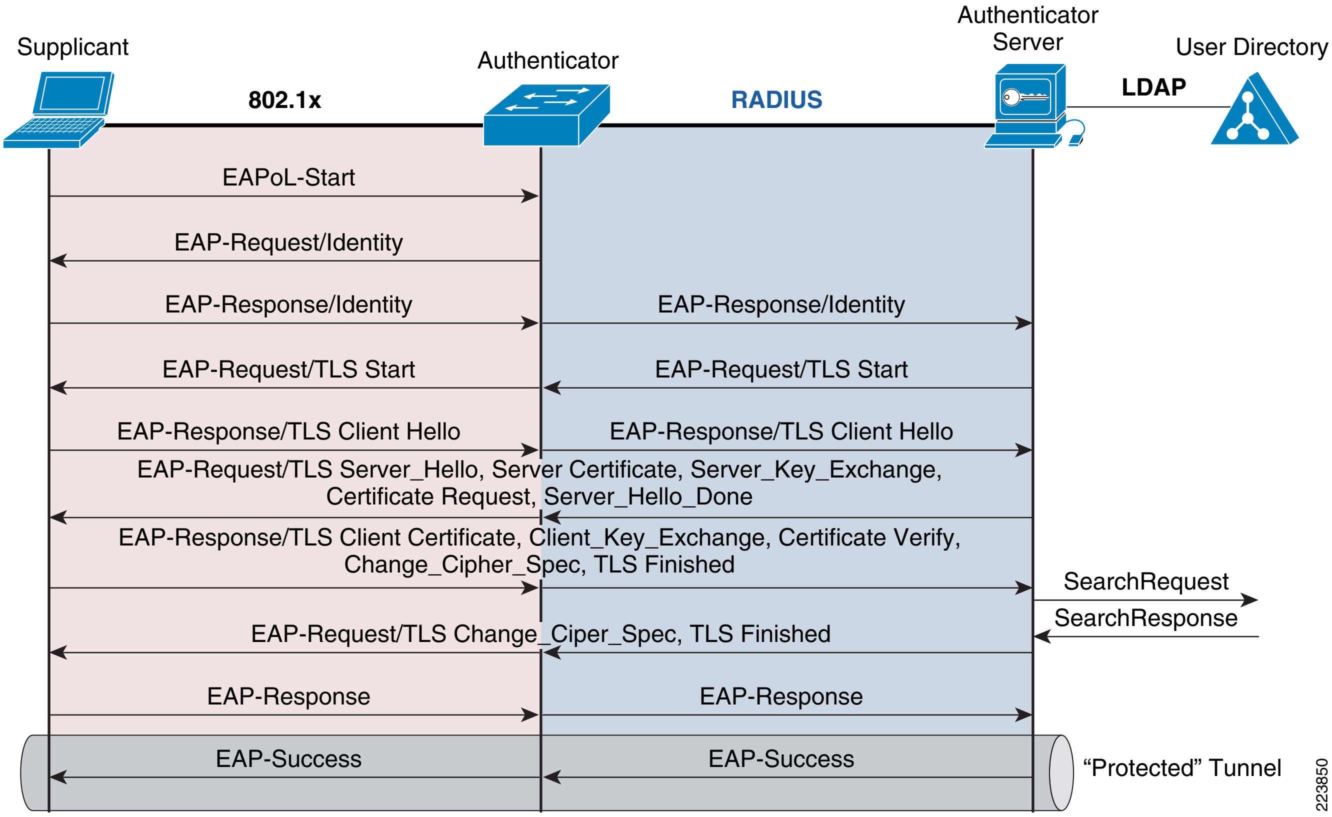
Some of the benefits of EAP-TLS include:

- The ability to provide per-packet confidentiality and integrity protection—which protects user identity.
- A standardized mechanism for key exchange.
- Support for acknowledged success/failure indications. The EAP-TLS protocol allows for TLS Alert messages which can be sent from the server or the client to describe exactly what caused the handshake to fail.

Within IEEE 802.1X, the EAP-TLS exchange of messages provides mutual authentication, negotiation of the encryption method, and encrypted key determination between a supplicant and an authentication server.

Figure 2-1 illustrates the EAP-TLS message exchange between the supplicant, authenticator, and authentication server.

Figure 2-1 EAP-TLS Message Exchange


Supplicant
Authenticator
Authenticator Server
User Directory
802.1x
RADIUS
LDAP
EAPoL-Start
EAP-Request/Identity
EAP-Response/Identity
EAP-Response/Identity
EAP-Request/TLS Start
EAP-Request/TLS Start
EAP-Response/TLS Client Hello
EAP-Response/TLS Client Hello
EAP-Request/TLS Server_Hello, Server Certificate, Server_Key_Exchange, Certificate Request, Server_Hello_Done
EAP-Response/TLS Client Certificate, Client_Key_Exchange, Certificate Verify, Change_Cipher_Spec, TLS Finished
SearchRequest
SearchResponse
EAP-Request/TLS Change_Ciper_Spec, TLS Finished
EAP-Response
EAP-Response
EAP-Success
EAP-Success
"Protected" Tunnel
223850

The EAP-TLS message exchange can be described as follows:

1. First, a client running the IEEE 802.1X supplicant connects to the network and sends an EAPoL-Start message to the authenticator.

Note The CSSC client always sends EAPoL-Start messages. The native supplicant in Windows XP uses the SupplicantMode registry setting to control if and when the supplicant sends an EAPoL-Start. See "Registry Settings" section on page 2-19 for more information on Windows XP registry settings.

2. Next, the authenticator sends an EAP Identity request to the supplicant and the supplicant replies with an EAP Identity response—which sends the EAP outer-identity (typically, the username) in the clear. For more information, see RFC 2716.
3. The authenticator forwards the response to the authentication server inside a RADIUS Request message.
4. The authentication server sends an EAP-TLS Start message, packaged inside a RADIUS Response message.
5. The authenticator extracts the EAP-TLS Start message and forwards it to the client via 802.1X. The authenticator continues to forward all subsequent EAP-TLS messages via RADIUS to the authentication server and via 802.1X to the supplicant.
6. In response to the EAP-TLS Start, the supplicant replies with an EAP-TLS Client Hello.
7. The authentication server sends its X.509 PKI certificate to the supplicant and requests that the supplicant send its certificate.
8. The supplicant verifies the certificate with the authentication server's public key and sends its certificate to the authentication server.
9. The authentication server verifies the supplicant's certificate, thus authenticating the identity of the user. The authentication server queries a user database (either the ACS internal database or an external database such as Active Directory or OpenLDAP) to verify that this user is allowed access to the network.
10. The authentication server instructs the authenticator to authorize network access for the user.
11. The authenticator then enables the port connected to the supplicant.

Deployment Recommendations (EAP-TLS)

This section includes descriptions of the following:

- Certificate Requirements, page 2-4
- EAP-TLS and Machine Authentication, page 2-5
- Deployment Recommendations, page 2-7

Certificate Requirements

One of the biggest challenges when deploying EAP-TLS is meeting the certificate requirements. EAP-TLS provides authentication through the exchange and verification of X.509 certificates. Therefore, installing the correct certificates on 802.1X supplicants and the authentication server is absolutely essential to a successful deployment.

Every end user and computer (including the ACS) that participates in EAP-TLS must possess at least two certificates:

- Personal Certificate signed by the Certificate Authority (CA)
- A copy of the CA Root Certificate

The Personal Certificate is like a passport that cannot be forged. A user (or computer) presents a Personal Certificate as proof of identity. The Personal Certificate is signed by the Certificate Authority (CA) that issued it. Anyone in possession of a copy of that CA's Root Certificate can validate the signature on the Personal Certificate. Thus, the CA is a trusted third party that allows entities to mutually authenticate.

In an EAP-TLS exchange, the authentication server must have a copy of the Root Certificate for the CA that signed the supplicant's Personal certificate. Conversely, the supplicant must have the Root Certificate for the CA that signed the authentication server's Personal certificate.

EAP-TLS cannot succeed without certificates. However, EAP-TLS does not define how to obtain, manage, or revoke certificates. Those tasks are the responsibility of an organization's PKI. Although a complete discussion of designing a PKI is beyond the scope of this paper, the following guidelines illustrate key components of PKI design that can impact the deployment and functionality of EAP-TLS:

- *Certificate Authorities*—Choosing a Certificate Authority is an important step in designing an organization's PKI. Broadly speaking, a Certificate Authority can be either external or internal. External CAs (such as RSA or Verisign) are owned and managed by third parties. Using an external CA can reduce some of the significant administrative overhead associated with provisioning and maintaining PKI.

  Internal CAs are owned and managed by the organization itself. An internal CA provides local control, confidentiality, and flexibility at the cost of an increased burden on an organization's security and IT administrators. In Microsoft environments, the administrative burden of an internal CA can be reduced by using a Microsoft Certificate Authority integrated into a Microsoft Active Directory infrastructure.

- *Managing Certificates*—Certificates do not live forever. Like passports, certificates can expire or be revoked. If either of these events occurs, the certificate can no longer be used for EAP-TLS authentication.

  Certificates expire according to the date set by the Certificate Authority that issued them. Client certificates issued by the Microsoft CA have a lifetime of one year by default. The duration of a certificate's lifetime should be configured in accordance with an organization's security policy. An organization's PKI should be designed to enable certificate renewal well in advance of the expiration date to prevent loss of connectivity.

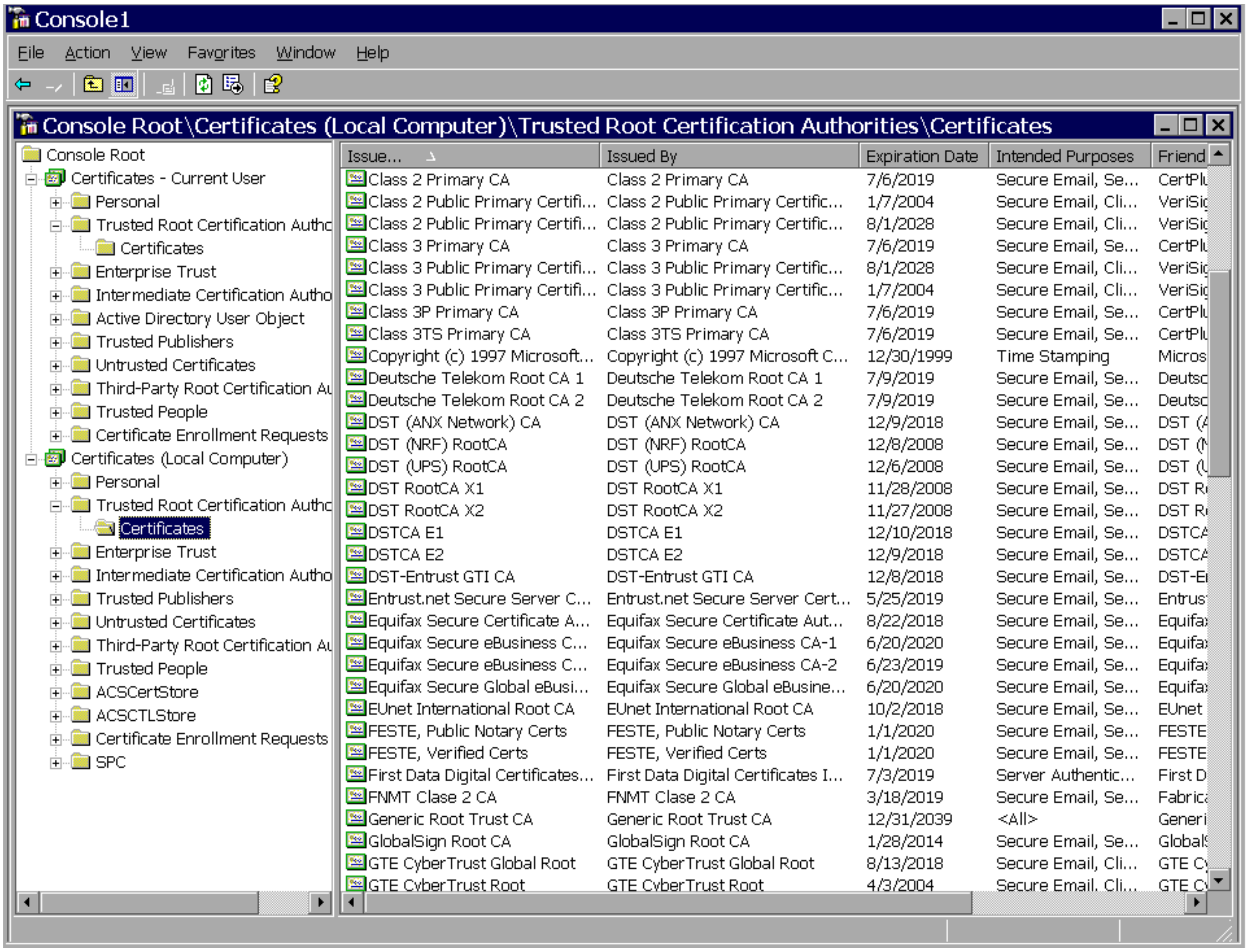
  Certificates can be revoked for a number of reasons. For example, the certificate may have been compromised or the person to whom the certificate was issued might have left the organization. These certificates will need to be revoked to prevent them being used to gain unauthorized access to an organization's assets. Certificate revocation is achieved through a Certificate Revocation List (CRL). A CA periodically generates a CRL which contains a list of all certificates that should no longer be trusted. Entities with a need to validate certificates issued by a CA can download the CRL and use it to validate certificates. This eliminates the need to contact the CA for every authentication. The CRL is issued with a (usually short) lifetime during which it is valid. When the CRL is about to expire (or at some configurable interval), a device will download the latest CRL from the CA. The short lifetime of the CRL ensures that the entity possesses current information about which certificates have been revoked.

EAP-TLS and Machine Authentication

As discussed earlier, machine authentication enables secure and rapid login to enterprise Active Directory domains. When deploying EAP-TLS for machine authentication, it is important to remember that the machine and the user who logs into the machine are two separate entities as far as 802.1X is concerned. The machine authenticates independently of any users that log onto the machine. This means that Personal Certificates are required for the machine itself as well as for any user who needs to log into that machine.

In Windows-based systems, certificates are locally stored in *certificate stores*. User certificate stores are separate from machine certificate store. Within each store, certificates are organized in folders. There are folders for Personal Certificates, Trusted Root CA Certificates and so on. The certificate stores for the local computer and current user are shown in Figure 2-2.

Figure 2-2 Microsoft Certificate Stores


Console1
File Action View Favorites Window Help
Console Root\Certificates (Local Computer)\Trusted Root Certification Authorities\Certificates
Console Root
Certificates - Current User
Personal
Trusted Root Certification Autho
Certificates
Enterprise Trust
Intermediate Certification Autho
Active Directory User Object
Trusted Publishers
Untrusted Certificates
Third-Party Root Certification Au
Trusted People
Certificate Enrollment Requests
Certificates (Local Computer)
Personal
Trusted Root Certification Autho
Certificates
Enterprise Trust
Intermediate Certification Autho
Trusted Publishers
Untrusted Certificates
Third-Party Root Certification Au
Trusted People
ACSCertStore
ACSCTLStore
Certificate Enrollment Requests
SPC
223851

Issue...	Issued By	Expiration Date	Intended Purposes	Friend
Class 2 Primary CA	Class 2 Primary CA	7/6/2019	Secure Email, Se...	CertPlu
Class 2 Public Primary Certifi...	Class 2 Public Primary Certific...	1/7/2004	Secure Email, Cli...	VeriSig
Class 2 Public Primary Certifi...	Class 2 Public Primary Certific...	8/1/2028	Secure Email, Cli...	VeriSig
Class 3 Primary CA	Class 3 Primary CA	7/6/2019	Secure Email, Se...	CertPlu
Class 3 Public Primary Certifi...	Class 3 Public Primary Certific...	8/1/2028	Secure Email, Cli...	VeriSig
Class 3 Public Primary Certifi...	Class 3 Public Primary Certific...	1/7/2004	Secure Email, Cli...	VeriSig
Class 3P Primary CA	Class 3P Primary CA	7/6/2019	Secure Email, Se...	CertPlu
Class 3TS Primary CA	Class 3TS Primary CA	7/6/2019	Secure Email, Se...	CertPlu
Copyright (c) 1997 Microsoft...	Copyright (c) 1997 Microsoft C...	12/30/1999	Time Stamping	Micros
Deutsche Telekom Root CA 1	Deutsche Telekom Root CA 1	7/9/2019	Secure Email, Se...	Deutsc
Deutsche Telekom Root CA 2	Deutsche Telekom Root CA 2	7/9/2019	Secure Email, Se...	Deutsc
DST (ANX Network) CA	DST (ANX Network) CA	12/9/2018	Secure Email, Se...	DST (A
DST (NRF) RootCA	DST (NRF) RootCA	12/8/2008	Secure Email, Se...	DST (N
DST (UPS) RootCA	DST (UPS) RootCA	12/6/2008	Secure Email, Se...	DST (U
DST RootCA X1	DST RootCA X1	11/28/2008	Secure Email, Se...	DST Ro
DST RootCA X2	DST RootCA X2	11/27/2008	Secure Email, Se...	DST Ro
DSTCA E1	DSTCA E1	12/10/2018	Secure Email, Se...	DSTCA
DSTCA E2	DSTCA E2	12/9/2018	Secure Email, Se...	DSTCA
DST-Entrust GTI CA	DST-Entrust GTI CA	12/8/2018	Secure Email, Se...	DST-En
Entrust.net Secure Server C...	Entrust.net Secure Server Cert...	5/25/2019	Secure Email, Se...	Entrus
Equifax Secure Certificate A...	Equifax Secure Certificate Aut...	8/22/2018	Secure Email, Se...	Equifa
Equifax Secure eBusiness C...	Equifax Secure eBusiness CA-1	6/20/2020	Secure Email, Se...	Equifa
Equifax Secure eBusiness C...	Equifax Secure eBusiness CA-2	6/23/2019	Secure Email, Se...	Equifa
Equifax Secure Global eBusi...	Equifax Secure Global eBusine...	6/20/2020	Secure Email, Se...	Equifa
EUnet International Root CA	EUnet International Root CA	10/2/2018	Secure Email, Se...	EUnet
FESTE, Public Notary Certs	FESTE, Public Notary Certs	1/1/2020	Secure Email, Se...	FESTE
FESTE, Verified Certs	FESTE, Verified Certs	1/1/2020	Secure Email, Se...	FESTE
First Data Digital Certificates...	First Data Digital Certificates I...	7/3/2019	Server Authentic...	First D
FNMT Clase 2 CA	FNMT Clase 2 CA	3/18/2019	Secure Email, Se...	Fabrica
Generic Root Trust CA	Generic Root Trust CA	12/31/2039	<All>	Generi
GlobalSign Root CA	GlobalSign Root CA	1/28/2014	Secure Email, Se...	GlobalS
GTE CyberTrust Global Root	GTE CyberTrust Global Root	8/13/2018	Secure Email, Cli...	GTE Cy
GTE CyberTrust Root	GTE CyberTrust Root	4/3/2004	Secure Email, Cli...	GTE Cy

In Windows environments, the machine certificate store and the user certificate store are independent. If the Root CA certificate exists in the Local Computer Trusted Root folder but not in the User Trusted Root folder, then machine authentication will pass, but user authentication will not.

Each user who needs to log into a machine will have his or her own User certificate store. For example, suppose that Bob and Alice are two users who need to be able to log into a desktop machine called PC1. The supplicant on PC1 is configured for both machine authentication and user authentication using EAP-TLS. The internal CA is called CA1. This situation will require three certificate stores on PC1:

- PC1's machine certificate store, which contains:
  - – Personal Certificate for PC1 signed by CA1 in the Personal folder

- CA1's Root Certificate in the Trusted Root folder

- Bob's user certificate store which contains:
  - Personal Certificate for Bob signed by CA1 in the Personal folder
  - CA1's Root Certificate in the Trusted Root folder
- Alice's user certificate store which contains:
  - Personal Certificate for Alice signed by CA1 in the Personal folder
  - CA1's Root Certificate in the Trusted Root folder

If either certificate in PC1's store is missing, expired or revoked, then machine authentication will fail and the PC will not have access to the network until a subsequent user authentication succeeds. If either certificate in Bob's store is missing, expired or revoked, then Bob's EAP-TLS user authentication will fail when Bob logs into PC1 and Bob will not get access to the network. If either certificate in Alice's store is missing, expired or revoked, then Alice's EAP-TLS user authentication will fail when Alice logs into PC1 and Alice will not get access to the network. These three authentications are independent, so if the machine certificate is expired, machine authentication will fail, but Bob might still be able to access the network—if he has the correct certificates for user authentication.

Deployment Recommendations

A working public key infrastructure is a prerequisite for a successful deployment of 802.1X with EAP-TLS. Good design choices are essential to deploying PKI and EAP-TLS. This section discusses best practice recommendations for deploying a PKI for use with EAP-TLS.

Choosing a CA

As discussed previously, Certificate Authorities can be either internal or external. While there is no single best-practice for internal CAs vs. external CAs, choosing one over the other will depend on many factors, such as the following:

- Whether there is a pre-existing PKI
- The organization's security policy
- The organization's IT expertise.
- Cost of certificates signed by external CA
- Cost of maintaining an internal CA

An organization which already has an established PKI that uses an external CA should continue to use that same CA for EAP-TLS (unless security policy dictates otherwise). An organization that does not have PKI and is only interested in PKI for doing EAP-TLS should consider establishing an internal CA that can be integrated with existing directory services (such as Microsoft CA with Active Directory) to ease the deployment of PKI.

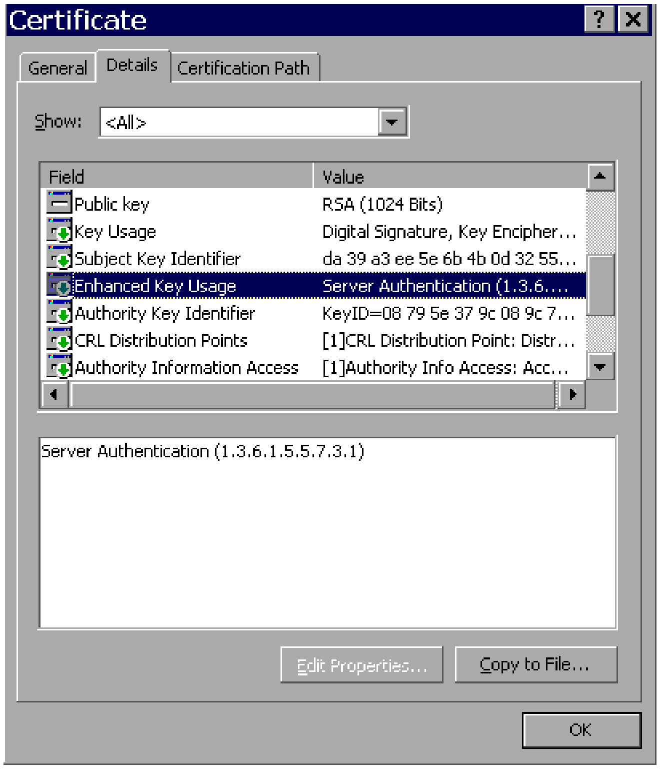
Note It is possible for EAP-TLS to function when the server and client certificates are not signed by the same CA. For example, a client may have a certificate signed by the Verisign CA while the authentication server's certificate may be signed by an internal CA. As long as the client trusts the internal CA (the client has the internal CA's root certificate) and the authentication server trusts the Verisign CA, then the client and the server can mutually authenticate via EAP-TLS. However, multiple CAs that are not in the same chain of authority can complicate the deployment, management, and troubleshooting of EAP-TLS. We recommend using a single CA certificate chain unless there is an explicit and well-understood need for multiple CAs with different certificate chains.

The configuration examples in this document reflect a best practice recommendation for an organization looking at PKI for the first time for the purposes of deploying EAP-TLS. In this topology, a single Microsoft Certificate Authority signs all certificates. Since there is a single CA, it is known as the Root CA. The CA is configured to integrate with Active Directory for simplified certificate provisioning and management. A Microsoft CA in this configuration is often referred to as an *Enterprise Root CA* as opposed to a *Standalone Root CA*—which is not integrated with Active Directory.

Note The choice of a CA may impact the choice of a supplicant. The native Microsoft Windows XP supplicant requires that the certificate presented by the ACS include an Enhanced Key Usage (EKU) field in the certificate that is set to *Server Authentication*. Likewise, the Microsoft supplicant requires that client certificates have an EKU field set to *Client Authentication*. Some CAs do not support the EKU field and thus cannot be used with the Microsoft supplicant.

Figure 2-3 shows the correct EKU field in an ACS certificate.

Figure 2-3 Required EKU for ACS Certificate



Show: <All>

Field	Value
Public key	RSA (1024 Bits)
Key Usage	Digital Signature, Key Encipher...
Subject Key Identifier	da 39 a3 ee 5e 6b 4b 0d 32 55...
Enhanced Key Usage	Server Authentication (1.3.6....
Authority Key Identifier	KeyID=08 79 5e 37 9c 08 9c 7...
CRL Distribution Points	[1]CRL Distribution Point: Distr...
Authority Information Access	[1]Authority Info Access: Acc...

Server Authentication (1.3.6.1.5.5.7.3.1)

Certificate Auto-Enrollment

While it is possible to manually install the required certificates on each host, manual certificate enrollment does not scale well. Automating the certificate enrollment process will greatly facilitate the deployment of PKI and EAP-TLS.

Caution Certificate auto-enrollment should be enabled prior to enabling 802.1X on the authenticator. If 802.1X is enabled on the authenticator before the host has acquired the necessary certificates for EAP-TLS, then authentication will fail and the host will not be able to get access to the network to perform auto-enrollment.

In Microsoft environments, it is possible to utilize Active Directory-based auto-enrollment mechanisms to simplify the deployment of PKI. The Active Directory default Group Policy will automatically propagate the Root CA certificate to the appropriate store of any device or user that joins the domain. Active Directory Group Policies can also be configured to auto-enroll machine and user personal certificates and to renew all certificates in advance of expiration. Basic instructions for configuring auto-enrollment are included in this document.

Note User Auto-Enrollment is only supported on Windows 2003 Server Enterprise Edition Certificate Authorities. Windows 2003 Server Standard Edition CA cannot be used for user auto-enrollment. Machine auto-enrollment is supported on both Editions. Because user auto-enrollment greatly simplifies PKI deployment, using a Windows 2003 Server Enterprise Edition CA is the recommended best practice when deploying EAP-TLS in a Microsoft environment. For detailed information on configuring User Certificate Auto-enrollment in Windows environments, see also: http://www.microsoft.com/technet/prodtechnol/windowsserver2003/technologies/security/autoenro.mspx#EFD

Managing Certificates

Machines or users attempting to connect to an 802.1X-protected network for the first time must have a valid certificate to gain full access to the network. Therefore, it is best to deploy certificates to all devices before enabling 802.1X in the network. After IEEE 802.1X is enabled and EAP-TLS is deployed, additional planning will be required for certificate enrollment, expiration and/or revocation. This section describes various methods that can be used when a new device must acquire a certificate and when existing devices have expired or revoked certificates.

Once 802.1X has been enabled, there are several ways for new devices to acquire certificates:

- *Organizations that pre-build device images should build certificates into the image before deploying the device*—This greatly simplifies certificate deployment and is recommended for organizations that deploy devices in this way.
- *MAB Authentication Bypass*—The new device's MAC address can be temporarily entered into a MAC database. After 802.1X times out, the device will be granted access to the network based on its MAC address. Once the device has obtained the necessary certificates, the MAC address can be removed from the MAC database so that the device will use EAP-TLS for all subsequent logins.
- *Guest VLAN*—If no MAC database is available to perform MAC authentication, then the authenticator can be configured to allow the device into the Guest VLAN after 802.1X times out. The Guest VLAN can be designed to allow limited access to the Certificate Authority so that valid certificates can be acquired. Full network access will be granted upon the next EAP-TLS authentication.

Certificates are always issued with an expiration date. To prevent devices from losing network access, these certificates must be renewed prior to expiration. A best practice is to automate certificate renewal. In Microsoft environments with Windows XP Pro clients and Windows 2003 Enterprise Edition Certificate Authority, certificates are, by default, renewed automatically within six weeks of expiration or when 80 percent of the certificate's lifetime has expired.

When certificates are revoked or expire without renewal, EAP-TLS will fail and network access will be denied. Since network access is required in order to request a new certificate, these devices and/or users will be permanently denied access by default. The device will not be able to gain access via the Guest VLAN or via MAB because those mechanisms only work when 802.1X times out, not when 802.1X fails because of a bad certificate. In this case, only the Auth-Fail VLAN can be used to grant limited access to machines or users that fail EAP-TLS authentication. The Auth-Fail VLAN can be designed to allow access to the Certificate Authority so that valid certificates can be acquired and used for the next authentication.

PEAP-MSCHAPv2

This section includes descriptions of the following:

- Basic Functionality (PEAP-MSCHAPv2), page 2-10
- Deployment Recommendations (PEAP-MSCHAPv2), page 2-12

Basic Functionality (PEAP-MSCHAPv2)

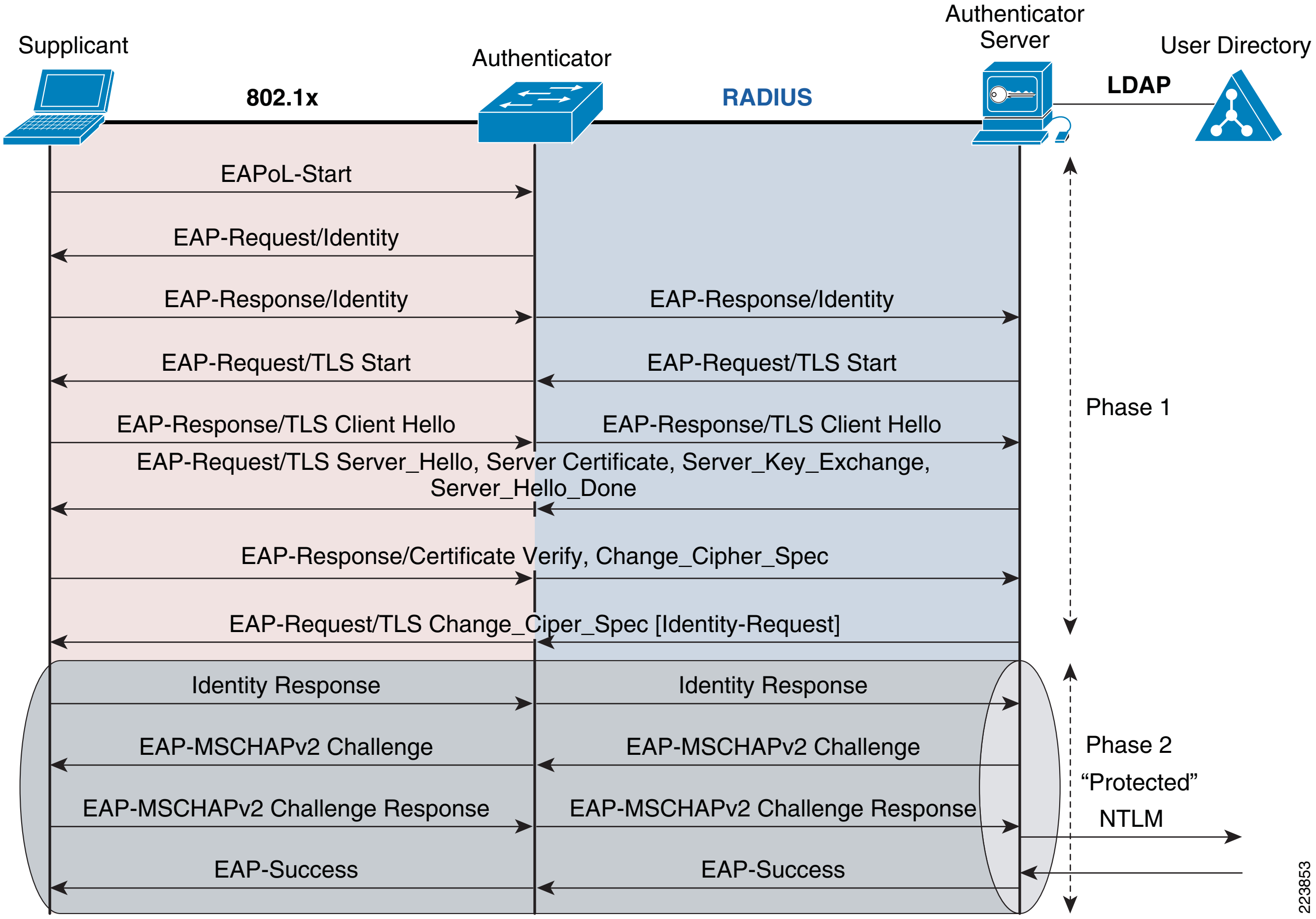
PEAP was developed by Cisco Systems, Microsoft Corporation, and RSA Security Inc. PEAP is an EAP type that addresses security issues by first creating a secure channel that is both encrypted and integrity-protected with TLS. This tunnel is created using a valid server certificate that the authentication server sends to the supplicant at the beginning of the PEAP negotiation. Inside this secure channel, a new EAP negotiation takes place to authenticate the client. This second EAP negotiation can be virtually any EAP type—such as MSCHAPv2 and Generic Token Card (GTC). This document addresses MSCHAPv2 because it is the default method of the Windows XP supplicant. The CSSC supplicant supports other inner methods as well.

Because the TLS channel protects EAP negotiation and authentication for the network access attempt, password-based authentication protocols that are normally susceptible to an offline dictionary attack can be safely used for authentication. By wrapping the EAP messages within TLS, any EAP method running within PEAP is provided with built-in support for key exchange, session resumption, fragmentation, and reassembly. Furthermore, since PEAP only requires a personal certificate on the authentication server, it is possible to securely authenticate LAN clients without requiring every client to have its own personal certificate. The client still needs a copy of the root CA certificate in order to validate the authentication server's certificate, but managing root CA certificates is significantly simpler than managing a unique personal certificate for every device and user in the network. This greatly reduces the burden of deploying and maintaining a public key infrastructure (PKI) and thus simplifies the architecture of secure wired/wireless LANs.

Note PEAP is supported in Windows XP Service Pack 1 (SP1), Windows XP Service Pack 2 (SP2), Windows Server 2003, and Windows 2000 Service Pack 4 (SP4). CSSC supports PEAP under the full wired/wireless license.

MSCHAPv2 is commonly used as the second EAP type inside a PEAP tunnel. MS-CHAPv2 is a password-based, challenge-response, mutual authentication protocol that uses MD4 and DES to encrypt responses. The authenticator challenges a supplicant and the supplicant can challenge the authentication server. If either challenge is not correctly answered, the connection can be rejected. MS-CHAPv2 was originally designed by Microsoft as a PPP authentication protocol to provide better protection for dial-up and VPN connections, although it is now an EAP type as well. Although MSCHAPv2 provides better protection than previous challenge-response authentication protocols, it is still susceptible to an offline dictionary attack. A malicious user can capture a successful MSCHAPv2 exchange and guess passwords until the correct one is determined. Used in the combination with PEAP, the MSCHAPv2 exchange is protected with the strong security of the TLS channel. Figure 2-4 illustrates the PEAP with MSCHAPv2 message exchange between the supplicant, authenticator, and authentication server.

Figure 2-4 PEAP MSCHAPv2 Message Exchange



The PEAP-MSCHAPv2 message exchange can be described by the following steps:

1. First, a client running the IEEE 802.1X supplicant connects to the network and sends an EAPoL-Start message to the authenticator.
2. The authenticator sends an EAP Identity request to the supplicant and the supplicant replies with an EAP Identity response which sends the EAP outer-identity (typically, the username) in the clear. For more information, see RFC 2716.
3. The authenticator forwards the response to the authentication server via RADIUS.
4. The authentication server sends an EAP-TLS Start message to the supplicant and the supplicant replies with an EAP-TLS Client Hello.
5. The authentication server sends its X.509 PKI certificate to the supplicant.
6. The supplicant verifies the certificate with the authentication server’s public key and sends an updated ciphersuite.
7. The authentication server agrees to the ciphersuite.

8. With the TLS tunnel now established, the authentication server sends an encrypted EAP-MSCHAPv2 challenge to the supplicant and the supplicant replies with a challenge-response.
9. The authentication server confirms the user identity by consulting a user database and then instructs the authenticator to authorize network access for the user.
10. The authenticator then enables the port connected to the supplicant.

Deployment Recommendations (PEAP-MSCHAPv2)

This section includes descriptions of the following:

- Credential Requirements, page 2-12
- PEAP-MSCHAPv2 and Machine Authentication, page 2-12
- Deployment Recommendations, page 2-13

Credential Requirements

Like EAP-TLS, PEAP-MSCHAPv2 requires that the authentication server present a certificate to the supplicant. To validate the server certificate, the supplicant must have the Root Certificate for the CA that signed the authentication server's Personal certificate. Unlike EAP-TLS, PEAP-MSCHAPv2 does not require that the supplicant have a Personal certificate. This is because supplicant establishes its identity inside the tunnel via MSCHAPv2. MSCHAPv2 authentication relies upon a shared secret (password), not a certificate.

Every end user and computer that participates in PEAP-MSCHAPv2 must possess the following credentials:

- Root CA Certificate for the CA that signed the authentication server's Personal certificate
- MSCHAPv2 password

The authentication server must possess the following credentials:

- Personal certificate signed by the root CA
- MSCHAPv2 password for every user and computer

Note For more specifics on certificate deployment and management, refer to the "EAP-TLS" section on page 2-2.

PEAP-MSCHAPv2 and Machine Authentication

When deploying PEAP-MSCHAPv2 for machine authentication, it is important to remember that the machine and the user who logs into the machine are two separate entities as far as 802.1X is concerned. The machine authenticates independently of any users that log onto the machine.

Note During PEAP-MSCHAPv2, the machine will send its username in the format *host/machinename.domain.com*. The *host/* prefix distinguishes a machine authentication from an end user authentication.

Because machine authentication is independent from user authentication, the root CA certificate must be in the machine certificate store as well as the user store so that the authentication server's certificate can be validated during machine authentication and during user authentication. For more information on Microsoft certificate stores, see "EAP-TLS" section on page 2-2. In addition, an MSCHAPv2 shared secret is required for the machine as well as each user. In Microsoft environments, a machine automatically acquires a machine password when it joins the domain. The machine password is stored in Active Directory and is typically refreshed every 30 days.

Deployment Recommendations

Deploying and Managing Certificates

PEAP does require X.509 certificates, but the certificate requirements are significantly less than those needed for EAP-TLS. Since PEAP does not require personal certificates on the supplicants, the root CA certificate is the only certificate needed by end hosts. In a Microsoft Active Directory environment with an integrated Microsoft Certificate Authority configured as the Enterprise root CA, the root CA certificate will automatically be added to the machine certificate store and the user certificate store of every machine and user in the domain. Therefore, the only certificate needed by the end host will, in many cases, be automatically downloaded without intervention from the end user or IT staff.

Unlike the supplicants, the authentication server will need a personal server certificate in addition to the root CA certificate that is automatically downloaded. The server certificates must be manually downloaded to the authentication server. However, since there are relatively few authentication servers, manual certificate enrollment can be easily managed in most cases.

See the "Deployment Recommendations" section on page 2-13 for more information on choosing a CA and deploying PKI.

Passwords

Since PEAP clients do not have personal certificates, they must use some other method to authenticate themselves to the authentication server. In the case of PEAP-MSCHAPv2, the clients use passwords to successfully complete the inner MSCHAPv2 challenge. In Microsoft Active Directory environments, the Active Directory passwords can be used for the MSCHAPv2 exchange. This is often referred to as *single sign-on* because the end user enters his or her password only once (at the Microsoft login window). The 802.1X supplicant reuses this password for MSCHAPv2 without having to query the user again. Re-using Active Directory credentials also reduces administrative overhead since there is only one password repository to manage. CSSC and the native Windows XP supplicant both support single sign-on with Active Directory passwords. This is a recommended best practice.

For machine authentication, machines need Active Directory passwords for the same reasons that users need Active Directory passwords. Active Directory automatically provisions machines with machine passwords suitable for MSCHAPv2 when the machine joins the domain. In most cases, no further action is required to provision the machine with suitable credentials.

Password aging is often enabled in Active Directory as part of a larger Windows security policy. To prevent network outages when Active Directory passwords expire, the Cisco ACS server supports user-changeable passwords during PEAP authentication. When attempting PEAP-MSCHAPv2 using an expired Active Directory password, users receive a dialog box prompting them to change their passwords upon their first successful authentication after their passwords have expired.

EAP-FAST

This section includes descriptions of the following:

- Basic Functionality (EAP-FAST), page 2-14
- Deployment Recommendations (EAP-FAST), page 2-16

Basic Functionality (EAP-FAST)

EAP-FAST was developed by Cisco Systems and published as the IETF Informational RFC 4851. Similar to PEAP, the EAP-FAST protocol first establishes a TLS tunnel. Inside this encrypted tunnel, a secondary EAP method (such as MSCHAPv2 or GTC) is used to authenticate the user. While the overall process is similar to PEAP, EAP-FAST differs significantly in that tunnel establishment is based upon a strong shared secret key (not a server-side certificate as it is in PEAP). These shared secrets are called Protected Access Credentials (PACs). Because handshakes based upon PAC shared secrets are intrinsically faster than handshakes based upon a PKI infrastructure, EAP-FAST is significantly faster than PEAP.

EAP-FAST requires that every user and machine in the network have a unique PAC prior to attempting authentication. These PACs may be distributed automatically or manually to client devices. When a PAC is provisioned automatically, the provisioning process is referred to as EAP-FAST Phase 0. Once the PAC has been provisioned, it can be re-used until it expires or until the Master PAC that was used to create it expires. After a PAC expires, the host must re-provision its PAC by executing EAP-FAST Phase 0 again. Optionally, as an optimization, an authentication server can refresh a host's PAC at the end of a successful EAP-FAST authentication. If a PAC is refreshed in this way, it is less likely to expire and require a full Phase 0 re-provisioning.

Note Cisco ACS automatically refreshes PACs after every successful EAP-FAST authentication.

When PACs are distributed automatically, the provisioning of the PAC must happen inside an encrypted tunnel so that the PAC cannot be snooped by malicious users. There are two ways to create an encrypted provisioning tunnel: anonymous and authenticated. In anonymous provisioning, the supplicant and the authentication server set up an anonymous TLS tunnel using the Diffie-Hellman protocol. The Diffie-Hellman key exchange protocol allows two anonymous parties to establish a shared secret key that can be used to encrypt further communication in a TLS tunnel. Diffie-Hellman does not require X.509 certificates of any sort on either the supplicant or authentication server side. Once this anonymous tunnel has been established, the supplicant and authenticator can use any EAP method that supports mutual authentication to verify each other's identity. MSCHAPv2 is often used for this purpose since the challenge-response mechanism requires that both parties have knowledge of the username and password being authenticated. Whichever inner method is used, once the encrypted authentication has succeeded, the authentication server can securely send a PAC to the supplicant inside the encrypted tunnel.

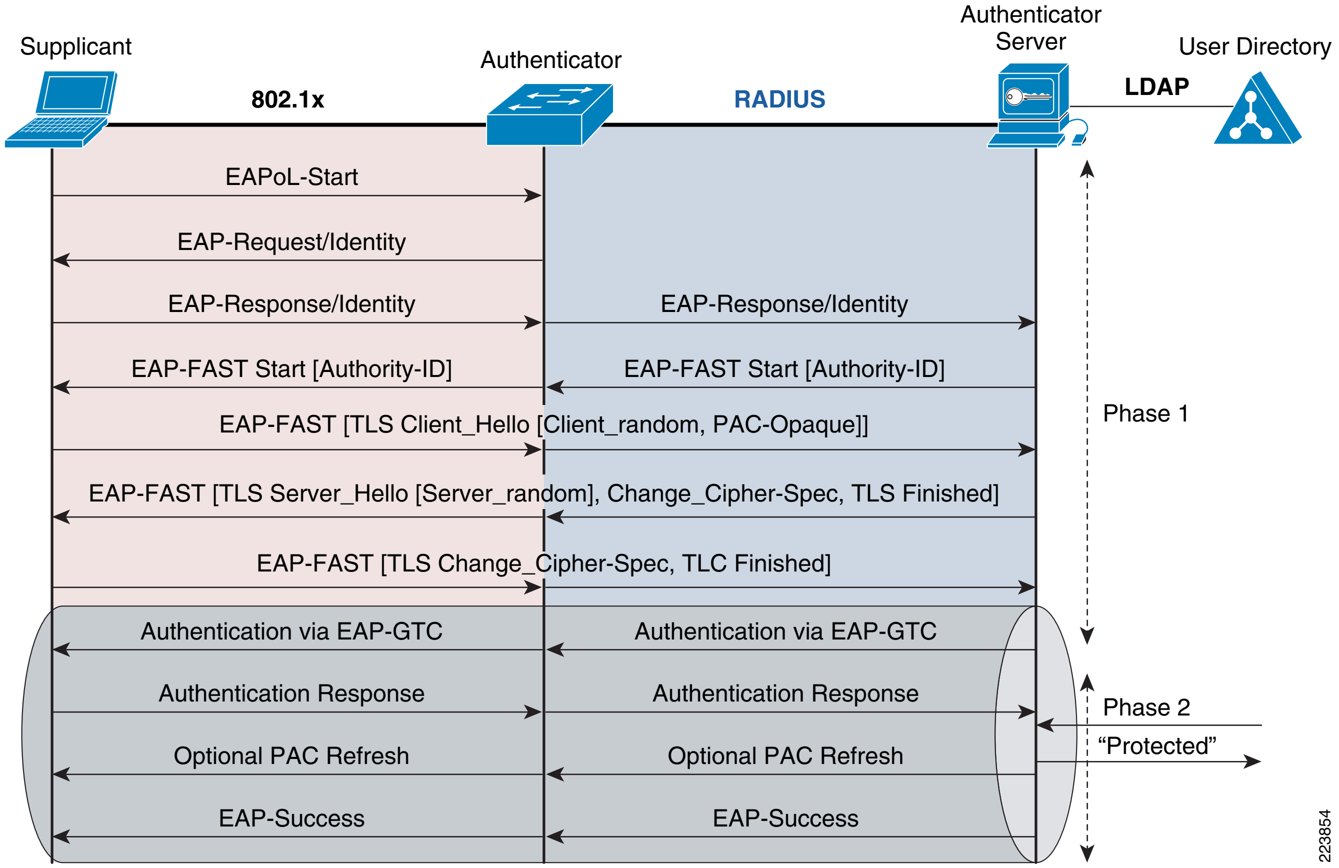
Note EAP-GTC cannot be used with anonymous PAC provisioning because it provides one-way authentication only. With GTC, the server can verify that the client possesses a valid password, but the client does not know if it is talking to a valid server. Since the server did not prove its identity during the anonymous tunnel establishment, the inner method must provide a mechanism for doing so.

In authenticated PAC provisioning, the TLS tunnel is created based on a server-side certificate presented by the authentication server. This is very similar to the establishment of a tunnel in PEAP. After the tunnel has been created, the client must authenticate itself to the authentication server in order to receive a PAC. Since the server has already authenticated itself by presenting a valid server certificate, the client can use any method to authenticate itself and is not restricted to mutually-authenticating protocols such as MSCHAPv2. MSCHAPv2 can still be used, but so can EAP-GTC or even EAP-TLS (if the client also has a personal certificate).

Once a supplicant is in possession of a PAC, EAP-FAST authentication can occur. This happens in two phases. In Phase 1, an encrypted tunnel is established based on the PAC. The PAC itself is never sent on the wire where it could be snooped and subjected to a dictionary attack. Instead, the supplicant sends an encrypted *PAC-Opaque* value from which the authentication server can derive the PAC (assuming it possesses the Master PAC). If the authentication server can derive the PAC and establish the tunnel, then the supplicant can be sure of the authentication server's identity. Thus, the establishment of the PAC-based tunnel effectively authenticates the server to the supplicant. In Phase 2, the supplicant authenticates itself to the server using an authentication protocol that is known as the *inner method*. The inner method can be any EAP method. The most commonly used are MSCHAPv2, EAP-TLS, and EAP-GTC.

Figure 2-5 illustrates the EAP-FAST Phase 1 and Phase 2 message exchange between the supplicant, authenticator, and authentication server using EAP-GTC as the inner method in Phase 2. This exchange presumes that a PAC has been previously provisioned using one of the methods described above so Phase 0 is not shown.

Figure 2-5 EAP-FAST Message Exchange


Supplicant
Authenticator
Authenticator Server
User Directory
802.1x
RADIUS
LDAP
EAPoL-Start
EAP-Request/Identity
EAP-Response/Identity
EAP-Response/Identity
EAP-FAST Start [Authority-ID]
EAP-FAST Start [Authority-ID]
EAP-FAST [TLS Client_Hello [Client_random, PAC-Opaque]]
EAP-FAST [TLS Server_Hello [Server_random], Change_Cipher-Spec, TLS Finished]
EAP-FAST [TLS Change_Cipher-Spec, TLC Finished]
Phase 1
Authentication via EAP-GTC
Authentication via EAP-GTC
Authentication Response
Authentication Response
Optional PAC Refresh
Optional PAC Refresh
EAP-Success
EAP-Success
Phase 2
"Protected"
223854

The process illustrated in Figure 2-5, sequences as outlined in the following:

1. First, a client running the IEEE 802.1X supplicant connects to the network and sends an EAPoL-Start message to the authenticator.
2. The authenticator sends an EAP Identity request to the supplicant and the supplicant replies with an EAP Identity response which sends the EAP outer-identity (typically, the username) in the clear. For more information, see RFC 2716.
3. The authenticator forwards the response to the authentication server via RADIUS.
4. The authentication server sends an EAP-FAST Start message, which includes the Authority ID, to the supplicant.

5. Based on the Authority ID sent by the authentication server, the supplicant selects a stored PAC, which is a unique shared key used to mutually authenticate the supplicant and server.
6. The supplicant then replies to the authentication server with a PAC opaque (based on the PAC key).
7. The authentication server decrypts the PAC opaque using a master key to derive the PAC key. At this point, both the supplicant and server possess the same PAC key and create a TLS tunnel.
8. The authentication server sends an EAP-GTC request to the supplicant and the supplicant replies with a response.
9. The authentication server confirms the user identity (querying an external database if necessary), optionally refreshes the PAC and then instructs the authenticator to authorize network access for the user.
10. The authenticator then enables the port connected to the supplicant.

Deployment Recommendations (EAP-FAST)

This section includes descriptions of the following:

- PAC Provisioning, page 2-16
- PAC Expiration, page 2-17
- Inner Methods, page 2-17
- Supplicants, page 2-18

PAC Provisioning

Before deploying EAP-FAST, it is essential to decide how PACs will be provisioned (and re-provisioned) in your network. There are three basic provisioning choices:

- Manual provisioning
- Automatic Authenticated provisioning (with MSCHAPv2, TLS or GTC inner method)
- Automatic Anonymous provisioning (with MSCHAPv2 inner method)

Each of these methods offers varying levels of convenience and security.

Manual provisioning is completely immune to any network based attacks. Since the PAC is never sent on the wire, it can never be snooped or cracked. However, manual provisioning can be a time-consuming process with high overhead. Moreover, a process for manual distribution must be developed to avoid the possibility of non-network-based attacks.

Note CSSC 4.2 does not support manual PAC provisioning.

Automatic Authenticated provisioning provides excellent security in the form of certificate-based TLS encryption along with the convenience of automatic, network-based distribution. However, certificate-based TLS tunnels require a PKI infrastructure to issue and validate server certificates.

Automatic Authenticated provisioning with MSCHAPv2 or GTC has the same certificate requirements as PEAP. In cases where there is an existing PKI infrastructure that is sufficient to support either PEAP or EAP-FAST Authenticated provisioning with MSCHAPv2 or GTC, the choice between the two methods will rest with the nature of the endpoints being authenticated. In largely wireless environments where roaming is a consideration, the speed improvements offered by PAC tunnels will make EAP-FAST more attractive. In wired environments where authentication speed is not an issue, the optimizations provided by EAP-FAST may not be worth the additional effort of deploying and maintaining PACs. This makes PEAP a better choice in wired environments with an existing PKI infrastructure that supports server-side certificates.

Automatic Authenticated provisioning with TLS has the same certificate requirements as EAP-TLS (server and client side certificates). In cases where there is an existing PKI infrastructure that is sufficient to support either EAP-TLS or EAP-FAST Authenticated provisioning with TLS, the choice between the two methods will rest with the nature of the endpoints being authenticated. In largely wireless environments where roaming is a consideration, the speed improvements offered by PAC tunnels will make EAP-FAST more attractive. In wired environments where authentication speed is not an issue, the optimizations provided by EAP-FAST might not be worth the additional effort of deploying and maintaining PACs. This makes EAP-TLS a better choice in wired environments with an existing PKI infrastructure that supports server-side and client-side certificates.

Automatic Anonymous provisioning with MSCHAPv2 offers the convenience of automatic, network-based PAC distribution without the need for any certificates. In situations where a PKI infrastructure does not exist and is not desired, Anonymous provisioning with MSCHAPv2 can be very attractive. However, the convenience of non-certificate-based PAC provisioning comes at the cost of a small security vulnerability. Since the supplicant begins the MSCHAPv2 exchange before authenticating the server, an attacker could intercept a PAC provisioning request and emulate the server. The attacker does not know the supplicant's password, so the MSCHAPv2 exchange would fail. However, the attacker would be able to collect enough information to execute an offline dictionary attack on the supplicant's password. This vulnerability, while real, is only present during EAP-FAST Phase 0 provisioning. Once the PAC is provisioned, the PAC-based encrypted tunnels will prevent any such attacks. In network environments without a PKI infrastructure and where the risk of provisioning attacks is low (where it is mitigated by physical security measures), EAP-FAST with Automatic Anonymous provisioning is a good choice for rapid deployments of 802.1X.

Note EAP-FAST with Automatic Anonymous provisioning requires a user database (such as Active Directory) that supports MSCHAPv2. Anonymous provisioning cannot be used with OTP, Novell or LDAP databases. The configuration examples in this document use Active Directory.

PAC Expiration

PACs expire in the same way passwords and certificates expire. An organization's security policy will determine the appropriate lifetime for a PAC.

The Master PAC exists on the authentication server and is used to create PACs for end users, similar to the way in which a Root CA signs Personal Certificates. The Master PAC also has an expiration time which should be configured in accordance with the organization's security policy.

Inner Methods

After the supplicant has been provisioned with a PAC, EAP-FAST authentication can begin. Phase 1 uses the PAC to establish an encrypted tunnel and, simultaneously, to authenticate the server to the supplicant. In Phase 2, the supplicant authenticates itself to the server using an inner method of authentication. Phase 2 inner methods include:

- EAP-TLS
- EAP-MSCHAPv2
- EAP-GTC

The Phase 2 inner method can be the same as the Phase 0 inner method, but need not be. The choice of a Phase 2 inner method can depend on several factors, including the Phase 0 inner method and an organization's PKI infrastructure.

If an organization has an existing (or planned) PKI infrastructure that supports client-side and server-side certificates, it would make sense to deploy Automatic Authenticated provisioning with EAP-TLS for the Phase 0 inner method. In this case, EAP-TLS would also be the natural choice for the Phase 2 inner method.

If an organization has a PKI infrastructure that supports only server-side certificates (and wants to deploy EAP-FAST instead of PEAP), then it would make sense to deploy Automatic Authenticated provisioning with MSCHAPv2 as the inner method for Phase 0 and GTC or MSCHAPv2 for Phase 2.

Note The Cisco ACS requires you to configure both GTC and MSCHAPv2 as inner methods.

If an organization had no PKI infrastructure, Automatic Anonymous provisioning with MSCHAPv2 would be the only option for Phase 0. In Phase 2, either GTC or MSCHAPv2 could be used.

Supplicants

EAP-FAST is supported by the CSSC supplicant. It is not supported by the Microsoft Windows XP supplicant.

Supplicant Specifics

Not every supplicant supports every EAP method. When planning an 802.1X deployment, it is important to choose a supplicant that supports the EAP method you wish to use. Table 2-1 lists the EAP methods supported by the Windows XP native supplicant and the Cisco SSC supplicant.

Matrix (EAP vs. Supplicant)

Table 2-1 EAP Methods Supported by Supplicants

Supplicant	Windows XP	Cisco SSC
EAP-MD5	**Yes**	**Yes**
EAP-MSCHAPV2	No	**Yes**
EAP-GTC	No	**Yes**
PEAP w/MSCHAPv2	**Yes**	**Yes**
PEAP w/OTP	No	**Yes**
PEAP w/TLS	**Yes**	**Yes**
EAP-TLS	**Yes**	**Yes**
LEAP	No	**Yes**
TTLS	No	**Yes**
EAP-FAST w/ GTC	No	**Yes**
EAP-FAST w/ MSCHAPv2	No	**Yes**
EAP-FAST w/ TLS	No	**Yes**

CSSC

The Cisco Secure Services Client (CSSC) is Cisco's 802.1X supplicant. CSSC supports user and machine authentication for wired and wireless clients. CSSC is a fully supported 802.1X supplicant with broad EAP support and an easy-to-use client interface. CSSC also offers an enterprise deployment mechanism in which user profiles can be distributed to the entire organization through a single Extensible Markup Language (XML) file.

The following options of the CSSC are available for download from the Cisco Software Center:

- Non-expiring, wired-only license for a limited feature set (see Cisco Client Services 4.1 Product Bulletin for detailed list of features)
- A 90-day full wired/wireless trial license

Window XP

Microsoft offers an integrated 802.1X supplicant as part of its Windows XP operating system. The supplicant's behavior is partially configured on the Network Properties page for each interface and partly configured via Registry Settings. These Registry Settings, which are completely independent of EAP type, are described below. The other EAP-specific configuration settings are described in Chapter 3, "Configuring 802.1X."

Registry Settings

Caution As with all modifications to the Windows Registry hive, caution must be exercised. Back up your registry before attempting these modifications. Errors in editing the registry may result in an unusable system. If you are unfamiliar or unsure of the procedures necessary to safely edit the Windows registry, do not attempt these changes.

The functionality of the Windows XP supplicant can be tuned by modifying two Windows Registry parameters: *SupplicantMode* and *AuthMode*. The functionality of these Registry settings is described below.

Note Starting with Windows 2003 server, these registry settings can also be changed via GPO. Using GPOs to modify the registry changes significantly decreases the configuration burden on the system administrator. For more information, see the *Windows Interoperability Document*.

Need the actual title of the above document .

SupplicantMode Parameter

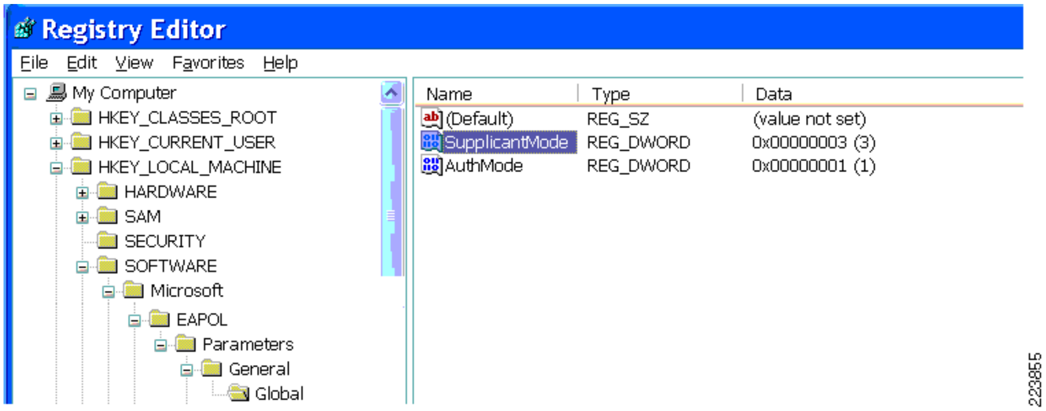
By default, the Windows XP supplicant will not send EAPoL-Start messages. This is not compliant with the IEEE 802.1X specification and might cause synchronization issues with the authenticator. For example, take an Windows XP supplicant that is configured for user authentication only. The machine is initialized and the link comes up. The authenticator will send three EAP Identity Requests at 30 second intervals by default. If user authentication is not started in that 90 second period (no one enters a username and password at the Windows login page), then the authenticator assumes that no supplicant is on the wire. If the Guest VLAN is configured, the port is deployed into the Guest VLAN and the authenticator will never send another Identity Request. When the user does eventually log in, the supplicant needs to be able to send an EAPoL-Start to alert the authenticator that it is ready to perform 802.1X. Another situation where EAPoL-Starts are required occurs when machine authentication and user authentication are both enabled. After a successful machine authentication, the authenticator will no longer send EAPoL-Requests. When the user logs in, an EAPoL start is required to alert the switch to begin user authentication.

To configure the Windows XP supplicant's EAPoL-Start behavior, create or modify the following registry setting:

- *Hive HKEY_LOCAL_MACHINE Software\Microsoft\EAPOL\Parameters\General\Global\SupplicantMode --REG_DWORD*

The location of the SupplicantMode registry setting is shown in Figure 2-6.

Figure 2-6 SupplicantMode Registry Setting



Name	Type	Data
(Default)	REG_SZ	(value not set)
SupplicantMode	REG_DWORD	0x00000003 (3)
AuthMode	REG_DWORD	0x00000001 (1)

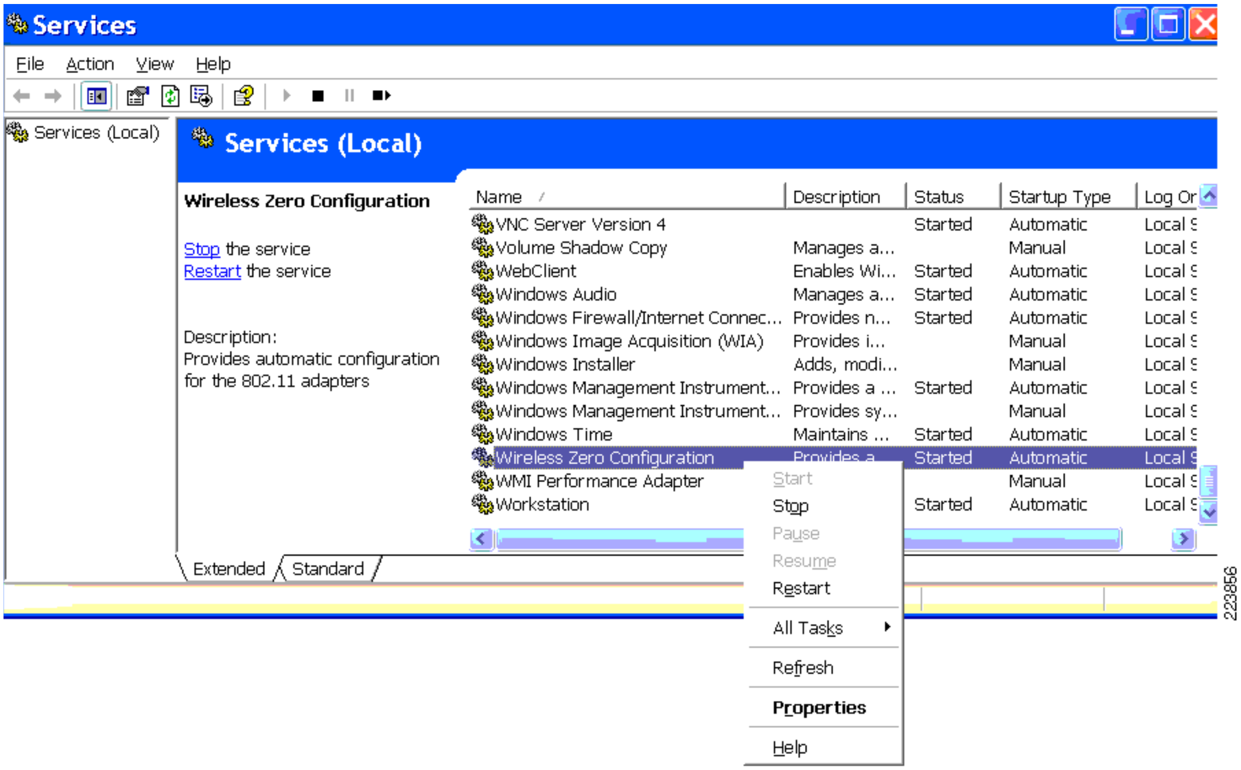
The AuthMode registry is a *REG_DWORD* variable with four possible settings:

- 0—Disable IEEE 802.1X operation.
- 1—Inhibit transmission of EAPOL-Start packets under all scenarios.
- 2—Include learning to determine when to initiate the transmission of EAPOL packets. A Windows XP Service Pack 2 (SP2)-based computer will only send an EAPOL start frame if the computer receives an EAP request identity frame and if no internal process is currently ongoing.
- 3—Compliant with IEEE 802.1X Specification.

This registry value is not created by default. If the registry value is not explicitly set, the Windows XP supplicant behaves as if the parameter is set as SupplicantMode = 2. We recommend setting SupplicantMode = 3. This registry setting affects all EAP methods. However, see the "Windows XP Client Configuration" section on page 3-106 for more discussion on EAP-TLS-specific implications of SupplicantMode.

Note If this parameter is set or modified in the registry, the service must be restarted for the parameters to take effect. To restart the Windows XP supplicant, select **Start** > **All Programs** > **Administrative Tools** > **Services**. Right-click **Wireless Zero Configuration** and select **Re-Start**. See Figure 2-7 for details.

Figure 2-7 Restarting the Microsoft Supplicant Service



Wireless Zero Configuration

Stop the service
Restart the service

Description:
Provides automatic configuration for the 802.11 adapters

Name /	Description	Status	Startup Type	Log Or
VNC Server Version 4		Started	Automatic	Local S
Volume Shadow Copy	Manages a...		Manual	Local S
WebClient	Enables Wi...	Started	Automatic	Local S
Windows Audio	Manages a...	Started	Automatic	Local S
Windows Firewall/Internet Connec...	Provides n...	Started	Automatic	Local S
Windows Image Acquisition (WIA)	Provides i...		Manual	Local S
Windows Installer	Adds, modi...		Manual	Local S
Windows Management Instrument...	Provides a ...	Started	Automatic	Local S
Windows Management Instrument...	Provides sy...		Manual	Local S
Windows Time	Maintains ...	Started	Automatic	Local S
Wireless Zero Configuration	Provides a...	Started	Automatic	Local S
WMI Performance Adapter			Manual	Local S
Workstation		Started	Automatic	Local S

AuthMode Parameter

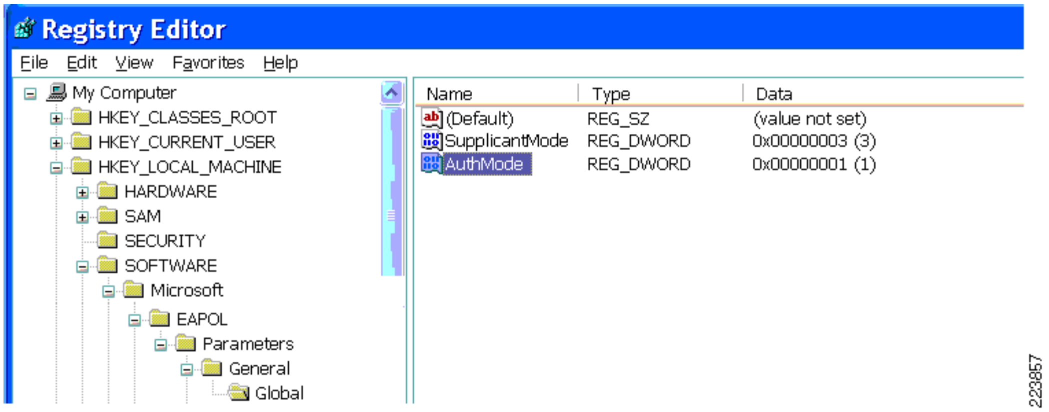
The AuthMode parameter controls whether or not the system performs user authentication. User authentication can be completely disabled, can be configured to execute after machine authentication, or can be configured as a fallback in case machine authentication fails. The AuthMode parameter cannot be used to globally enable or disable machine authentication, only user authentication. Machine authentication is enabled or disabled in the *Authentication* tab of the *Network Properties* pane of each interface. Conflicts between these two settings can cause loss of connectivity. If the AuthMode is set to globally disable user authentication and machine authentication is disabled in the *Authentication* tab, then the device will have no way to authenticate and will never gain access to the network.

To enable or disable the Windows XP supplicant's user authentication settings, create or modify the following registry setting:

- *Hive HKEY_LOCAL_MACHINE Software\Microsoft\EAPOL\Parameters\General\Global\AuthMode*

The location of the AuthMode registry setting is shown in Figure 2-8.

Figure 2-8 AuthMode Registry Setting



Name	Type	Data
(Default)	REG_SZ	(value not set)
SupplicantMode	REG_DWORD	0x00000003 (3)
AuthMode	REG_DWORD	0x00000001 (1)

The AuthMode registry is a *REG_DWORD* variable with three possible values:

- 0—Machine authentication mode with user authentication fallback. When a user logs in, if the connection has already been authenticated with Machine credentials, the user's credentials are not used for authentication. If the connection has not already been authenticated with Machine credentials, then the user's credentials will be used for authentication.
- 1—Machine authentication with user re-authentication functionality. Whenever a user logs in, 802.1X authentication is performed using the user's-credentials.
- 2—Machine authentication only - Whenever a user logs in, it has no effect on the connection. 802.1X authentication is performed using machine credentials only.

This registry value is not created by default. If the registry value is not explicitly set, the Windows XP supplicant behaves as if the parameter is set as AuthMode = 1. The recommended value for this parameter is AuthMode=1.

Note If this parameter is set or modified in the registry, the service must be restarted for the parameters to take effect. To restart the Windows XP supplicant, select **Start** > **All Programs** > **Administrative Tools** > **Services**. Right-click **Wireless Zero Configuration** and select **Re-Start**. See Figure 2-8 for more details.

RADIUS Server Specifics

Not all RADIUS servers supports all EAP types. Cisco ACS supports one of the widest arrays of EAP methods in the industry, including EAP-TLS, EAP-PEAP, EAP-FAST, and many others. Other RADIUS servers might support a subset of these types.

Backend Directory Specifics

Matrix (EAP vs. Directory)

Not all EAP methods are supported with all backend directory types. Table 2-2 summarizes the backend databases that can be used with the EAP methods discussed in this publication.

Table 2-2 Backend Databases for use with EAP Methods in this Publication

Backend Directory	EAP-TLS	PEAP-MSCHAPv2	EAP-FAST Phase 0 Anonymous	EAP-FAST Phase 0 Authenticated	EAP-FAST Phase 2
Cisco Secure ACS	Yes	Yes	Yes	Yes	Yes
Windows Active Directory	Yes	Yes	Yes	Yes	Yes
LDAP	Yes	No	No	Yes	Yes
Novell NDS	No	No	No	Yes	Yes
ODBC	Yes	Yes	Yes	Yes	Yes
All Token Servers	No	No	No	Yes	Yes

CHAPTER 3

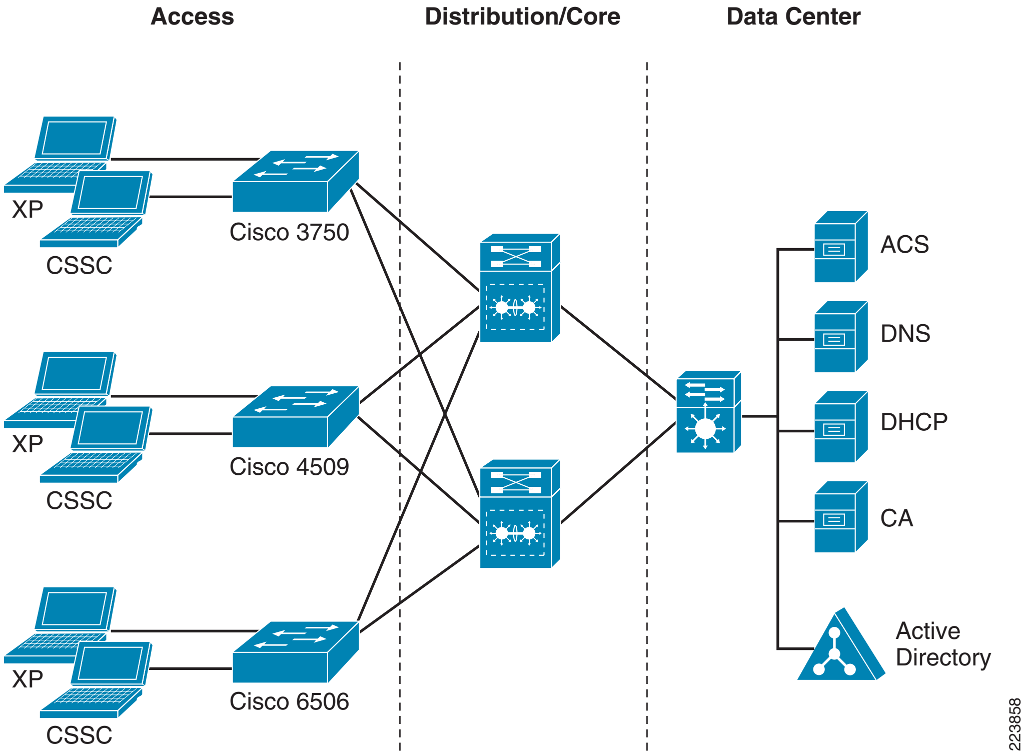
Configuring 802.1X

The three principal conceptual components of 802.1X are the *supplicant*, the *authenticator,* and the *authentication server*. Each of these components must be configured correctly for successful 802.1X authentication to occur.

Of the three key components, the authenticator is the only one from which configuration is completely independent of the EAP method. A Cisco Catalyst switch will be configured in the same way regardless of whether EAP-TLS, PEAP-MSCHAP, or EAP-FAST (or any EAP method) is used to authenticate the supplicant. In contrast, the supplicant and the authentication server are configured differently depending on the chosen EAP method.

The configuration steps listed in this guide are for a standard reference topology that represents a typically Enterprise environment. This topology is represented in Figure 3-1.

Figure 3-1 Standard Campus Design



The processes and procedures presented in this guide make the following assumptions:

- The network has been deployed following current best practices for Campus Design.
- Basic network connectivity exists between all components.
- DNS and DHCP are fully operational.
- The Windows domain has been configured in Active Directory. The domain controller is a Windows 2003 Server.
- For certificate auto-enrollment to work, the Windows Certificate Authority must run on a Windows 2003 Enterprise Edition domain member server.
- Cisco ACS runs on a domain member server. Cisco ACS software has been installed.
- Client machines with Windows XP Service Pack 2 with CSSC (if used) are installed.

Authenticators

This section details the basic configuration of the Cisco Catalyst switch deployed as an authenticator in an 802.1X deployment. The authenticator controls physical access to the network based on the authentication status of the client. The authenticator acts as an intermediary between the client and the authentication server, requesting identity information from the client, verifying that information with the authentication server, and relaying a response to the client. The authenticator communicates with the client via EAPoL and with the authentication server via RADIUS.

The basic configuration of the Cisco Catalyst switch remains constant within any IEEE 802.1X deployment regardless of the EAP method chosen for authentication. The EAP method is agreed upon by the client and authentication server and the authenticator simply proxies the information between the two of them.

Cisco IOS

Cisco Catalyst switches running Cisco IOS require certain commands to enable IEEE 802.1X. Additional commands can be configured to enable optional functionality or change default parameters. The necessary global and interface commands are explained in the following sections. A basic example is also provided to highlight the recommended configuration requirements. These configurations are valid for the versions listed in Table 3-1.

Table 3-1 Software Supported and Tested

Platform and OS	Minimum Supported OS Version	OS Version Tested
Cisco Catalyst 6500 CatOS	6.2(2)	8.6(1)
Cisco Catalyst 6500 Cisco IOS	12.1(12b)E	12.2(33)SXH
Cisco Catalyst 4500 Cisco IOS	12.1(12c)EW	12.2(37)SE
Cisco Catalyst 3750 Cisco IOS	12.1(11)AX	12.2(40)SG

RADIUS Configuration for Cisco IOS

RADIUS is the protocol the switch uses to communicate with the ACS server during 802.1X authentication. The RADIUS commands required to configure IEEE 802.1X on a Cisco Catalyst switch running Cisco IOS are provided in this section. These commands are all entered at the CLI configuration mode.

Step 1 Enable AAA globally with the following command:

```
switch(config)# aaa new-model
```

Step 2 Configure the switch to use RADIUS as the sole method for 802.1X authentication with the following command:

```
switch(config)# aaa authentication dot1x [default] group radius
```

Note Though other methods appear as configuration options, only **group radius** is supported.

Step 3 Configure the RADIUS server parameters. Use the command below to specify the IP address (or hostname if the switch is configured for DNS) and the key of the RADIUS server. This key must match the key that is configured on the ACS.

```
switch(config)# radius-server host [host name | IP address] key [string]
```

Globally Enable IEEE 802.1X for Cisco IOS

IEEE 802.1X must be globally enabled on the switch. If 802.1X is not enabled with the following command, then the interface configurations will have no effect and the switch will not authenticate hosts connecting to its ports.

Enable IEEE 802.1X globally with the following command:

```
switch(config)# dot1x system-auth-control
```

Interface IEEE 802.1X Configuration for Cisco IOS

Once RADIUS has been configured and 802.1X has been globally enabled, each interface must also be configured to perform 802.1X.

Note To configure multiple ports at the same time, use the **interface range** command.

Step 1 Select the ports that will run IEEE 802.1X with the following command.

```
switch(config)# interface range GigabitEthernet 1/0/10-11
switch(config-if-range)#
```

Step 2 Configure a port-type that is compatible with 802.1X. IEEE 802.1X can only be configured on static Layer-2 access ports and the voice VLAN port; IEEE 802.1X is not supported on dynamic access ports, trunk ports, or EtherChannel.

```
switch(config-if-range)# switchport mode access
```

Step 3 Enable 802.1X on the port. Note that this command is added automatically if the port control is configured (as shown in the next step).

```
switch(config-if-range)# dot1x pae authenticator
```

Step 4 Configure the method of port control. To enable the 802.1X default security level, select **auto**.

```
switch(config-if-range)# dot1x port-control auto
```

Caution Once **dot1x port-control auto** is configured, the switch will revert to the default security level for 802.1X. All traffic except for EAP will be dropped until a successful authentication has occurred. To prevent unexpected loss of network access, ensure that the rest of the solution has been properly configured before enabling this command. This includes proper PKI deployment and complete configurations of the switch, supplicants, ACS and Active Directory.

IEEE 802.1X Timer Configuration for Cisco IOS

There are multiple timers that affect the operation of 802.1X. These timers should not be modified without a careful consideration of the impact on the operation of your network. See the *Baseline Identity Design Overview Guide* for a detailed discussion of these timers.

```
(config-if)# dot1x timeout ?
  quiet-period      QuietPeriod in Seconds
  ratelimit-period  Ratelimit Period in seconds
  reauth-period     Time after which an automatic reauthentication should be
                    initiated
  server-timeout    Timeout for Radius Retries
  supp-timeout      Timeout for supplicant reply
  tx-period         Timeout for supplicant retries
```

IEEE 802.1X Re-Authentication Configuration for Cisco IOS [Optional]

By default, 802.1X reauthentication is disabled on Cisco IOS switches. If needed, it can be enabled on the switch on a per-port basis. The switch can be configured to use a locally configured reauthentication timer or to use values sent down by the RADIUS server in the attributes of the Access-Accept that is sent after a successful authentication. Only one method, switch-based timers or server-based timers, can be configured at one time. This avoids any potential conflict between locally configured timers and RADIUS-based timers.

We recommend configuring the switch to use values sent by the RADIUS server to control reauthentication behavior. The RADIUS server provides a centralized repository for the reauthentication timer that will ensure consistent behavior across all switches.

When configured to use values from the RADIUS server, the switch uses two attributes to control the timing and behavior of reauthentication:

- The Session-Timeout RADIUS attribute (Attribute [27]) specifies the time after which reauthentication occurs.
- The Termination-Action RADIUS attribute (Attribute [29]) specifies the action to take during reauthentication. When the attribute value is set to Default, the IEEE 802.1X session ends, and connectivity is lost during reauthentication. When the attribute value is set to RADIUS-Request, the session is not affected during reauthentication.

Cisco recommends setting Attribute [29] to RADIUS-Request to ensure that connectivity is not lost during reauthentication.

Note If server-based reauthentication is configured on the switch and the RADIUS server does not send Attribute [29], the switch behaves as if it were set to Default and connectivity will be lost during reauthentication. If server-based reauthentication is configured on the switch and Attribute [27] is not sent, reauthentication will be disabled on the port.

Configuring Server-based Reauthentication for Cisco IOS

The section details how to configure Server-based Reauthentication on the switch and the ACS. This is the recommended method when reauthentication is required.

Step 1 Enable reauthentication on the switch port.

```
(config-if)# dot1x reauthentication
```

Step 2 Configure the switch to use setting sent by the RADIUS server during authentication.

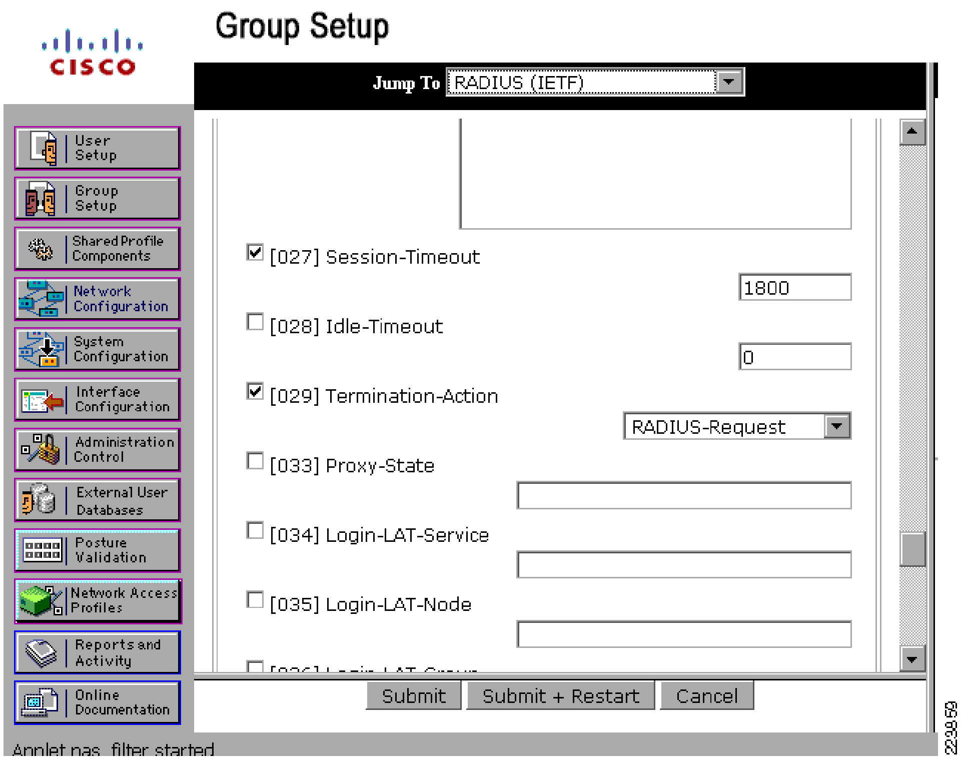
```
(config-if)# dot1x timeout reauth-period server
```

Step 3 Open *ACS Admin* from the desktop shortcut created during the installation. Click **Group Setup**. Select the *Group* you wish to configure and click **Edit Settings**.

Step 4 In the *Group Settings* window, scroll down to *IETF RADIUS Attributes*. Check the box next to *[27] Session-Timeout* and enter a value between **1** and **65535** seconds. Check the box next to *[029] Termination-Action* and select **RADIUS-Request from** the drop-down box. Click **Submit+Restart**. See Figure 3-2.

Note The Group Setup is shown only as an example in Figure 3-2. The attributes can also be configured as part of the User Setup or as part of a RADIUS Authorization Component (RAC).

Figure 3-2 Configuring RADIUS Attributes for Re-Authentication



Group Setup

Jump To RADIUS (IETF)

☑ [027] Session-Timeout 1800

□ [028] Idle-Timeout 0

☑ [029] Termination-Action RADIUS-Request

□ [033] Proxy-State

□ [034] Login-LAT-Service

□ [035] Login-LAT-Node

Configuring Server-based Reauthentication for Cisco IOS

The section details how to configure switch-based reauthentication on the switch and the ACS.

Step 1 Enable reauthentication on the switch port.

```
(config-if)# dot1x reauthentication
```

Step 2 Configure a reauthentication timer.

```
(config-if)# dot1x timeout reauth-period 1800
```

Note If no timer value is specified, the switch will use a default value of 3600 seconds.

Note When reauthentication is locally configured on the switch, the existing session is not affected during reauthentication and connectivity is maintained (until and unless the reauthentication fails). The switch behaves the same way it would if it received Attribute [29] = RADIUS-Request during a server-based reauthentication.

WoL Configuration for Cisco IOS (Optional)

If needed, the switch can be configured to support Wake-on-Lan (WoL) devices on 802.1X-enabled interfaces. Use the following interface configuration command to enable unidirectional port control for WoL devices connected to an interface configured for 802.1X:

```
(config-if)# dot1x control-direction in
```

Verify IEEE 802.1X Operation for Cisco IOS

There are several **show** commands that can be used in global exec mode to verify the operation of IEEE 802.1X on a Cisco Catalyst switch running Cisco IOS. See Table 3-2.

Table 3-2 IEEE 802.1X Show Commands for Cisco IOS

Command	Description
show dot1x	Display the operational status of IEEE 802.1X.
show dot1x {**all** | {**statistics** {**interface** *interface interface-number*}}} **details**	Display the IEEE 802.1X status for all ports or a specific port
show dot1x {**interface** *interface interface-number*}	Display IEEE 802.1X statistics for a specific port.
show aaa servers	Display the status and operational information for all configured AAA servers.

Basic Configuration Example for Cisco IOS

The following basic configuration example highlights the minimum command set required to enable IEEE 802.1X on a Cisco Catalyst switch running Cisco IOS:

```
aaa new-model
aaa authentication dot1x default group radius
!
dot1x system-auth-control
!
interface Gigabit 3/0/1
switchport mode access
dot1x port-control auto
!
radius-server host 10.1.1.5 auth-port 1812 acct-port 1813 key cisco
```

It is important that the user understand the ramifications of adding AAA commands to the Cisco IOS configuration because they affect device access as well. For example, by adding the AAA commands listed in the sample configuration above, all administrative access (Telnet and console) will be blocked. If an administrative session is lost while enabling AAA and no default login authentication method has been defined, the administrator will be locked out of the router and the entire saved configuration could be lost. To avoid this scenario, specify alternative methods for administrative access using the default login configuration. For example, to authenticate administrative access via RADIUS or, if the RADIUS server is not available, by the enable password, add the following command:

aaa authentication login default group radius enable

Verifying 802.1X Port Status for Cisco IOS

The output of the following command shows that a supplicant with the MAC address 0018.f809.cfc5 has successfully passed IEEE 802.1X authentication on this port. The output also shows the default values for IEEE 802.1X interface parameters that result from the minimum configuration described above.

```
Switch# show dot1x interface FastEthernet 2/5 details
Dot1x Info for FastEthernet2/5
-----------------------------------
PAE                        = AUTHENTICATOR
PortControl                = AUTO
ControlDirection           = Both
HostMode                   = SINGLE_HOST
ReAuthentication           = Disabled
QuietPeriod                = 60
ServerTimeout              = 30
SuppTimeout                = 30
ReAuthPeriod               = 3600 (Locally configured)
ReAuthMax                  = 2
MaxReq                     = 2
TxPeriod                   = 30
RateLimitPeriod            = 0

Dot1x Authenticator Client List
-------------------------------
Domain                     = DATA
Supplicant                 = 0018.f809.cfc5
        Auth SM State      = AUTHENTICATED
        Auth BEND SM Stat  = IDLE

Port Status                = AUTHORIZED
Authentication Method      = Dot1x
Authorized By              = Authentication Server
Vlan Policy                = N/A
```

Cisco Catalyst OS

Cisco Catalyst switches running Cisco Catalyst OS (CatOS) require certain commands to enable IEEE 802.1X.

Additional commands can be configured to enable optional functionality or change default parameters.

The RADIUS, global, and port commands are explained in the following sections. A basic example is also provided to highlight the minimum configuration requirement.

RADIUS Configuration for Cisco Catalyst OS

The RADIUS commands required to configure IEEE 802.1X on a Cisco Catalyst switch running Cisco Catalyst OS are provided in this section.

Step 1 Use the command below to specify the IP address of the RADIUS server. If more than one server is configured, the **primary** keyword can be used to select which server is contacted first.

set radius server [*IP address*] **auth-port** [*port*]**acct-port** [*port*] [**primary**]

Step 2 Use the command below to specify the key used to authentication communications between the switch and the RADIUS server. The key must match what is configured on the ACS.

```
set radius key [key]
```

Global IEEE 802.1X Configuration for Cisco Catalyst OS

IEEE 802.1X must be globally enabled on the switch. If 802.1X is not enabled with the following command, then the interface configurations will have no effect and the switch will not authenticate hosts connecting to its ports.

Enable IEEE 802.1X globally with the following command:

```
set dot1x system-auth-control enabled
```

Port IEEE 802.1X Configuration for Cisco Catalyst OS

Once RADIUS has been configured and 802.1X has been globally enabled, each interface must also be configured to perform 802.1X.

Select the mode for 802.1X authentication. The default is force-authorized (meaning that the port is open to all traffic). To switch to the 802.1X default security level, select **auto**.

```
set port dot1x [module/port] port-control [force-authorized | force-unauthorized | auto]
```

Note Once **set port dot1x port-control auto** is configured, the switch will revert to the default security level for 802.1X. In other words, all traffic except for EAP will be dropped until a successful authentication has occurred. To prevent unexpected loss of network access, ensure that the rest of the solution has been properly configured before enabling this command. This includes proper PKI deployment and complete configuration of the switch, supplicants, ACS and Active Directory.

Verify IEEE 802.1X Operation for Cisco Catalyst OS

The **show** commands used to verify the operation of IEEE 802.1X on a Cisco Catalyst switch running Cisco Catalyst OS are provided in Table 3-3.

Table 3-3 IEEE 802.1X Show Commands for Cisco Catalyst OS

Command	Description
show radius	Displays configured RADIUS parameters.
show dot1x	Displays system IEEE 802.1X capabilities.
show dot1x group [**all** | **authenticated** | *group name*]	Displays IEEE 802.1X user group information.
show dot1x user [**all** | *user name*]	Displays IEEE 802.1X user information.
show dot1x vlan [**all** | *VLAN ID*]	Displays information about IEEE 802.1X authenticated users in a VLAN.
show dot1x vlan-group [**all** | *VLAN-group-name*]	Displays IEEE 802.1X VLAN group information.

Table 3-3 IEEE 802.1X Show Commands for Cisco Catalyst OS

Command	Description
show port dot1x [*module/port*]	Displays all the configurable and current state values associated with the authenticator port access entity (PAE) and backend authenticator and statistics for the different types of Extensible Authentication Protocol (EAP) packets transmitted and received by the authenticator on a specific port.
show port dot1x statistics [*module/port*]	Displays statistics for different EAP packets transmitted and received by the authenticator on a specific port.
show port dot1x [*module/port*] **guest-vlan** [*VLAN ID* | **none**]	Displays the active VLAN that functions as an IEEE 802.1X guest VLAN.
show port dot1x auth-fail-vlan [*VLAN ID* | **none**]	Displays information about ports that have VLANs for users that have failed IEEE 802.1X authentication.

Basic Configuration Example for Cisco Catalyst OS

The following basic configuration example is provided to highlight the minimum command set required to enable IEEE 802.1X on a Cisco Catalyst switch running Catalyst OS.

```
set radius server 10.100.10.117
set radius key cisco
!
set dot1x system-auth-control enable
!
set port dot1x 1/5 port-control auto
```

Verifying 802.1X Port Status for Cisco Catalyst OS

The output of this command shows that the supplicant connected to port 1/5 has successfully passed 802.1X authentication. The output also shows 802.1X parameters configured for the port.

```
Switch> (enable) show port dot1x 1/5
Port  Auth-State          BEnd-State Port-Control        Port-Status
----- ------------------- ---------- ------------------- -------------
 1/5  authenticated       idle       auto                authorized

Port  Port-Mode     Reauthentication   Shutdown-timeout   Control-Mode
                                                           admin   oper
----- ------------- -----------------   ----------------   ---------------
 1/5  SingleAuth    disabled            disabled           Both    Both

Port  Posture-Token Critical-Status Termination action Session-timeout
----- ------------- --------------- ------------------ ---------------
 1/5  -             no              NoReAuth           -

Port  Session-Timeout-Override Url-Redirect
----- ------------------------ ----------------------------------
 1/5  disabled                 -

Port  Critical ReAuth-When
----- -------- ------------
 1/5  disabled -
```

Deploying EAP-TLS

The section describes how to configure EAP-TLS on the ACS and on the CSSC and native XP supplicants.

The username for EAP-TLS is acquired from the user when he or she logs into Windows via Single Sign-On (SSO). The supplicant uses this username to select a certificate from the local certificate stores to send to the ACS during authentication. ACS verifies the supplicant's certificate and consults Active Directory to verify that the user specified in the certificate is allowed access to the network.

EAP-TLS deployment is presented as a series descriptions in the following two primary sections:

- Authentication Server Configuration, page 3-11
- Client Configuration for EAP-TLS, page 3-56

Authentication Server Configuration

There are multiple steps to complete when configuring the Cisco ACS to act as the Authentication Server for IEEE 802.1X EAP-TLS authentications. The following steps are addressed in the sections that follow:

- Step 1: Obtain and Install the Root CA Certificate on Cisco Secure ACS, page 3-11
- Step 2: Configure Certificate Revocation, page 3-21
- Step 3: Acquire and Configure Cisco Secure ACS Server Certificate, page 3-23
- Step 4: Configure EAP-TLS Settings on the ACS, page 3-46
- Step 5: Specify and Configure the Catalyst Switch as a AAA Client, page 3-50
- Step 6: Configure the External User Databases, page 3-51

Once Step 6 is completed, you must restart the Cisco Secure ACS-based service.

Note These instructions are for Cisco Secure ACS on Windows. There is also an appliance version of ACS called the Solution Engine (SE). SE has functional and configuration differences compared with the ACS for Windows version, especially in the area of certificate management.

Step 1: Obtain and Install the Root CA Certificate on Cisco Secure ACS

The Cisco Secure ACS must possess the root certificate of the CA that issued the supplicant's certificate in order to validate the client certificate sent by a supplicant during the EAP-TLS exchange. In a typical Windows environment, this will happen automatically when the Cisco Secure ACS server joins the Windows domain. Thus, in many cases, this is purely a verification exercise and little or no configuration will be required.

The following procedures are discussed in this section:

1. Verify that the CA Root Certificate is in the Cisco Secure ACS's local machine certificate store. If the certificate is not present, acquire the certificate and install it in either the local machine store or the local Cisco Secure ACS store.
2. Verify that the CA is listed in the Cisco Secure ACS's certificate trust list.

Verify the CA Root Certificate in Local Machine Storage

When a server joins a Microsoft domain, it will automatically retrieve the Enterprise Root CA certificate from the Enterprise Root CA as a result of the Active Directory default Group Policy. Therefore, the Cisco Secure ACS server will most likely already have the Enterprise CA Root Certificate in its Windows local machine certificate storage. If the client’s certificate is issued by the same CA as per best Cisco’s practices recommendation, then this is the only CA that the Cisco Secure ACS needs to trust for EAP-TLS to succeed.

To verify that the Cisco Secure ACS server has the Enterprise CA Certificate in local machine storage, follow these steps on the Cisco Secure ACS server:

Step 1 On the Cisco Secure ACS server, enter **Start** > **Run**, type *mmc*, and click **OK**.

Step 2 On the *File* menu, click **Add/Remove Snap-in** and then click **Add**.

Step 3 Under *Snap-in*, double-click **Certificates**. Select *Computer Account* and click **Next**.

Step 4 Select *Local Computer* and click **Finish**.

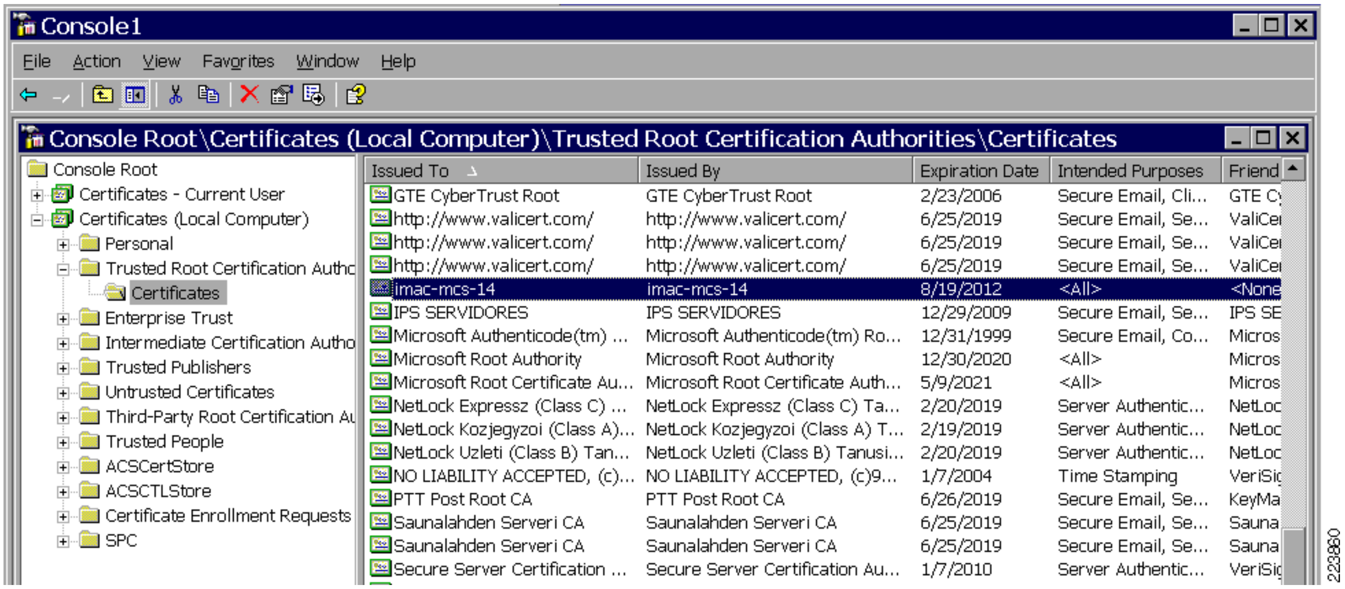
Step 5 On the *Add Standalone Snap-in* window, click **Close**.

Step 6 On the *Add/Remove Snap-in* window, click **OK**

Step 7 On the *Console*, select *Certificates (Local Computer)* > *Trusted Root Certification Authorities* > *Certificates*.

Step 8 Verify that the Enterprise Root CA that issued the supplicant's certificate is in the list (*imac-mcs-14* in Figure 3-3). If it is, proceed to configuring the Cisco Secure ACS Trust list.

Figure 3-3 Trusted Root Certificate on Cisco Secure ACS


Console1
File
Action
View
Favorites
Window
Help
Console Root\Certificates (Local Computer)\Trusted Root Certification Authorities\Certificates
223880

- Console Root
  - Certificates - Current User
  - Certificates (Local Computer)
    - Personal
    - Trusted Root Certification Authc
      - Certificates
    - Enterprise Trust
    - Intermediate Certification Autho
    - Trusted Publishers
    - Untrusted Certificates
    - Third-Party Root Certification Au
    - Trusted People
    - ACSCertStore
    - ACSCTLStore
    - Certificate Enrollment Requests
    - SPC

Issued To	Issued By	Expiration Date	Intended Purposes	Friend
GTE CyberTrust Root	GTE CyberTrust Root	2/23/2006	Secure Email, Cli...	GTE Cy
http://www.valicert.com/	http://www.valicert.com/	6/25/2019	Secure Email, Se...	ValiCer
http://www.valicert.com/	http://www.valicert.com/	6/25/2019	Secure Email, Se...	ValiCer
http://www.valicert.com/	http://www.valicert.com/	6/25/2019	Secure Email, Se...	ValiCer
imac-mcs-14	imac-mcs-14	8/19/2012	<All>	<None
IPS SERVIDORES	IPS SERVIDORES	12/29/2009	Secure Email, Se...	IPS SE
Microsoft Authenticode(tm) ...	Microsoft Authenticode(tm) Ro...	12/31/1999	Secure Email, Co...	Micros
Microsoft Root Authority	Microsoft Root Authority	12/30/2020	<All>	Micros
Microsoft Root Certificate Au...	Microsoft Root Certificate Auth...	5/9/2021	<All>	Micros
NetLock Expressz (Class C) ...	NetLock Expressz (Class C) Ta...	2/20/2019	Server Authentic...	NetLoc
NetLock Kozjegyzoi (Class A)...	NetLock Kozjegyzoi (Class A) T...	2/19/2019	Server Authentic...	NetLoc
NetLock Uzleti (Class B) Tan...	NetLock Uzleti (Class B) Tanusi...	2/20/2019	Server Authentic...	NetLoc
NO LIABILITY ACCEPTED, (c)...	NO LIABILITY ACCEPTED, (c)9...	1/7/2004	Time Stamping	VeriSig
PTT Post Root CA	PTT Post Root CA	6/26/2019	Secure Email, Se...	KeyMa
Saunalahden Serveri CA	Saunalahden Serveri CA	6/25/2019	Secure Email, Se...	Sauna
Saunalahden Serveri CA	Saunalahden Serveri CA	6/25/2019	Secure Email, Se...	Sauna
Secure Server Certification ...	Secure Server Certification Au...	1/7/2010	Server Authentic...	VeriSig

If the CA certificate is not listed, it is possible to manually download the certificate. There are two options when downloading a root certificate. First, the root CA certificate can be downloaded into the Windows machine store. Once the download is finished, the certificate will appear in the MMC Console above and can be used by Cisco Secure ACS or any other service on the server. The second option is to download the certificate into the Cisco Secure ACS local store. This certificate will not be listed in the MMC console and it will only be available to the Cisco Secure ACS.

Manually Installing Root Certificate in Cisco Secure ACS

Most often, a CA's root certificate will be in the Windows machine certificate storage if the Cisco Secure ACS is a Windows domain member. However, there might be some situations when it is not. The Cisco Secure ACS might not be a member of the domain. Or there might be a scenario in which the supplicant's certificate was signed by a different CA than the one that signed the Cisco Secure ACS's certificate. In that case, the supplicant's CA root certificate may need to be manually downloaded to the Cisco Secure ACS.

If the root CA Certificate does not appear in the machine store list as described in the previous section, the certificate can be manually downloaded to the local Window machine certificate store on the Cisco Secure ACS. Alternatively, the root Certificate can be manually downloaded to the private certificate store maintained by the Cisco Secure ACS itself. Both methods are described below.

Note In the recommended solution topology that is the focus of this document, the same root CA issues certificates to the clients and the servers and the default Group Policy ensures that the Cisco Secure ACS server automatically downloads the root CA certificate to the local machine store. In this scenario, manually downloading the CA Certificate is not required. Therefore, this section is for reference only

Manually Installing the Root Certificate in Cisco Secure ACS Machine Store

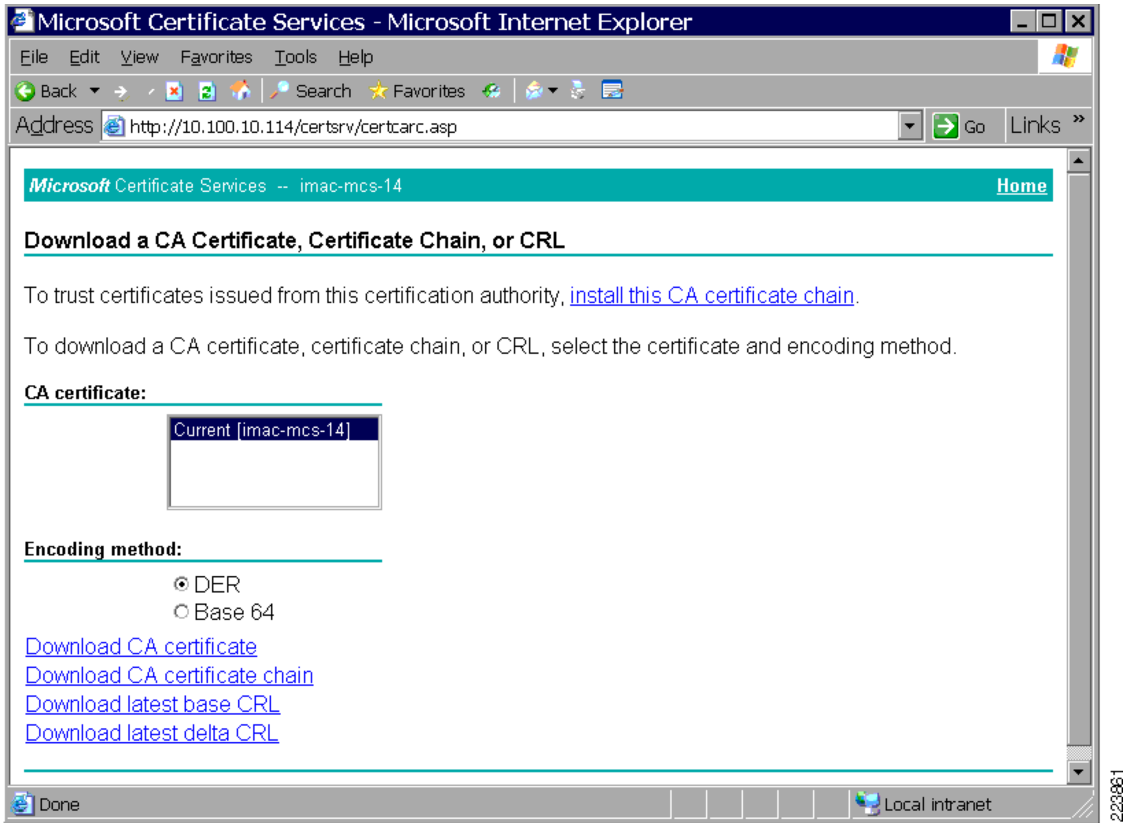
If the root CA Certificate does not appear in the machine store list, the certificate can be manually downloaded to the Windows machine certificate store on the Cisco Secure ACS by the following steps:

Step 1 On the Cisco Secure ACS, point the browser at the Microsoft CA server: http://CA-srv-ip /certsrv.

Step 2 From the *Select a Task* option choose *Download a CA certificate*, *certificate chain,* or *CRL.*

Step 3 Click **Download CA Certificate**. See Figure 3-4.

Figure 3-4 Download CA Certificate



Microsoft Certificate Services - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://10.100.10.114/certsrv/certcarc.asp
Go Links
Microsoft Certificate Services -- imac-mcs-14
Home
Done
Local intranet
223861

Download a CA Certificate, Certificate Chain, or CRL

To trust certificates issued from this certification authority, install this CA certificate chain.

To download a CA certificate, certificate chain, or CRL, select the certificate and encoding method.

CA certificate:

Current [imac-mcs-14]

Encoding method:

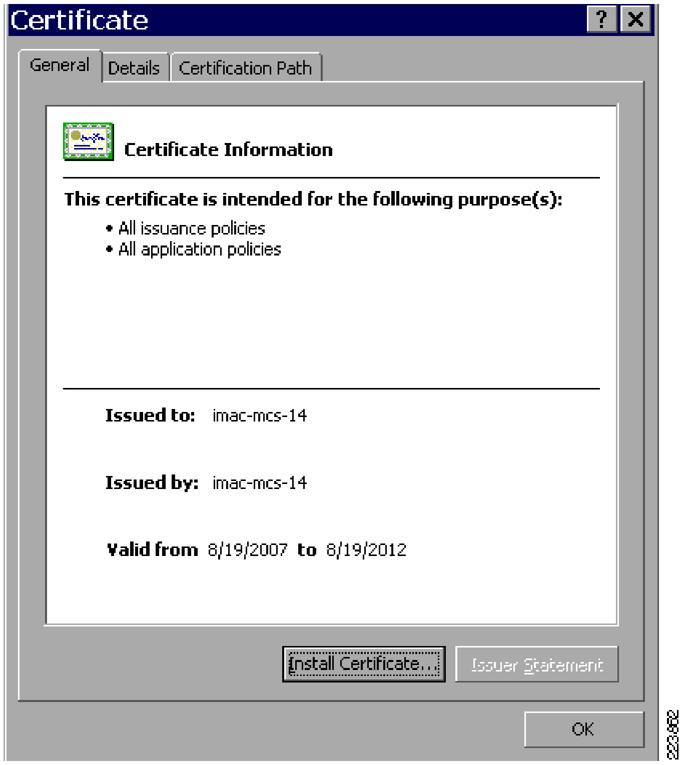
● DER
○ Base 64

Download CA certificate
Download CA certificate chain
Download latest base CRL
Download latest delta CRL

Step 4 A File Download Security Warning window appears. Click **Open**

Step 5 A Certificate Installation Window appears. Click **Install Certificate**. See Figure 3-5.

Figure 3-5 Install Certificate



Certificate

Certificate Information

This certificate is intended for the following purpose(s):

- All issuance policies
- All application policies

Issued to: imac-mcs-14

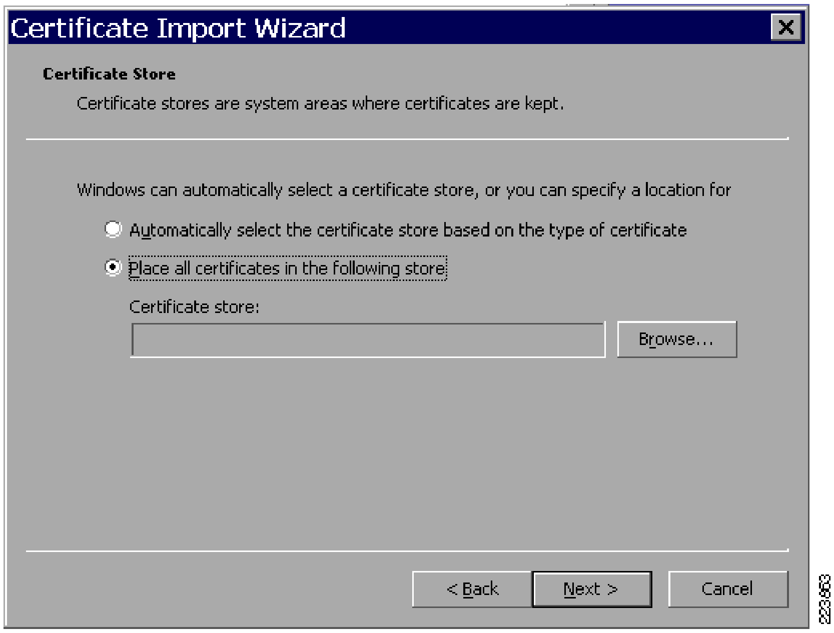
Issued by: imac-mcs-14

Valid from 8/19/2007 to 8/19/2012

Step 6 The Certificate Import Wizard opens. Click **Next**.

Step 7 Select *Place all certificates in the following store* and browse. See Figure 3-6.

Figure 3-6 Certificate Store



Certificate Import Wizard

Certificate Store

Certificate stores are system areas where certificates are kept.

Windows can automatically select a certificate store, or you can specify a location for

○ Automatically select the certificate store based on the type of certificate

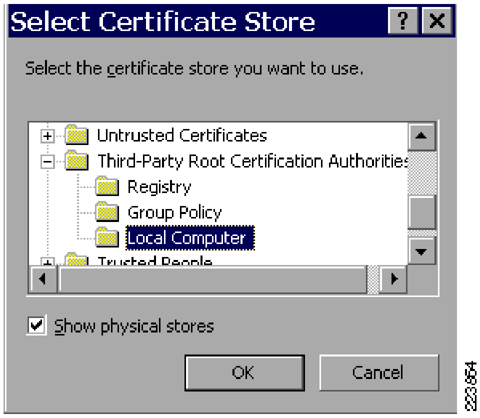
● Place all certificates in the following store

Certificate store:

Note The first option, *automatically select the certificate store*, will install the root certificate in the Current User Trusted Root Certificate Authorities, not the Local Computer Trusted Root Certificate Authorities. The certificate must be in the Local Computer store for Cisco Secure ACS to access it.

Step 8 In *Select Certificate Store* window, click **Show physical stores**. Click *Trusted Root Certificate Authorities* and select the *Local Computer* folder. Click **OK**. See Figure 3-7.

Figure 3-7 Select Certificate Store



Select the certificate store you want to use.

☑ Show physical stores

Step 9 Click **Next** and **Finish**.

Step 10 Verify that the certificate has been properly installed by repeating the steps in the "Verify the CA Root Certificate in Local Machine Storage" section on page 3-12. Proceed to configuring the Cisco Secure ACS Certificate Trust List.

Manually Installing the Root Certificate in Cisco Secure ACS Private Store

If the root CA Certificate does not appear in the machine store list, the certificate can be manually downloaded to the Cisco Secure ACS's private certificate store by the following steps.

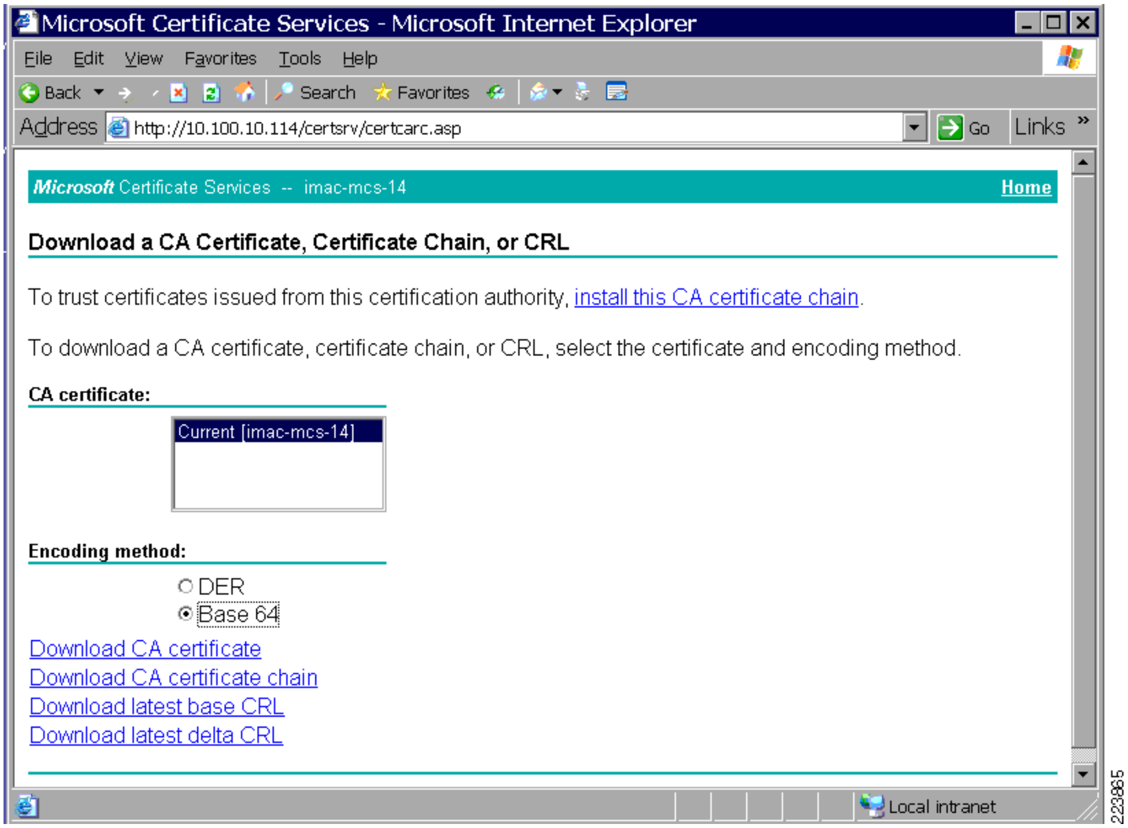
Note The Cisco Secure ACS's private store is independent of the Windows certificate store. The steps below detail how to get the root certificate into the Cisco Secure ACS private store only.

Step 1 On the Cisco Secure ACS server, point the browser at the Microsoft CA server: http://CA-srv-ip /certsrv.

Step 2 From the *Select a Task* option choose **Download a CA certificate**, certificate chain or CRL.

Step 3 Choose the *Base 64* radio encoding method and click **Download CA Certificate**. See Figure 3-8.

Figure 3-8 Download CA Certificate for Private Store


Microsoft Certificate Services - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://10.100.10.114/certsrv/certcarc.asp
Go Links
Local intranet
223865

Microsoft Certificate Services -- imac-mcs-14 Home

Download a CA Certificate, Certificate Chain, or CRL

To trust certificates issued from this certification authority, install this CA certificate chain.

To download a CA certificate, certificate chain, or CRL, select the certificate and encoding method.

CA certificate:

Current [imac-mcs-14]

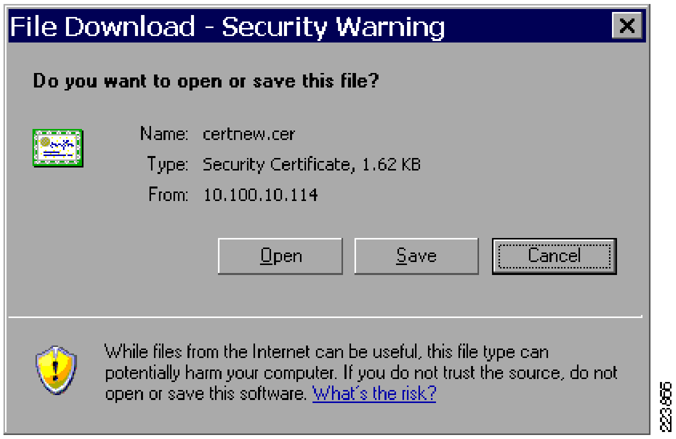
Encoding method:

○ DER
● Base 64

Download CA certificate
Download CA certificate chain
Download latest base CRL
Download latest delta CRL

Step 4 A File Download Security Warning window appears. Click **Save**. See Figure 3-9.

Figure 3-9 Save Certificate



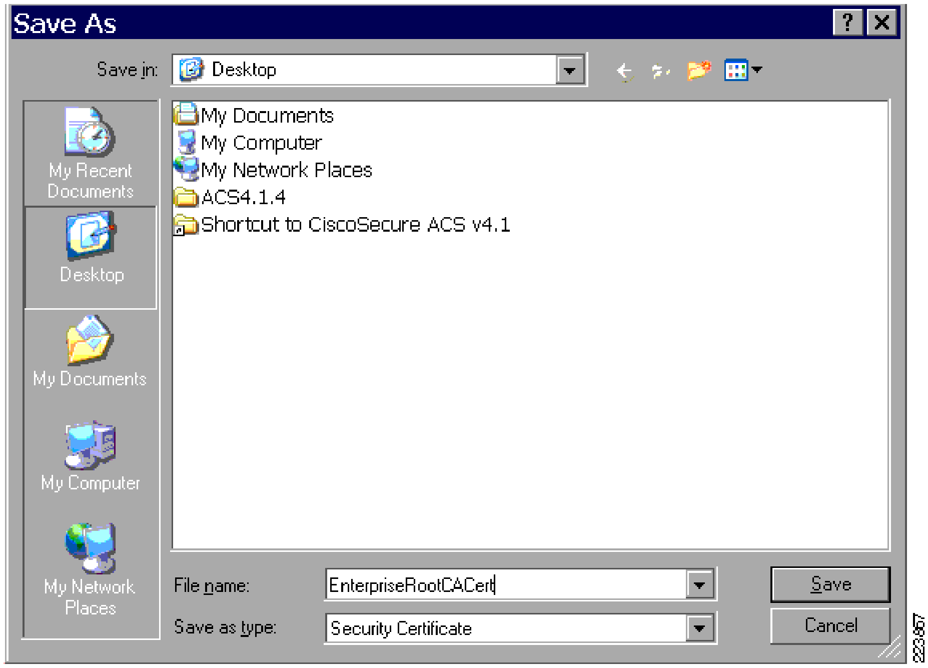
Do you want to open or save this file?

Name: certnew.cer
Type: Security Certificate, 1.62 KB
From: 10.100.10.114

While files from the Internet can be useful, this file type can potentially harm your computer. If you do not trust the source, do not open or save this software. What's the risk?

Step 5 Enter a location to save the file and click **Save**. Make a note of the filename and directory since you will need this information when configuring Cisco Secure ACS to trust this CA's certificate. See Figure 3-10.

Figure 3-10 Save Certificate for Private Storage



Save in: Desktop

File name: EnterpriseRootCACert

Save as type: Security Certificate

Because the root certificate was downloaded manually to the private Cisco Secure ACS store, it is not installed in the Microsoft local machine certificate storage. Therefore, it will not appear in the MMC Certificate snap-in nor will it be automatically added to the list of candidate CAs on the Cisco Secure ACS Certificate Trust List (CTL). The CTL defines the root CAs that the Cisco Secure ACS will trust when validating the signature on a certificate presented by a supplicant. Since the CTL is automatically updated with the root CAs in the Microsoft machine certificate store and since the Cisco Secure ACS automatically trusts the CA that issued its own certificate, there is no need to modify it in most cases. The CTL only becomes an issue when the root CA certificate is added to the Cisco Secure ACS private store (as described in this step) and when this CA is different from the CA that issued the Cisco Secure ACS's certificate.

If a CA has been manually added to the Cisco Secure ACS private certificate store and this CA is not the one that signed the Cisco Secure ACS's own certificate, additional steps will be required to configure the Cisco Secure ACS to add the CA to the Certificate Trust List:

Step 6 On the Cisco Secure ACS Server, open Cisco Secure ACS Admin from the desktop shortcut created during the installation.

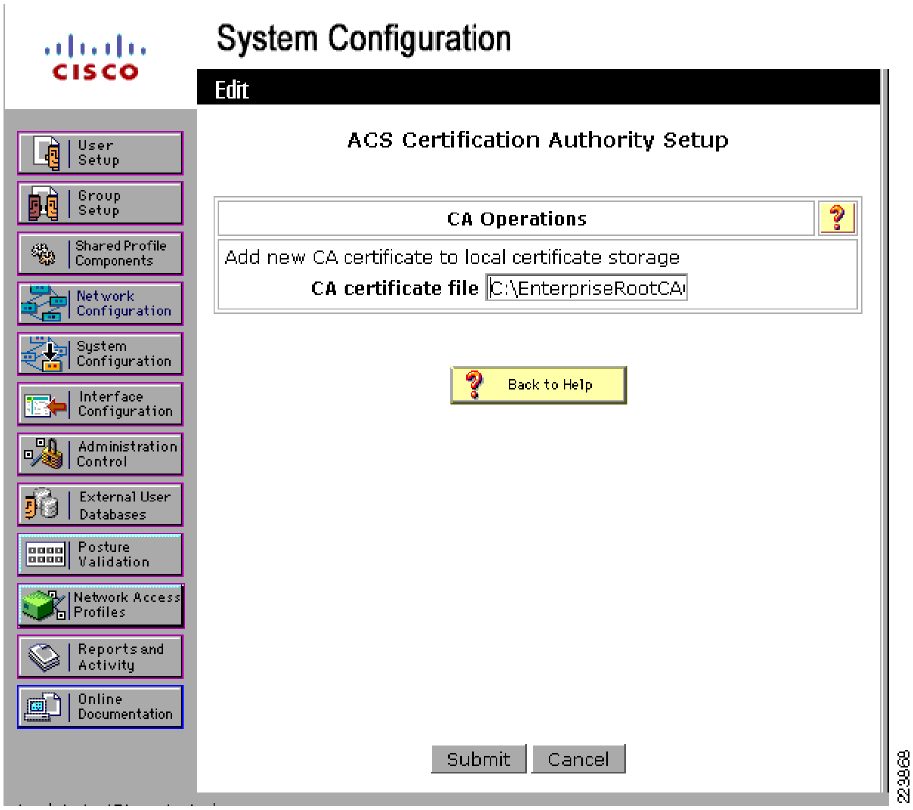
Step 7 Click **System Configuration**.

Step 8 Click **ACS Certificate Setup**

Step 9 Click **ACS Certification Authority Setup**. See Figure 3-11.

Step 10 Under the *ACS Certification Authority Setup* window, type the name and location of the *.cer file created earlier. In this example, the *.cer file created is *EnterpriseRoot-CA-cert.cer* in the root directory C:\.

Figure 3-11 Cisco Secure ACS CA Setup


System Configuration

Edit

ACS Certification Authority Setup

CA Operations

Add new CA certificate to local certificate storage

CA certificate file C:\EnterpriseRootCA\

Step 11 Click **Submit**.

Step 12 Restart the ACS Services.

Now the CA can be configured in the Certificate Trust List as described in the following section.

Verify the CA in Cisco Secure ACS Certificate Trust List

Having the root certificate in the local store of the Cisco Secure ACS server is not enough by itself. The CA must also be trusted by the Cisco Secure ACS. To be trusted by the Cisco Secure ACS, a server must be on the Cisco Secure ACS Certificate Trust List. By default, ACS will add all the trusted root certificates in the Windows local machine storage to the list of candidates CAs on the ACS Certificate Trust List. The only configuration task is to select which candidates should be added to the list.

The Cisco Secure ACS will automatically trust the CA that signed its own personal certificate. There is no need to configure the CTL for this CA.

To configure the Cisco Secure ACS server to trust the Root CA, perform the following steps:

Step 1 On the Cisco Secure ACS for Windows server, open Cisco Secure ACS Admin from the desktop shortcut created during the installation.

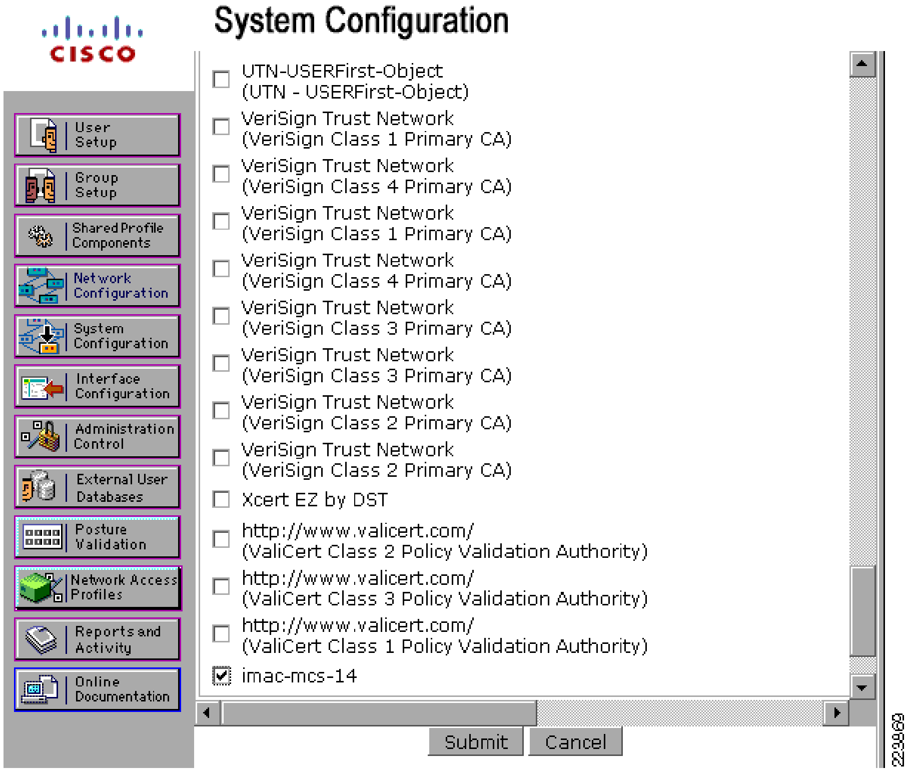
Note Cisco Secure ACS SE users will browse remotely to the Cisco Secure ACS Admin interface.

Step 2 Click **System Configuration**.

Step 3 Click **ACS Certificate Setup**.

Step 4 Click **Edit Certificate Trust List**. See Figure 3-12.

Figure 3-12 Certificate Trust List



System Configuration

- ☐ UTN-USERFirst-Object (UTN - USERFirst-Object)
- ☐ VeriSign Trust Network (VeriSign Class 1 Primary CA)
- ☐ VeriSign Trust Network (VeriSign Class 4 Primary CA)
- ☐ VeriSign Trust Network (VeriSign Class 1 Primary CA)
- ☐ VeriSign Trust Network (VeriSign Class 4 Primary CA)
- ☐ VeriSign Trust Network (VeriSign Class 3 Primary CA)
- ☐ VeriSign Trust Network (VeriSign Class 3 Primary CA)
- ☐ VeriSign Trust Network (VeriSign Class 2 Primary CA)
- ☐ VeriSign Trust Network (VeriSign Class 2 Primary CA)
- ☐ Xcert EZ by DST
- ☐ http://www.valicert.com/ (ValiCert Class 2 Policy Validation Authority)
- ☐ http://www.valicert.com/ (ValiCert Class 3 Policy Validation Authority)
- ☐ http://www.valicert.com/ (ValiCert Class 1 Policy Validation Authority)
- ☑ imac-mcs-14

Step 5 Scroll down the list to find the name of the Root CA that issues the client certificates. Check the box next to the Root CA's name. Click **Submit** and then **Restart**.

Note In many cases, this step will not be required, since Cisco Secure ACS will automatically trust the CA that issued the Cisco Secure ACS's server certificate. If the client certificates are issued by the same CA that issued the Cisco Secure ACS server certificate, then this is the only CA that Cisco Secure ACS needs to trust and no further action is necessary. If, however, different CAs were used to issue the server certificate and the client certificates, then all the CAs that issued client certificates must be checked on the Cisco Secure ACS Certificate Trust List.

After this step is complete, the Cisco Secure ACS is ready to use the Enterprise Root CA Certificate to validate the user certificates it receives from supplicants during IEEE 802.1X EAP-TLS authentications.

Step 2: Configure Certificate Revocation

Before accepting a client certificate, the Cisco Secure ACS must verify that the certificate has not been revoked since it was issued. To do this, the Cisco Secure ACS must download the Certificate Revocation List (CRL) from every CA that signs the client certificates that the Cisco Secure ACS needs to verify. To enable CRLs on the Cisco Secure ACS, complete the following steps.

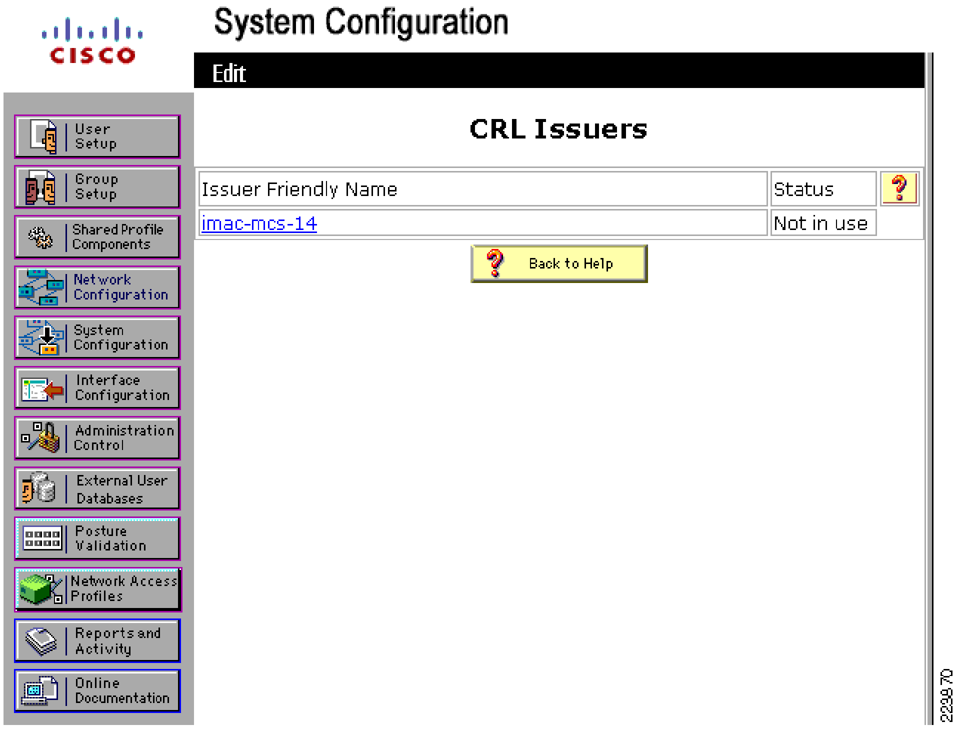
Step 1 On the Cisco Secure ACS Server, open Cisco Secure ACS Admin from the desktop shortcut created during the installation.

Step 2 Click the **System Configuration** button.

Step 3 Select *ACS Certificate Setup*.

Step 4 Select *Certificate Revocation List*. Every CA in the Certificate Trust List will appear in the list of CRL Issuers. See Figure 3-13.

Figure 3-13 CRL Issuers



System Configuration

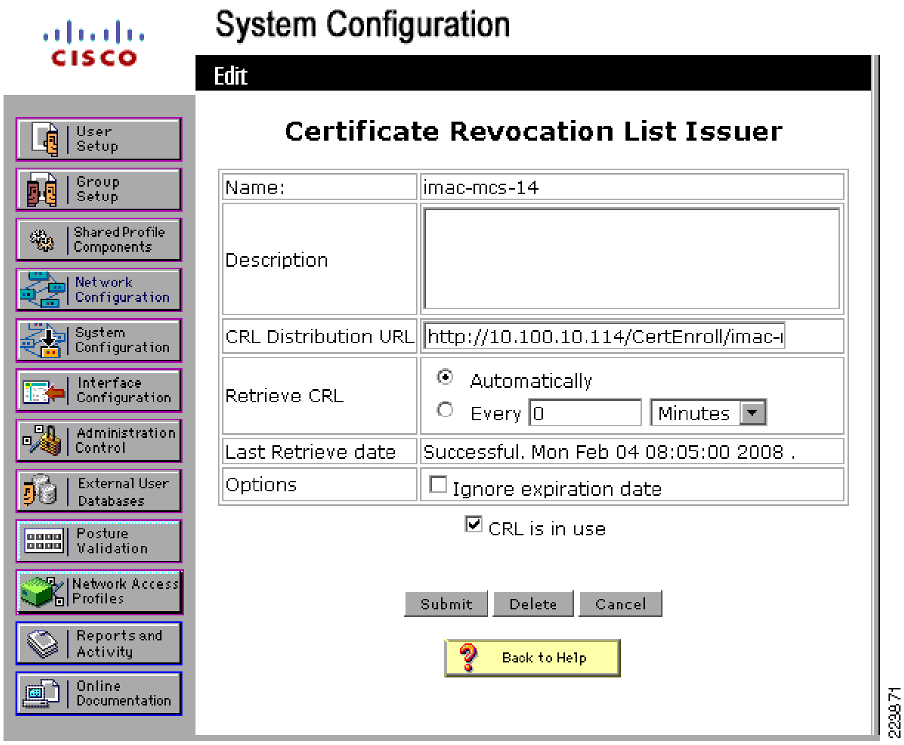
Edit

CRL Issuers

Issuer Friendly Name	Status
imac-mcs-14	Not in use

Step 5 Select the CA from which the Cisco Secure ACS should download a CRL (*imac-mcs-14* in Figure 3-14). The *Certificate Revocation List Issuer* window will appear. See Figure 3-14.

Figure 3-14 CRL Configuration



Certificate Revocation List Issuer

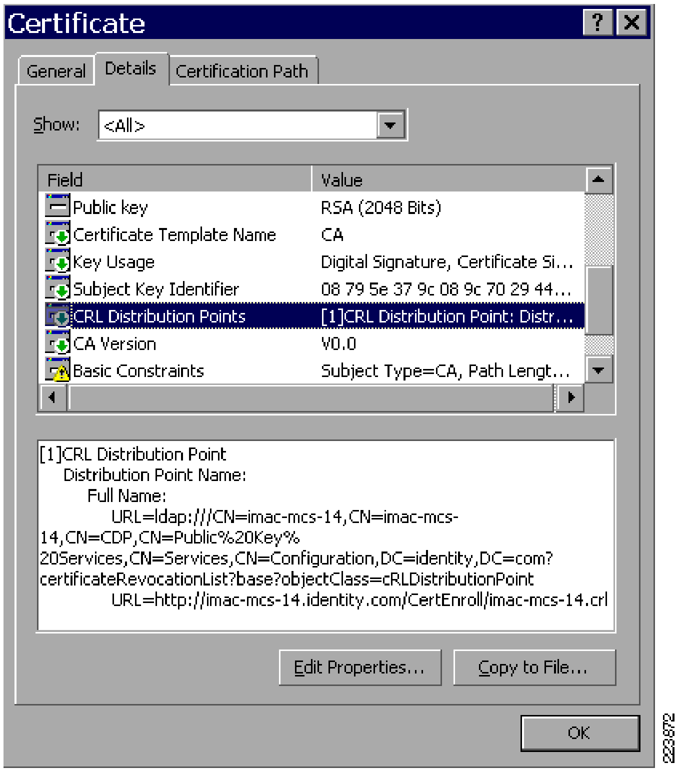
Name:	imac-mcs-14
Description	
CRL Distribution URL	http://10.100.10.114/CertEnroll/imac-i
Retrieve CRL	● Automatically ○ Every 0 Minutes
Last Retrieve date	Successful. Mon Feb 04 08:05:00 2008 .
Options	□ Ignore expiration date

☑ CRL is in use

Step 6 The CRL Distribution URL is automatically filled in based on what was provided in the root CA certificate. If some other URL should be used to download the CRL, enter it in the *CRL Distribution URL*.

Note The CRL Distribution URL above was automatically filled in based on the information in the root CA certificate (as seen in MMC). See Figure 3-15.

Figure 3-15 Finding the CRL in the Root CA Certificate



Field	Value
Public key	RSA (2048 Bits)
Certificate Template Name	CA
Key Usage	Digital Signature, Certificate Si...
Subject Key Identifier	08 79 5e 37 9c 08 9c 70 29 44...
CRL Distribution Points	[1]CRL Distribution Point: Distr...
CA Version	V0.0
Basic Constraints	Subject Type=CA, Path Lengt...

```
[1]CRL Distribution Point
     Distribution Point Name:
          Full Name:
               URL=ldap:///CN=imac-mcs-14,CN=imac-mcs-
14,CN=CDP,CN=Public%20Key%
20Services,CN=Services,CN=Configuration,DC=identity,DC=com?
certificateRevocationList?base?objectClass=cRLDistributionPoint
               URL=http://imac-mcs-14.identity.com/CertEnroll/imac-mcs-14.crl
```

Step 7 Use the radio buttons on the *Certificate Revocation List configuration* page to select the method that Cisco Secure ACS should use for retrieving a CRL. This value should be determined in accordance with your organization’s security policy.

- *Automatically*—Uses the value contained in the Next Update field in the CRL file to retrieve a new CRL from the CA. If unsuccessful, Cisco Secure ACS tried to retrieve the CRL every 10 minutes after the first failure until it succeeds.
- *Every*—Determines the frequency between retrieval attempts. Enter the amount in units of time.

Note In both modes, if retrieval fails for some reason, a reattempt is tried every 10 minutes.

Step 8 Select the *CRL is in use* option to enable CRL checking for this CA.

Step 9 Click **Submit**.

Step 3: Acquire and Configure Cisco Secure ACS Server Certificate

During the EAP-TLS exchange with the 802.1X supplicant, the Cisco Secure ACS must present a valid server certificate that it has previously retrieved from the Enterprise CA. There are two ways to acquire a server certificate. The end result is the same in both cases. The only differences are in how the certificates are stored and retrieved.

Method 1 retrieves a server certificate from the CA and installs it in the Windows machine certificate store on the Cisco Secure ACS. Once in the machine store, this certificate can be imported into Cisco Secure ACS by referencing the certificate's Common Name (CN). Because the certificate must have exportable keys in order to be exported from the machine store, a new certificate template must be created for use by the CA.

Method 2 uses the Cisco Secure ACS Certificate Signing Request feature to generate a certificate request. This certificate request is used to generate a certificate on the CA. This certificate and its associated key file can be saved to the Cisco Secure ACS server and then imported by Cisco Secure ACS. Because the certificate is not in the Windows machine certificate store, it does not need to be exported and so does not need exportable keys. Therefore, no new certificate template is need on the CA when using this method.

Cisco Secure ACS Certificate—Method 1

This method consists of the following:

1. Create Certificate Template on the Enterprise Root CA, page 3-24
2. Obtain a Server Certificate for the ACS Server, page 3-32
3. Configure ACS to Use the Server Certificate, page 3-36

Each of these steps is described in detail below.

Create Certificate Template on the Enterprise Root CA

For the Cisco Secure ACS to use a certificate in the Windows machine store, the certificate must have exportable keys. A certificate with exportable private keys can be exported from Windows storage and installed in Cisco Secure ACS. Exportable keys also allow the certificate to be exported from Windows and installed on another computer.

In earlier versions of the Microsoft CA, it was possible to use the pre-configured Web Server template when requesting an Cisco Secure ACS server certificate. However, Microsoft has changed the Web Server template with the release of the Windows 2003 Enterprise CA so that keys are no longer exportable (the option is grayed out). There are no other default certificate templates supplied with certificate services that are for server authentication and give the ability to mark keys as exportable. Therefore, you must create a new template. Once the template has been created, the Cisco Secure ACS can retrieve its server certificate. This section describes how to create the certificate template on the Enterprise CA. Subsequent sections describe how to retrieve the certificate from the Cisco Secure ACS.

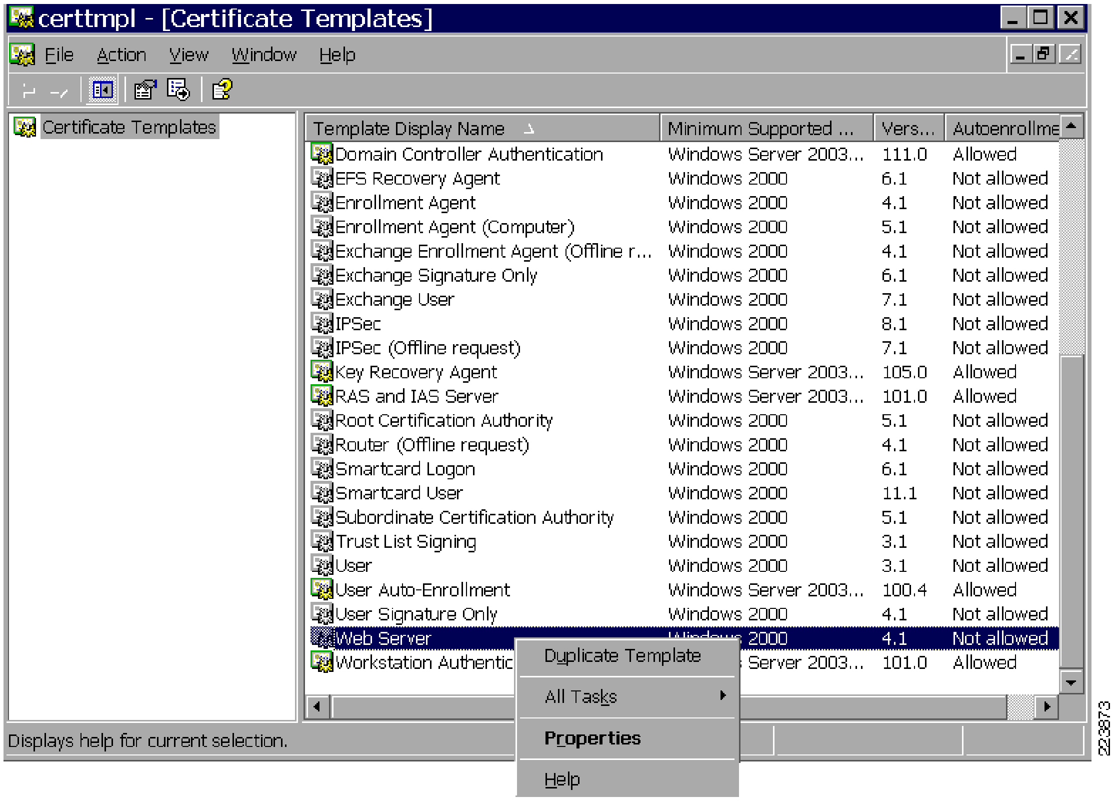
Note Microsoft Certificate Authorities running on Windows 2000 allows for exportable keys and these procedures do not need to be followed if you use Windows 2000 Certificate Authority. Skip to Obtain a Server Certificate for the ACS Server, page 3-41, if your CA is running on Windows 2000 server and use the default Web server template. Before deploying a Windows 2000 CA, however, recall that user auto-enrollment (a best practice for simplifying PKI deployment) cannot be enabled on a Windows 2000 CA.

Install the Certificate Templates Snap-in

On the Enterprise CA or the Domain Controller (both can be used to configure templates), complete these steps:

Step 1 Choose **Start** > **Run**, type *certtmpl.msc*, and click **OK** to open the *Certificate Templates* snap-in. See Figure 3-16.

Figure 3-16 Certificate Template Snap-in



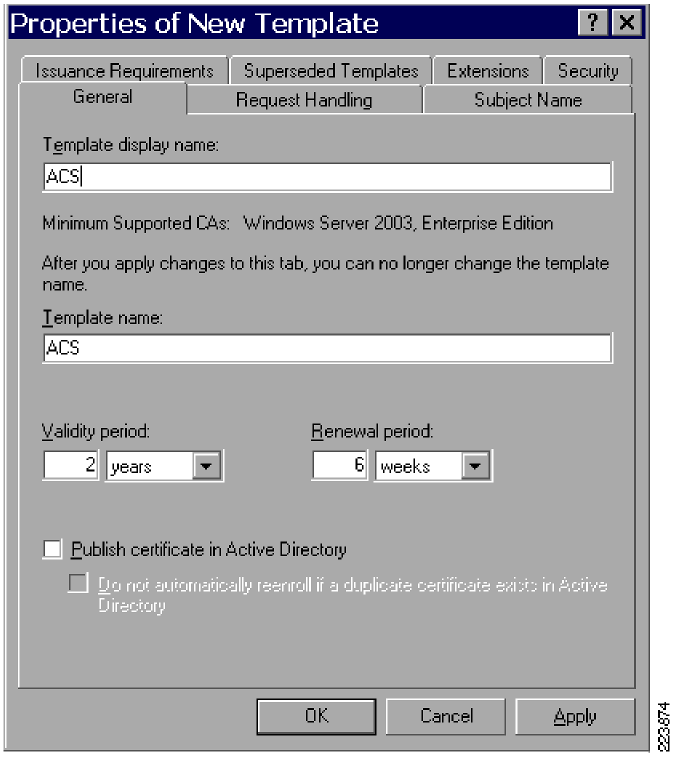
Template Display Name	Minimum Supported ...	Vers...	Autoenrollme
Domain Controller Authentication	Windows Server 2003...	111.0	Allowed
EFS Recovery Agent	Windows 2000	6.1	Not allowed
Enrollment Agent	Windows 2000	4.1	Not allowed
Enrollment Agent (Computer)	Windows 2000	5.1	Not allowed
Exchange Enrollment Agent (Offline r...	Windows 2000	4.1	Not allowed
Exchange Signature Only	Windows 2000	6.1	Not allowed
Exchange User	Windows 2000	7.1	Not allowed
IPSec	Windows 2000	8.1	Not allowed
IPSec (Offline request)	Windows 2000	7.1	Not allowed
Key Recovery Agent	Windows Server 2003...	105.0	Allowed
RAS and IAS Server	Windows Server 2003...	101.0	Allowed
Root Certification Authority	Windows 2000	5.1	Not allowed
Router (Offline request)	Windows 2000	4.1	Not allowed
Smartcard Logon	Windows 2000	6.1	Not allowed
Smartcard User	Windows 2000	11.1	Not allowed
Subordinate Certification Authority	Windows 2000	5.1	Not allowed
Trust List Signing	Windows 2000	3.1	Not allowed
User	Windows 2000	3.1	Not allowed
User Auto-Enrollment	Windows Server 2003...	100.4	Allowed
User Signature Only	Windows 2000	4.1	Not allowed
Web Server	Windows 2000	4.1	Not allowed
Workstation Authentic	Server 2003...	101.0	Allowed

Displays help for current selection.

Step 2 In the *Details* pane of the *Certificate Templates* snap-in, click the **Web Server** template.

Step 3 From the *Action* pull down menu, click **Duplicate Template**. The *Properties of New Template* window appears. See Figure 3-17.

Figure 3-17 Cisco Secure ACS Certificate Template: General Tab



Properties of New Template

Template display name: ACS

Minimum Supported CAs: Windows Server 2003, Enterprise Edition

After you apply changes to this tab, you can no longer change the template name.

Template name: ACS

Validity period: 2 years

Renewal period: 6 weeks

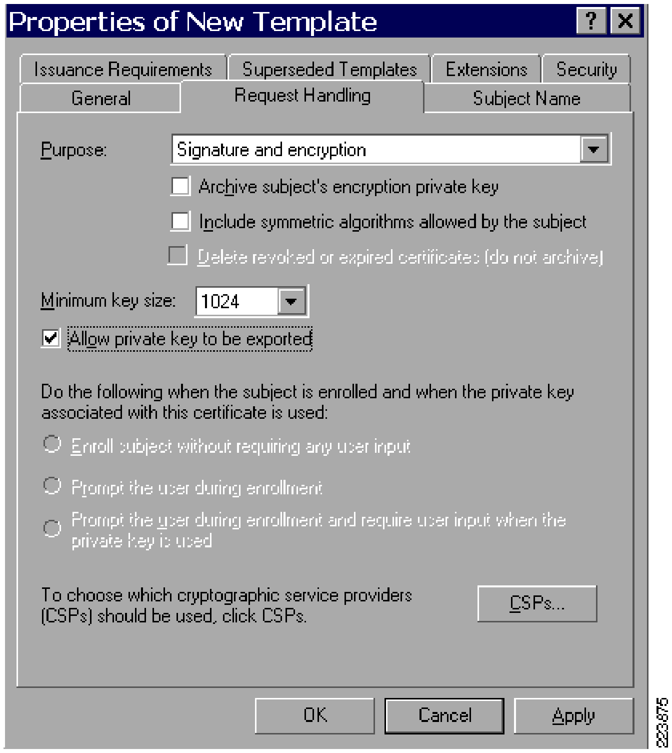
□ Publish certificate in Active Directory

□ Do not automatically reenroll if a duplicate certificate exists in Active Directory

Step 4 In the *Template display name* field of the *General* tab, enter **Cisco Secure ACS**.

Step 5 Go to the *Request Handling* tab and check *Allow private key to be exported*. See Figure 3-18.

Figure 3-18 ACS Certificate Template: Request Handling tab


Properties of New Template

Purpose: Signature and encryption

□ Archive subject's encryption private key

□ Include symmetric algorithms allowed by the subject

□ Delete revoked or expired certificates (do not archive)

Minimum key size: 1024

☑ Allow private key to be exported

Do the following when the subject is enrolled and when the private key associated with this certificate is used:

○ Enroll subject without requiring any user input

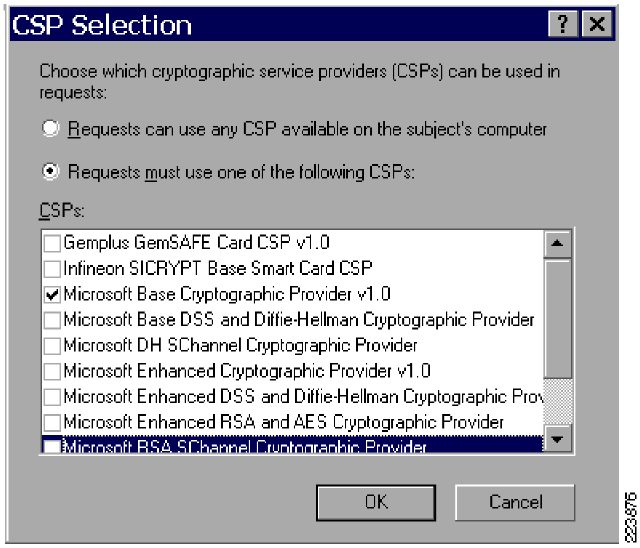
○ Prompt the user during enrollment

○ Prompt the user during enrollment and require user input when the private key is used

To choose which cryptographic service providers (CSPs) should be used, click CSPs.

Step 6 Click the **CSPs** button near the bottom of the *Request Handling* tab. In the CSP Selection window, select *Requests must use one of the following CSPs* and check *Microsoft Base Cryptographic Provider v1.0*. Uncheck any other CSPs that are checked and then click **OK**. See Figure 3-19.

Figure 3-19 CSP Selection


CSP Selection

Choose which cryptographic service providers (CSPs) can be used in requests:

○ Requests can use any CSP available on the subject's computer

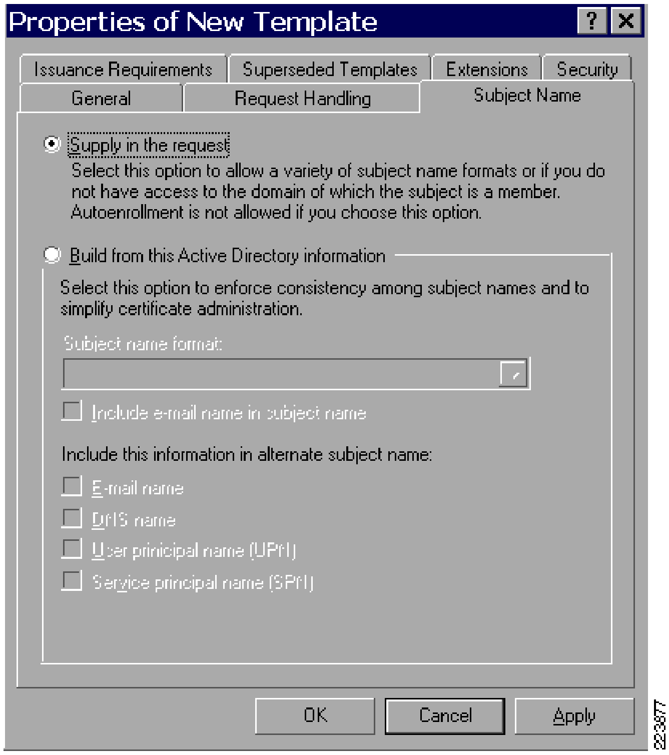
● Requests must use one of the following CSPs:

CSPs:

□ Gemplus GemSAFE Card CSP v1.0
□ Infineon SICRYPT Base Smart Card CSP
☑ Microsoft Base Cryptographic Provider v1.0
□ Microsoft Base DSS and Diffie-Hellman Cryptographic Provider
□ Microsoft DH SChannel Cryptographic Provider
□ Microsoft Enhanced Cryptographic Provider v1.0
□ Microsoft Enhanced DSS and Diffie-Hellman Cryptographic Prov
□ Microsoft Enhanced RSA and AES Cryptographic Provider
□ Microsoft RSA SChannel Cryptographic Provider

Step 7 Go to the *Subject Name* tab, choose *Supply in the request* and click **OK**. See Figure 3-20.

Figure 3-20 ACS Certificate Template: Subject Name Tab



Properties of New Template

Issuance Requirements | Superseded Templates | Extensions | Security
General | Request Handling | Subject Name

● Supply in the request
Select this option to allow a variety of subject name formats or if you do not have access to the domain of which the subject is a member. Autoenrollment is not allowed if you choose this option.

○ Build from this Active Directory information
Select this option to enforce consistency among subject names and to simplify certificate administration.

Subject name format:

□ Include e-mail name in subject name

Include this information in alternate subject name:

□ E-mail name

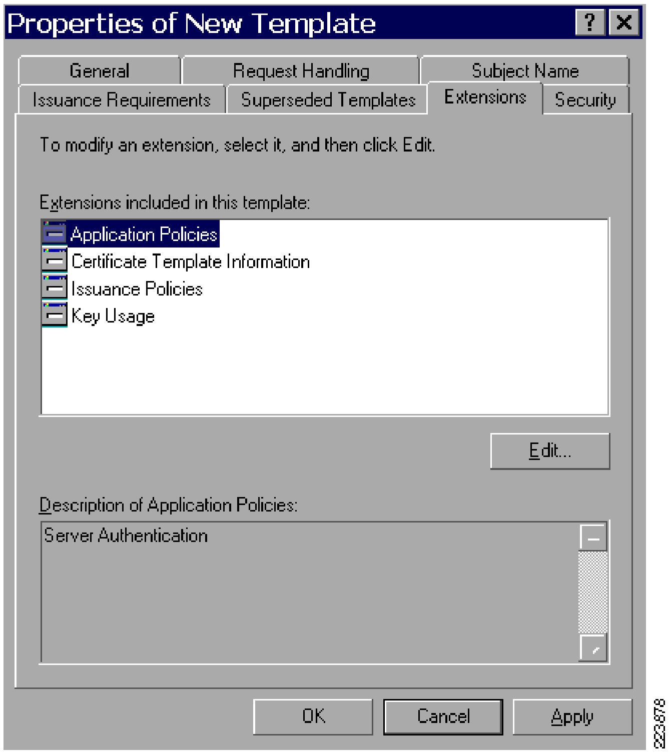
□ DNS name

□ User principal name (UPN)

□ Service principal name (SPN)

Step 8 Go to the *Extensions* tab. Highlight *Application Policies* and verify that description of application policies includes *Server Authentication*. This should happen automatically if you have duplicated the default *Web Server Template*. See Figure 3-21.

Figure 3-21 ACS Certificate Template: Extensions Tab



Properties of New Template

To modify an extension, select it, and then click Edit.

Extensions included in this template:

- Application Policies
- Certificate Template Information
- Issuance Policies
- Key Usage

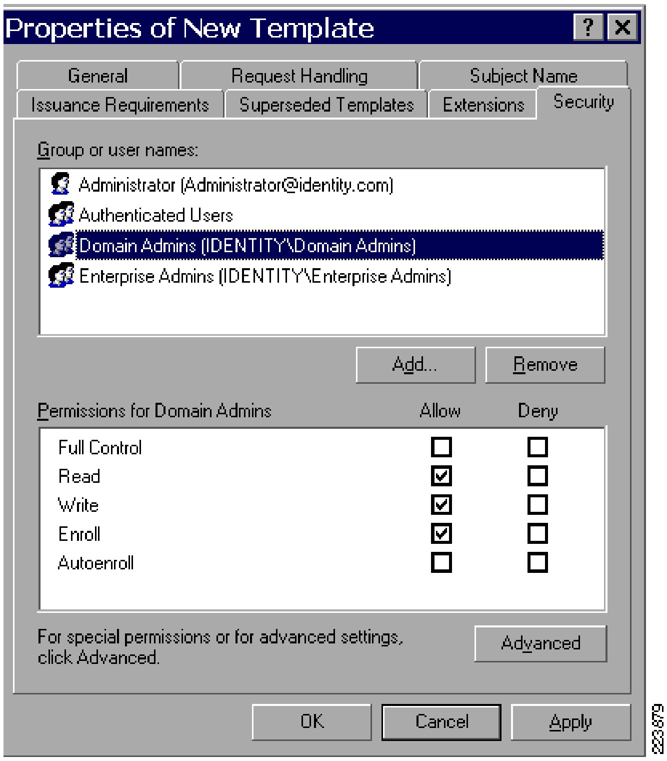
Description of Application Policies:

Server Authentication

Note The Application Policy extension is used to populate the Enhanced Key Usage field on the certificate. This field is mandatory when you use the Microsoft supplicant for EAP-TLS or PEAP.

Step 9 Go to the *Security* tab, highlight the *Domain Admins Group* and ensure that the *Enroll* option is checked under *Allowed*. See Figure 3-22.

Figure 3-22 ACS Certificate Template: Security Tab



Group or user names:

- Administrator (Administrator@identity.com)
- Authenticated Users
- Domain Admins (IDENTITY\Domain Admins)
- Enterprise Admins (IDENTITY\Enterprise Admins)

Permissions for Domain Admins	Allow	Deny
Full Control	□	□
Read	☑	□
Write	☑	□
Enroll	☑	□
Autoenroll	□	□

For special permissions or for advanced settings, click Advanced.

Step 10 Click **OK** to save the template and move onto issuing this template from the Certificate Authority snap-in.

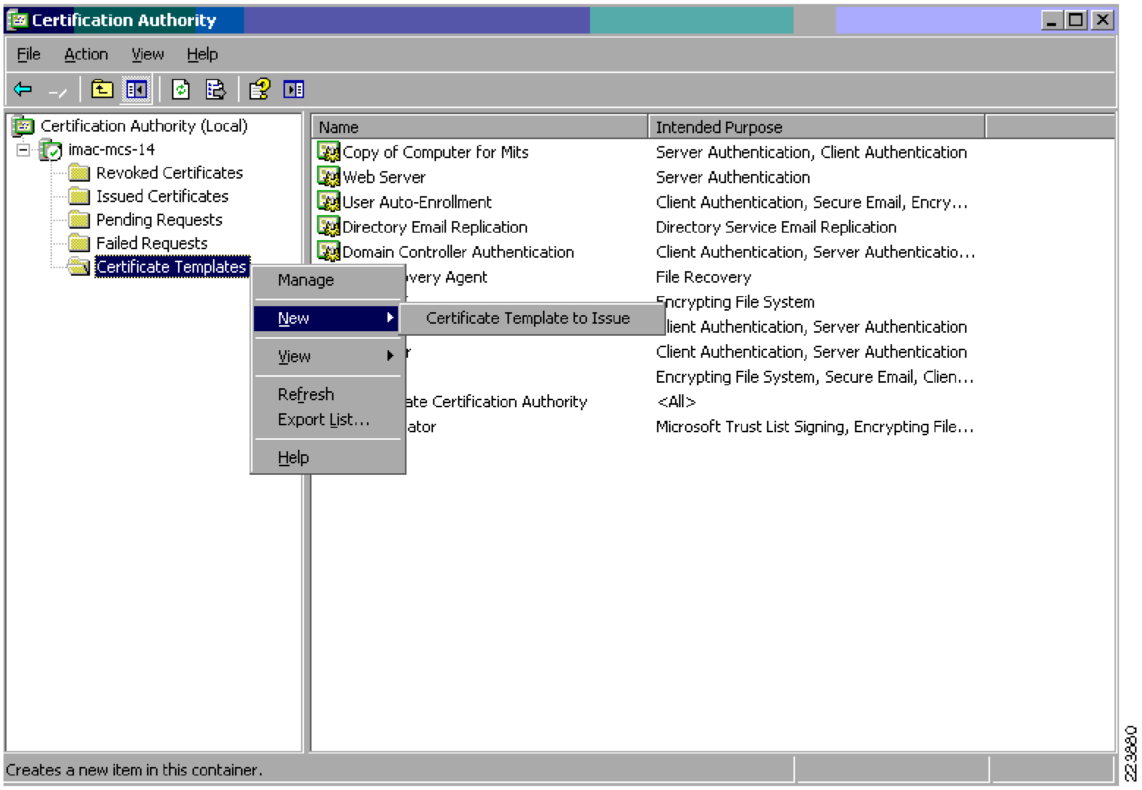
Enabling the New ACS Web Server Certificate Template

Complete these steps to enable the new ACS Web Server Certificate Template:

Step 1 On the Enterprise CA server, open the Certification Authority by choosing **Start** > **All Programs** > **Administrative Tools** > **Certification Authority**.

Step 2 In the console tree, click the name of the CA (*imac-mcs-14* in Figure 3-23) to expand the certificate list. Right-click **Certificate Templates**. Choose **New** > **Certificate Template to Issue**. See Figure 3-23.

Figure 3-23 Issuing a New Certificate from the Certification Authority

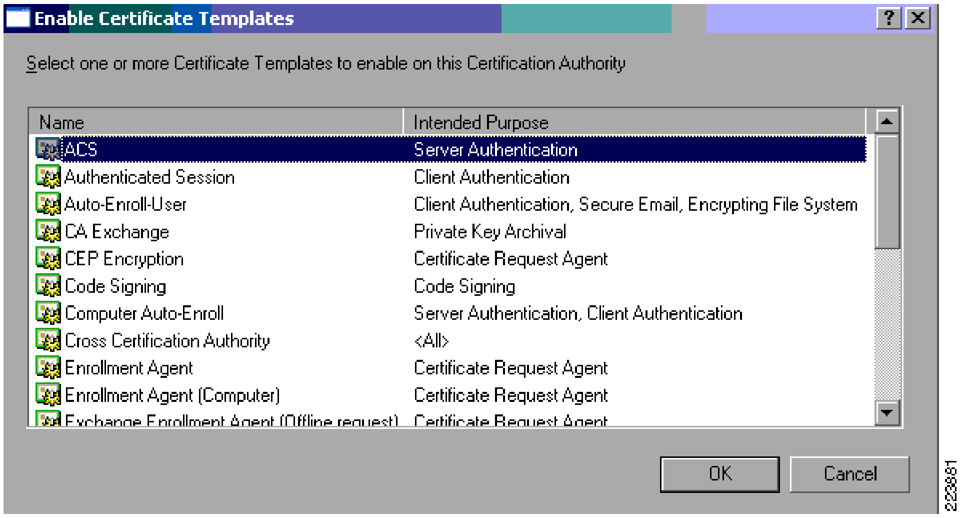


Name	Intended Purpose
Copy of Computer for Mits	Server Authentication, Client Authentication
Web Server	Server Authentication
User Auto-Enrollment	Client Authentication, Secure Email, Encry...
Directory Email Replication	Directory Service Email Replication
Domain Controller Authentication	Client Authentication, Server Authenticatio...
very Agent	File Recovery
	Encrypting File System
	lient Authentication, Server Authentication
r	Client Authentication, Server Authentication
	Encrypting File System, Secure Email, Clien...
ate Certification Authority	<All>
ator	Microsoft Trust List Signing, Encrypting File...

Creates a new item in this container.

Step 3 Select the **ACS** Certificate Template created in the previous section and click **OK**. See Figure 3-24.

Figure 3-24 Issue the ACS Certificate Template



Select one or more Certificate Templates to enable on this Certification Authority

Name	Intended Purpose
ACS	Server Authentication
Authenticated Session	Client Authentication
Auto-Enroll-User	Client Authentication, Secure Email, Encrypting File System
CA Exchange	Private Key Archival
CEP Encryption	Certificate Request Agent
Code Signing	Code Signing
Computer Auto-Enroll	Server Authentication, Client Authentication
Cross Certification Authority	<All>
Enrollment Agent	Certificate Request Agent
Enrollment Agent (Computer)	Certificate Request Agent
Exchange Enrollment Agent (Offline request)	Certificate Request Agent

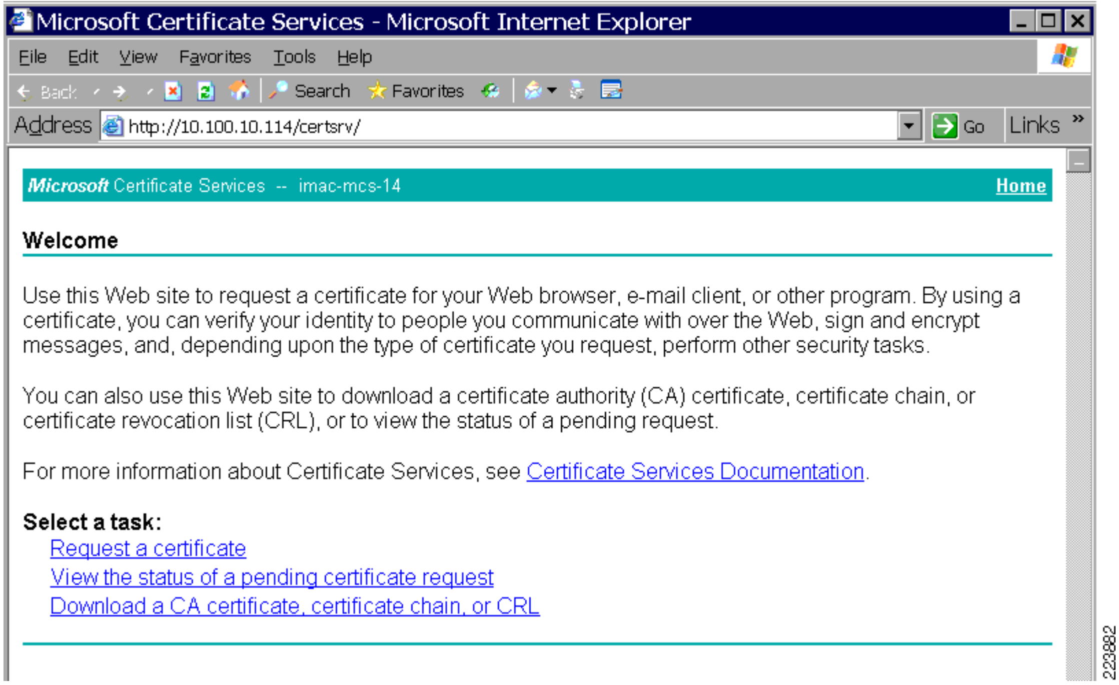
Obtain a Server Certificate for the ACS Server

Now that a suitable certificate template exists on the CA server, the ACS server can obtain a server authentication certificate that can be used for EAP-TLS authentication. Follow the steps below to download a server certificate to the ACS.

Step 1 Log into the ACS server with an account that has Enterprise Admin rights.

Step 2 On the local ACS machine, point the browser at the Microsoft certification authority server at http://IP-address-of-Root-CA/certsrv. In Figure 3-25, the IP address of the CA is 10.100.10.114. Select **Request a Certificate**. See Figure 3-25.

Figure 3-25 CA Web Interface


Microsoft Certificate Services - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back
Search
Favorites
Address
Go
Links
223882

http://10.100.10.114/certsrv/

Microsoft Certificate Services -- imac-mcs-14 Home

Welcome

Use this Web site to request a certificate for your Web browser, e-mail client, or other program. By using a certificate, you can verify your identity to people you communicate with over the Web, sign and encrypt messages, and, depending upon the type of certificate you request, perform other security tasks.

You can also use this Web site to download a certificate authority (CA) certificate, certificate chain, or certificate revocation list (CRL), or to view the status of a pending request.

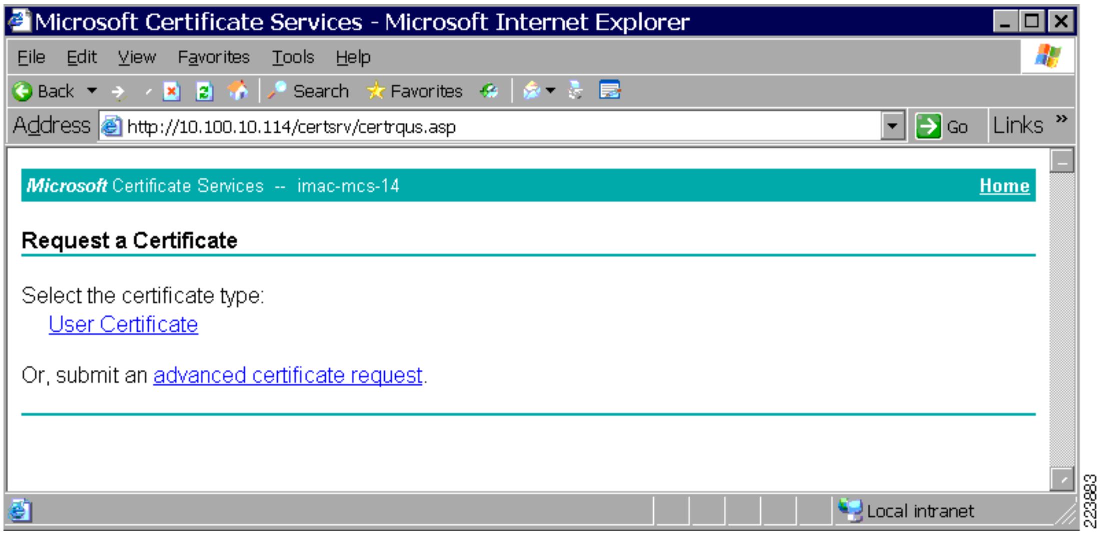
For more information about Certificate Services, see Certificate Services Documentation.

Select a task:

- Request a certificate
- View the status of a pending certificate request
- Download a CA certificate, certificate chain, or CRL

Step 3 In the *Certificate Request* window, click **Advanced Certificate Request**. See Figure 3-26.

Figure 3-26 Request a Certificate from the CA


Microsoft Certificate Services - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back
Search
Favorites
Address
http://10.100.10.114/certsrv/certrqus.asp
Go
Links
Microsoft Certificate Services -- imac-mcs-14
Home
Local intranet
223883

Request a Certificate

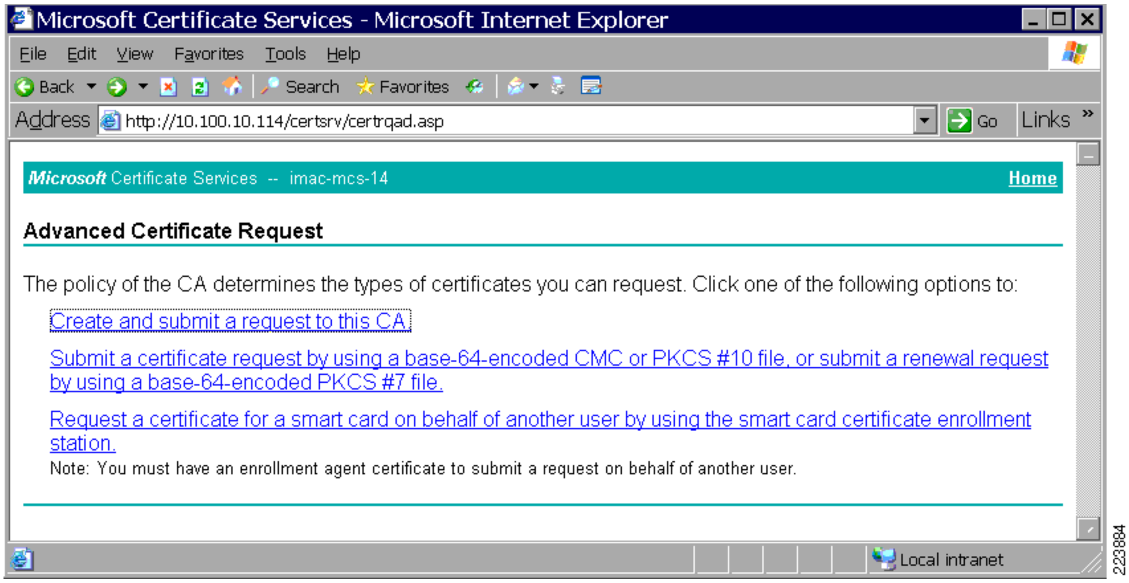
Select the certificate type:
User Certificate

Or, submit an advanced certificate request.

Step 4 In the *Advanced Certificate Request* screen, click **Create and submit a request to this CA**. See Figure 3-27.

Note The reason for this step is that the Windows 2003 Certificate Authority does not allow for exportable keys by default and you need to generate a certificate request based on the ACS Certificate Template that you created earlier.

Figure 3-27 Creating an Advanced Certificate Request


Microsoft Certificate Services - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back
Search
Favorites
Address
http://10.100.10.114/certsrv/certrqad.asp
Go
Links
Microsoft Certificate Services -- imac-mcs-14
Home
Local intranet
223884

Advanced Certificate Request

The policy of the CA determines the types of certificates you can request. Click one of the following options to:

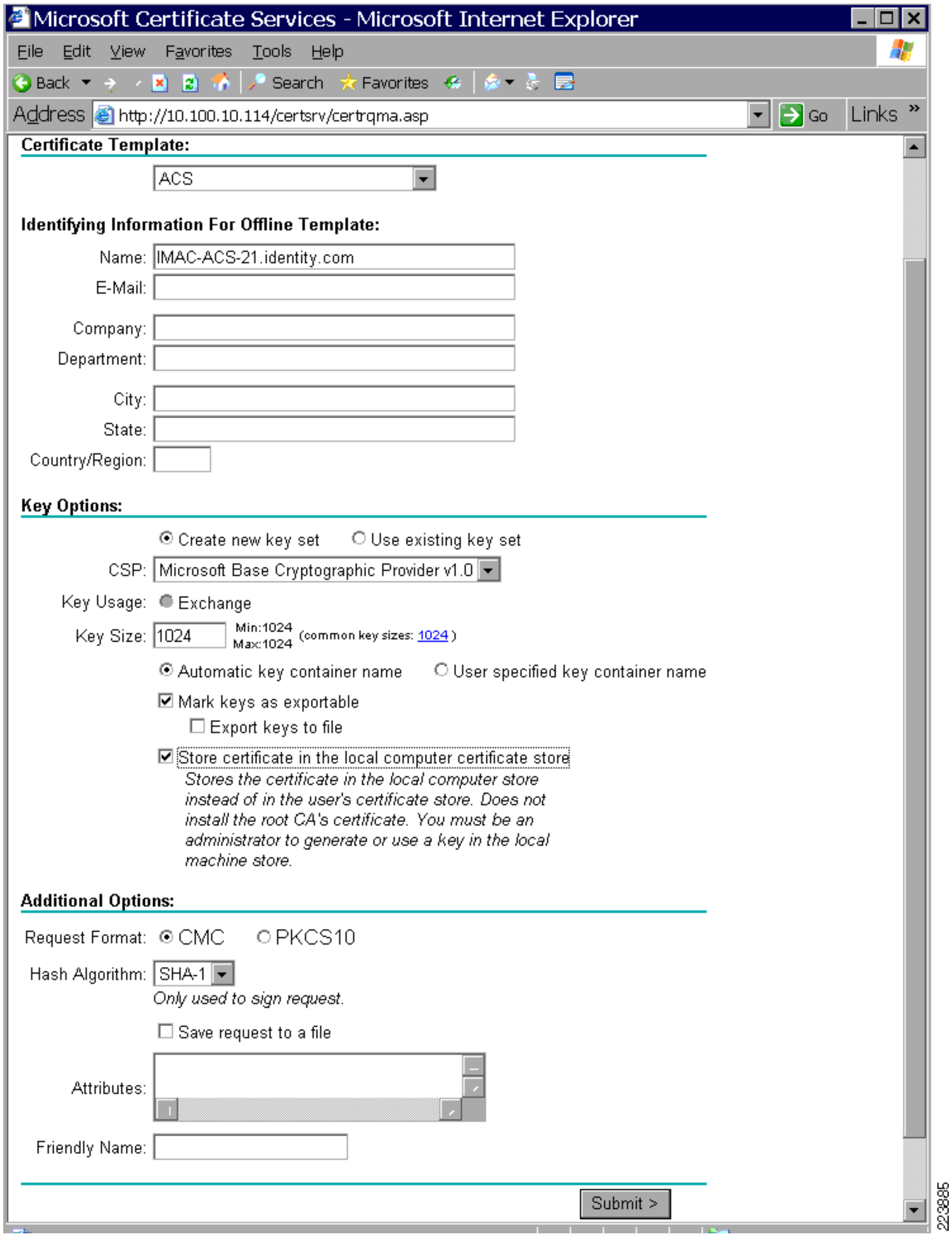
Create and submit a request to this CA.

Submit a certificate request by using a base-64-encoded CMC or PKCS #10 file, or submit a renewal request by using a base-64-encoded PKCS #7 file.

Request a certificate for a smart card on behalf of another user by using the smart card certificate enrollment station.
Note: You must have an enrollment agent certificate to submit a request on behalf of another user.

Step 5 In the *Advanced Certificate Request* form, select the certificate template created earlier named *ACS* from the *Certificate Template* drop-down list. The available options in the form change after you select the template. See Figure 3-28.

Figure 3-28 Completing the ACS Certificate Template Form


Microsoft Certificate Services - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Go Links
Submit >
223885

Address: http://10.100.10.114/certsrv/certrqma.asp

Certificate Template:

ACS

Identifying Information For Offline Template:

Name:	IMAC-ACS-21.identity.com
E-Mail:	
Company:	
Department:	
City:	
State:	
Country/Region:	

Key Options:

● Create new key set ○ Use existing key set

CSP: Microsoft Base Cryptographic Provider v1.0

Key Usage: ● Exchange

Key Size: 1024 Min:1024 Max:1024 (common key sizes: 1024)

● Automatic key container name ○ User specified key container name

☑ Mark keys as exportable

□ Export keys to file

☑ Store certificate in the local computer certificate store

Stores the certificate in the local computer store instead of in the user's certificate store. Does not install the root CA's certificate. You must be an administrator to generate or use a key in the local machine store.

Additional Options:

Request Format: ● CMC ○ PKCS10

Hash Algorithm: SHA-1

Only used to sign request.

□ Save request to a file

Attributes:

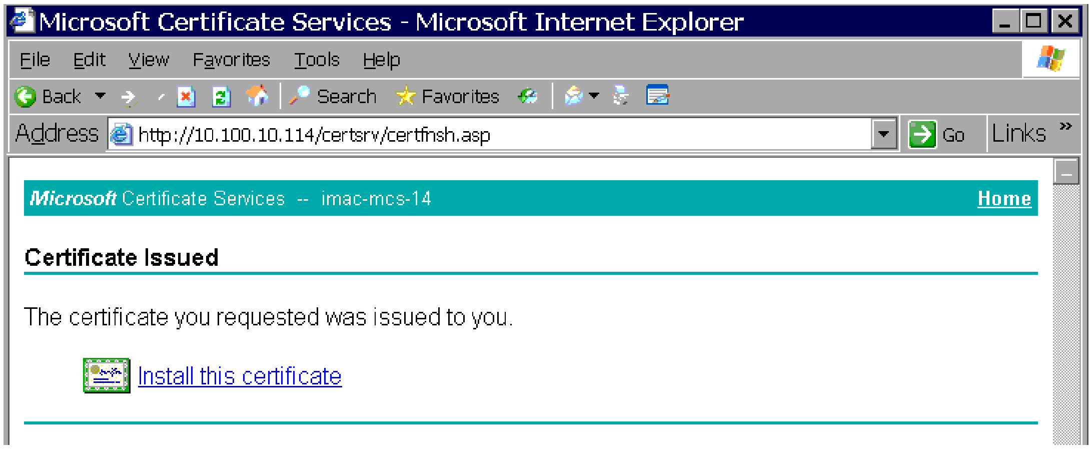
Friendly Name:

Step 6 In the *Certificate Template* form, configure the *Name* to be the fully qualified domain name of the ACS server. In this case the ACS server name is *IMAC-ACS-21.identity.com*. Remember this name (the Common Name) as it will be used later when configuring Trusted Servers on the client side. The other identifying information in the form is optional. Ensure that the *Mark Keys as Exportable* and *Store certificate in the local computer certificate store* options are checked and click **Submit**.

Step 7 A pop up window may appear that warns about a potential scripting violation. Click **Yes**. The certificate will be issued.

Step 8 In the *Certificate Issued* window, click **Install this certificate**. See Figure 3-29.

Figure 3-29 Issuing the ACS Server Certificate


Microsoft Certificate Services - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://10.100.10.114/certsrv/certfnsh.asp
Go Links
Microsoft Certificate Services -- imac-mcs-14
Home
223896

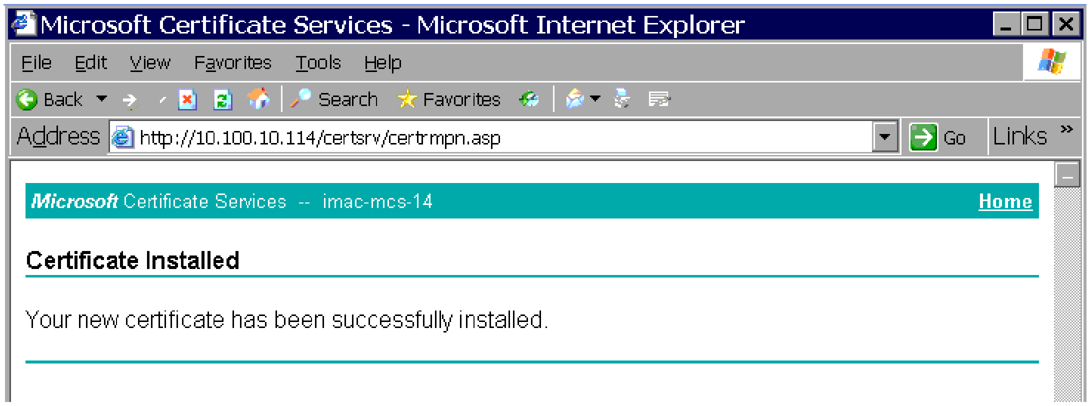
Certificate Issued

The certificate you requested was issued to you.

Install this certificate

Step 9 A pop up window might appear that warns about a potential scripting violation. Click **Yes**. The certificate will be installed in the Local Computer store Personal certificates folder. See Figure 3-30.

Figure 3-30 Installing the ACS Server Certificate

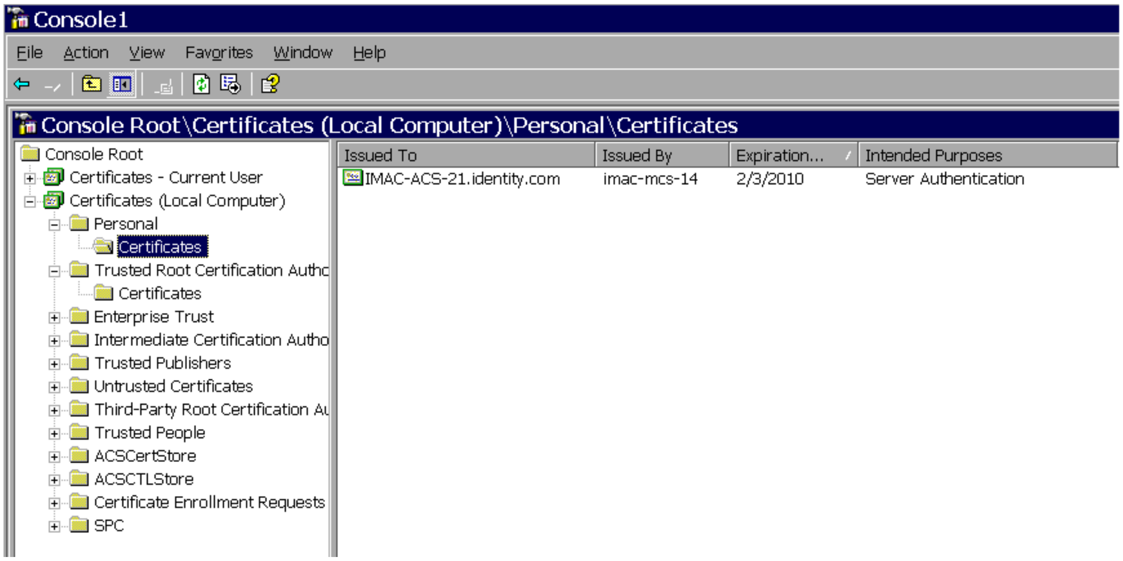

Microsoft Certificate Services - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://10.100.10.114/certsrv/certrmpn.asp
Go Links
Microsoft Certificate Services -- imac-mcs-14
Home
223897

Certificate Installed

Your new certificate has been successfully installed.

Step 10 Verify that the certificate is installed in the Local Computer store Personal certificate folder using the Microsoft Management Console (MMC). See Figure 3-31.

Figure 3-31 Verifying ACS Server Certificate Storage



Console1

Console Root\Certificates (Local Computer)\Personal\Certificates

Issued To	Issued By	Expiration...	Intended Purposes
IMAC-ACS-21.identity.com	imac-mcs-14	2/3/2010	Server Authentication

File
Action
View
Favorites
Window
Help
Console Root
Certificates - Current User
Certificates (Local Computer)
Personal
Certificates
Trusted Root Certification Authc
Certificates
Enterprise Trust
Intermediate Certification Autho
Trusted Publishers
Untrusted Certificates
Third-Party Root Certification Au
Trusted People
ACSCertStore
ACSCTLStore
Certificate Enrollment Requests
SPC
223888

Configure ACS to Use the Server Certificate

After the previous step, the ACS server has a server certificate in its local machine store. Complete the following steps to configure ACS to use the server certificate in the local machine store.

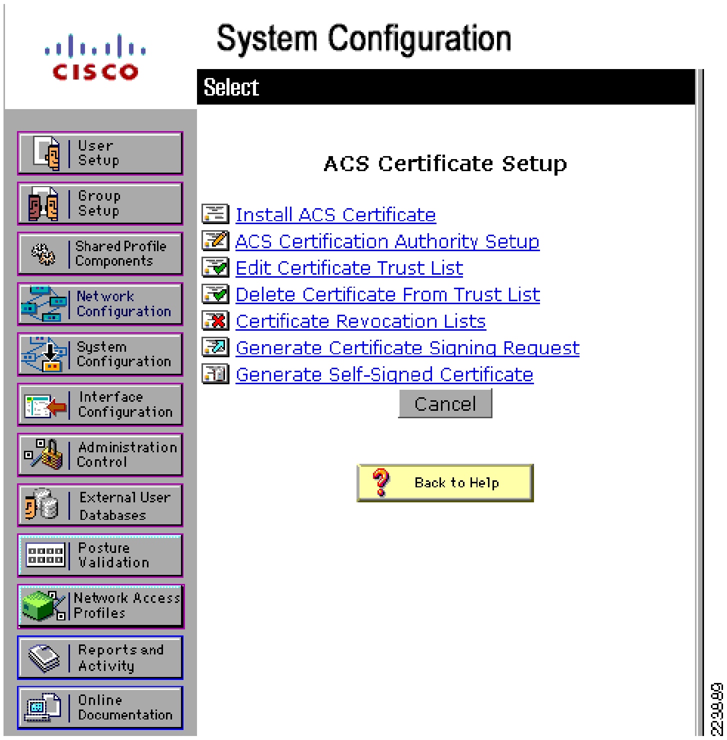
Step 1 Open ACS Admin from the desktop shortcut created during the installation.

Step 2 Click the **System Configuration** button.

Step 3 Select *ACS Certificate Setup*.

Step 4 Select *Install ACS Certificate*. See Figure 3-32.

Figure 3-32 ACS Server Certificate

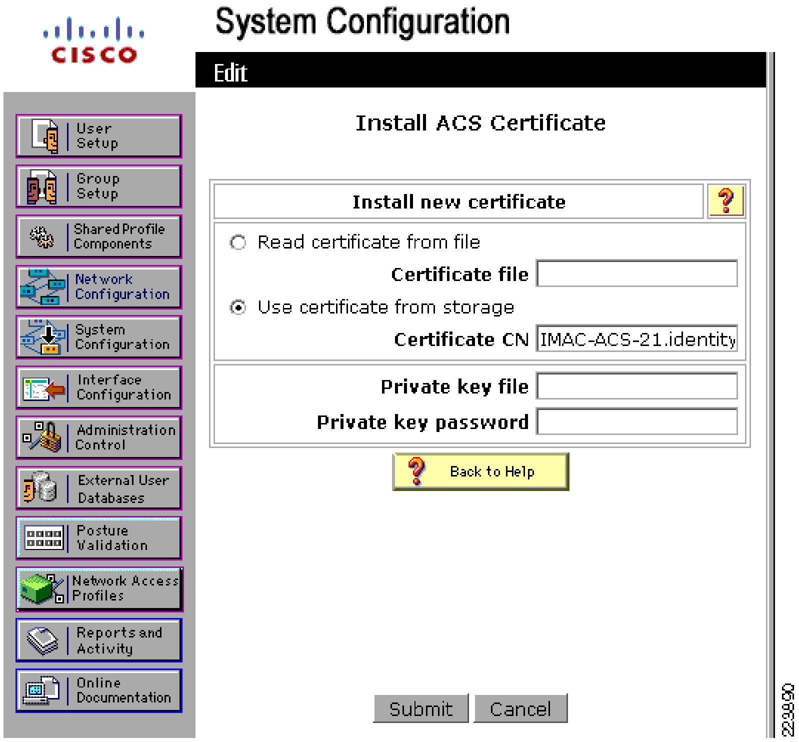


ACS Certificate Setup

- Install ACS Certificate
- ACS Certification Authority Setup
- Edit Certificate Trust List
- Delete Certificate From Trust List
- Certificate Revocation Lists
- Generate Certificate Signing Request
- Generate Self-Signed Certificate

Step 5 Choose *Use certificate from storage* and enter the fully qualified domain name of the ACS server (*IMAC-MCS-21.identity.com* in this example). See Figure 3-33.

Figure 3-33 Use Certificate from Storage


System Configuration

Edit

Install ACS Certificate

Install new certificate

○ Read certificate from file

Certificate file

● Use certificate from storage

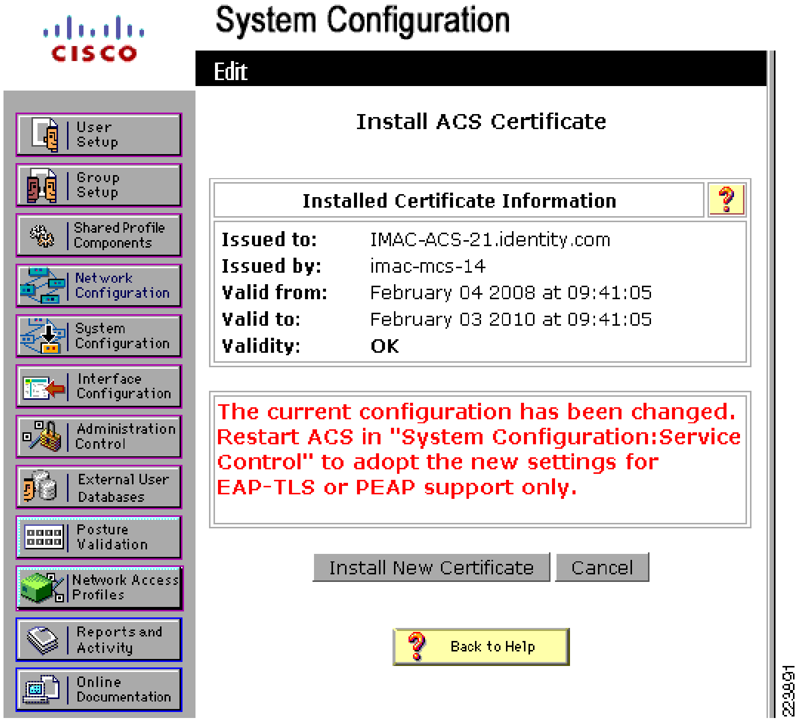
Certificate CN IMAC-ACS-21.identity

Private key file

Private key password

Step 6 Click **Submit**. See Figure 3-34.

Figure 3-34 Certificate Installation Confirmation



Install ACS Certificate

Installed Certificate Information	
Issued to:	IMAC-ACS-21.identity.com
Issued by:	imac-mcs-14
Valid from:	February 04 2008 at 09:41:05
Valid to:	February 03 2010 at 09:41:05
Validity:	OK

The current configuration has been changed. Restart ACS in "System Configuration:Service Control" to adopt the new settings for EAP-TLS or PEAP support only.

Step 7 Restart the ACS to adopt the new settings.

ACS Certificate—Method 2

This method consists of the following:

1. Generate a Certificate Signing Request, page 3-39
2. Obtain a Server Certificate for the ACS Server, page 3-41
3. Configure ACS to Use the Server Certificate, page 3-45

Each of these steps is described in the sections that follow.

Note Method 2 is an alternative to Method 1. There is no need to perform Method 2 if Method 1 was successful and vice versa.

Generate a Certificate Signing Request

In this step, ACS is used to generate a certificate signing request that can be used to acquire a certificate from the CA.

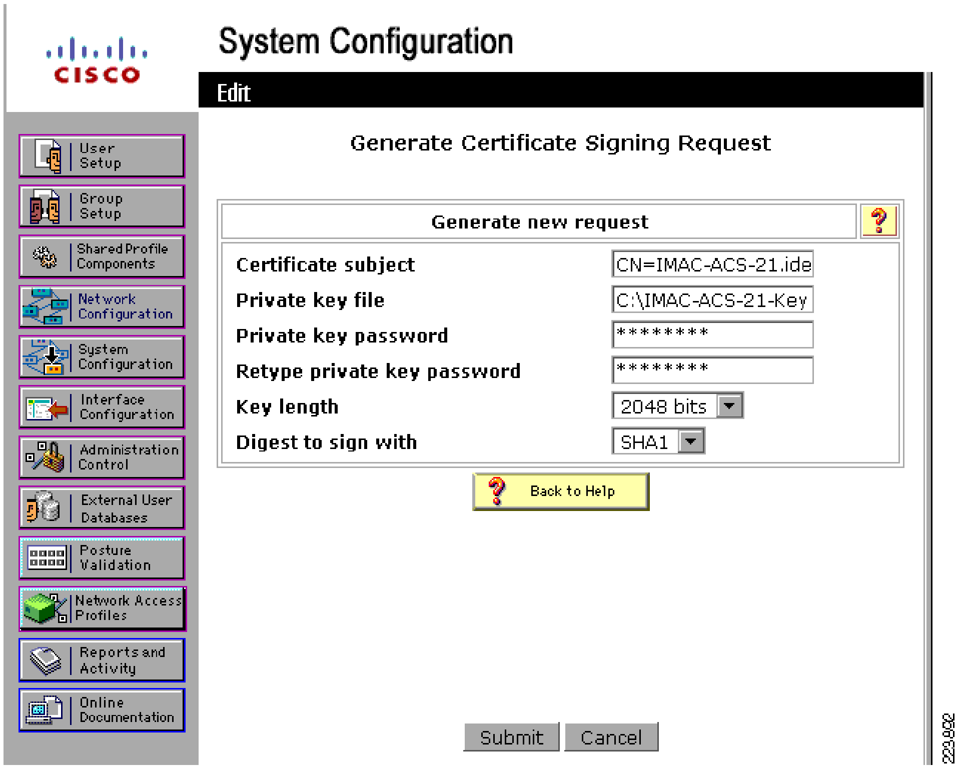
Step 1 Open ACS Admin from the desktop shortcut created during the installation.

Step 2 Click the **System Configuration** button.

Step 3 Select *ACS Certificate Setup*.

Step 4 Select *Generate Certificate Signing Request*. The *Certificate Signing Request* window will appear. See Figure 3-35.

Figure 3-35 Generating an ACS Certificate Signing Request



Generate Certificate Signing Request

Generate new request

Certificate subject	CN=IMAC-ACS-21.ide
Private key file	C:\IMAC-ACS-21-Key
Private key password	********
Retype private key password	********
Key length	2048 bits
Digest to sign with	SHA1

Step 5 Enter a Common Name (CN) for the certificate in the *Certificate subject* field with the format *CN=<cert-name>*.

Step 6 Under *Private key file*, enter the full path and file name for the private key file that will be downloaded with the certificate. Make a note of this file name as it will be required when configuring ACS to use this certificate.

Step 7 Enter a *Private key password*. Make a note of this password as it will be required when configuring ACS to use the private key file.

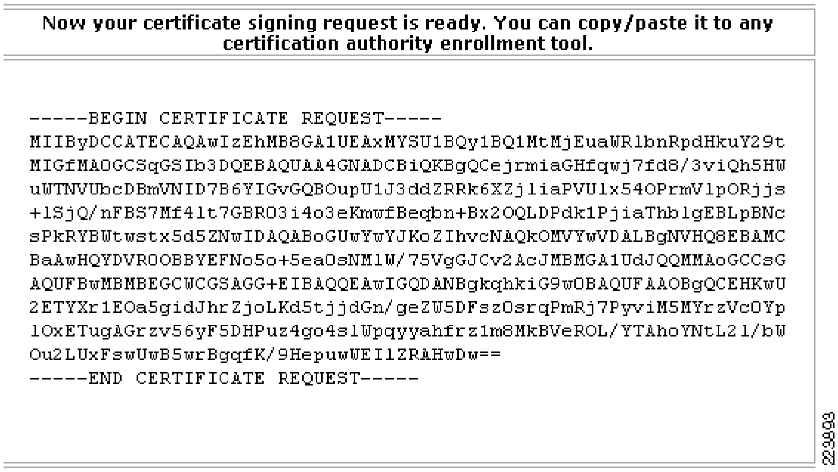
Step 8 Under *Key length*, select **1024**.

Note While you can create the server certificate with key sizes larger than 1024, any key larger than 1024 does not work with EAP-PEAP. If there is any chance you will need to support EAP-PEAP in your network, do not select a key size greater than 1024.

Step 9 Click **Submit**.

Step 10 The encoded certificate signing request appears. Using the mouse to select the entire request (all the characters between `MIIB` and `Dw==` in Figure 3-36) and copy it to the clipboard on the ACS. This will be used in the next step when requesting a certificate from the CA. See Figure 3-36.

Figure 3-36 Encoded Certificate Signing Request



Now your certificate signing request is ready. You can copy/paste it to any certification authority enrollment tool.

```
-----BEGIN CERTIFICATE REQUEST-----
MIIByDCCATECAQAwIzEhMB8GA1UEAxMYSU1BQy1BQ1MtMjEuaWRlbnRpdHkuY29t
MIGfMA0GCSqGSIb3DQEBAQUAA4GNADCBiQKBgQCejrmiaGHfqwj7fd8/3viQh5HW
uWTNVUbcDBmVNID7B6YIGvGQBOupU1J3ddZRRk6XZjliaPVUlx54OPrmVlpORjjs
+lSjQ/nFBS7Mf4lt7GBRO3i4o3eKmwfBeqbn+Bx2OQLDPdk1PjiaThblgEBLpBNc
sPkRYBWtwstx5d5ZNwIDAQABoGUwYwYJKoZIhvcNAQkOMVYwVDALBgNVHQ8EBAMC
BaAwHQYDVR0OBBYEFNo5o+5ea0sNMlW/75VgGJCv2AcJMBMGA1UdJQQMMAoGCCsG
AQUFBwMBMBEGCWCGSAGG+EIBAQQEAwIGQDANBgkqhkiG9w0BAQUFAAOBgQCEHKwU
2ETYXr1EOa5gidJhrZjoLKd5tjjdGn/geZW5DFsz0srqPmRj7PyviM5MYrzVcOYp
lOxETugAGrzv56yF5DHPuz4go4slWpqyyahfrz1m8MkBVeROL/YTAhoYNtL2l/bW
Ou2LUxFswUwB5wrBgqfK/9HepuwWEIlZRAHwDw==
-----END CERTIFICATE REQUEST-----
```

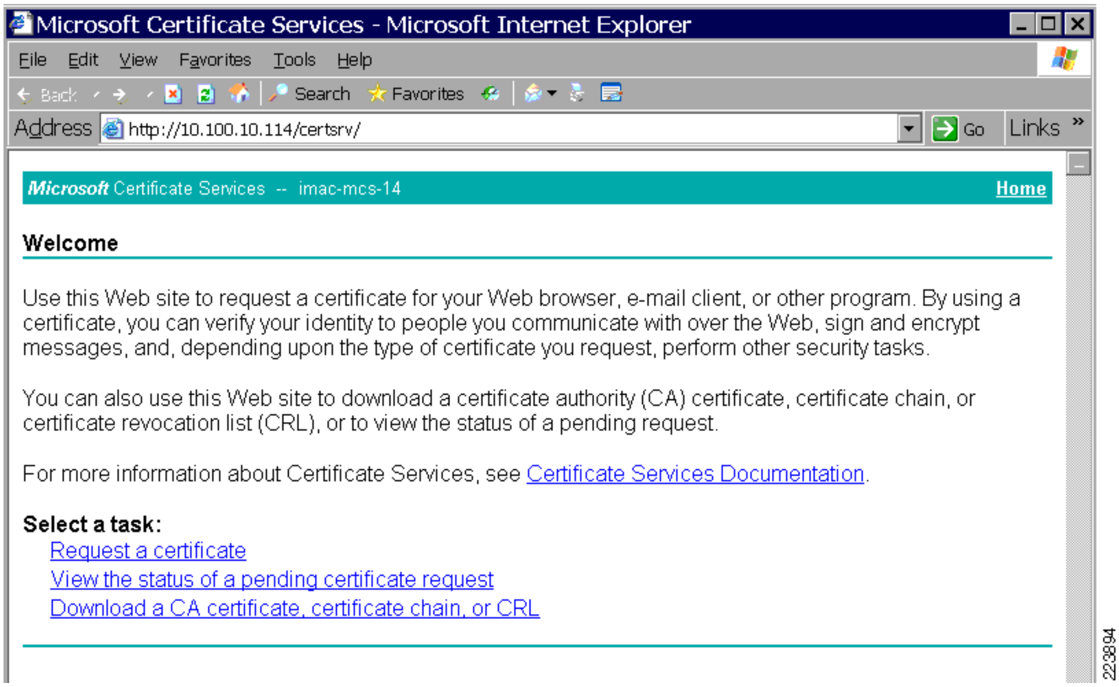
Obtain a Server Certificate for the ACS Server

In this step, the certificate signing request from the previous step is used to acquire a certificate and save it on the ACS server.

Step 1 Log into the ACS server with an account that has Enterprise Admin rights.

Step 2 On the local ACS machine, open a browser and point it to the Microsoft certification authority server at http://IP-address-of-Root-CA/certsrv. In the example below, the IP address is 10.100.10.114. Click **Request a certificate**. See Figure 3-37.

Figure 3-37 CA Web Interface


Microsoft Certificate Services - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://10.100.10.114/certsrv/
Go Links
223894

Microsoft Certificate Services -- imac-mcs-14 Home

Welcome

Use this Web site to request a certificate for your Web browser, e-mail client, or other program. By using a certificate, you can verify your identity to people you communicate with over the Web, sign and encrypt messages, and, depending upon the type of certificate you request, perform other security tasks.

You can also use this Web site to download a certificate authority (CA) certificate, certificate chain, or certificate revocation list (CRL), or to view the status of a pending request.

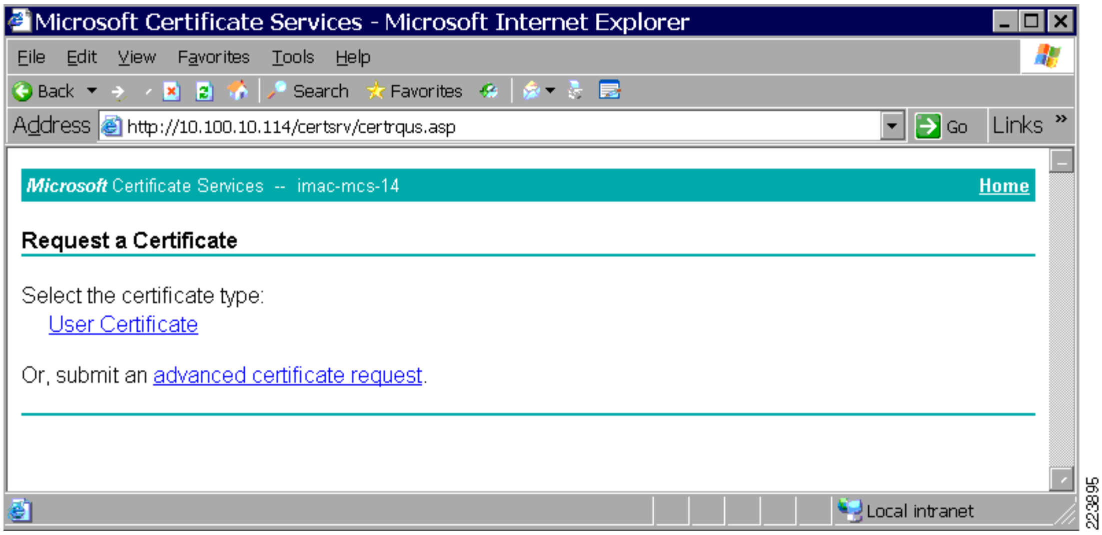
For more information about Certificate Services, see Certificate Services Documentation.

Select a task:

Request a certificate
View the status of a pending certificate request
Download a CA certificate, certificate chain, or CRL

Step 3 In the *Certificate Request* window, click **advanced certificate request**. See Figure 3-38.

Figure 3-38 Request a Certificate from the CA


Microsoft Certificate Services - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://10.100.10.114/certsrv/certrqus.asp
Go Links
Local intranet
223895

Microsoft Certificate Services -- imac-mcs-14 Home

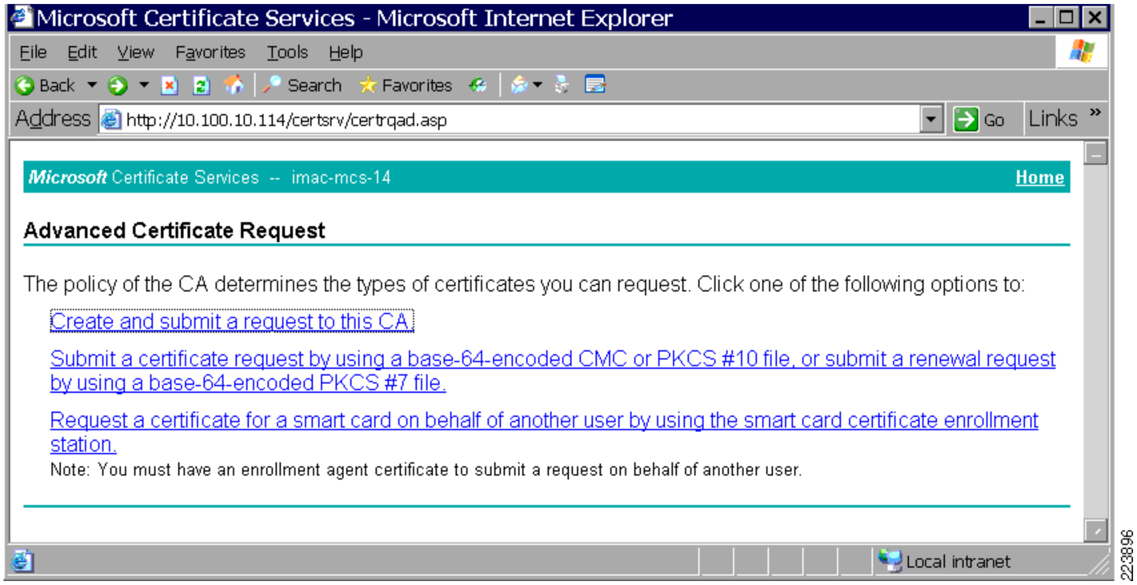
Request a Certificate

Select the certificate type:
User Certificate

Or, submit an advanced certificate request.

Step 4 In the *Advanced Certificate Request* screen, click **Submit a certificate request by using a base-64-encoded CMC or PKCS #10 file, or submit a renewal request by using a base-64-encoded PKCS #7 file**. See Figure 3-39.

Figure 3-39 Creating an Advanced Certificate Request


Microsoft Certificate Services - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://10.100.10.114/certsrv/certrqad.asp
Go Links
Microsoft Certificate Services -- imac-mcs-14
Home
Local intranet
223896

Advanced Certificate Request

The policy of the CA determines the types of certificates you can request. Click one of the following options to:

Create and submit a request to this CA.

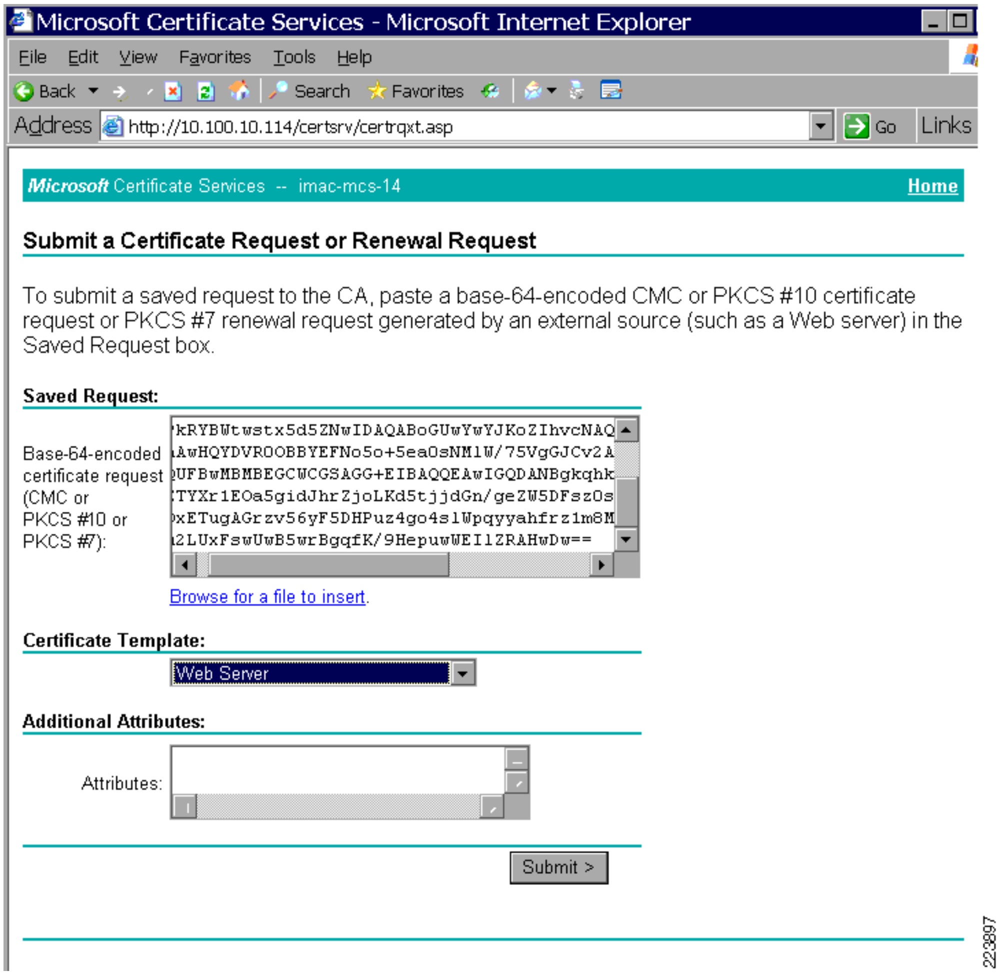
Submit a certificate request by using a base-64-encoded CMC or PKCS #10 file, or submit a renewal request by using a base-64-encoded PKCS #7 file.

Request a certificate for a smart card on behalf of another user by using the smart card certificate enrollment station.

Note: You must have an enrollment agent certificate to submit a request on behalf of another user.

Step 5 In the *Saved Request* field, paste the text of the encoded certificate request that you generated in the previous step. Under *Certificate Template*, select *Web Server*. Click **Submit**. See Figure 3-40.

Figure 3-40 Submitting the Encoded Certificate Request



Microsoft Certificate Services - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://10.100.10.114/certsrv/certrqxt.asp
Go Links
Microsoft Certificate Services -- imac-mcs-14
Home
223897

Submit a Certificate Request or Renewal Request

To submit a saved request to the CA, paste a base-64-encoded CMC or PKCS #10 certificate request or PKCS #7 renewal request generated by an external source (such as a Web server) in the Saved Request box.

Saved Request:

Base-64-encoded certificate request (CMC or PKCS #10 or PKCS #7):

```
kRYBWtwstx5d5ZNwIDAQABoGUwYwYJKoZIhvcNAQ
AwHQYDVROOBBYEFNo5o+5ea0sNM1W/75VgGJCv2A
UFBwMBMBEGCWCGSAGG+EIBAQQEAwIGQDANBgkqhk
TYXr1EOa5gidJhrZjoLKd5tjjdGn/geZW5DFsz0s
xETugAGrzv56yF5DHPuz4go4s1Wpqyyahfrz1m8M
2LUxFswUwB5wrBgqfK/9HepuwWEIlZRAHwDw==
```

Browse for a file to insert.

Certificate Template:

Web Server

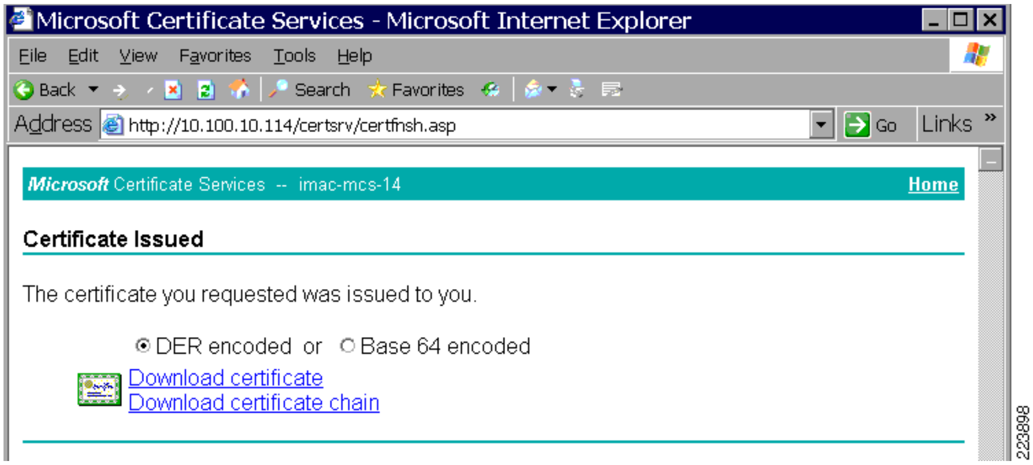
Additional Attributes:

Attributes:

Submit >

Step 6 The certificate is issued. Click **Download Certificate**. See Figure 3-41.

Figure 3-41 ACS Server Certificate is Issued



Microsoft Certificate Services - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://10.100.10.114/certsrv/certfnsh.asp
Go Links
Microsoft Certificate Services -- imac-mcs-14
Home
223898

Certificate Issued

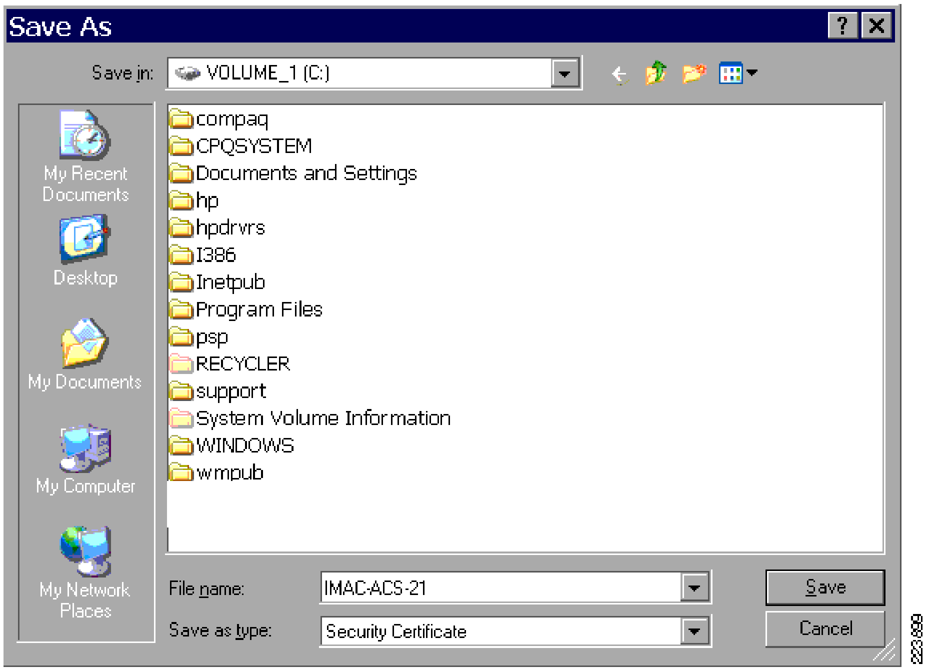
The certificate you requested was issued to you.

● DER encoded or ○ Base 64 encoded

Download certificate
Download certificate chain

Step 7 A File Download Security Warning box appears. Click **Save**. In the *Save As* dialogue box, enter a name for the certificate and click **Save**. See Figure 3-42.

Figure 3-42 Saving the downloaded ACS certificate



Configure ACS to Use the Server Certificate

After the previous step, the ACS server has a server certificate in the local hard drive. Complete the following steps to configure ACS to use the server certificate.

Step 1 Open ACS Admin from the desktop shortcut created during the installation.

Step 2 Click the **System Configuration** button.

Step 3 Select *ACS Certificate Setup*.

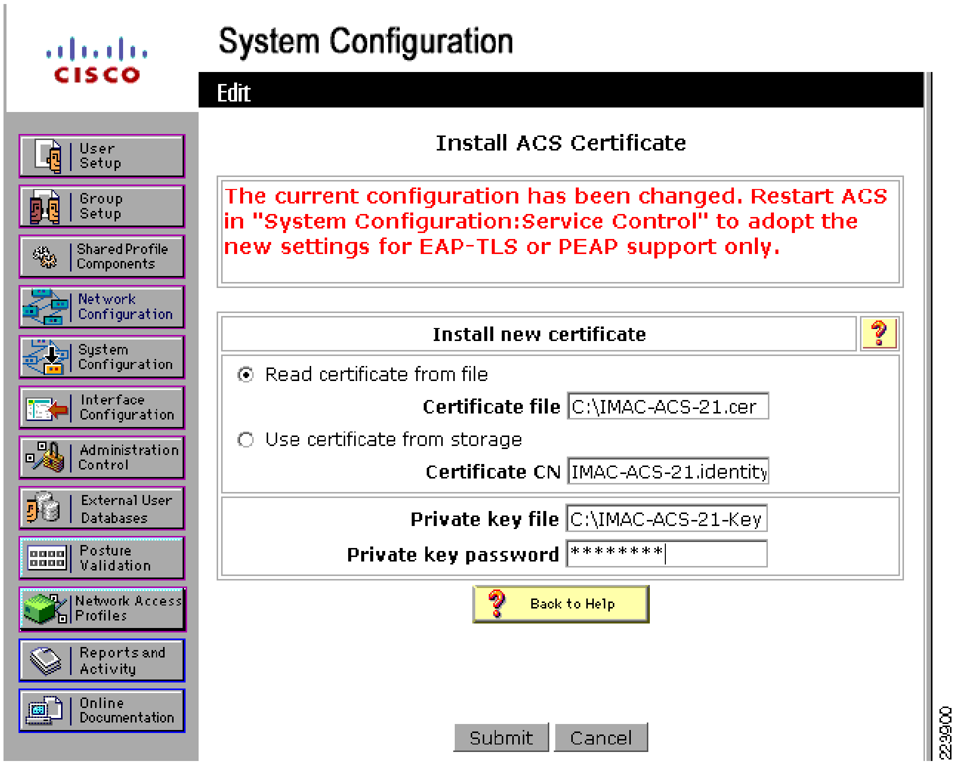
Step 4 Select *Install ACS Certificate*.

Step 5 Select *Read certificate from file* and enter the full path and file name of the certificate file that you saved in the previous step (*c:\IMAC-ACS-21.cer* in this example).

Step 6 Under *Private key file*, enter the full path and file name of the private key file that you entered when generating the certificate request in the first step of this Method (*c:\IMAC-ACS-21-Key* in this example).

Step 7 Under *Private key password*, enter the private key password that you entered when generating the certificate request in the first step of this Method. See Figure 3-43.

Figure 3-43 Install ACS Certificate from Certificate File



System Configuration

Edit

Install ACS Certificate

The current configuration has been changed. Restart ACS in "System Configuration:Service Control" to adopt the new settings for EAP-TLS or PEAP support only.

Install new certificate

● Read certificate from file

Certificate file: C:\IMAC-ACS-21.cer

○ Use certificate from storage

Certificate CN: IMAC-ACS-21.identity

Private key file: C:\IMAC-ACS-21-Key

Private key password: ********

Step 8 Click **Submit**.

Step 9 Restart the ACS.

Step 4: Configure EAP-TLS Settings on the ACS

Once the ACS has acquired a server certificate and installed it using either of the methods described in the previous step, the ACS can be configured for EAP-TLS.

Step 1 Open ACS Admin from the desktop shortcut created during the installation.

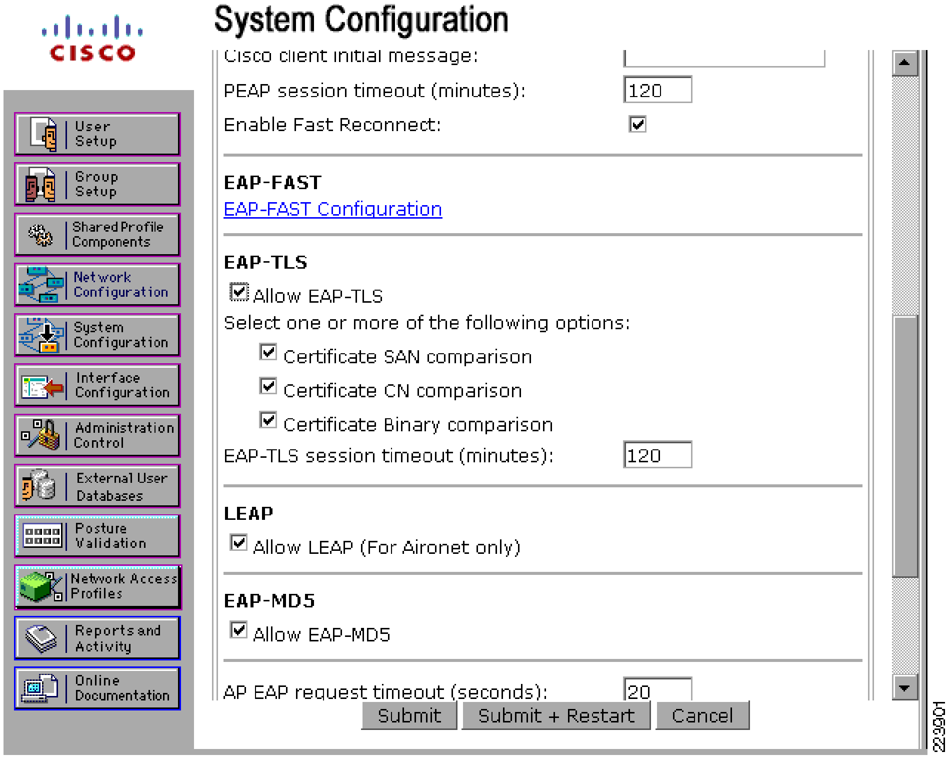
Step 2 Click **System Configuration**.

Step 3 Click **Global Authentication Setup**.

Step 4 Check *Allow EAP-TLS* and all of the Certificate comparison options underneath it. See the "Certificate Comparison Explained" section on page 3-47 for more information on these options.

Step 5 Leave the *EAP-TLS Session Timeout* value at the default value. See the"EAP-TLS Session Timeout Explained" section on page 3-49 for more information about this option. See Figure 3-44.

Figure 3-44 Global Authentication Setup for EAP-TLS



System Configuration

Cisco client initial message:

PEAP session timeout (minutes): 120

Enable Fast Reconnect: ☑

EAP-FAST

EAP-FAST Configuration

EAP-TLS

☑ Allow EAP-TLS

Select one or more of the following options:

☑ Certificate SAN comparison

☑ Certificate CN comparison

☑ Certificate Binary comparison

EAP-TLS session timeout (minutes): 120

LEAP

☑ Allow LEAP (For Aironet only)

EAP-MD5

☑ Allow EAP-MD5

AP EAP request timeout (seconds): 20

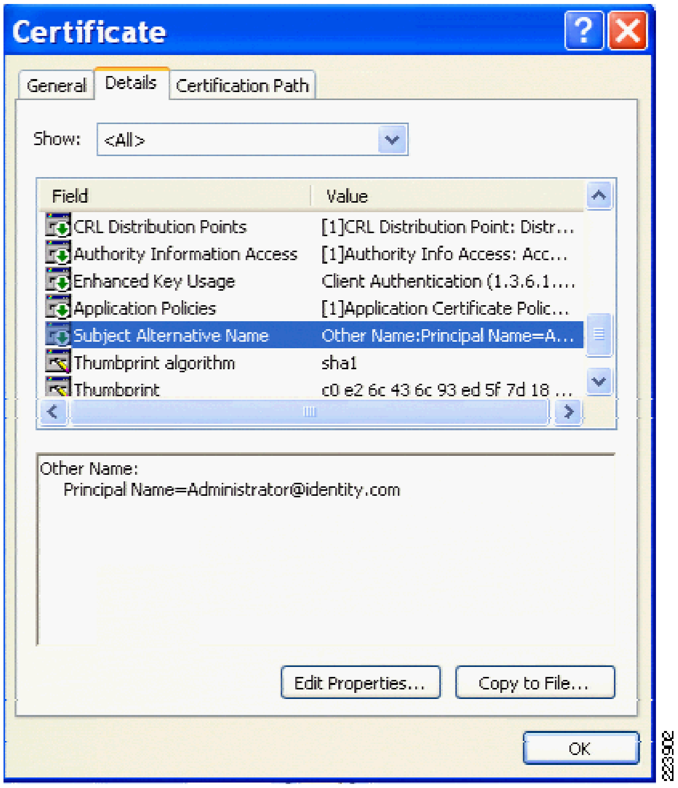
Step 6 Click **Submit** and **Restart**.

Certificate Comparison Explained

When a client presents a valid certificate (properly signed by a trusted root CA and neither expired nor revoked), the ACS knows the identity of the user (or host) attempting to gain access. However, the ACS does not know if the user is permitted onto the network. For that, ACS must verify that the user exists in the user database (either the local ACS database or an external database). This would be straight-forward except for the fact that the user's certificate might list the user's name in different fields in different formats in the certificate (this depends on the certificate template of the CA that issued the certificate). ACS provides three comparison options to allow any or all of these name fields to be checked against the user database:

- Certificate SAN Comparison uses the Subject Alternative Name when querying the user database. If the user certificate does not contain a SAN, then this method cannot be used. In Figure 3-44, the Subject Alternative Name in the certificate is *Administrator@identity.com*.

Figure 3-45 Certificate Subject Alternative Name (SAN)

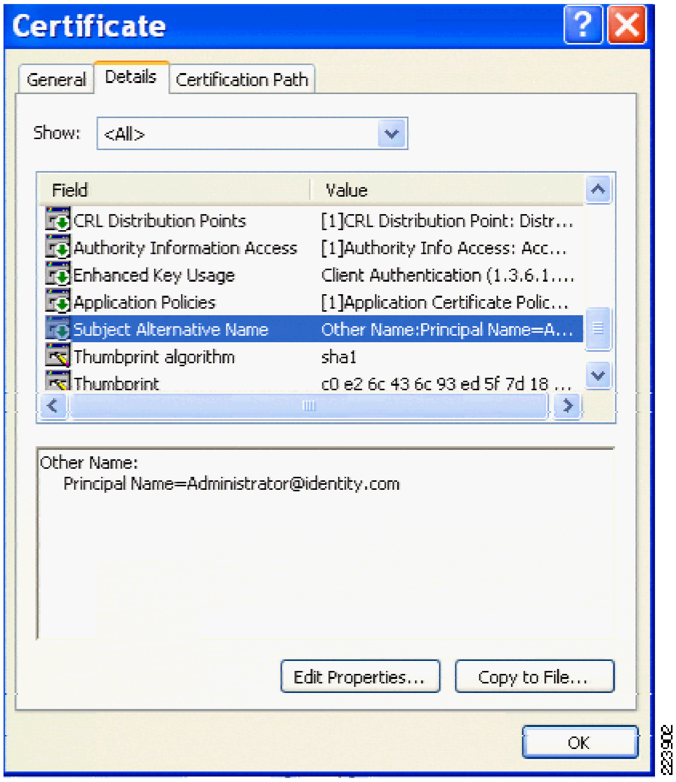


Field	Value
CRL Distribution Points	[1]CRL Distribution Point: Distr...
Authority Information Access	[1]Authority Info Access: Acc...
Enhanced Key Usage	Client Authentication (1.3.6.1....
Application Policies	[1]Application Certificate Polic...
Subject Alternative Name	Other Name:Principal Name=A...
Thumbprint algorithm	sha1
Thumbprint	c0 e2 6c 43 6c 93 ed 5f 7d 18 ...

```
Other Name:
    Principal Name=Administrator@identity.com
```

- Certificate CN Comparison users the Common Name (CN) in the Subject field of the certificate. In Figure 3-45, the Common Name is *Administrator*.

Figure 3-46 Certificate Common Name (CN)



Show: <All>

Field	Value
CRL Distribution Points	[1]CRL Distribution Point: Distr...
Authority Information Access	[1]Authority Info Access: Acc...
Enhanced Key Usage	Client Authentication (1.3.6.1....
Application Policies	[1]Application Certificate Polic...
Subject Alternative Name	Other Name:Principal Name=A...
Thumbprint algorithm	sha1
Thumbprint	c0 e2 6c 43 6c 93 ed 5f 7d 18 ...

Other Name:
Principal Name=Administrator@identity.com

- Certificate Binary Comparison compares the entire certificate in binary format to the user certificate in the LDAP server or Active Directory. You cannot use this comparison method to authenticate users in an ODBC external user database or the local user database.

Whichever method is selected, the information in the appropriate field (CN or SAN) must match the name that your database uses for authentication. Review these fields in your certificate templates to ensure that they match to valid usernames in your user database.

If more than one comparison method is checked, ACS will start with the first method. If that method fails, ACS will try the next method. The first method that passes will results in a successful authentication. The authentication will fail only when all enabled methods fail. Enabling all three Comparison methods maximizes the ACS's ability to correctly locate users in the user database.

EAP-TLS Session Timeout Explained

ACS supports an EAP-TLS session resume feature that caches the TLS session created during a new EAP-TLS authentication. When an EAP-TLS client reconnects, the cached TLS session is used to restore the session without performing a certificate comparison, which improves EAP-TLS performance. ACS deletes cached TLS sessions when they time out.

Session resume is most appropriate in wireless environments where endpoints need to rapidly reauthenticate when roaming. The mechanism works the same way in wired environments, but the optimization is less important and it can be disabled without impacting the network. To disable the session resume feature, set the timeout value to 0 (zero).

Note For session resume to work, it must be supported and enabled on both the ACS and the supplicant. Not all supplicants support session resume. See the Client Configuration for EAP-TLS, page 3-56 for more details.

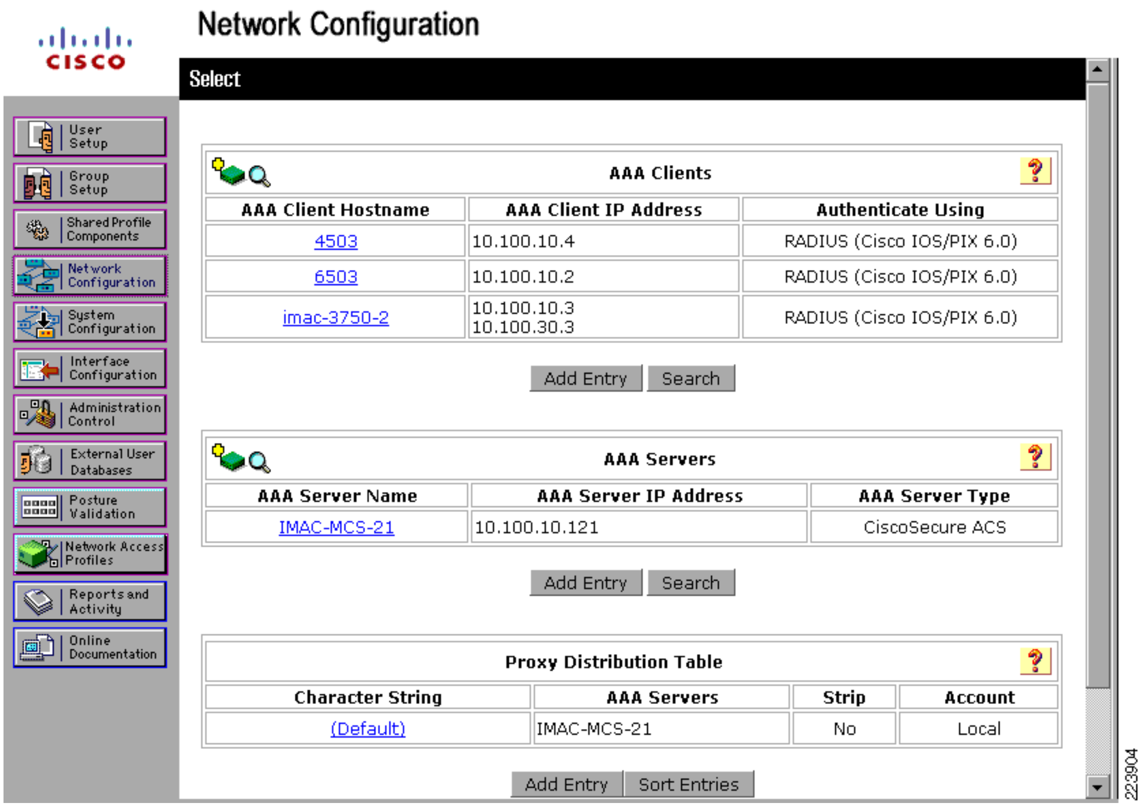
Step 5: Specify and Configure the Catalyst Switch as a AAA Client

Complete the following steps to configure the ACS to accept RADIUS requests from the authenticator.

Step 1 On the ACS server, open ACS Admin from the desktop shortcut created during the installation.

Step 2 Click **Network Configuration**. See Figure 3-47.

Figure 3-47 ACS Network Configuration



Network Configuration

Select

AAA Clients

AAA Client Hostname	AAA Client IP Address	Authenticate Using
4503	10.100.10.4	RADIUS (Cisco IOS/PIX 6.0)
6503	10.100.10.2	RADIUS (Cisco IOS/PIX 6.0)
imac-3750-2	10.100.10.3 10.100.30.3	RADIUS (Cisco IOS/PIX 6.0)

AAA Servers

AAA Server Name	AAA Server IP Address	AAA Server Type
IMAC-MCS-21	10.100.10.121	CiscoSecure ACS

Proxy Distribution Table

Character String	AAA Servers	Strip	Account
(Default)	IMAC-MCS-21	No	Local

Step 3 Click **Add Entry** under the *AAA Clients* table to add an authenticator.

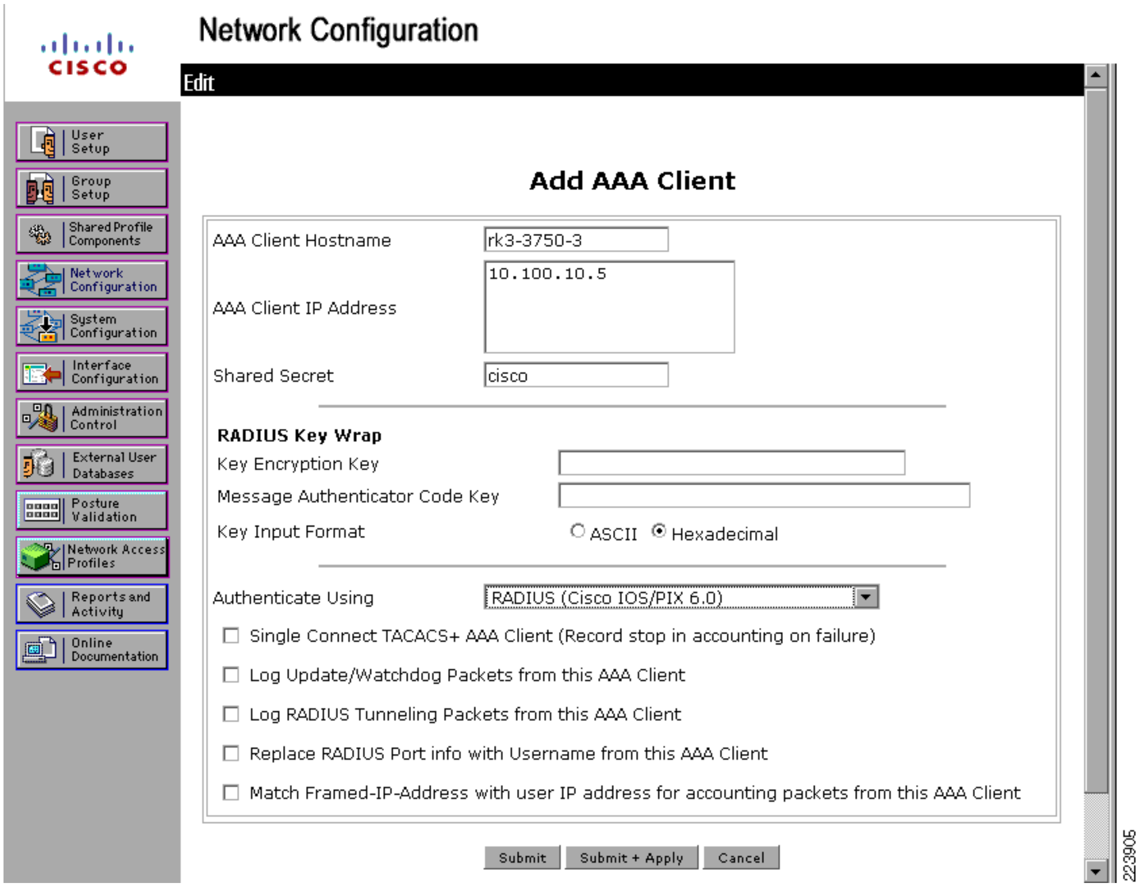
Step 4 See Figure 3-48. For the *AAA Client Host Name*, enter the name of the Catalyst switch authenticator.

Step 5 For *AAA Client IP Address*, enter the IP address of the Catalyst switch authenticator.

Step 6 For *Key*, enter the same RADIUS key configured on the Catalyst switch.

Step 7 For the *Authenticate Using* option, select *RADIUS* (Cisco IOS/PIX 6.0).

Figure 3-48 Adding a Catalyst Switch as a AAA Client



Add AAA Client

AAA Client Hostname: rk3-3750-3

AAA Client IP Address: 10.100.10.5

Shared Secret: cisco

RADIUS Key Wrap

Key Encryption Key:

Message Authenticator Code Key:

Key Input Format: ○ ASCII ● Hexadecimal

Authenticate Using: RADIUS (Cisco IOS/PIX 6.0)

□ Single Connect TACACS+ AAA Client (Record stop in accounting on failure)

□ Log Update/Watchdog Packets from this AAA Client

□ Log RADIUS Tunneling Packets from this AAA Client

□ Replace RADIUS Port info with Username from this AAA Client

□ Match Framed-IP-Address with user IP address for accounting packets from this AAA Client

Note The RADIUS (Cisco IOS/PIX 6.0) option enables the use of Cisco IOS RADIUS Vendor-Specific Attributes (VSA).

Step 8 Click **Submit + Apply**.

Step 6: Configure the External User Databases

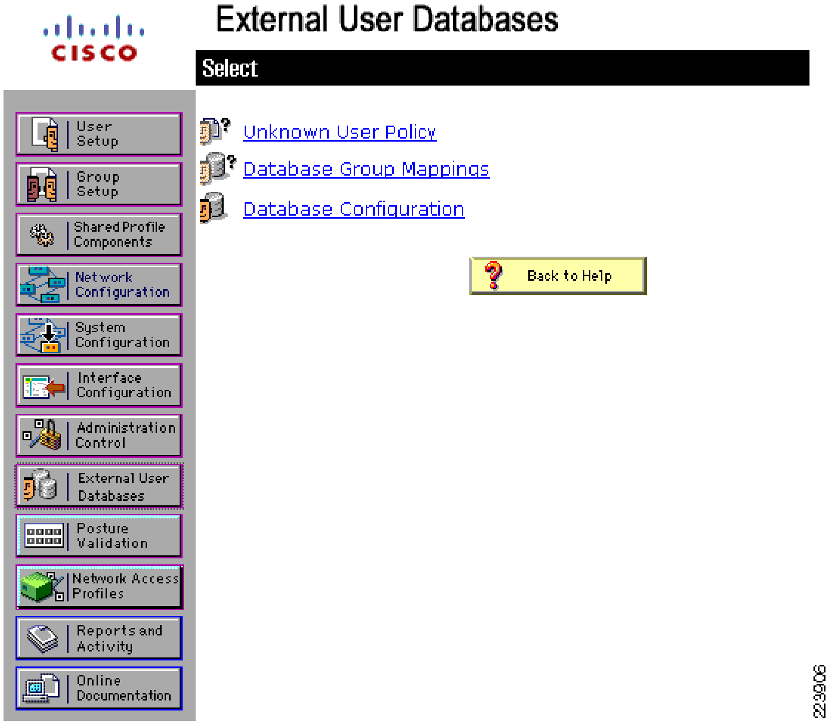
EAP-TLS is commonly deployed in networks where user credentials are stored in an external user database such as Active Directory. That configuration is described in detail in the following section. See the ACS Configuration Guide for detailed information on configuring external user databases other than Active Directory.

Note Although this configuration example uses Active Directory as an external user database, EAP-TLS by itself does not always require the use of an external user database. The internal ACS database can be used as long as the Certificate Binary Comparison method is not selected as the only option in the Global Authentication configuration for EAP-TLS. If Certificate Binary Comparison is the only comparison method allowed when using the internal user database, a failed authentication will result. The ACS Failed Authentication report will show *Certificate name or binary comparison failed.*

Note A bug in ACS 4.1.3 Build 12 prevents CN Comparison from working with the local database: CSCsj97652.

Step 1 Click **External User Databases** on the main menu. In the *External User Databases* menu, select **Unknown User Policy**. See Figure 3-49.

Figure 3-49 External User Databases



External User Databases

Select

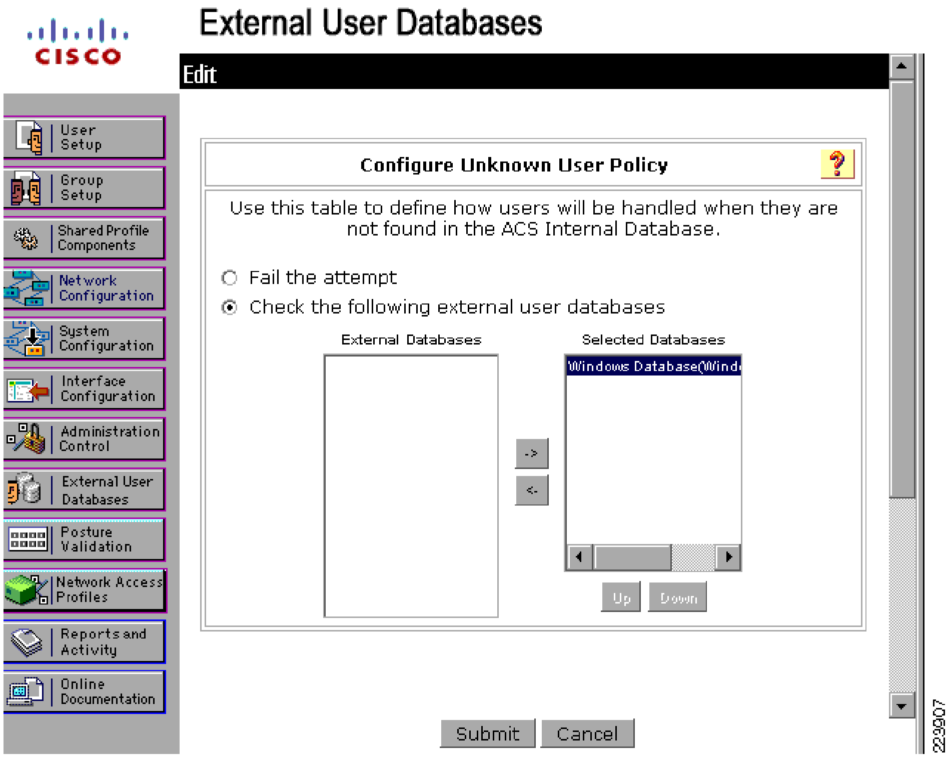
Unknown User Policy

Database Group Mappings

Database Configuration

Step 2 See Figure 3-50. In the *Configure Unknown User Policy* section, select the *Check the following external user databases* radio button. Move the *Windows Database* option from the *External Databases* column to the *Selected Databases* column. Click **Submit**.

Figure 3-50 Configure Unknown User Policy



External User Databases

Edit

Configure Unknown User Policy

Use this table to define how users will be handled when they are not found in the ACS Internal Database.

○ Fail the attempt

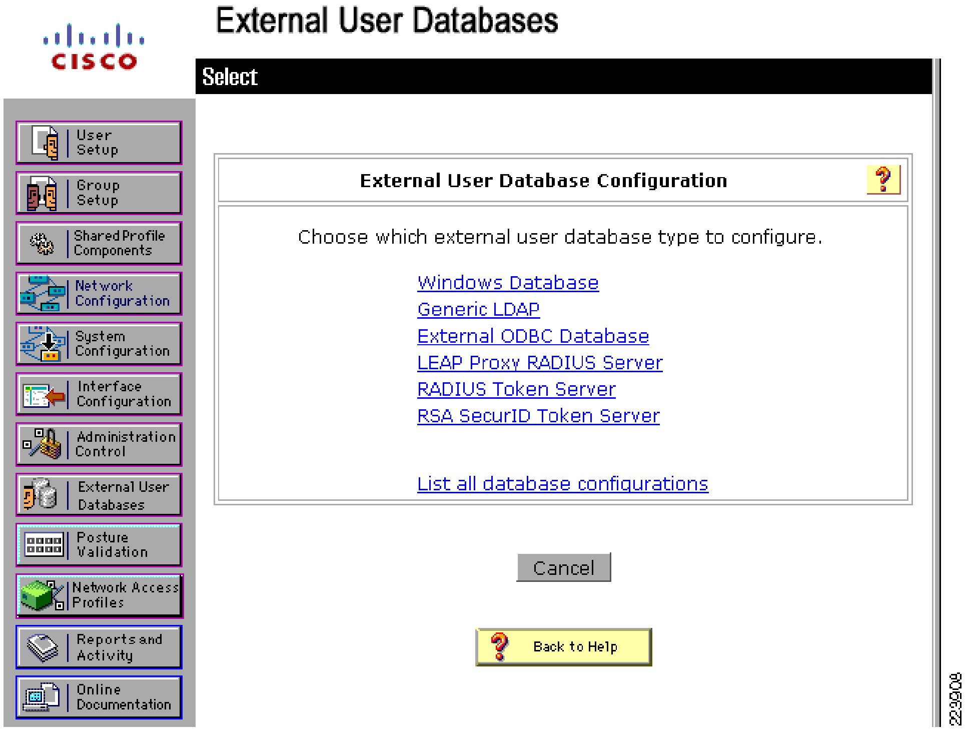
● Check the following external user databases

External Databases

Selected Databases: Windows Database(Wind

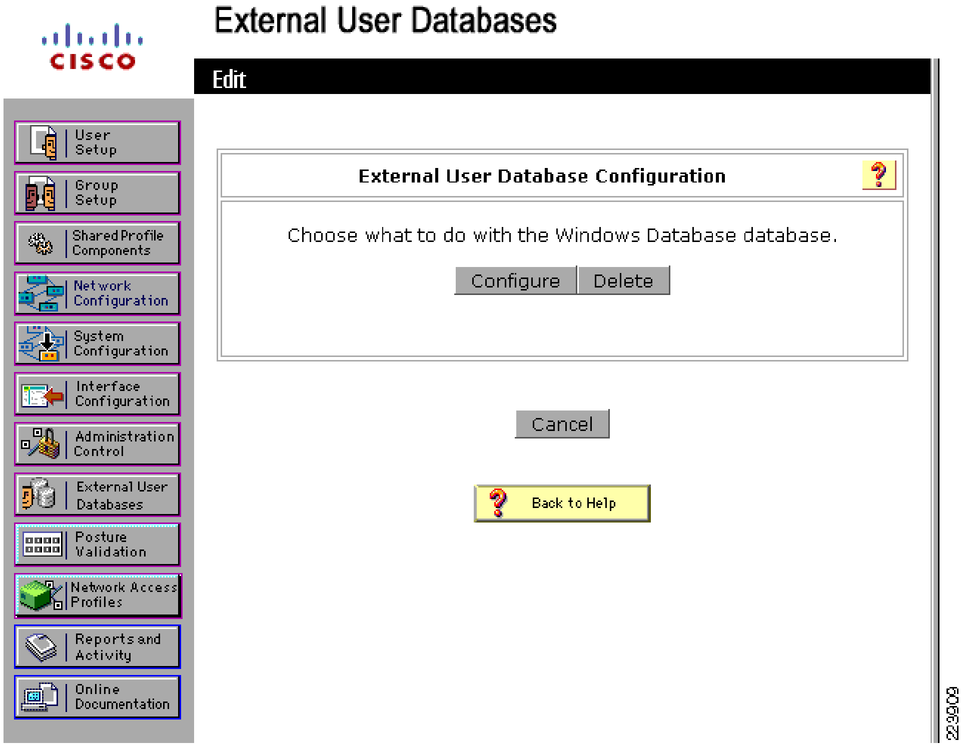
Step 3 Select the *Database Configuration* option from the *External User Databases* menu. In the *External User Database Configuration* section, select the *Windows Database* option. See Figure 3-51.

Figure 3-51 External User Database Configuration



Step 4 See Figure 3-52. Click the **Configure** button in the *External User Database Configuration* section.

Figure 3-52 Configuring External Databases



External User Databases

Edit

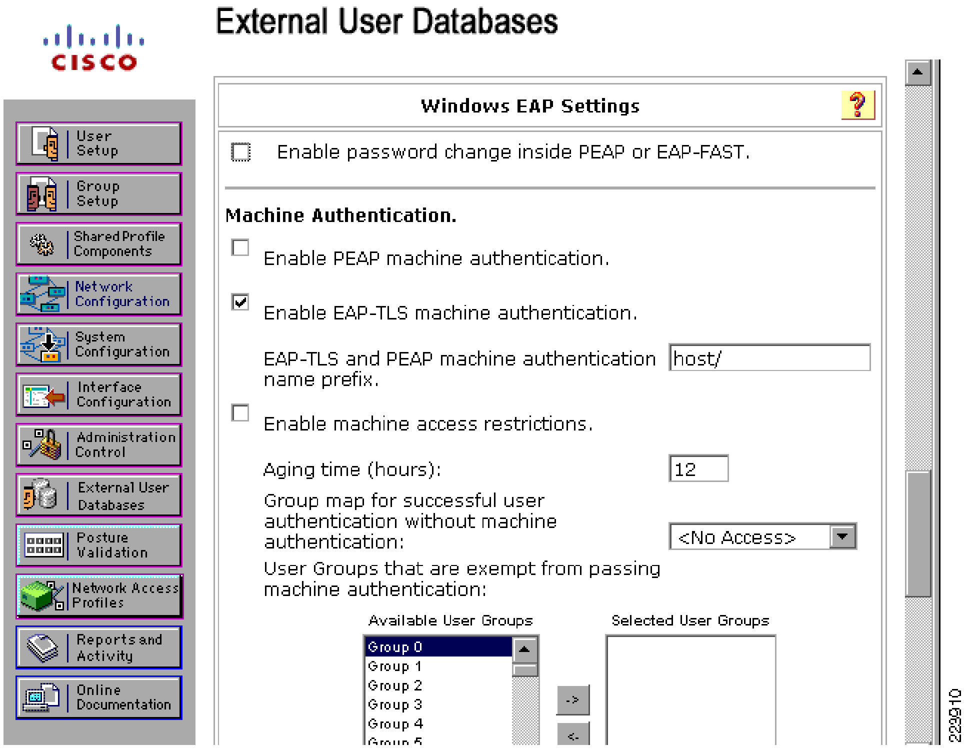
External User Database Configuration

Choose what to do with the Windows Database database.

Step 5 See Figure 3-53. Scroll down to the *Machine Authentication* section and check the *Enable EAP-TLS Machine Authentication* box. Click **Submit**.

Note The Enable EAP-TLS machine authentication box is checked to enable machine authentication using machine certificates with EAP-TLS; the option is configured for this scenario because the supplicant is configured, in the next section, to use a machine account profile.

Figure 3-53 Enabling Machine Authentication for EAP-TLS



External User Databases

Windows EAP Settings

□ Enable password change inside PEAP or EAP-FAST.

Machine Authentication.

□ Enable PEAP machine authentication.

☑ Enable EAP-TLS machine authentication.

EAP-TLS and PEAP machine authentication name prefix. host/

□ Enable machine access restrictions.

Aging time (hours): 12

Group map for successful user authentication without machine authentication: <No Access>

User Groups that are exempt from passing machine authentication:

Step 6 Click **Submit**.

Step 7 Restart ACS.

Client Configuration for EAP-TLS

This section provides the following descriptions:

- Installation of Client Certificates, page 3-56
- CSSC Configuration, page 3-82
- Windows XP Client Configuration, page 3-106

Installation of Client Certificates

In EAP-TLS, the 802.1X supplicant authenticates itself to the ACS by presenting a client certificate that is signed by a root CA that the ACS also trusts. The ACS in turn authenticates itself to the client by presenting a certificate that is signed by a root CA that the client trusts. Therefore, every host and user that wishes to authenticate via EAP-TLS must possess two certificates:

- Certificate Authority (CA) Root Certificate (to validate the ACS certificate)
- Client Certificate signed by the CA (to send to the ACS)

Deploying these certificates to the end user or host is required regardless of whether you are using the Cisco Secure Services Client (CSSC), the Windows XP native supplicant, or some other 802.1X client software. The installation of certificate is independent of the supplicant deployment process.

If the end host will be performing machine authentication and user authentication, then at least two client certificates will be required (one for the machine and one for every user who will log into that machine). The root CA certificate will must be installed in the user's Trusted Root certificate store and in the machine’s Trusted Root certificate store.

Certificates Required for Machine Authentication

The following sections describe how to verify and install the certificates needed to successfully complete machine authentication.

Note To verify and/or manipulate machine certificate stores, you must be logged into the machine as an Administrator.

Verifying Machine Root CA Certificate

When a user logs into a computer in the Microsoft domain, the Windows operating system will automatically retrieve the Enterprise CA Root Certificate from the Enterprise Root CA as a result of the Active Directory default Group Policy. Therefore, the client will most likely already have the Enterprise CA Root Certificate in the Trusted Root folder of the machine certificate store.

To verify that the client has the Enterprise CA Certificate in machine certificate storage, follow these steps on the client PC.

Step 1 Choose **Start** > **Run**, type mmc, and click **OK**.

Step 2 On the *File* menu, click **Add/Remove Snap-in** and then click **Add**.

Step 3 On the Add *Standalone Snap-in*, double-click **Certificates**. Select *Computer Account* and click **Next**.

Note If Computer Account is not listed, you do not have Administrative rights on this machine. Logoff and log back in using an Administrator's account credentials.

Step 4 Under *Select Computer*, select *Local Computer* and click **Finish**.

Step 5 On the *Add Standalone Snap-in* window, click **Close**.

Step 6 On the *Add/Remove Snap-in* window, click **OK**.

Step 7 On the Console, select *Certificates (Local Computer)* > *Trusted Root Certification Authorities* > *Certificates*.

Step 8 Locate the Enterprise Root CA Certificate in the list (*imac-mcs-14* in Figure 3-54). If the certificate is listed, no further action is necessary. Proceed to downloading the client certificate in the “User Client Certificate” section on page 3-71. If the certificate is not listed, follow the instructions for manually downloading the CA certificate.

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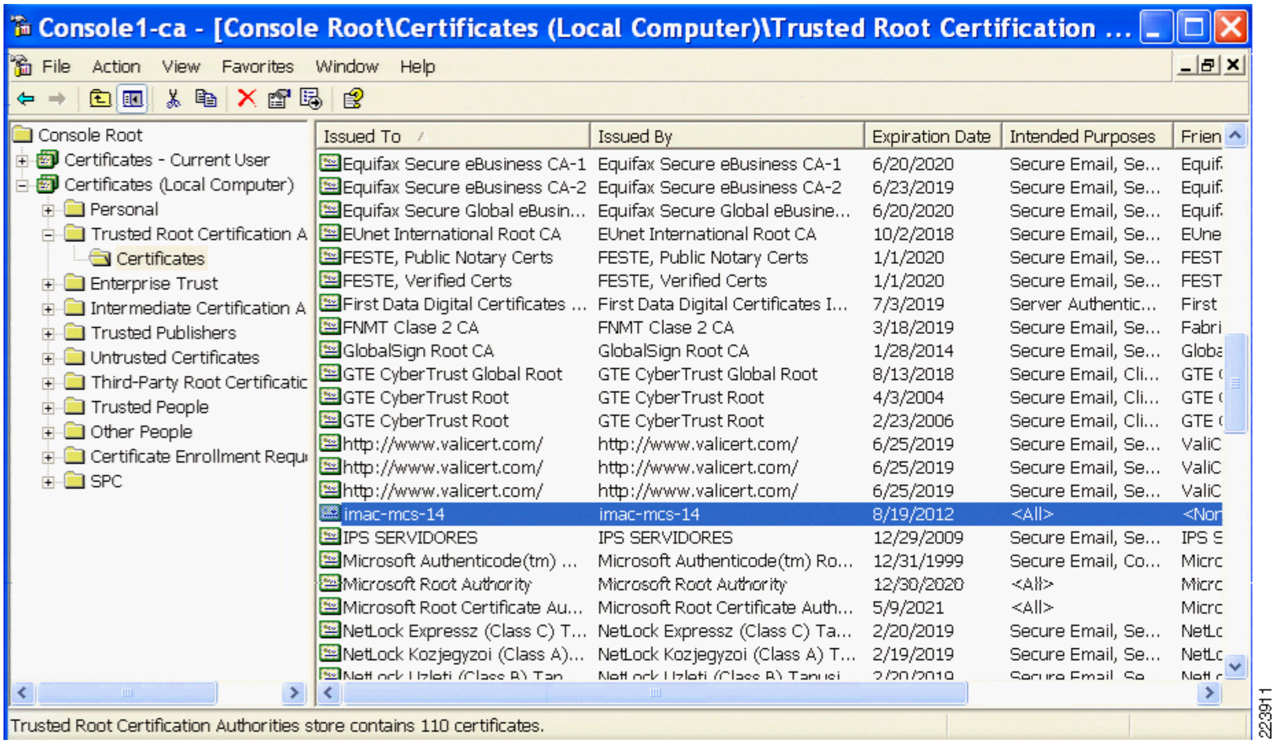
Figure 3-54 Enterprise Root CA Certificate in Local Computer Store


Console1-ca - [Console Root\Certificates (Local Computer)\Trusted Root Certification ...
File
Action
View
Favorites
Window
Help
Console Root
Certificates - Current User
Certificates (Local Computer)
Personal
Trusted Root Certification A
Certificates
Enterprise Trust
Intermediate Certification A
Trusted Publishers
Untrusted Certificates
Third-Party Root Certificatic
Trusted People
Other People
Certificate Enrollment Requi
SPC
223911

Issued To	Issued By	Expiration Date	Intended Purposes	Frien
Equifax Secure eBusiness CA-1	Equifax Secure eBusiness CA-1	6/20/2020	Secure Email, Se...	Equif.
Equifax Secure eBusiness CA-2	Equifax Secure eBusiness CA-2	6/23/2019	Secure Email, Se...	Equif.
Equifax Secure Global eBusin...	Equifax Secure Global eBusine...	6/20/2020	Secure Email, Se...	Equif.
EUnet International Root CA	EUnet International Root CA	10/2/2018	Secure Email, Se...	EUne
FESTE, Public Notary Certs	FESTE, Public Notary Certs	1/1/2020	Secure Email, Se...	FEST
FESTE, Verified Certs	FESTE, Verified Certs	1/1/2020	Secure Email, Se...	FEST
First Data Digital Certificates ...	First Data Digital Certificates I...	7/3/2019	Server Authentic...	First
FNMT Clase 2 CA	FNMT Clase 2 CA	3/18/2019	Secure Email, Se...	Fabri
GlobalSign Root CA	GlobalSign Root CA	1/28/2014	Secure Email, Se...	Globa
GTE CyberTrust Global Root	GTE CyberTrust Global Root	8/13/2018	Secure Email, Cli...	GTE (
GTE CyberTrust Root	GTE CyberTrust Root	4/3/2004	Secure Email, Cli...	GTE (
GTE CyberTrust Root	GTE CyberTrust Root	2/23/2006	Secure Email, Cli...	GTE (
http://www.valicert.com/	http://www.valicert.com/	6/25/2019	Secure Email, Se...	ValiC
http://www.valicert.com/	http://www.valicert.com/	6/25/2019	Secure Email, Se...	ValiC
http://www.valicert.com/	http://www.valicert.com/	6/25/2019	Secure Email, Se...	ValiC
imac-mcs-14	imac-mcs-14	8/19/2012	<All>	<Nor
IPS SERVIDORES	IPS SERVIDORES	12/29/2009	Secure Email, Se...	IPS S
Microsoft Authenticode(tm) ...	Microsoft Authenticode(tm) Ro...	12/31/1999	Secure Email, Co...	Micrc
Microsoft Root Authority	Microsoft Root Authority	12/30/2020	<All>	Micrc
Microsoft Root Certificate Au...	Microsoft Root Certificate Auth...	5/9/2021	<All>	Micrc
NetLock Expressz (Class C) T...	NetLock Expressz (Class C) Ta...	2/20/2019	Secure Email, Se...	NetLc
NetLock Kozjegyzoi (Class A)...	NetLock Kozjegyzoi (Class A) T...	2/19/2019	Secure Email, Se...	NetLc
NetLock Uzleti (Class B) Tan	NetLock Uzleti (Class B) Tanusi	2/20/2019	Secure Email, Se	NetLc

Trusted Root Certification Authorities store contains 110 certificates.

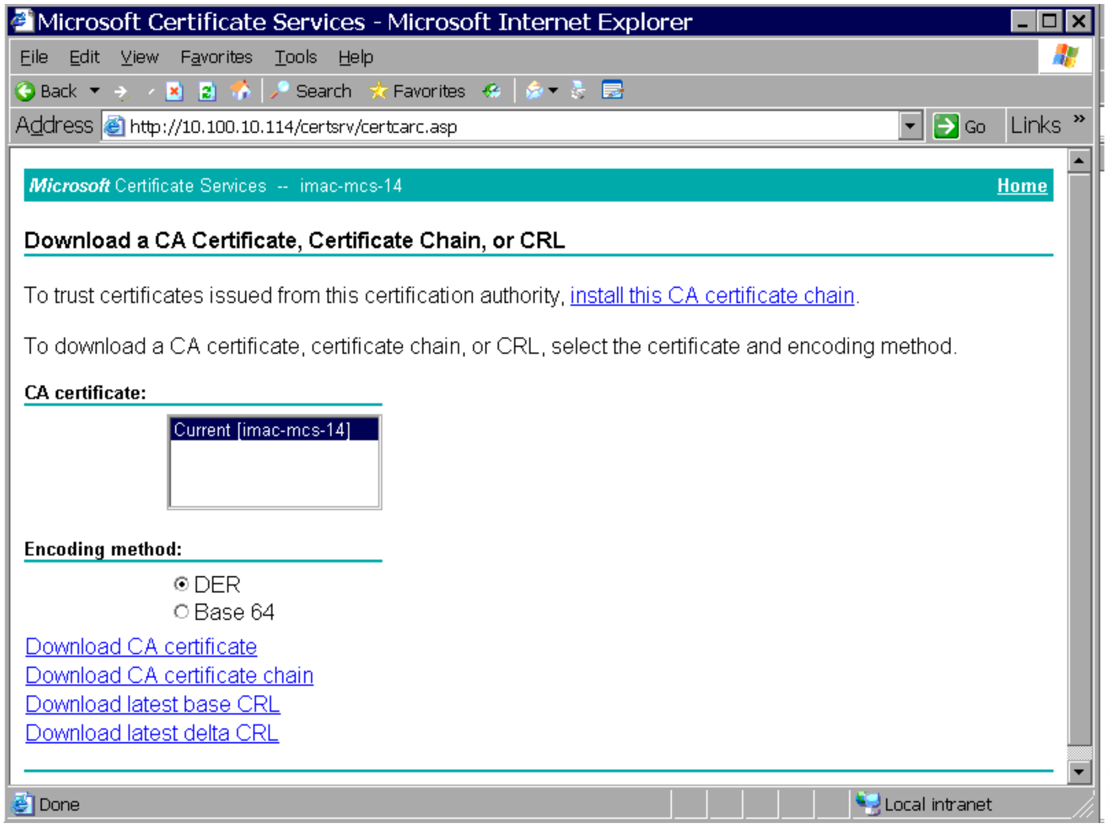
Manually Downloading CA Certificate in Local Machine Store

Step 1 On the client, point the browser at the Microsoft CA server: http://CA-srv-ip /certsrv.

Step 2 From the *Select a Task* option choose *Download a CA certificate, certificate chain or CRL.*

Step 3 Click **Download CA Certificate**. See Figure 3-55.

Figure 3-55 Download CA Certificate



Microsoft Certificate Services - Microsoft Internet Explorer

Address http://10.100.10.114/certsrv/certcarc.asp

Microsoft Certificate Services -- imac-mcs-14 Home

Download a CA Certificate, Certificate Chain, or CRL

To trust certificates issued from this certification authority, install this CA certificate chain.

To download a CA certificate, certificate chain, or CRL, select the certificate and encoding method.

CA certificate:

Current [imac-mcs-14]

Encoding method:

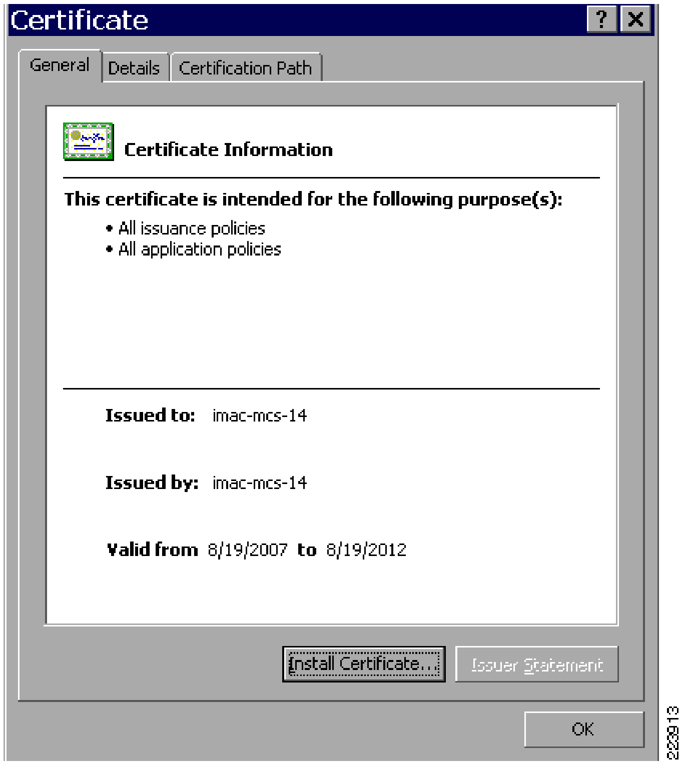
● DER
○ Base 64

Download CA certificate
Download CA certificate chain
Download latest base CRL
Download latest delta CRL

Step 4 A File Download Security Warning window appears. Click **Open**.

Step 5 A *Certificate Installation* window appears. Click **Install Certificate**. See Figure 3-56.

Figure 3-56 Install Certificate



Certificate

General | Details | Certification Path

Certificate Information

This certificate is intended for the following purpose(s):

- All issuance policies
- All application policies

Issued to: imac-mcs-14

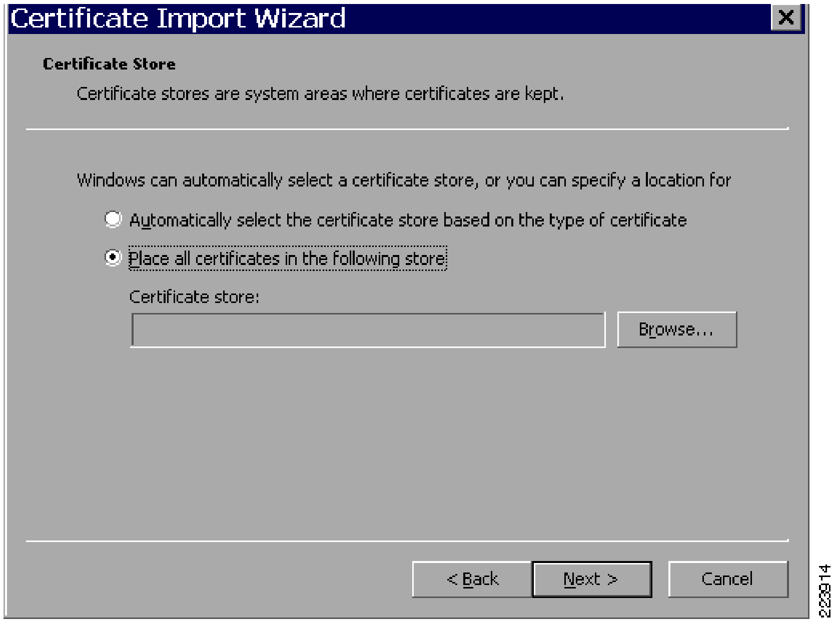
Issued by: imac-mcs-14

Valid from 8/19/2007 **to** 8/19/2012

Step 6 The *Certificate Import Wizard* opens. Click **Next**.

Step 7 Select *Place all certificates in the following store* and click **Browse**. See Figure 3-57.

Figure 3-57 Certificate Store



Certificate Import Wizard

Certificate Store

Certificate stores are system areas where certificates are kept.

Windows can automatically select a certificate store, or you can specify a location for

○ Automatically select the certificate store based on the type of certificate

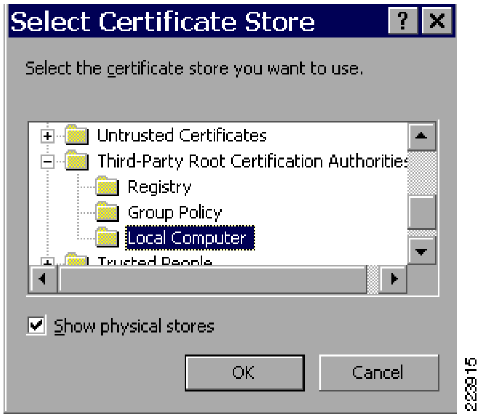
● Place all certificates in the following store

Certificate store:

Note The first option, *Automatically select the certificate store*, will install the root certificate in the Current User Trusted Root Certificate Authorities, not the Local Computer Trusted Root Certificate Authorities. The certificate must be in the Local Computer store for ACS to access it.

Step 8 In *Select Certificate Store* window, select *Show physical stores*. Expand *Trusted Root Certificate Authorities* and select the *Local Computer* folder. Click **OK**. See Figure 3-58.

Figure 3-58 Select Certificate Store



Select Certificate Store

Select the certificate store you want to use.

- Untrusted Certificates
- Third-Party Root Certification Authorities
  - Registry
  - Group Policy
  - Local Computer
- Trusted People

☑ Show physical stores

Step 9 Click **Next** and **Finish**.

Step 10 Verify that the certificate has been properly installed by repeating the steps in "Step 1: Obtain and Install the Root CA Certificate on Cisco Secure ACS" section on page 3-11.

Machine Client Certificate

When a computer joins a Microsoft domain, the Windows operating system will automatically retrieve the machine client certificate from the Enterprise Root CA as a result of the Active Directory default Group Policy. Therefore, the computer will most likely already have a Client Certificate in the Personal Folder of the Local Computer certificate store. If this is not the case, machine certificates can also be acquired manually from the client itself either via MMC.

Verify Machine Client Certificate

Note Only users with Administrative rights can view the machine certificate store.

Step 1 Choose **Start** > **Run**, type *mmc*, and click **OK**.

Step 2 On the *File* menu, click **Add/Remove Snap-in** and then click **Add**.

Step 3 Under *Snap-in*, double-click **Certificates**. Select *Computer Account* and click **Next**.

Step 4 Under *Select Computer*, select *Local Computer* and click **Finish**.

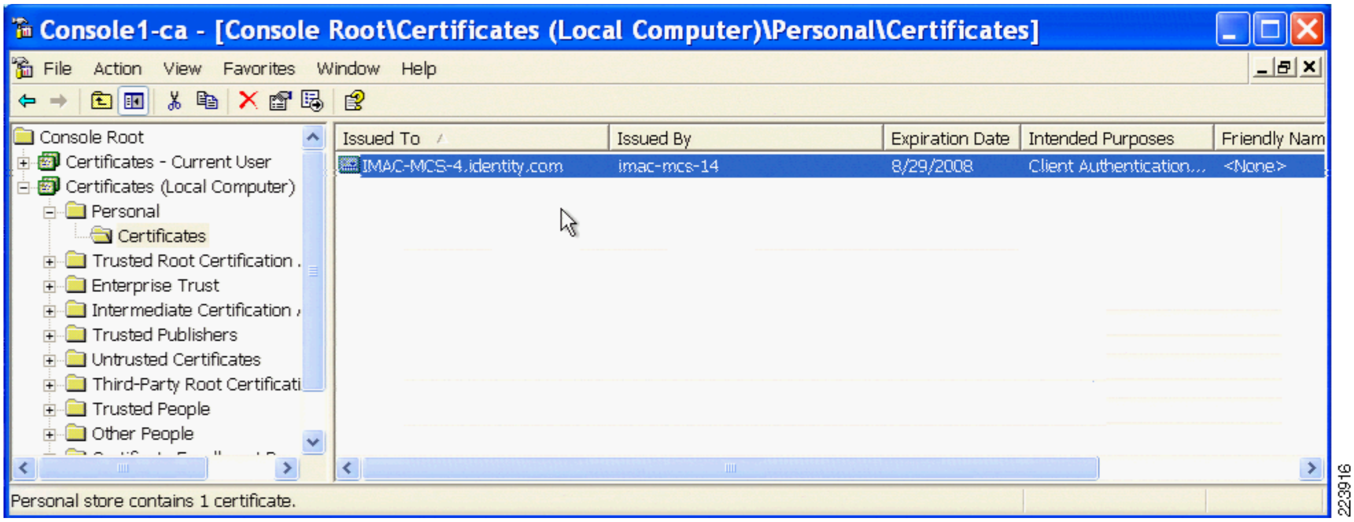
Step 5 On the *Add Standalone Snap-in* window, click **Close**.

Step 6 On the *Add/Remove Snap-in* window, click **OK**

Step 7 On the Console, select *Certificates (Local Computer)* > *Personal* > *Certificates*.

Step 8 Locate the machine client certificate in the list (*IMAC-MCS-4.identity.com* in Figure 3-59) and verify that it is issued by the appropriate CA (*imac-mcs-14* in Figure 3-59). If the certificate is listed, no further action is necessary.

Figure 3-59 Machine Client Certificate


Console1-ca - [Console Root\Certificates (Local Computer)\Personal\Certificates]

Issued To	Issued By	Expiration Date	Intended Purposes	Friendly Nam
IMAC-MCS-4.identity.com	imac-mcs-14	8/29/2008	Client Authentication...	<None>

Personal store contains 1 certificate.

If the certificate is not listed, there are two options: Auto enrollment via Group Policy or certificate download via MMC. To determine which is appropriate, verify on the Windows Domain Controller that the default Group Policy supports machine certificate auto-enrollment. Auto-enrollment via Group Policy is the most efficient and scalable way to distribute machine client certificates. If auto-enrollment is not supported or cannot be configured, the machine client certificate can be downloaded via MMC. These procedures are described in the following sections.

Using Group Policy to Download Client Certificates for Machine Authentication (Preferred for Enterprise CAs)

The following steps outline how to configure the default Group Policy to enable auto-enrollment for machine certificates.

Step 1 On the *Active Directory Domain Controller*, open the *Active Directory Users and Computers* snap-in.

Note This can be performed on any Domain Controller in the domain.

Step 2 In the console tree, double-click **Active Directory Users and Computers**, right-click the domain, and then click **Properties**. See Figure 3-60.

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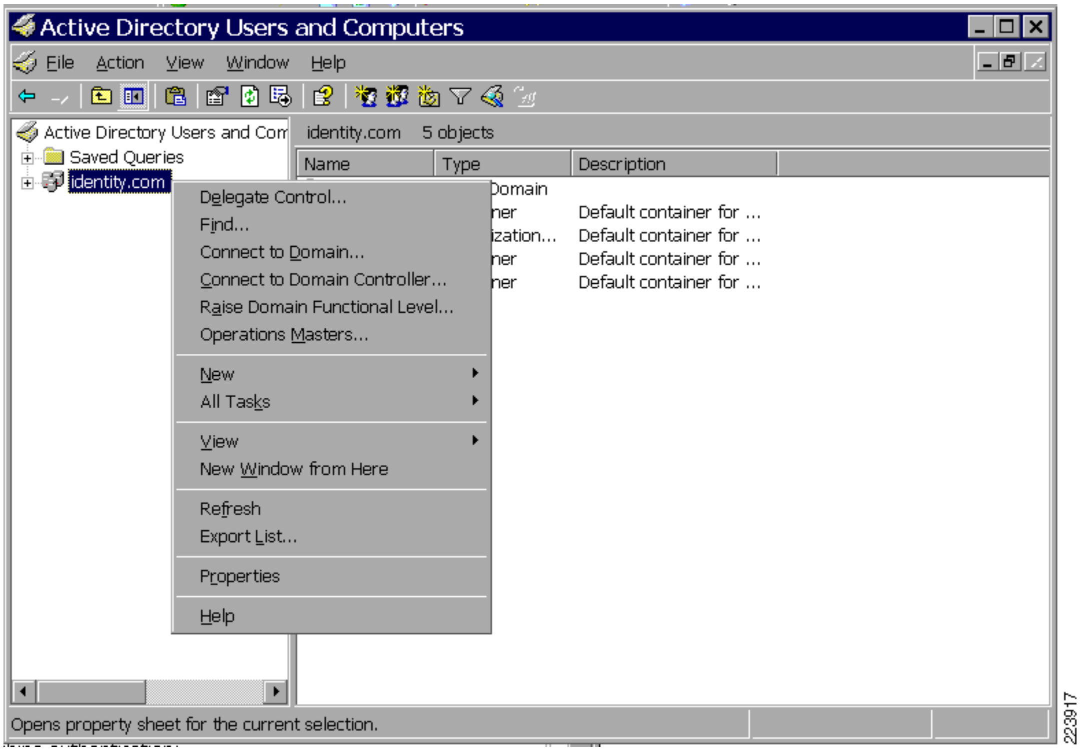
Figure 3-60 Active Directory Domain Properties

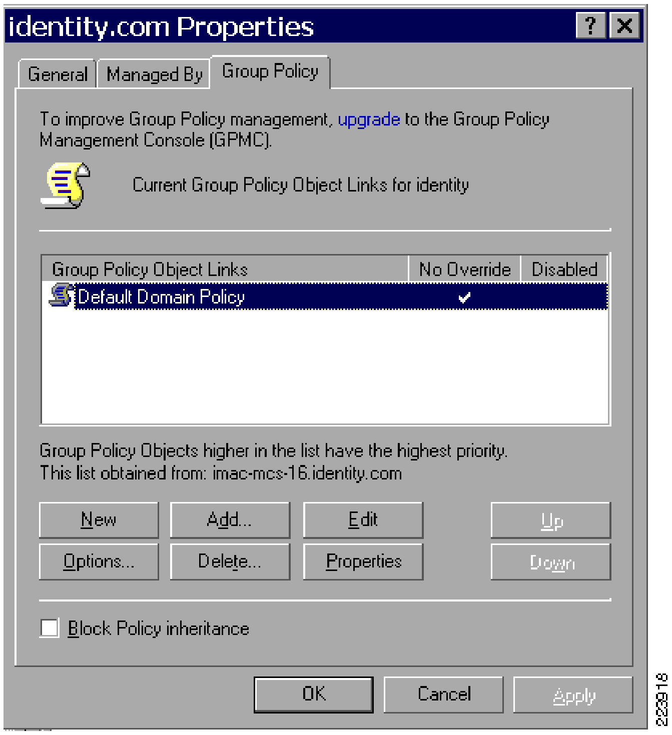


Name	Type	Description
	omain	
	ner	Default container for ...
	ization...	Default container for ...
	ner	Default container for ...
	ner	Default container for ...

Opens property sheet for the current selection.

Step 3 On the *Group Policy* tab, click **Default Domain Policy**, and then click **Edit**. See Figure 3-61.

Figure 3-61 Group Policy Properties



To improve Group Policy management, upgrade to the Group Policy Management Console (GPMC).

Current Group Policy Object Links for identity

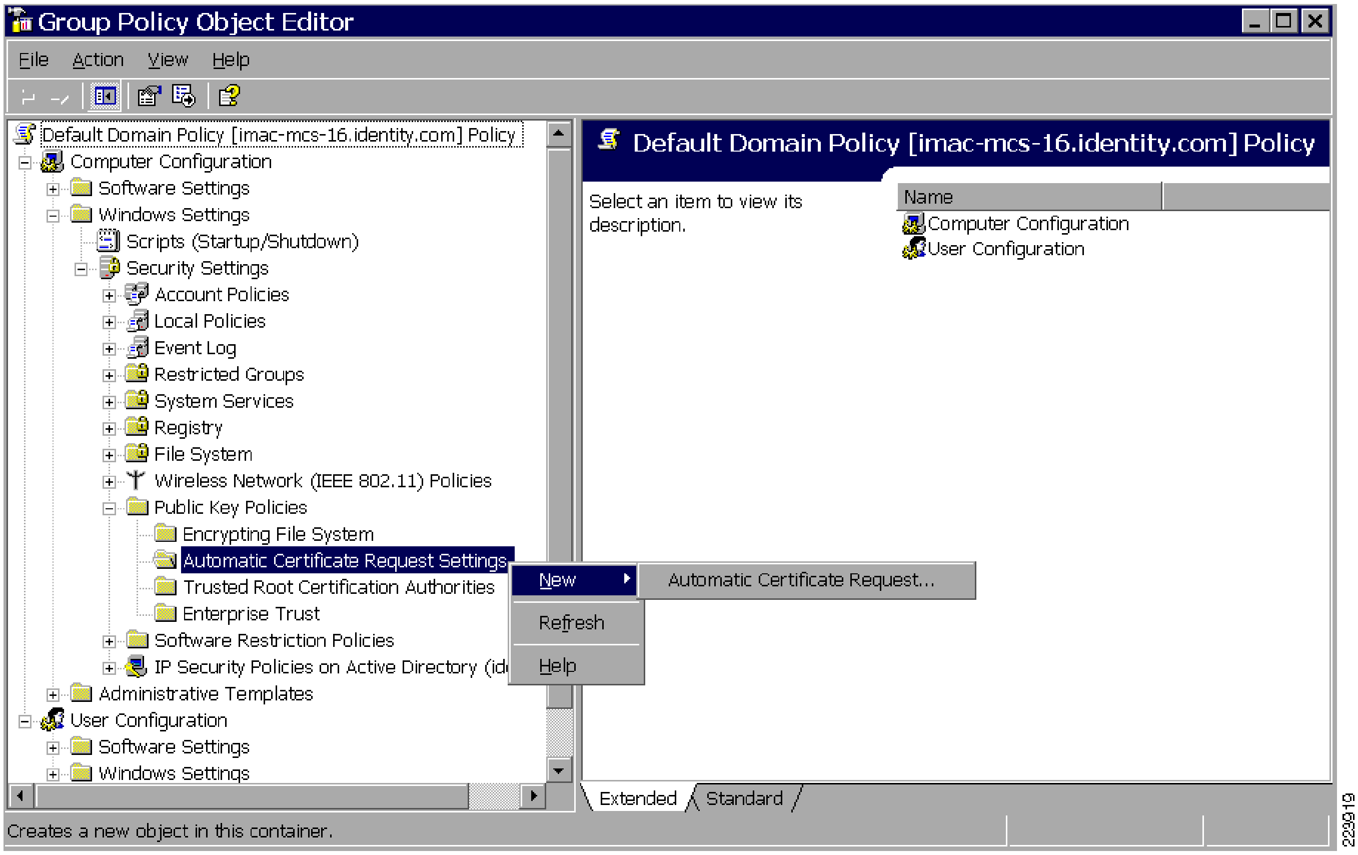
Group Policy Object Links	No Override	Disabled
Default Domain Policy	✓	

Group Policy Objects higher in the list have the highest priority.
This list obtained from: imac-mcs-16.identity.com

□ Block Policy inheritance

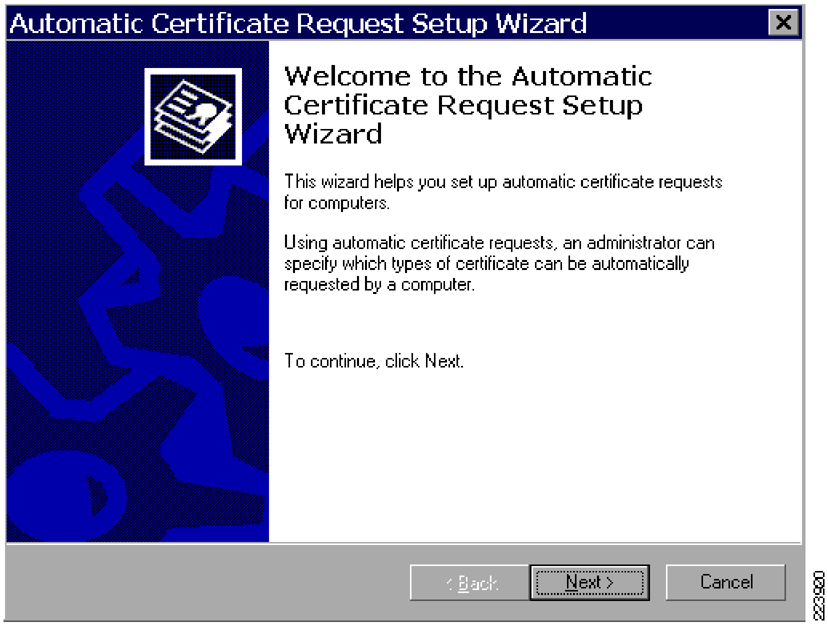
Step 4 The *Group Policy Object Editor* opens. In the console tree, expand *Computer Configuration* > *Windows Settings* > *Security Settings* > *Public Key Policies*. Right click **Automatic Certificate Request Settings**. Select *New* > *Automatic Certificate Request*. See Figure 3-62.

Figure 3-62 Configuring an Automatic Certificate Request


Group Policy Object Editor
File Action View Help
Default Domain Policy [imac-mcs-16.identity.com] Policy
Computer Configuration
Software Settings
Windows Settings
Scripts (Startup/Shutdown)
Security Settings
Account Policies
Local Policies
Event Log
Restricted Groups
System Services
Registry
File System
Wireless Network (IEEE 802.11) Policies
Public Key Policies
Encrypting File System
Automatic Certificate Request Settings
Trusted Root Certification Authorities
Enterprise Trust
Software Restriction Policies
IP Security Policies on Active Directory (id
Administrative Templates
User Configuration
Software Settings
Windows Settings
Default Domain Policy [imac-mcs-16.identity.com] Policy
Select an item to view its description.
Name
Computer Configuration
User Configuration
New
Automatic Certificate Request...
Refresh
Help
Extended
Standard
Creates a new object in this container.
229919

Step 5 The Automatic Certificate Request Setup Wizard will launch. Click **Next**. See Figure 3-63.

Figure 3-63 Automatic Certificate Request Wizard



Automatic Certificate Request Setup Wizard

Welcome to the Automatic Certificate Request Setup Wizard

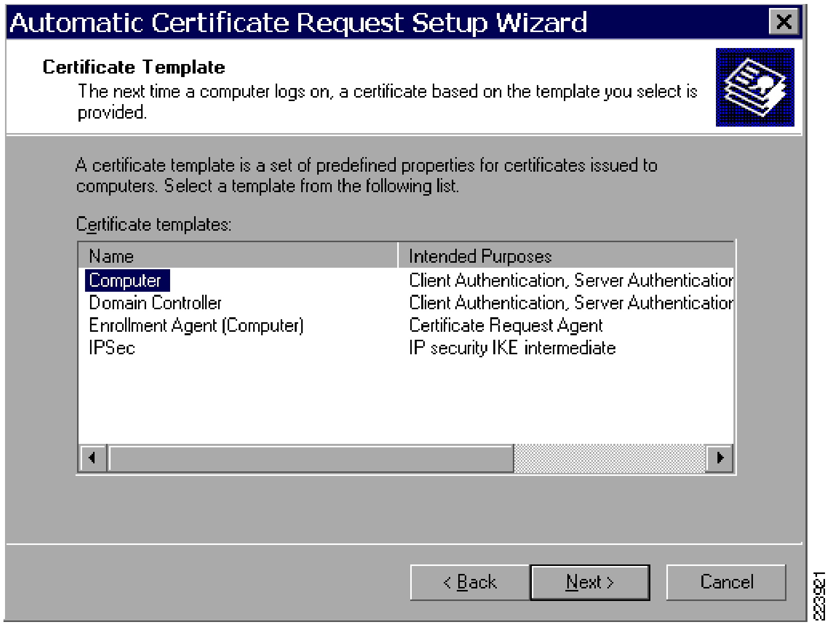
This wizard helps you set up automatic certificate requests for computers.

Using automatic certificate requests, an administrator can specify which types of certificate can be automatically requested by a computer.

To continue, click Next.

Step 6 On the *Certificate Template* page, click **Computer** and click **Next**. See Figure 3-64.

Figure 3-64 Selecting A Certificate Template for Automatic Request



Automatic Certificate Request Setup Wizard

Certificate Template

The next time a computer logs on, a certificate based on the template you select is provided.

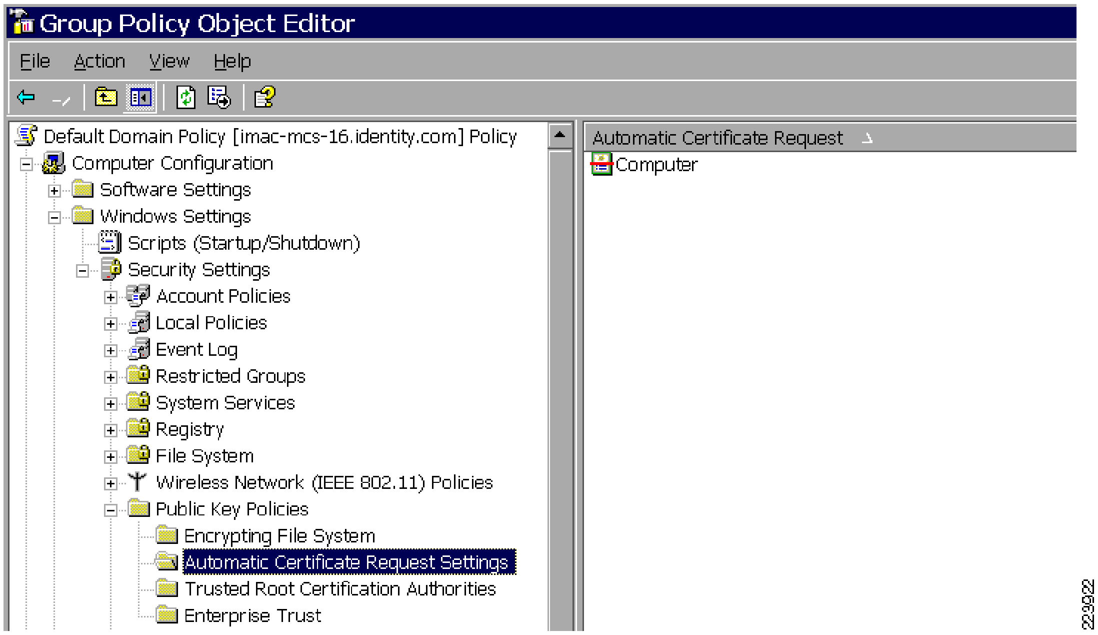
A certificate template is a set of predefined properties for certificates issued to computers. Select a template from the following list.

Certificate templates:

Name	Intended Purposes
Computer	Client Authentication, Server Authenticatior
Domain Controller	Client Authentication, Server Authenticatior
Enrollment Agent (Computer)	Certificate Request Agent
IPSec	IP security IKE intermediate

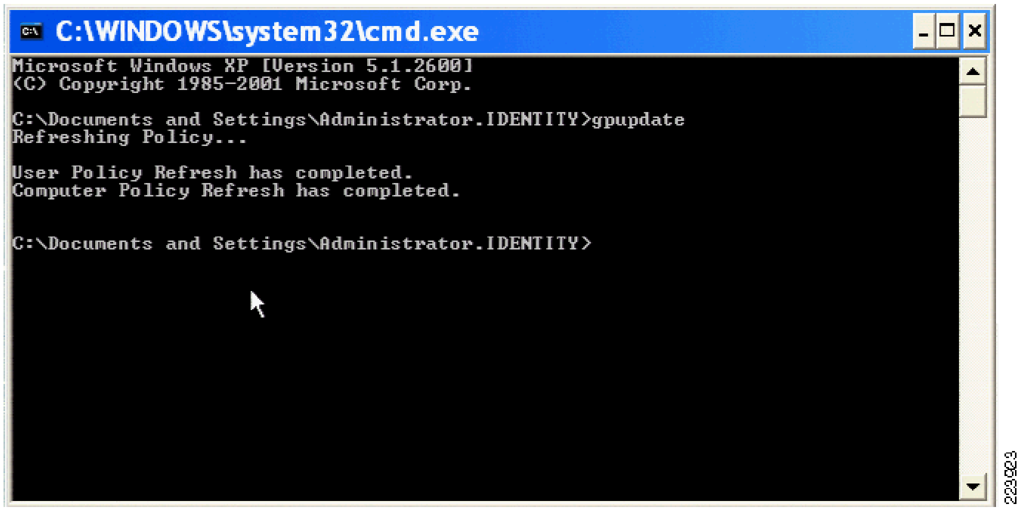
Step 7 On the *Completing the Automatic Certificate Request Setup Wizard* page, click **Finish**. The *Computer* certificate type now appears in the details pane of the *Group Policy Object Editor* snap-in. See Figure 3-65.

Figure 3-65 Newly Created Certificate Request



Step 8 Refresh the machine group policy on the client PC. This can be accomplished by rebooting the PC or by issuing the **gpudpate** command in a DOS window as shown in Figure 3-66.

Figure 3-66 Updating the Group Policy on the Client PC



```
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Documents and Settings\Administrator.IDENTITY>gpupdate
Refreshing Policy...

User Policy Refresh has completed.
Computer Policy Refresh has completed.


C:\Documents and Settings\Administrator.IDENTITY>
```

Manually Downloading the Machine Client Certificate via MMC

In a Windows domain environment, the machine client certificate will typically already be in the Windows user certificate storage as a result of the default Group Policy. However, there may be some situations when it is not. If the certificate does not appear in the machine store list, the certificate can be downloaded manually using the following steps.

Note Using Group Policy to deploy the root CA certificate as described in the previous section is a much more scalable and manageable process and is preferable in most circumstances.

Step 1 Choose **Start** > **Run**, type *mmc*, and click **OK**.

Step 2 On the *File* menu, click **Add/Remove Snap-in** and then click **Add**.

Step 3 Under *Snap-in*, double-click **Certificates**. Select *Computer Account* and click **Next**.

Step 4 Under *Select Computer*, select *Local Computer* and click **Finish**.

Step 5 On the *Add Standalone Snap-in* window, click **Close**.

Step 6 On the *Add/Remove Snap-in* window, click **OK**.

Step 7 In the *Certificates* window, right click **Personal**. Select *All Tasks* > *Request New Certificate*.

Step 8 Click **Next** on the *Certificate Type* window.

Step 9 Enter a friendly name and description. Click **Next**.

Step 10 Click **Finish**.

Certificates Required for User Authentication

The following sections describe how to verify and install the certificates needed to successfully complete user authentication.

Verify User Root CA Certificate

When a user logs into a computer in the Microsoft domain, the Windows operating system will automatically retrieve the Enterprise CA Root Certificate from the Enterprise Root CA as a result of the Active Directory default Group Policy. Therefore, the client will most likely already have the Enterprise CA Root Certificate in the Trusted Root folder of the user certificate store.

To verify that the client has the Enterprise CA Certificate in user certificate storage, follow these steps on the client PC.

Step 1 Choose **Start** > **Run**, type *mmc*, and click **OK**.

Step 2 On the *File* menu, click **Add/Remove Snap-in** and then click **Add**.

Step 3 Under *Snap-in*, double-click **Certificates**. Select *My User Account* and click **Finish**.

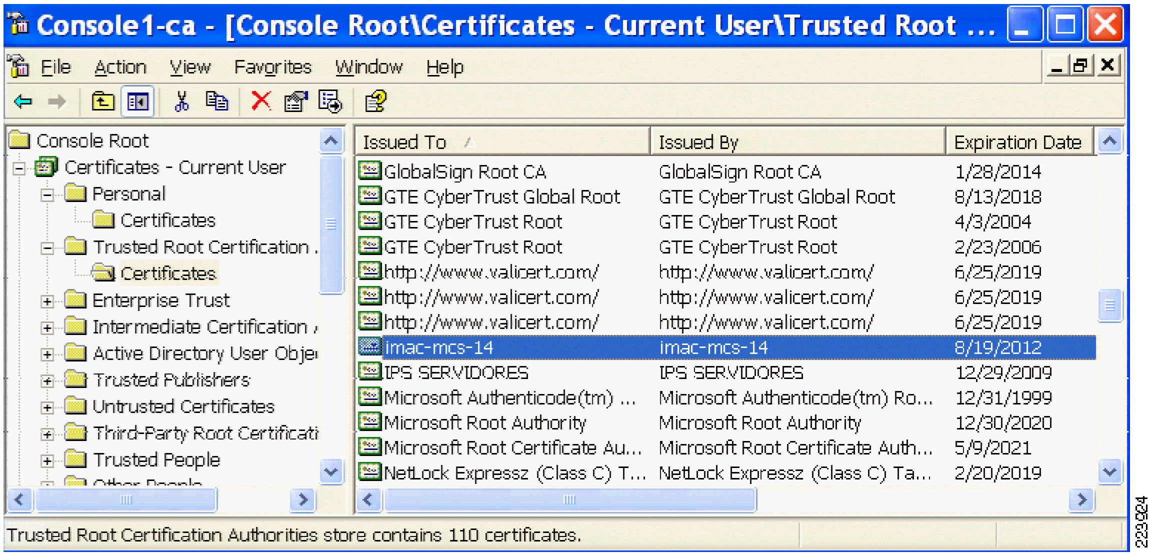
Step 4 On the *Add Standalone Snap-in* window, click **Close**.

Step 5 On the *Add/Remove Snap-in* window, click **OK**.

Step 6 On the Console, select *Certificates (Current User)* > *Trusted Root Certification Authorities* > *Certificates*.

Step 7 Locate the Enterprise Root CA Certificate in the list (*imac-mcs-14* in Figure 3-67). If the certificate is listed, no further action is necessary. Proceed to downloading the client certificate in "Verifying Machine Root CA Certificate" section on page 3-57.

Figure 3-67 Enterprise Root CA in User Certificate Storage


Console1-ca - [Console Root\Certificates - Current User\Trusted Root ...
File
Action
View
Favorites
Window
Help
Console Root
Certificates - Current User
Personal
Certificates
Trusted Root Certification .
Certificates
Enterprise Trust
Intermediate Certification /
Active Directory User Obje
Trusted Publishers
Untrusted Certificates
Third-Party Root Certificati
Trusted People
Other People
223924

Issued To	Issued By	Expiration Date
GlobalSign Root CA	GlobalSign Root CA	1/28/2014
GTE CyberTrust Global Root	GTE CyberTrust Global Root	8/13/2018
GTE CyberTrust Root	GTE CyberTrust Root	4/3/2004
GTE CyberTrust Root	GTE CyberTrust Root	2/23/2006
http://www.valicert.com/	http://www.valicert.com/	6/25/2019
http://www.valicert.com/	http://www.valicert.com/	6/25/2019
http://www.valicert.com/	http://www.valicert.com/	6/25/2019
imac-mcs-14	imac-mcs-14	8/19/2012
IPS SERVIDORES	IPS SERVIDORES	12/29/2009
Microsoft Authenticode(tm) ...	Microsoft Authenticode(tm) Ro...	12/31/1999
Microsoft Root Authority	Microsoft Root Authority	12/30/2020
Microsoft Root Certificate Au...	Microsoft Root Certificate Auth...	5/9/2021
NetLock Expressz (Class C) T...	NetLock Expressz (Class C) Ta...	2/20/2019

Trusted Root Certification Authorities store contains 110 certificates.

If the certificate is not listed, follow the instructions for manually downloading the CA certificate.

Manually Downloading the Root CA Certificate

In a Windows domain environment, the CA's root certificate will typically already be in the Windows user certificate storage. However, there may be some situations when it is not. If the root CA Certificate does not appear in the user store list, the certificate can be manually downloaded by the following steps.

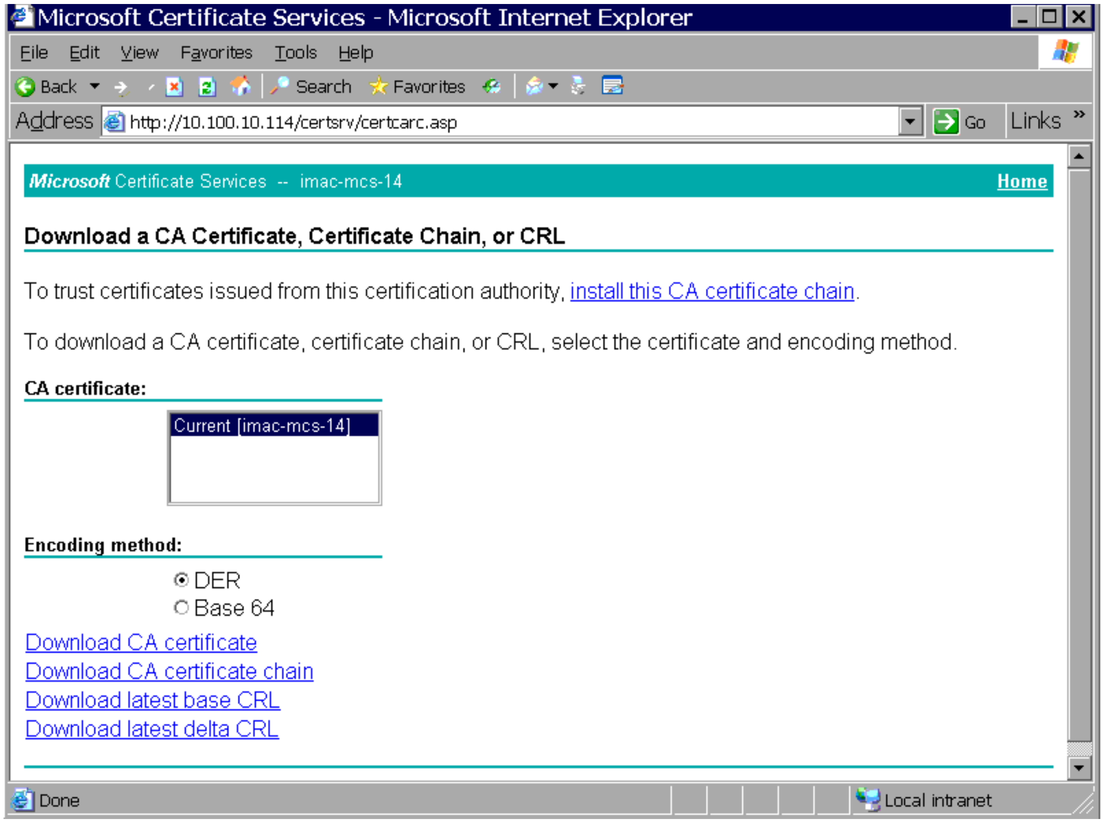
Note Using the default Group Policy to deploy the root CA certificate is a much more scalable and manageable process and is recommended in most circumstances.

Step 1 On the client, point the browser at the Microsoft CA server: http://CA-srv-ip /certsrv.

Step 2 From the *Select a Task* option choose *Download a CA certificate, certificate chain or CRL*.

Step 3 Click **Download CA Certificate**. See Figure 3-68.

Figure 3-68 Download CA certificate



Microsoft Certificate Services - Microsoft Internet Explorer

http://10.100.10.114/certsrv/certcarc.asp

Microsoft Certificate Services -- imac-mcs-14

Download a CA Certificate, Certificate Chain, or CRL

To trust certificates issued from this certification authority, install this CA certificate chain.

To download a CA certificate, certificate chain, or CRL, select the certificate and encoding method.

CA certificate:

Current [imac-mcs-14]

Encoding method:

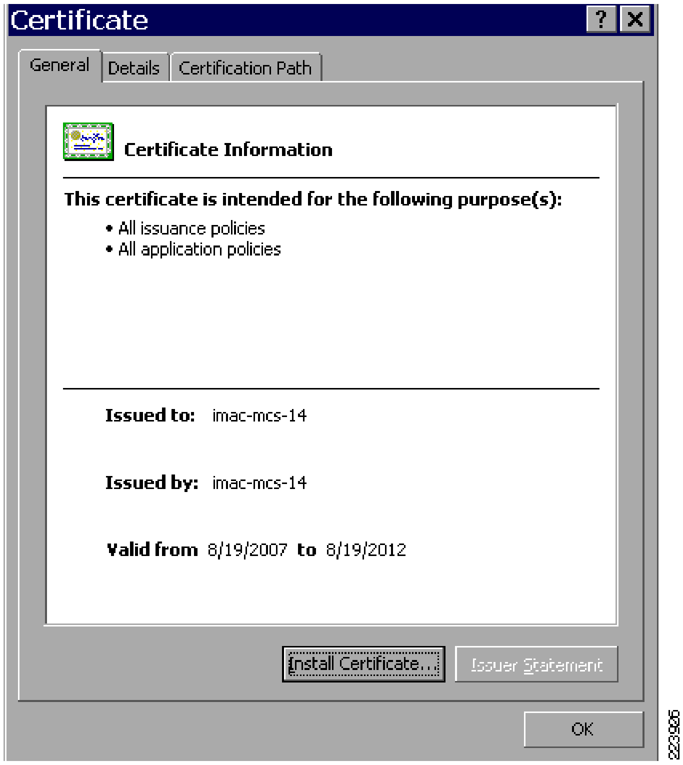
● DER
○ Base 64

Download CA certificate
Download CA certificate chain
Download latest base CRL
Download latest delta CRL

Step 4 A File Download Security Warning window appears. Click **Open**.

Step 5 A Certificate Installation Window appears. Click **Install Certificate**. See Figure 3-69.

Figure 3-69 Certificate Installation Window



Certificate

General | Details | Certification Path

Certificate Information

This certificate is intended for the following purpose(s):

- All issuance policies
- All application policies

Issued to: imac-mcs-14

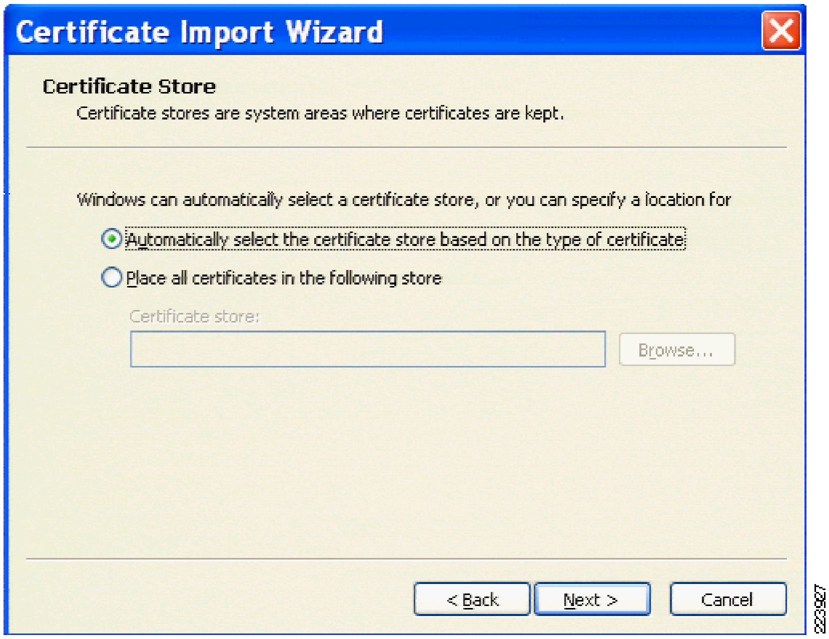
Issued by: imac-mcs-14

Valid from 8/19/2007 to 8/19/2012

Step 6 The Certificate Import Wizard opens. Click **Next**.

Step 7 Select *Automatically select the certificate store based on the type of certificate* and click **Next**. See Figure 3-70.

Figure 3-70 Automatically Select Certificate Store



Certificate Import Wizard

Certificate Store

Certificate stores are system areas where certificates are kept.

Windows can automatically select a certificate store, or you can specify a location for

● Automatically select the certificate store based on the type of certificate

○ Place all certificates in the following store

Certificate store:

Step 8 Click **Finish**.

Step 9 The CA Root certificate should now be in the *Trusted Root* folder of the *User certificate store*.

User Client Certificate

The most efficient and scalable way to download client certificates for user authentication is to configure the Group Policy in Active Directory to automatically download the client certificates. Client certificates can also be acquired manually from the client itself, either via the MMC or via Web enrollment. All three methods are described in the following section.

Note User Auto-Enrollment is only supported on Certificate Authorities running on Windows 2003 Server Enterprise Edition. Windows 2003 Standard Edition supports Machine Auto-Enrollment only, not User Auto-Enrollment.

Method 1: Using Group Policy to Download Client Certificates for User Authentication (Preferred for Enterprise CAs)

There are two steps for automating user certificate enrollment in a Windows environment. The first step is to create a user certificate template that has auto-enrollment enabled. The second step is to modify the default Group Policy to enable user auto-enrollment on the end host. These and subordinate steps are summarized in the following procedure.

Step 1 Create User Auto-Enroll Certificate Template on the Enterprise Root CA.

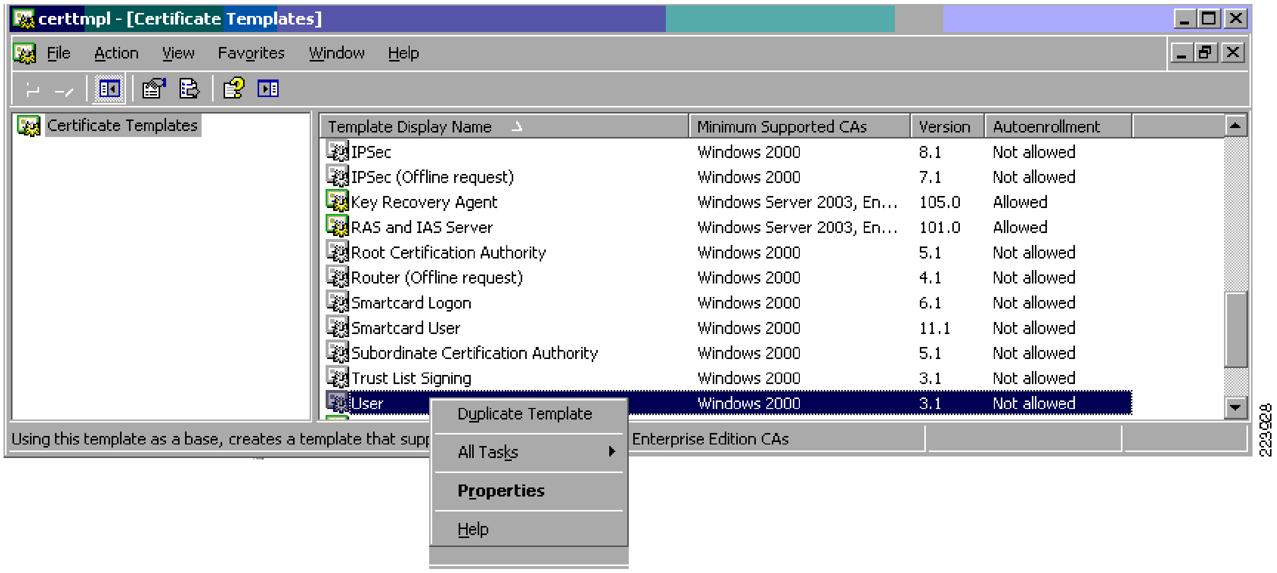
Unlike the default machine certificate template, the default User certificate template in the Microsoft CA is not enabled for auto-enrollment. In order to enable user auto-enrollment, you must create a duplicate User certificate template with auto-enrollment enabled.

Install the Certificate Templates Snap-in

On the Enterprise CA or the Domain Controller (either can be used to configure templates), complete these steps:

1. Choose **Start** > **Run**, type *certtmpl.msc* to open the *Certificate Templates* snap-in.
2. In the *Details* pane of the *Certificate Templates* snap-in, right-click the **User template** and select **Duplicate Template**. See Figure 3-71.

Figure 3-71 Creating a Duplicate of the User Template

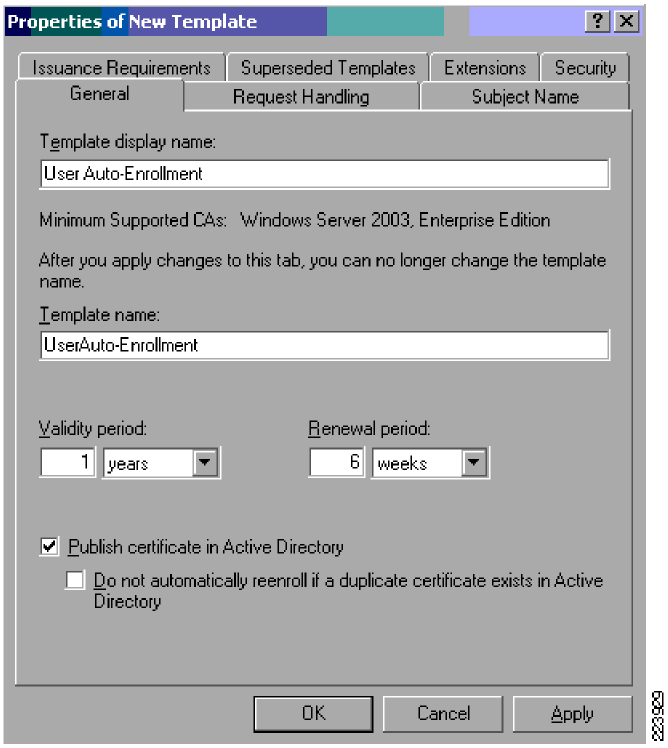


Template Display Name	Minimum Supported CAs	Version	Autoenrollment
IPSec	Windows 2000	8.1	Not allowed
IPSec (Offline request)	Windows 2000	7.1	Not allowed
Key Recovery Agent	Windows Server 2003, En...	105.0	Allowed
RAS and IAS Server	Windows Server 2003, En...	101.0	Allowed
Root Certification Authority	Windows 2000	5.1	Not allowed
Router (Offline request)	Windows 2000	4.1	Not allowed
Smartcard Logon	Windows 2000	6.1	Not allowed
Smartcard User	Windows 2000	11.1	Not allowed
Subordinate Certification Authority	Windows 2000	5.1	Not allowed
Trust List Signing	Windows 2000	3.1	Not allowed
User	Windows 2000	3.1	Not allowed

Using this template as a base, creates a template that supp Enterprise Edition CAs

3. In the *Template* display name field of the *General* tab, enter the text *User Auto-Enrollment*. This will be the name of the template. See Figure 3-72.

Figure 3-72 User Auto-Enrollment Template: General Tab



Template display name:
User Auto-Enrollment

Minimum Supported CAs: Windows Server 2003, Enterprise Edition

After you apply changes to this tab, you can no longer change the template name.

Template name:
UserAuto-Enrollment

Validity period: 1 years

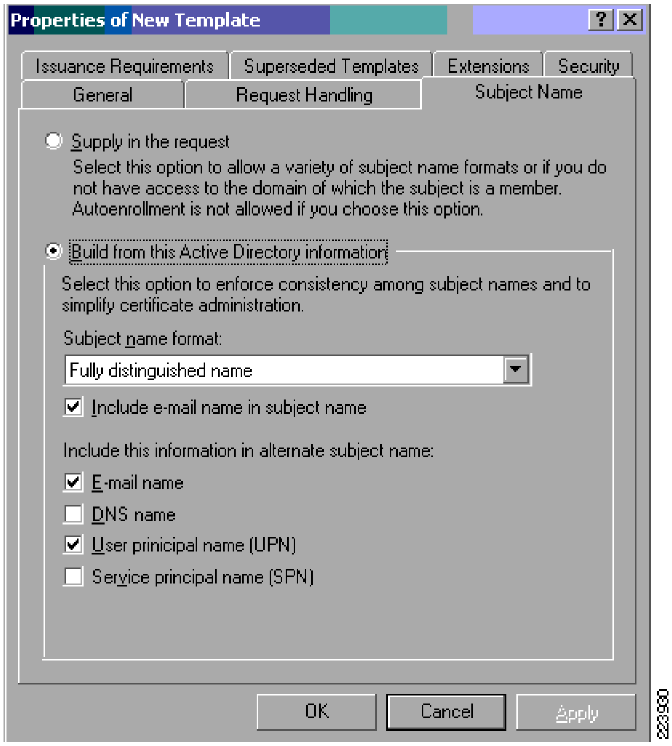
Renewal period: 6 weeks

☑ Publish certificate in Active Directory

☐ Do not automatically reenroll if a duplicate certificate exists in Active Directory

4. Go to the *Subject Name* tab, choose **Build from this Active Directory information**. Select Common name from the drop-down menu for *Subject name format*. Under *Include this information in alternate subject name*, check *E-mail name* and *User principal name (UPN)*. Click **OK**. See Figure 3-73.

Figure 3-73 User Auto-Enrollment Template: Subject Name Tab



○ Supply in the request
Select this option to allow a variety of subject name formats or if you do not have access to the domain of which the subject is a member. Autoenrollment is not allowed if you choose this option.

● Build from this Active Directory information
Select this option to enforce consistency among subject names and to simplify certificate administration.

Subject name format:
Fully distinguished name

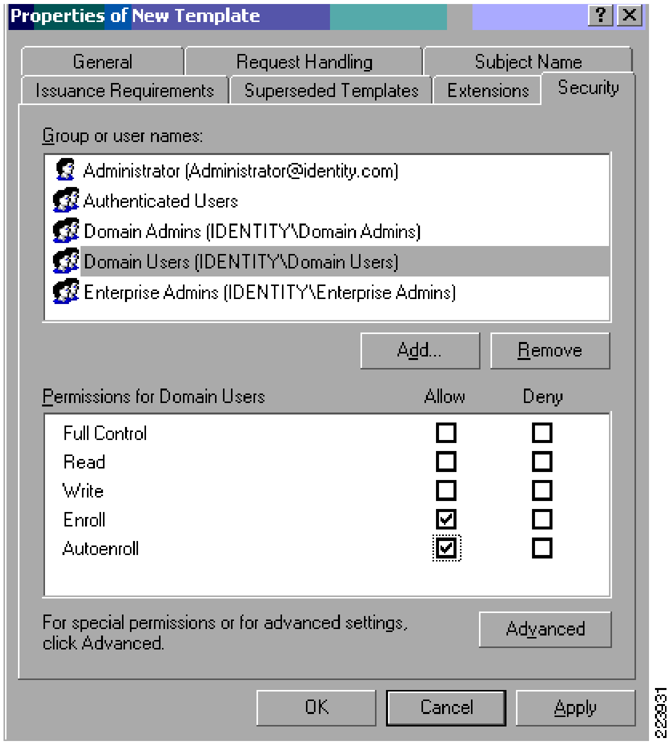
☑ Include e-mail name in subject name

Include this information in alternate subject name:

☑ E-mail name
☐ DNS name
☑ User prinicipal name (UPN)
☐ Service principal name (SPN)

5. Go to the *Security* tab, highlight the *Domain Users Group* and ensure that the *Auto-Enroll* option is checked under *Allowed.* See Figure 3-74.

Figure 3-74 User Auto-Enrollment Template: Security Tab



Group or user names:

- Administrator (Administrator@identity.com)
- Authenticated Users
- Domain Admins (IDENTITY\Domain Admins)
- Domain Users (IDENTITY\Domain Users)
- Enterprise Admins (IDENTITY\Enterprise Admins)

Permissions for Domain Users	Allow	Deny
Full Control	□	□
Read	□	□
Write	□	□
Enroll	☑	□
Autoenroll	☑	□

For special permissions or for advanced settings, click Advanced.

6. Click **OK** to save the template and move onto issuing this template from the *Certificate Authority* snap-in.

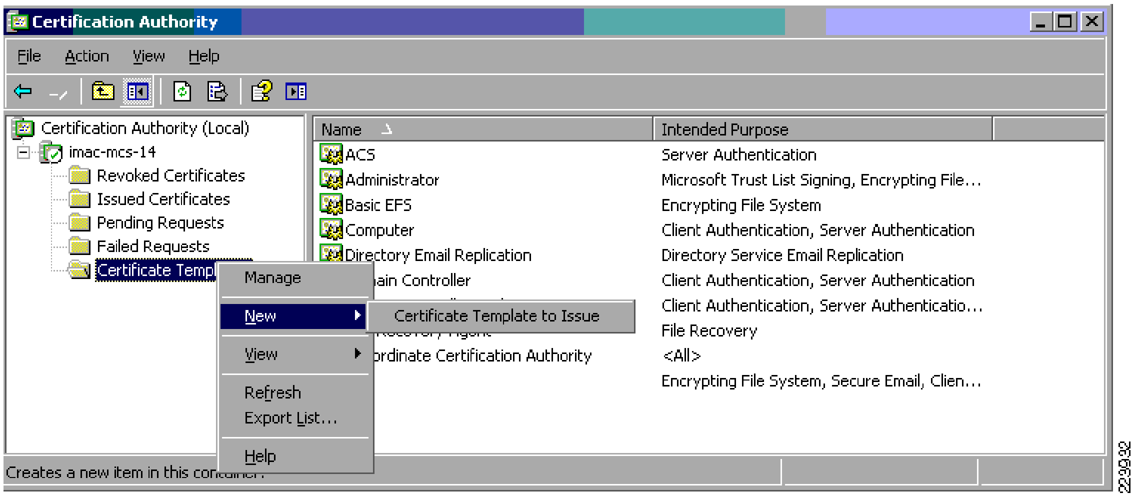
Enabling the New User Auto Enrollment Certificate Template

Complete these steps:

1. On the Enterprise CA server, open the Certification Authority by choosing *Start* > *All Programs* > *Administrative Tools* > *Certification Authority.*

2. In the console tree, click the name of the CA (*imac-mcs-14* in Figure 3-75) to expand the certificate list. Right-click **Certificate Templates**. Choose *New* > *Certificate Template to Issue*. A list of un-issued templates appears. Highlight the *User Auth-Enrollment Certificate Template* and click **OK**.

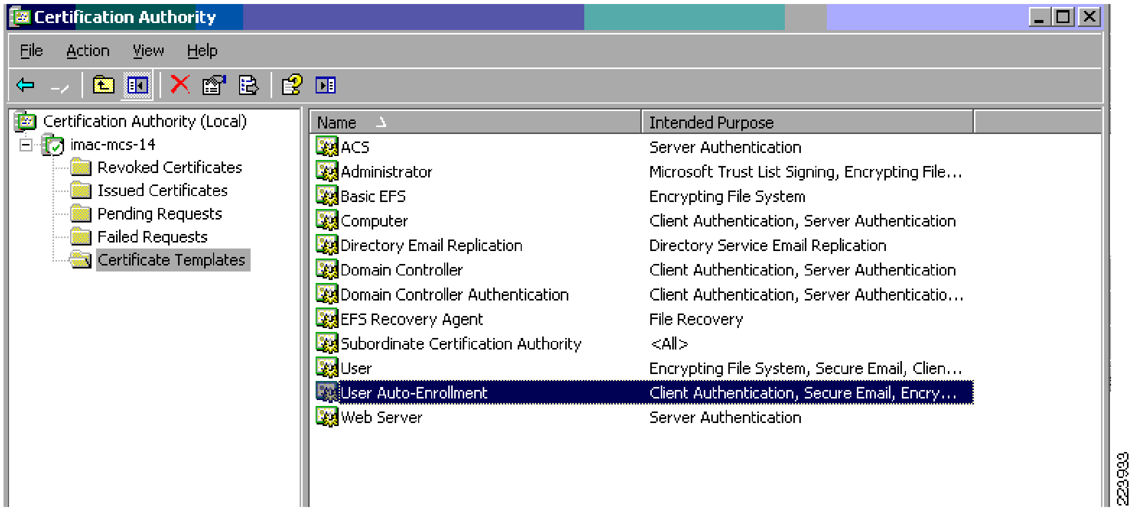
Figure 3-75 Issuing a New Certificate from the Certification Authority



Name	Intended Purpose
ACS	Server Authentication
Administrator	Microsoft Trust List Signing, Encrypting File...
Basic EFS	Encrypting File System
Computer	Client Authentication, Server Authentication
Directory Email Replication	Directory Service Email Replication
ain Controller	Client Authentication, Server Authentication
	Client Authentication, Server Authenticatio...
	File Recovery
ordinate Certification Authority	<All>
	Encrypting File System, Secure Email, Clien...

3. Verify that the *User Auto-Enrollment* template is listed in the *Certificate Templates* folder as shown in Figure 3-76.

Figure 3-76 Verify that the User Auto-Enrollment Certificate Has Been Issued



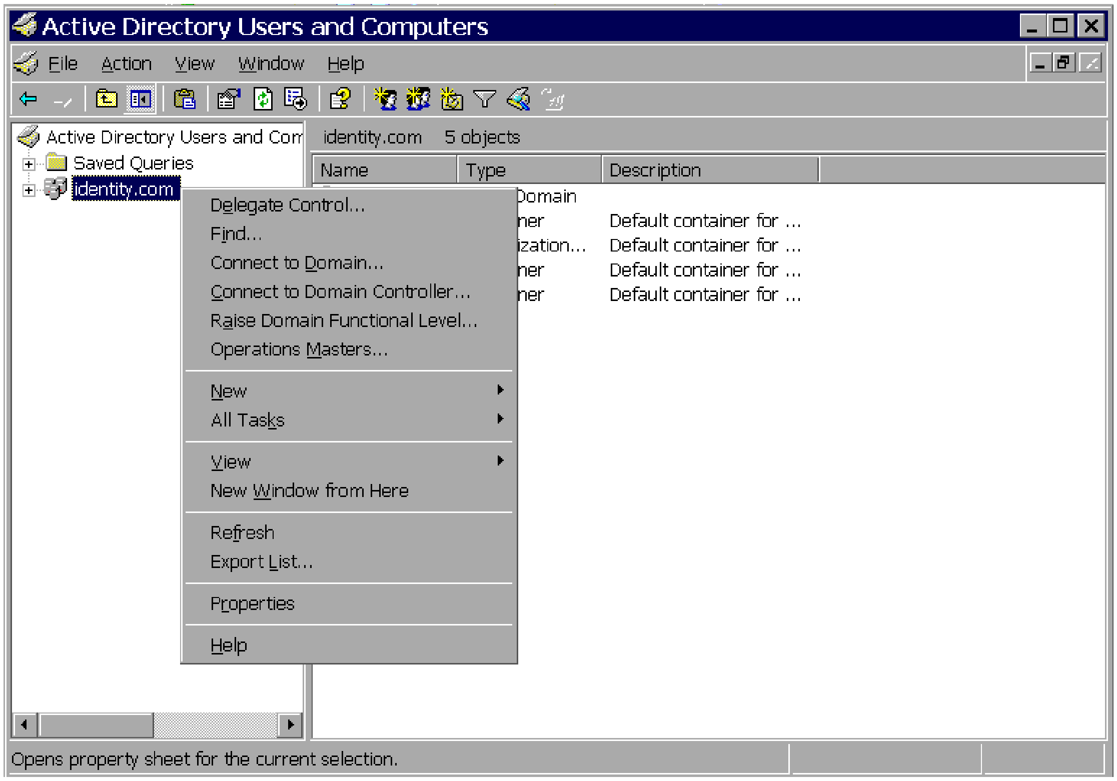
Name	Intended Purpose
ACS	Server Authentication
Administrator	Microsoft Trust List Signing, Encrypting File...
Basic EFS	Encrypting File System
Computer	Client Authentication, Server Authentication
Directory Email Replication	Directory Service Email Replication
Domain Controller	Client Authentication, Server Authentication
Domain Controller Authentication	Client Authentication, Server Authenticatio...
EFS Recovery Agent	File Recovery
Subordinate Certification Authority	<All>
User	Encrypting File System, Secure Email, Clien...
User Auto-Enrollment	Client Authentication, Secure Email, Encry...
Web Server	Server Authentication

Step 2 Using Group Policy to Download Client Certificates for User Authentication.

Once a User Auto-Enrollment Certificate template has been created, modify the default Group Policy to enable User Auto Enrollment as described below.

1. On the *Active Directory Domain Controller*, open the *Active Directory Users and Computers* snap-in.
2. In the console tree, double-click **Active Directory Users and Computers**, right-click the domain, and then click **Properties**. See Figure 3-77.

Figure 3-77 Active Directory Domain Properties

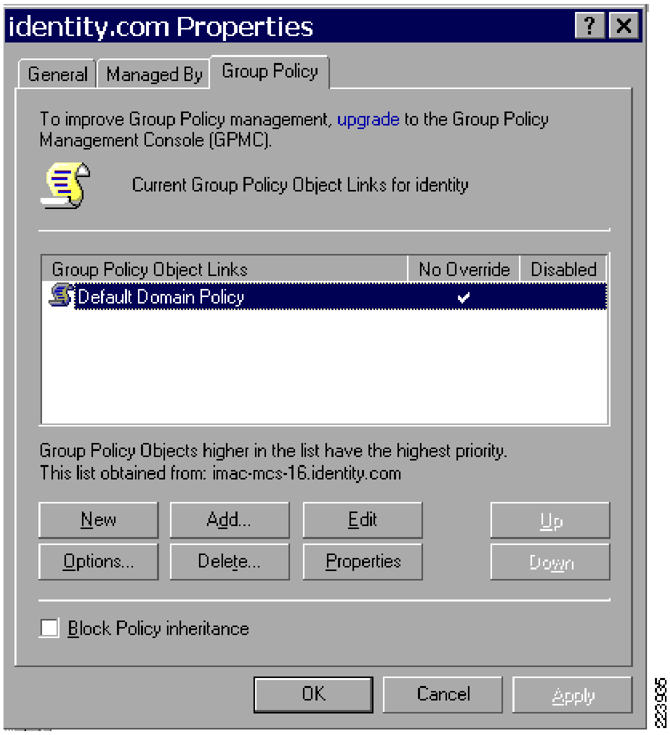

Active Directory Users and Computers
File Action View Window Help
Active Directory Users and Com
Saved Queries
identity.com
identity.com 5 objects
Name
Type
Description
Domain
ner Default container for ...
ization... Default container for ...
ner Default container for ...
ner Default container for ...
Delegate Control...
Find...
Connect to Domain...
Connect to Domain Controller...
Raise Domain Functional Level...
Operations Masters...
New
All Tasks
View
New Window from Here
Refresh
Export List...
Properties
Help

Opens property sheet for the current selection.

229934

3. On the *Group Policy* tab, click **Default Domain Policy**, and then click **Edit**. See Figure 3-78. This opens the *Group Policy Object Editor* snap-in. See Figure 3-79.

Figure 3-78 Default Domain Policy



To improve Group Policy management, upgrade to the Group Policy Management Console (GPMC).

Current Group Policy Object Links for identity

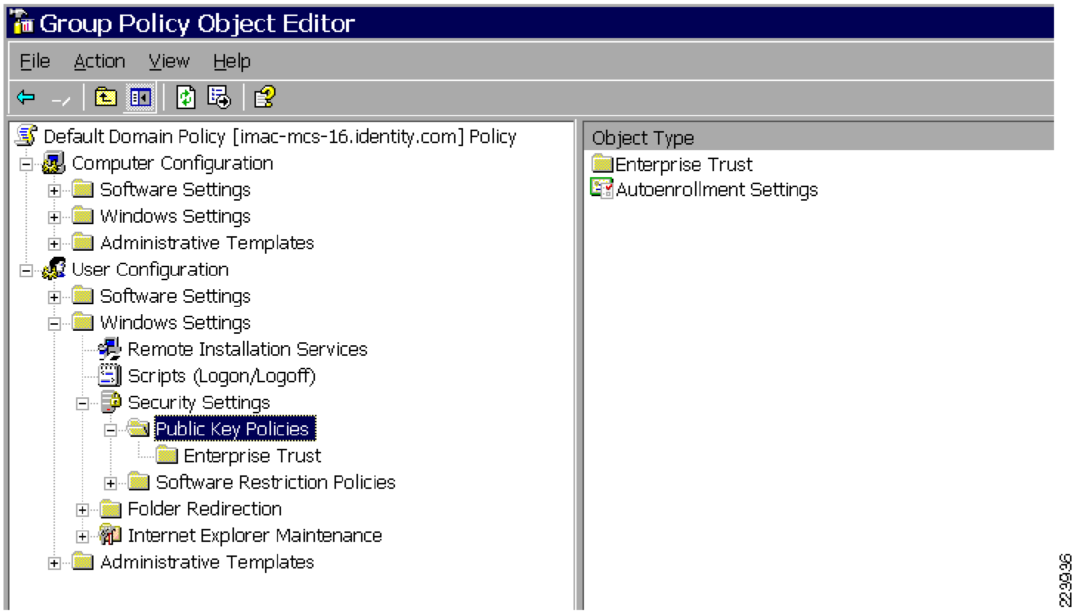
Group Policy Object Links	No Override	Disabled
Default Domain Policy	✓	

Group Policy Objects higher in the list have the highest priority.
This list obtained from: imac-mcs-16.identity.com

□ Block Policy inheritance

4. In the console tree, expand *User Configuration* > *Windows Settings* > *Security Settings* > *Public Key Policies*. See Figure 3-79.

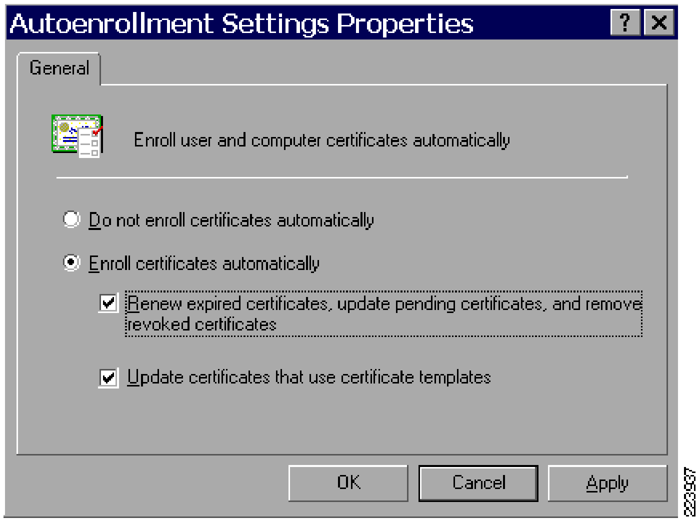
Figure 3-79 Group Policy User Configuration



5. In the details pane, double-click **Auto-enrollment Settings**.

6. See Figure 3-80. Choose *Enroll certificates automatically* and check *Renew expired certificates, update pending certificates and remove revoked certificates* and *Update certificates that use certificate templates*.

Figure 3-80 User Auto-Enrollment Properties


Autoenrollment Settings Properties

Enroll user and computer certificates automatically

○ Do not enroll certificates automatically

● Enroll certificates automatically

☑ Renew expired certificates, update pending certificates, and remove revoked certificates

☑ Update certificates that use certificate templates

7. Click **OK**. A client certificate should automatically be downloaded the next time the user logs into a machine. It can also be triggered by issuing the **gpupdate** command in a DOS window or rebooting the PC. Proceed to the sections for configuring the XP or CSSC client.

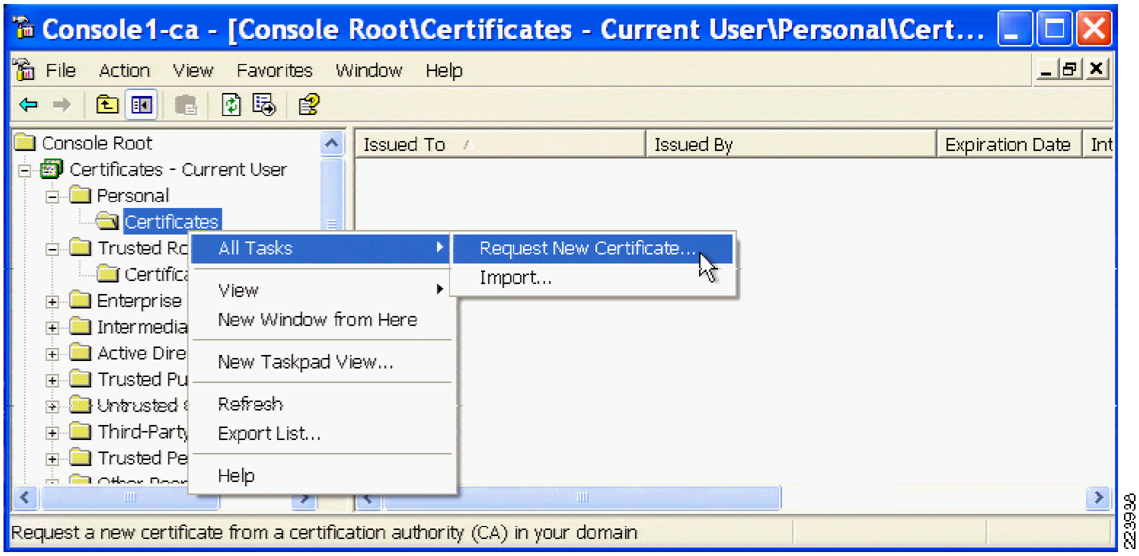
Method 2: Using MMC to Download User Certificate

If Active Directory cannot be used to automatically distribute user certificates as described in the previous section, then the certificate can be manually downloaded using the Microsoft Management Console (MMC) on the client.

Note The client must have sufficient network connectivity to contact the Domain Controller and the Certificate Authority in order to download a certificate.

1. Log into the client with the Windows user credentials of the user for whom a certificate is to be downloaded.
2. On the client, choose **Start** > **Run**, type *mmc*, and click **OK**.
3. On the *File* menu, click **Add/Remove Snap-in** and then click **Add**.
4. Under *Snap-in*, double-click **Certificates**. Select *My User Account* and click **Finish**.
5. On the *Add Standalone Snap-in* window, click **Close**.
6. On the *Add/Remove Snap-in* window, click **OK**
7. On the *Console*, select *Certificates (Current User)* > *Personal* > *All Tasks* > *Request New Certificate*. See Figure 3-81.

Figure 3-81 Request User Certificate from MMC

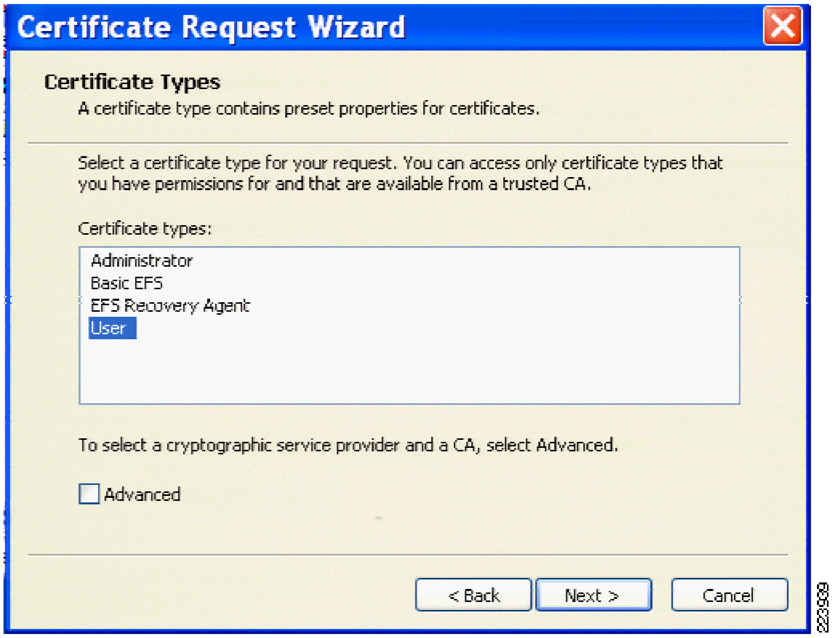


Request a new certificate from a certification authority (CA) in your domain

8. The Certificate Request Wizard will appear. Click **Next**.

9. Under *Certificate type*, select *User* and click **Next**. See Figure 3-82.

Figure 3-82 Certificate Request Wizard



Certificate Types

A certificate type contains preset properties for certificates.

Select a certificate type for your request. You can access only certificate types that you have permissions for and that are available from a trusted CA.

Certificate types:

Administrator
Basic EFS
EFS Recovery Agent
User

To select a cryptographic service provider and a CA, select Advanced.

□ Advanced

Note If there is more than one CA chain in the Active Directory domain, select Advanced instead of User. The wizard will give you an opportunity to select from all the CAs known to the Domain Controller.

10. Enter a friendly name and description for the certificate and click **Next**.

Note The *friendly name* is a separate field from the common name and subject alternative name of the certificate. The certificate will be issued to the user who is logged into the PC making the request.

11. Click **Finish**. The user certificate will be added to the store.

Method 3: Download User Certificates via Web Enrollment

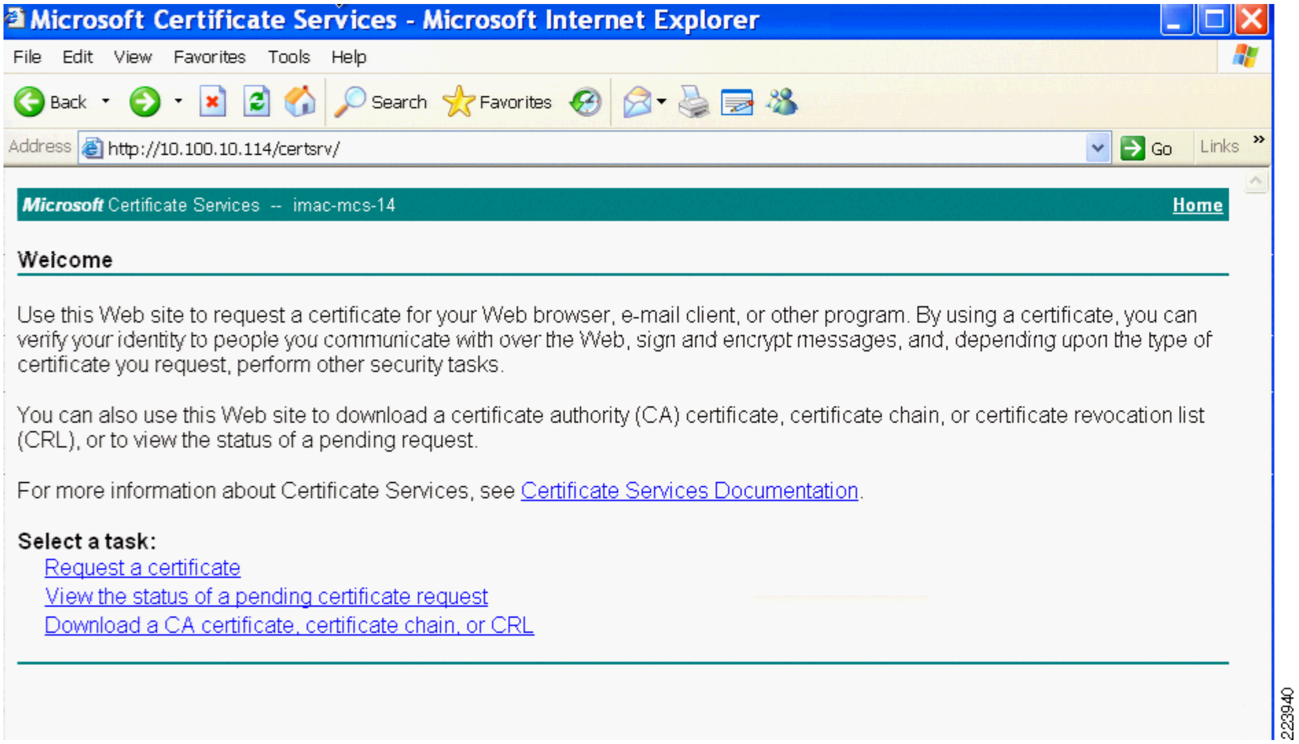
If Active Directory Group Policy cannot be used to automatically distribute user certificates, then the certificate can be manually downloaded using the Web interface on the CA. Web enrollment is equivalent to using MMC to manually download the certificate. The choice of one method over the other depends largely on end-user preference.

1. On the client, open a browser and point the browser at the Microsoft CA server: http://CA-srv-ip /certsrv.

Note IIS must be installed on the Certificate Authority for Web Enrollment to succeed. If browsing to the CA server results in a `404 file not found` error, verify that IIS is installed on the CA.

2. A Windows login screen appears. Enter the *username*, *domain* and *password* for the user requesting a certificate. The Windows CA Web page appears.
3. From the *Select a Task* option, choose **Request a Certificate**. See Figure 3-83.

Figure 3-83 Windows CA Web Interface


Microsoft Certificate Services - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address
Go Links
223940

http://10.100.10.114/certsrv/

Microsoft Certificate Services -- imac-mcs-14 Home

Welcome

Use this Web site to request a certificate for your Web browser, e-mail client, or other program. By using a certificate, you can verify your identity to people you communicate with over the Web, sign and encrypt messages, and, depending upon the type of certificate you request, perform other security tasks.

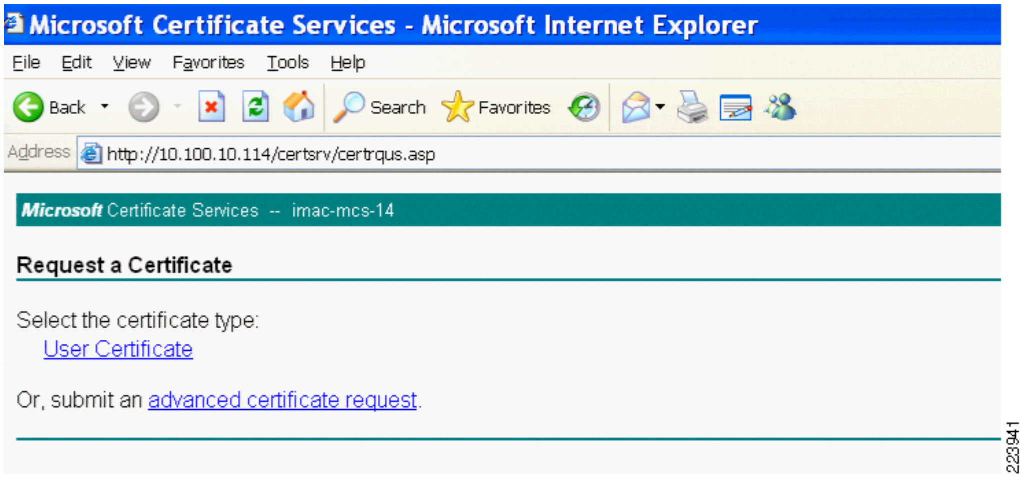
You can also use this Web site to download a certificate authority (CA) certificate, certificate chain, or certificate revocation list (CRL), or to view the status of a pending request.

For more information about Certificate Services, see Certificate Services Documentation.

Select a task:
Request a certificate
View the status of a pending certificate request
Download a CA certificate, certificate chain, or CRL

4. Under *Select the certificate type*, click **User Certificate**. See Figure 3-84.

Figure 3-84 Request a User Certificate


Microsoft Certificate Services - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://10.100.10.114/certsrv/certrqus.asp
223941

Microsoft Certificate Services -- imac-mcs-14

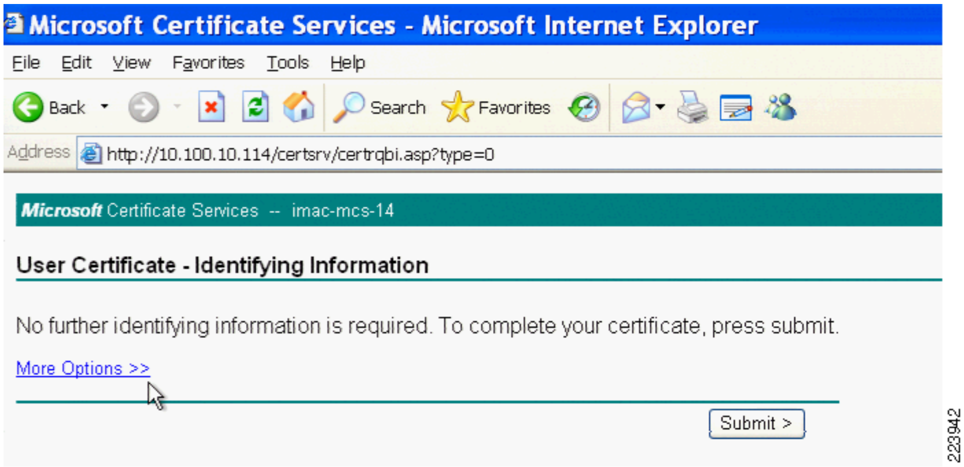
Request a Certificate

Select the certificate type:
User Certificate

Or, submit an advanced certificate request.

5. Click **Submit**. See Figure 3-85.

Figure 3-85 User Certificate Identification


Microsoft Certificate Services - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://10.100.10.114/certsrv/certrqbi.asp?type=0
More Options >>
Submit >
223942

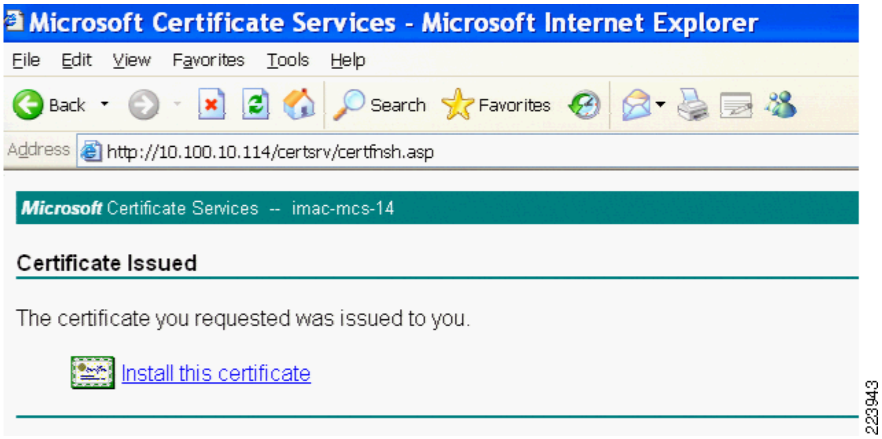
Microsoft Certificate Services -- imac-mcs-14

User Certificate - Identifying Information

No further identifying information is required. To complete your certificate, press submit.

6. A *Potential Scripting Violation* window appears. Click **Yes**. The *Certificate Issued* window appears. Click **Install this Certificate**. See Figure 3-86.

Figure 3-86 Install Issued User Certificate


Microsoft Certificate Services - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back
Search
Favorites
Address
http://10.100.10.114/certsrv/certfnsh.asp
Microsoft Certificate Services -- imac-mcs-14
223943

Certificate Issued

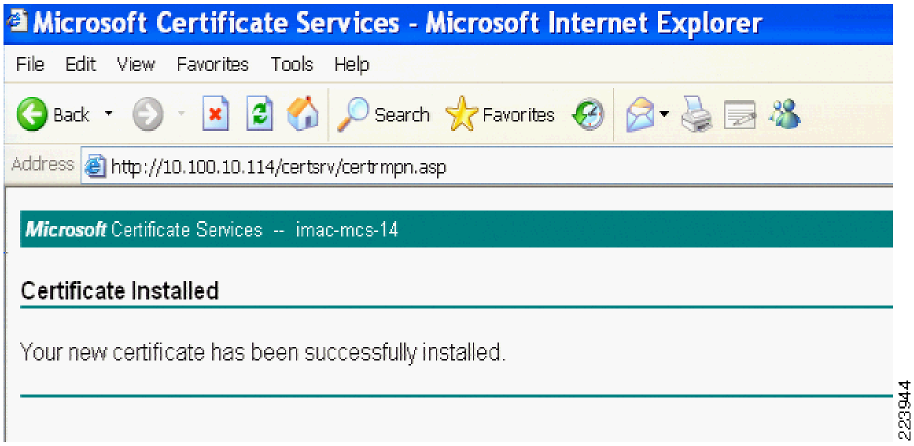
The certificate you requested was issued to you.

Install this certificate

7. Click **Yes** if the *Potential Scripting Violation* window appears again. A confirmation of the certificate installation will appear. See Figure 3-87.

Figure 3-87 Confirmation of User Certificate Installation

1


Microsoft Certificate Services - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back
Search
Favorites
Address
http://10.100.10.114/certsrv/certrmpn.asp
Microsoft Certificate Services -- imac-mcs-14
223944

Certificate Installed

Your new certificate has been successfully installed.

CSSC Configuration

The steps provided in this section explain how to configure the Cisco Secure Services Client (CSSC) for EAP-TLS authentication on wired LAN networks.

Note CSSC version 5.0.1.8 is running on Windows XP operating system with Service Pack 2.

Note Prior to configuring CSSC, validate that the correct certificates exist in the Windows certificate stores as described in previous sections.

There are three components required to install and configure CSSC:

1.

- CSSC client image (CSSC_SSC-XP2K)—802.1X client software that runs on the end host.
- Client Utilities (CiscoClientUtilities)—Troubleshooting tool that runs on the end host.
- Client Management Utility (SSCMgmtToolkit)—Management utility that configures user profiles that can be distributed to the entire organization through a single Extensible Markup Language (XML) file. This utility is typically run on a centralized server. For testing purposes, it can be run on the end client to modify and test the supplicant configuration on the fly.

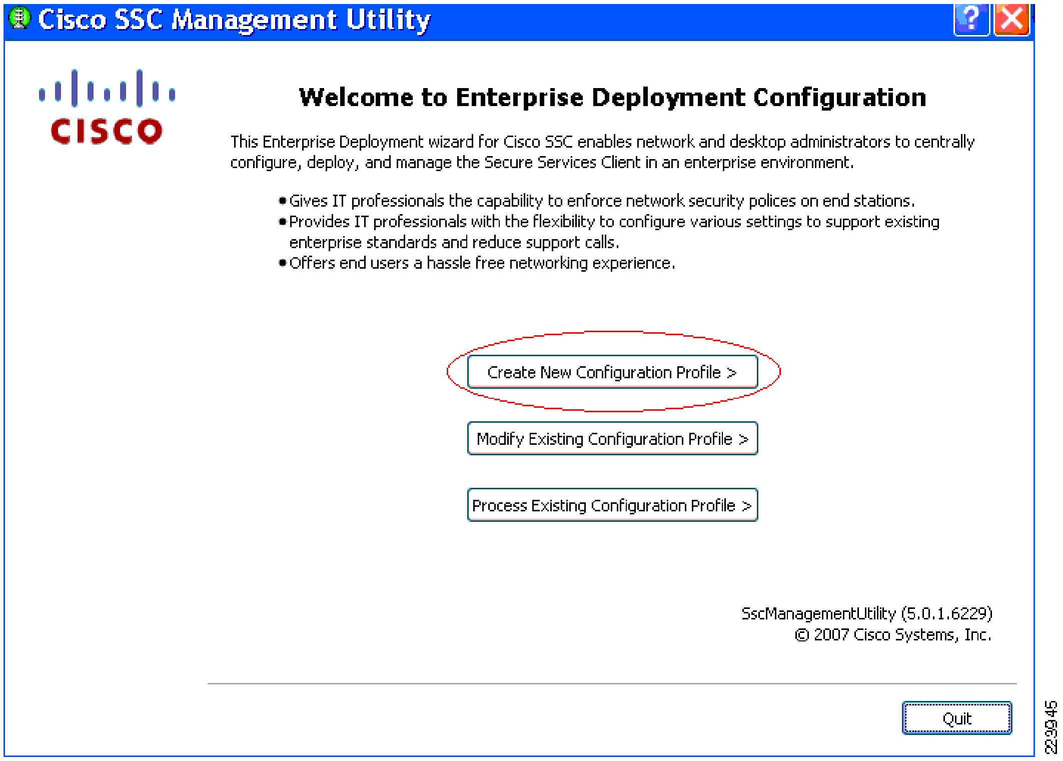
Note The CSSC Management Utility does not address client-side certificate management and distribution. Those tasks must be accomplished using Active Directory Group Policies or some other mechanism as described in previous sections. Client-side certificates are required for EAP-TLS.

This section discusses how to use the Management Utility to configure an EAP-TLS profile for the CSSC client. Once created, the user profiles can be bundled with the client image into an *.msi* file which can be deployed using standard deployment tools, including Microsoft Active Directory GPOs, SMS, Altiris, and Novell Zenworks.

Step 1 Create a New Configuration Profile.

1. Click **sscManagementUtility.exe** to access the welcome page. Select *Create New Configuration Profile*. See Figure 3-88.

Figure 3-88 Cisco SSC Management Utility Window



Cisco SSC Management Utility

Welcome to Enterprise Deployment Configuration

This Enterprise Deployment wizard for Cisco SSC enables network and desktop administrators to centrally configure, deploy, and manage the Secure Services Client in an enterprise environment.

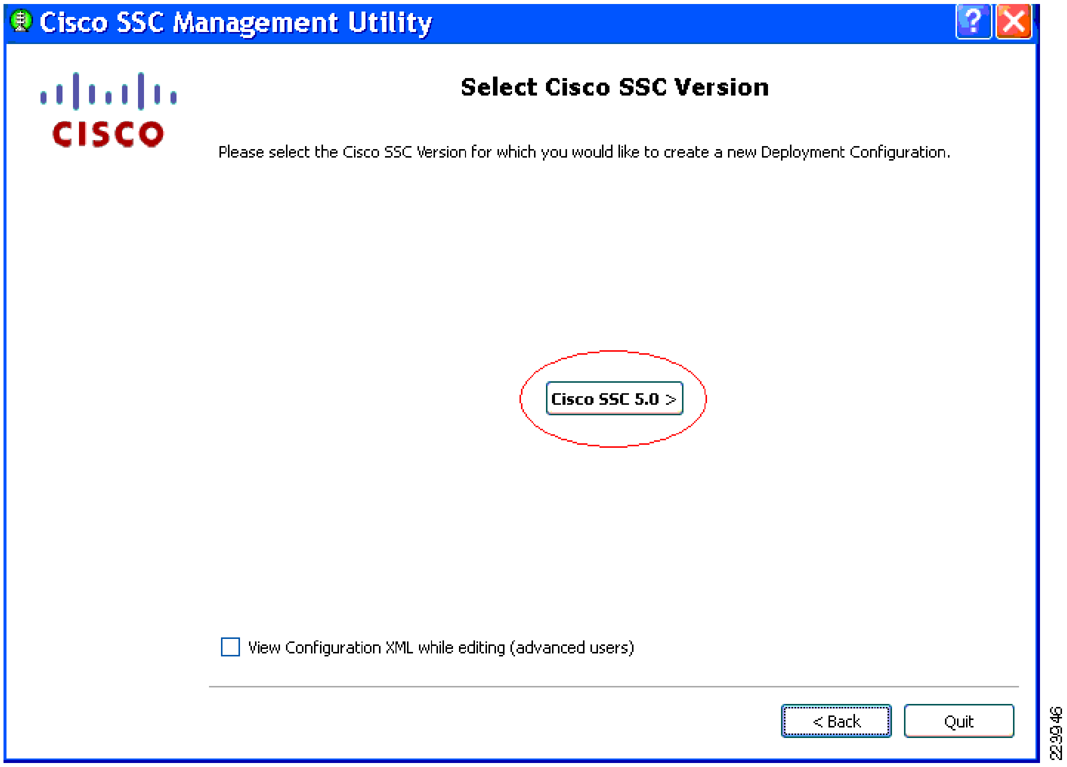
- Gives IT professionals the capability to enforce network security polices on end stations.
- Provides IT professionals with the flexibility to configure various settings to support existing enterprise standards and reduce support calls.
- Offers end users a hassle free networking experience.

SscManagementUtility (5.0.1.6229)
© 2007 Cisco Systems, Inc.

Create New Configuration Profile >
Modify Existing Configuration Profile >
Process Existing Configuration Profile >
Quit
229945

2. Select **Cisco SSC 5.0**. See Figure 3-89.

Figure 3-89 Select Cisco SSC Version Window



Cisco SSC Management Utility

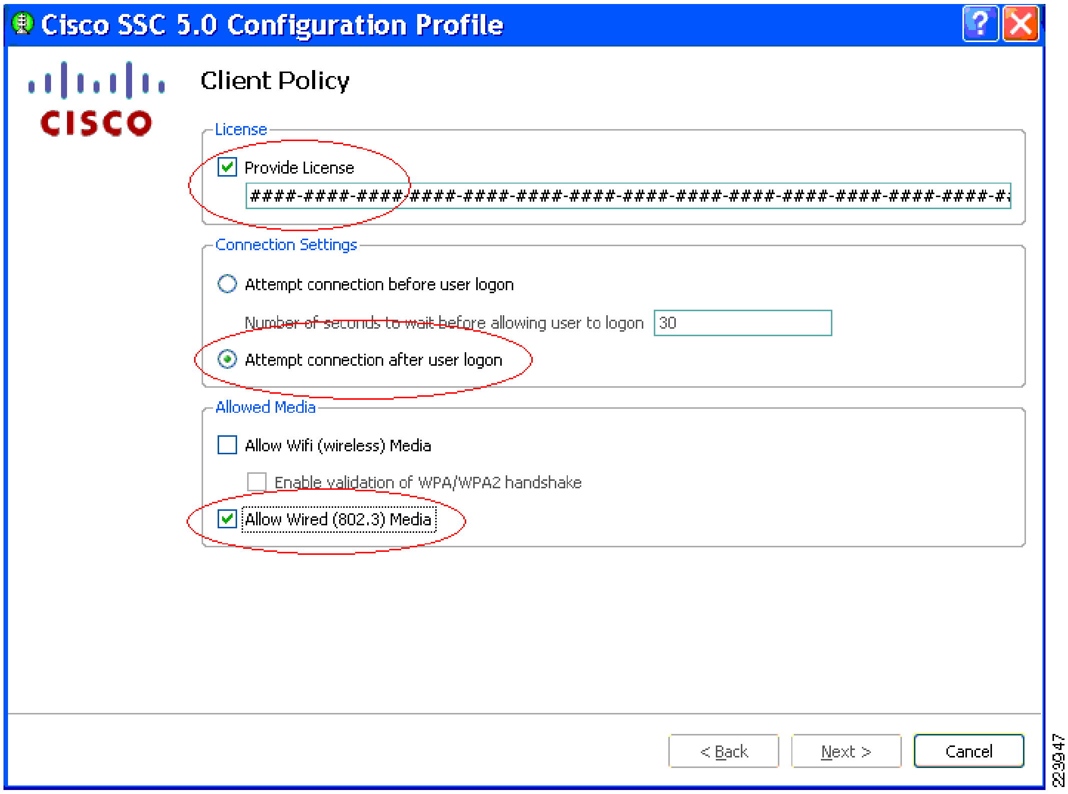
Select Cisco SSC Version

Please select the Cisco SSC Version for which you would like to create a new Deployment Configuration.

Step 2 Configure Client Policy.

In the *Client Policy* window, enter the license. Select *Attempt connection after user logon* and select *Allow Wired (802.3) Media*. See Figure 3-90.

Figure 3-90 Client Policy Window



Cisco SSC 5.0 Configuration Profile

Client Policy

License

☑ Provide License

####-####-####-####-####-####-####-####-####-####-####-####-####-####-#

Connection Settings

○ Attempt connection before user logon

Number of seconds to wait before allowing user to logon 30

● Attempt connection after user logon

Allowed Media

□ Allow Wifi (wireless) Media

□ Enable validation of WPA/WPA2 handshake

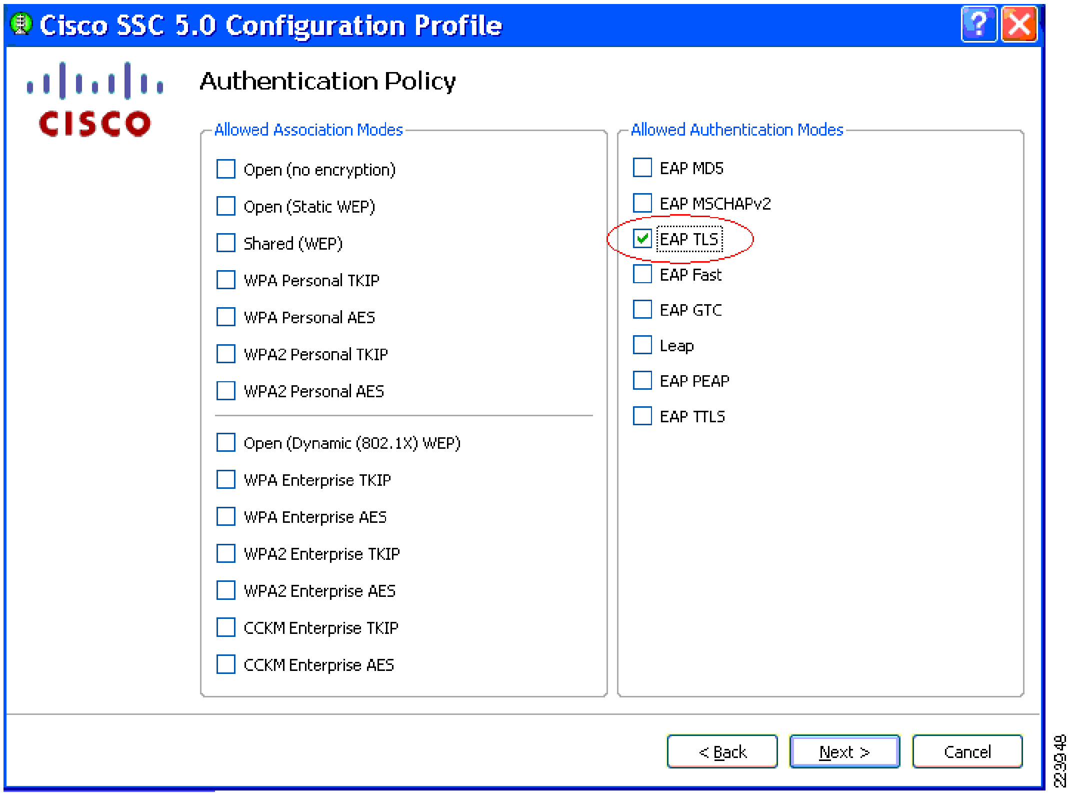
☑ Allow Wired (802.3) Media

Note The *Attempt connection after user logon* setting enables the user to login to Windows before CSSC initiates 802.1X user authentication. This setting is important because of the way user certificates are stored in Windows. In the Windows operation system, the user must login to Windows before the user certificate storage can be accessed. Since the user certificate is required for user authentication with EAP-TLS, the Windows login must occur first if SSC is to be able to present a valid credential during the 802.1X authentication. If the machine authenticated previously, the user will login to the Windows domain on the VLAN that was enabled (or assigned) as a result of machine authentication. If machine authentication was not enabled or was unsuccessful, the user will login to the local machine using cached credentials.

Step 3 Configure Authentication Policy.

In the *Authentication Policy* window, select *EAP TLS* under *Allowed Authentication Modes* and click **Next**. See Figure 3-91.

Figure 3-91 Authentication Policy Window



Cisco SSC 5.0 Configuration Profile

Authentication Policy

Allowed Association Modes

□ Open (no encryption)
□ Open (Static WEP)
□ Shared (WEP)
□ WPA Personal TKIP
□ WPA Personal AES
□ WPA2 Personal TKIP
□ WPA2 Personal AES

□ Open (Dynamic (802.1X) WEP)
□ WPA Enterprise TKIP
□ WPA Enterprise AES
□ WPA2 Enterprise TKIP
□ WPA2 Enterprise AES
□ CCKM Enterprise TKIP
□ CCKM Enterprise AES

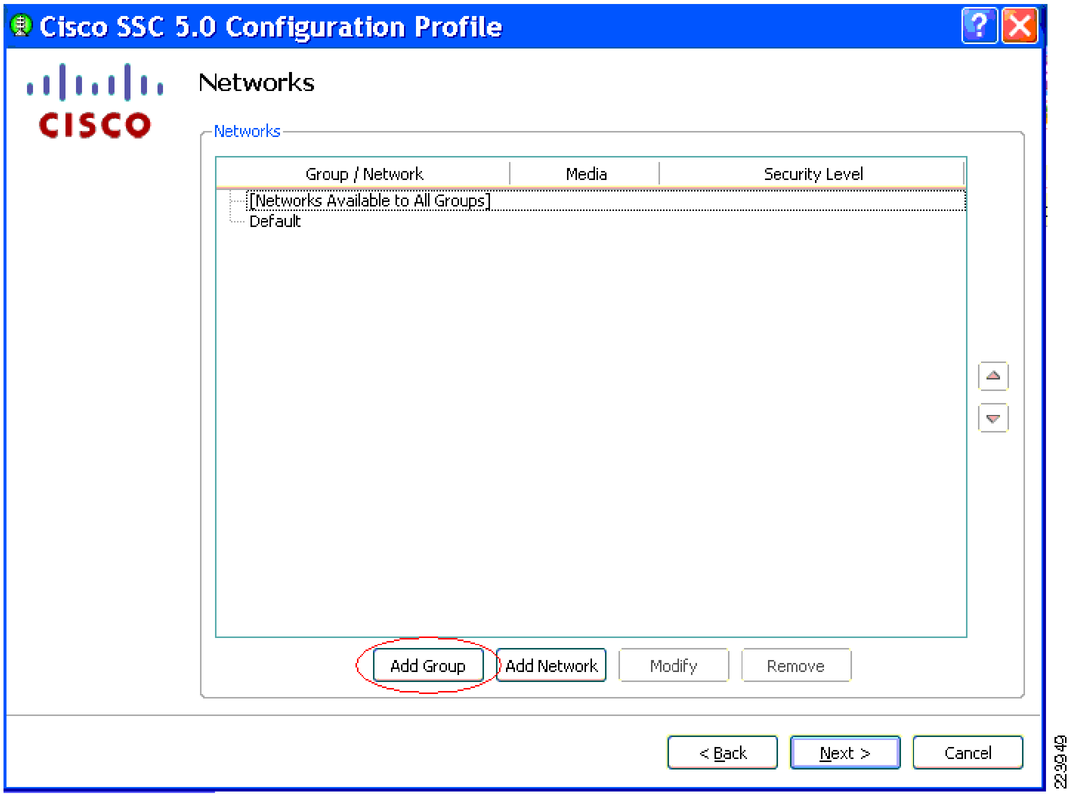
Allowed Authentication Modes

□ EAP MD5
□ EAP MSCHAPv2
☑ EAP TLS
□ EAP Fast
□ EAP GTC
□ Leap
□ EAP PEAP
□ EAP TTLS

Step 4 Create a New Group.

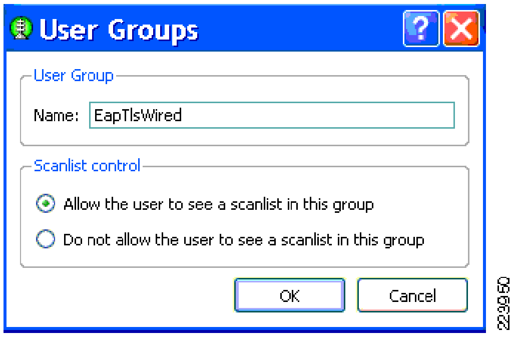
1. In the *Networks* window, create a new group by clicking **Add Group**. See Figure 3-92.

Figure 3-92 Networks Window



2. Enter a name for the new group and click **OK**. See Figure 3-93.

Figure 3-93 User Group Window



Name: EapTlsWired

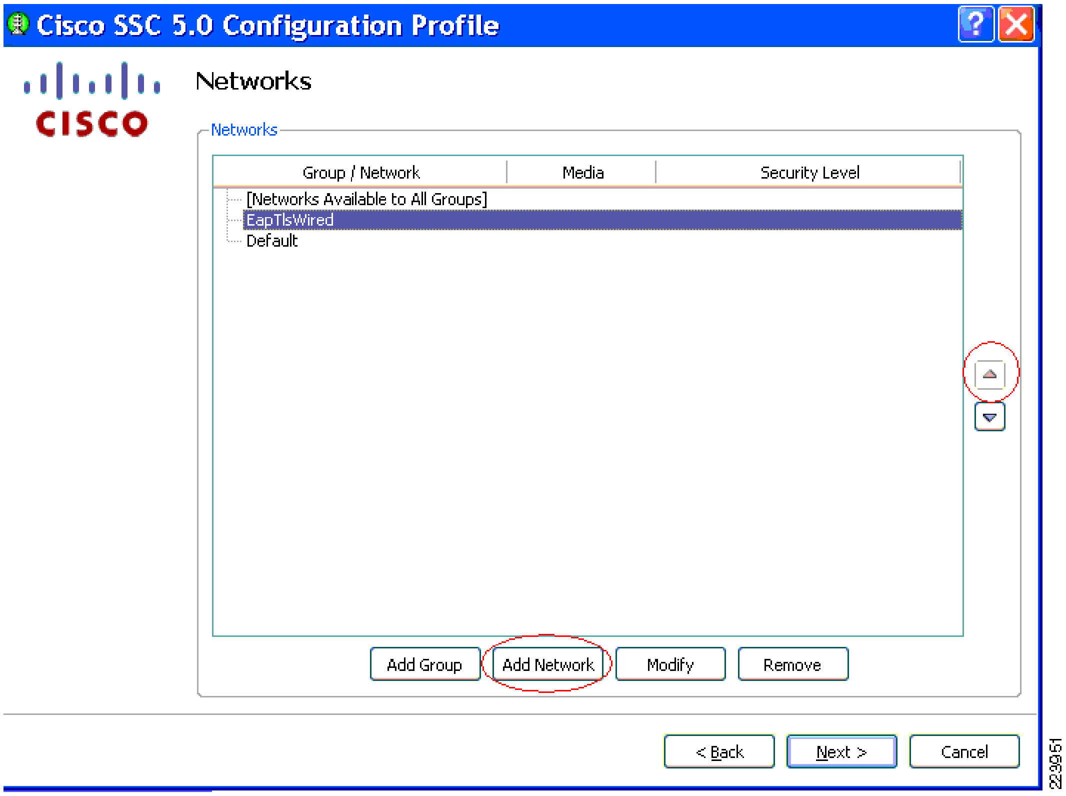
● Allow the user to see a scanlist in this group

○ Do not allow the user to see a scanlist in this group

Step 5 Add a Network to the Group.

1. In the main *Networks* screen, use the *Up* arrow button on the right side of the screen to move the group that was just created (*EapTlsWired*) above the *Default* group. Select *EapTlsWired* and click **Add Network**. See Figure 3-94.

Figure 3-94 Networks Window



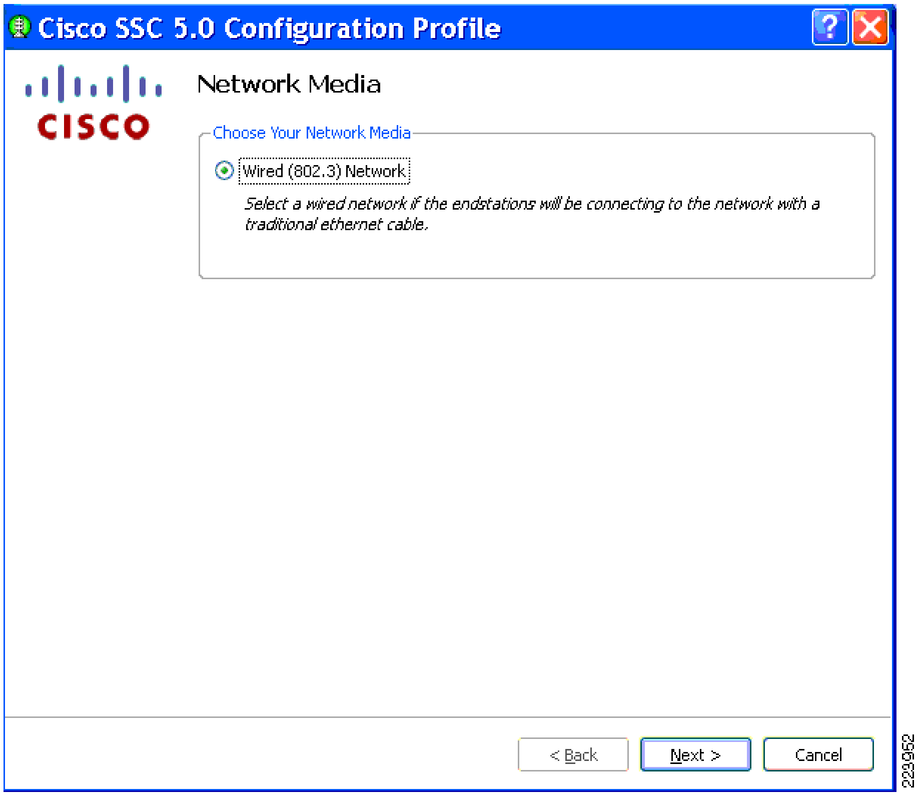
Networks

Networks

Group / Network	Media	Security Level
[Networks Available to All Groups]		
EapTlsWired		
Default		

2. In the *Network Media* window, select *Wired (802.3) Network* and click **Next**. See Figure 3-95.

Figure 3-95 Networks Media Window



Cisco SSC 5.0 Configuration Profile

Network Media

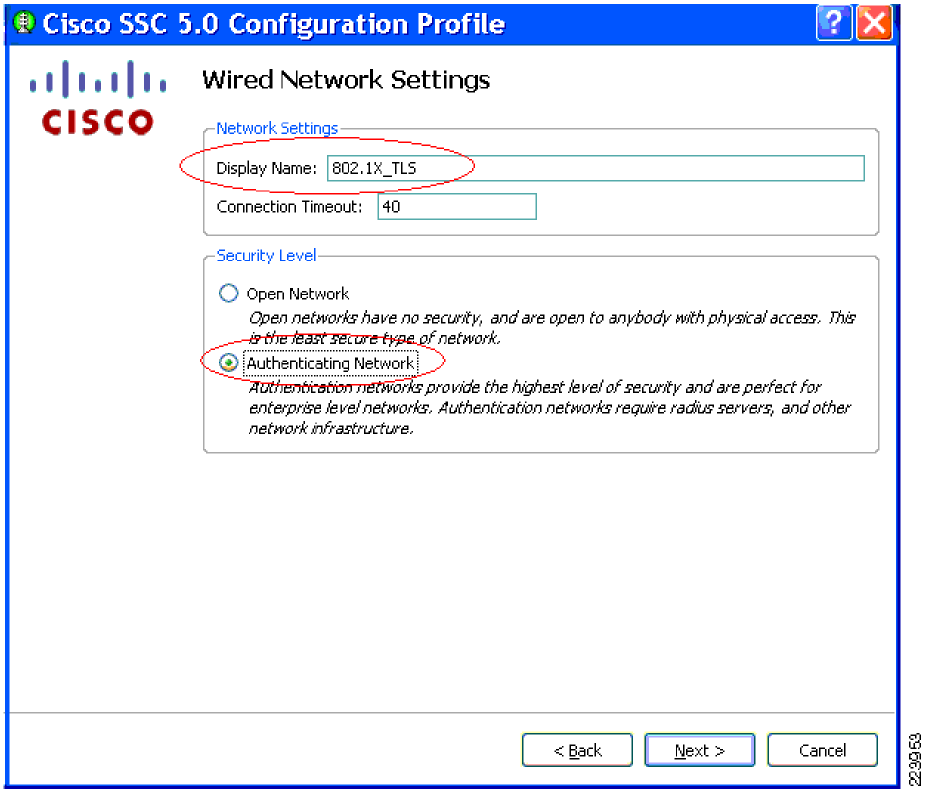
Choose Your Network Media

● Wired (802.3) Network

Select a wired network if the endstations will be connecting to the network with a traditional ethernet cable.

3. Provide a name for the profile and specify the *Authenticating Network* option. Leave the default *Connection Timeout* at 40 seconds. See Figure 3-96.

Figure 3-96 Wired Network Settings Window



Cisco SSC 5.0 Configuration Profile

Wired Network Settings

Network Settings

Display Name: 802.1X_TLS

Connection Timeout: 40

Security Level

○ Open Network

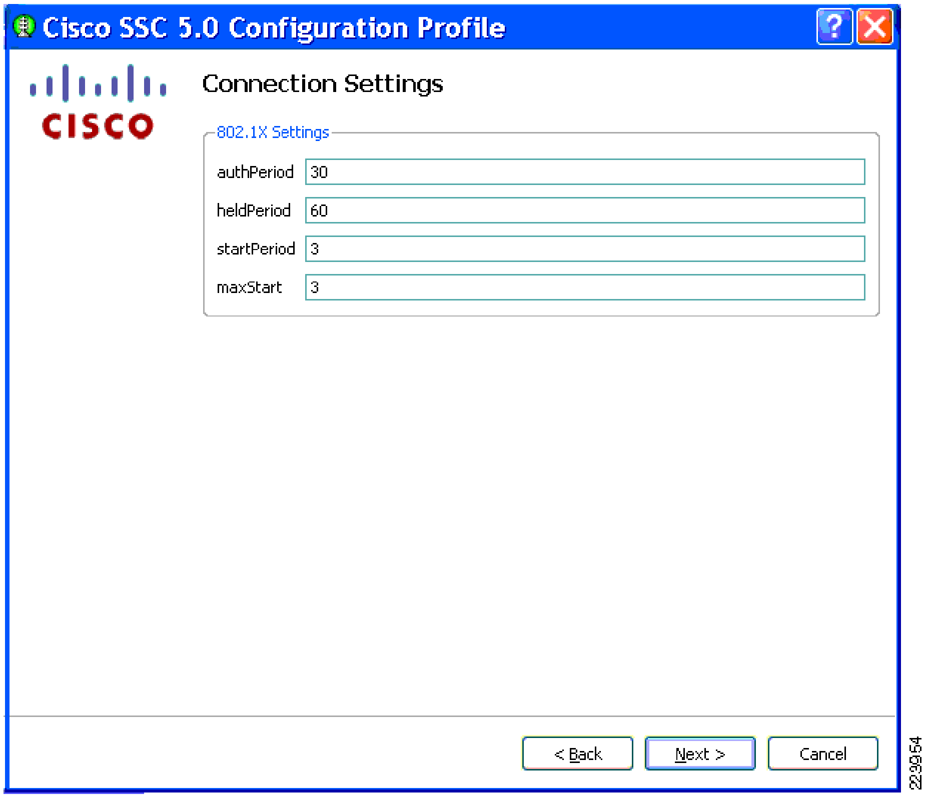
Open networks have no security, and are open to anybody with physical access. This is the least secure type of network.

● Authenticating Network

Authentication networks provide the highest level of security and are perfect for enterprise level networks. Authentication networks require radius servers, and other network infrastructure.

4. Leave the default *Connection Settings* and click **Next**. See Figure 3-97.

Figure 3-97 Connection Settings Window



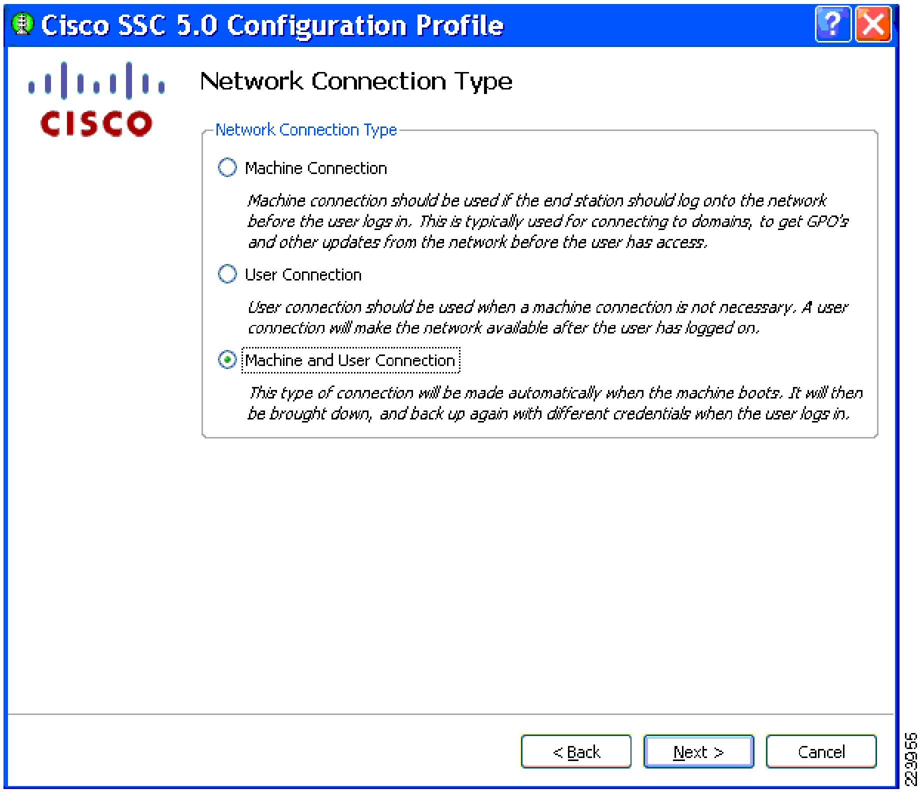
Connection Settings

802.1X Settings

authPeriod	30
heldPeriod	60
startPeriod	3
maxStart	3

5. Select the type of authentication scenario. To perform machine authentication and user authentication, select the *Machine and User Connection* radio button. Clicking **Next** will initiate *Machine Authentication* configuration. See Figure 3-98.

Figure 3-98 Network Connection Type Window



Cisco SSC 5.0 Configuration Profile

Network Connection Type

Network Connection Type

○ Machine Connection

Machine connection should be used if the end station should log onto the network before the user logs in. This is typically used for connecting to domains, to get GPO's and other updates from the network before the user has access.

○ User Connection

User connection should be used when a machine connection is not necessary. A user connection will make the network available after the user has logged on.

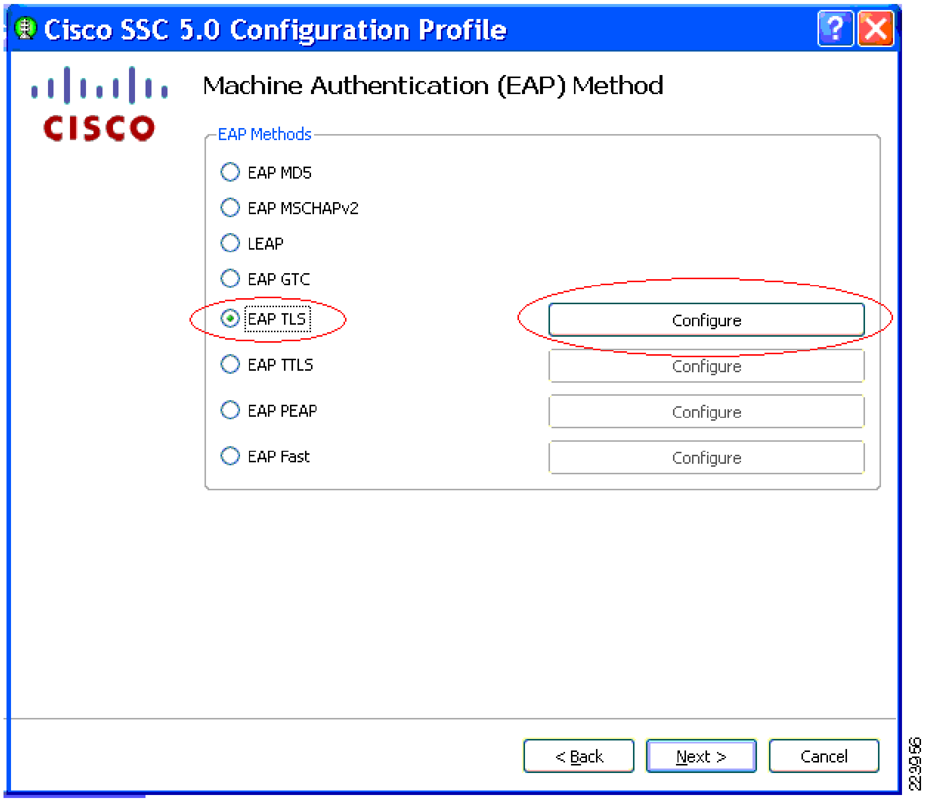
● Machine and User Connection

This type of connection will be made automatically when the machine boots. It will then be brought down, and back up again with different credentials when the user logs in.

Step 6 Configure Machine Authentication Parameters.

1. In the *Machine Authentication* window, select *EAP-TLS* and click the **Configure** button. See Figure 3-99.

Figure 3-99 Machine Authentication Window



Cisco SSC 5.0 Configuration Profile

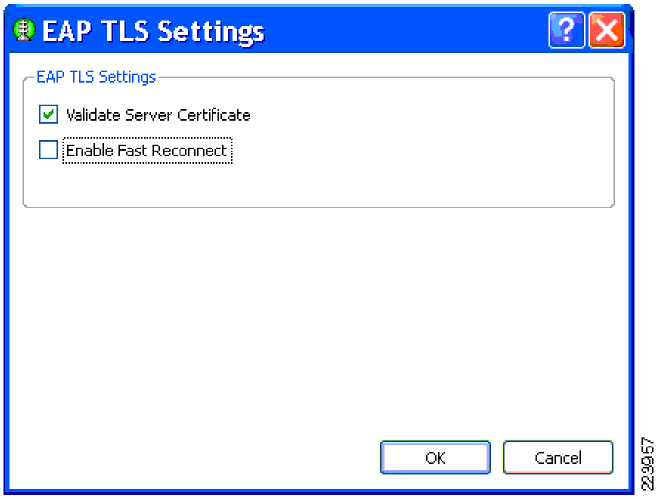
Machine Authentication (EAP) Method

EAP Methods

- ○ EAP MD5
- ○ EAP MSCHAPv2
- ○ LEAP
- ○ EAP GTC
- ● EAP TLS — Configure
- ○ EAP TTLS — Configure
- ○ EAP PEAP — Configure
- ○ EAP Fast — Configure

2. In the *EAP-TLS Settings* window, select *Validate Server Certificate*. Deselect *Enable Fast Reconnect* because this feature is not required for wired scenarios. Fast Reconnect is the equivalent of session resume in Cisco Secure ACS. Click **Ok**. See Figure 3-100.

Figure 3-100 EAP TLS Settings Window



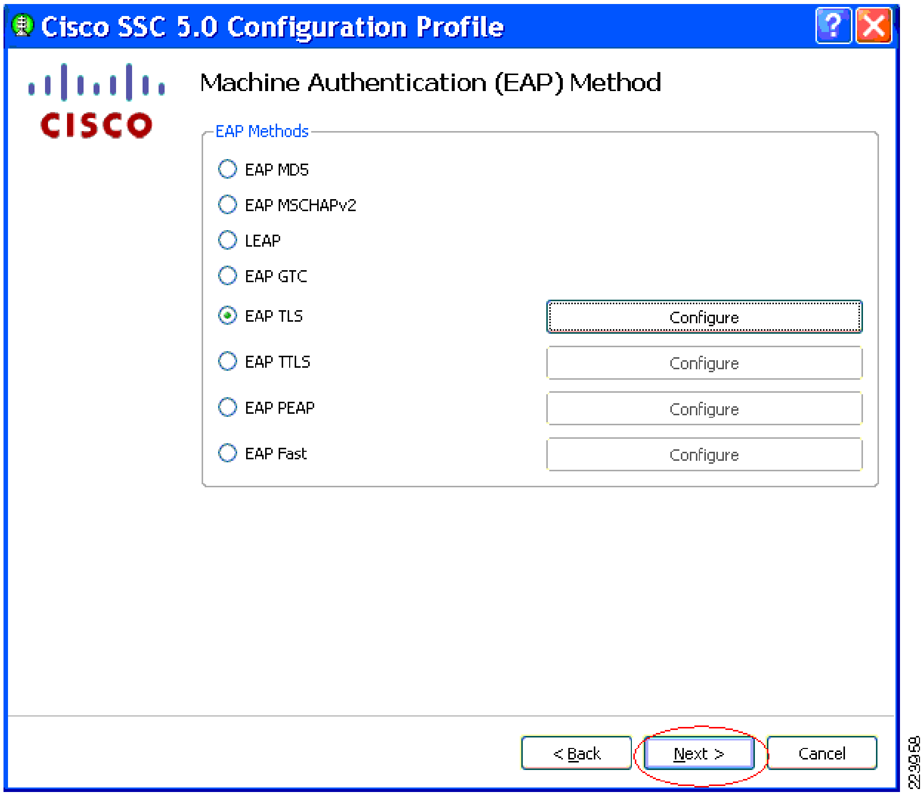
EAP TLS Settings

EAP TLS Settings

- ☑ Validate Server Certificate
- □ Enable Fast Reconnect

3. The configuration utility returns to the *Machine Authentication* screen. Click **Next**. See Figure 3-101.

Figure 3-101 Machine Authentication Window



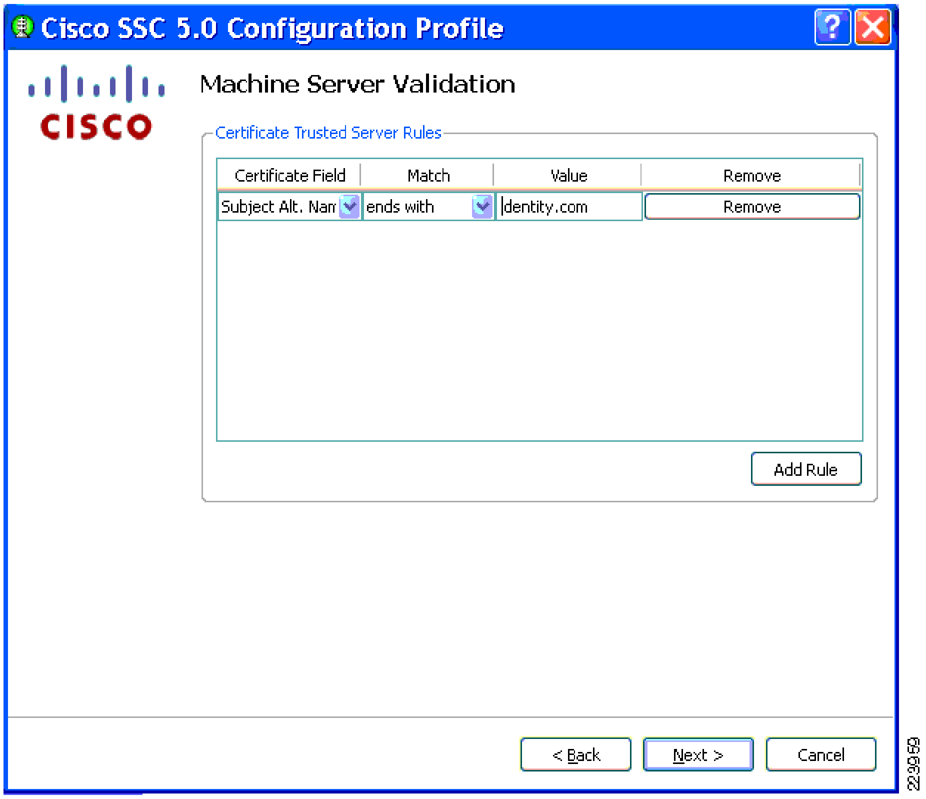
Machine Authentication (EAP) Method

EAP Methods

○ EAP MD5
○ EAP MSCHAPv2
○ LEAP
○ EAP GTC
● EAP TLS
○ EAP TTLS
○ EAP PEAP
○ EAP Fast

4. [Optional] See Figure 3-102. *The Machine Server Validation* window can be used to restrict the ACS servers from which the client will accept a certificate authentication during machine authentication. If no *Rule* is added in this window, the client will accept any server certificate that has been signed by a trusted root CA.

Figure 3-102 Machine Server Validation Window



Cisco SSC 5.0 Configuration Profile

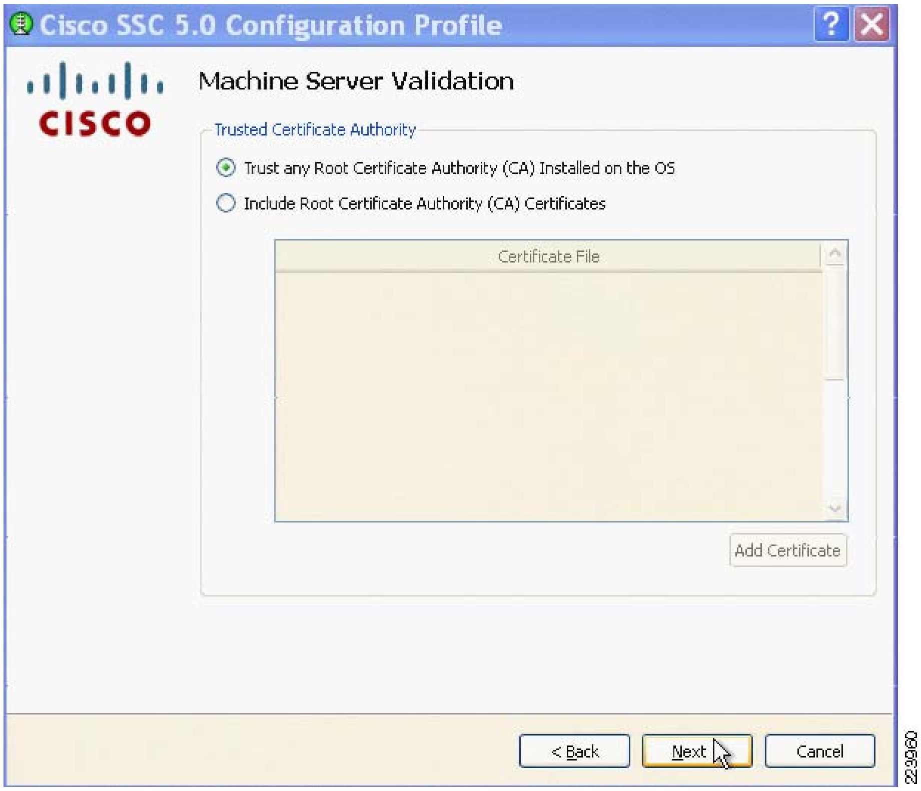
Machine Server Validation

Certificate Trusted Server Rules

Certificate Field	Match	Value	Remove
Subject Alt. Nan	ends with	ldentity.com	Remove

5. [Optional] If desired, use this window to restrict which root CAs the client will trust to sign the ACS server certificate. Click **Next** to accept the default setting. See Figure 3-103.

Figure 3-103 Machine Server Validation Window (Trusted Certificate Authority)



Cisco SSC 5.0 Configuration Profile

Machine Server Validation

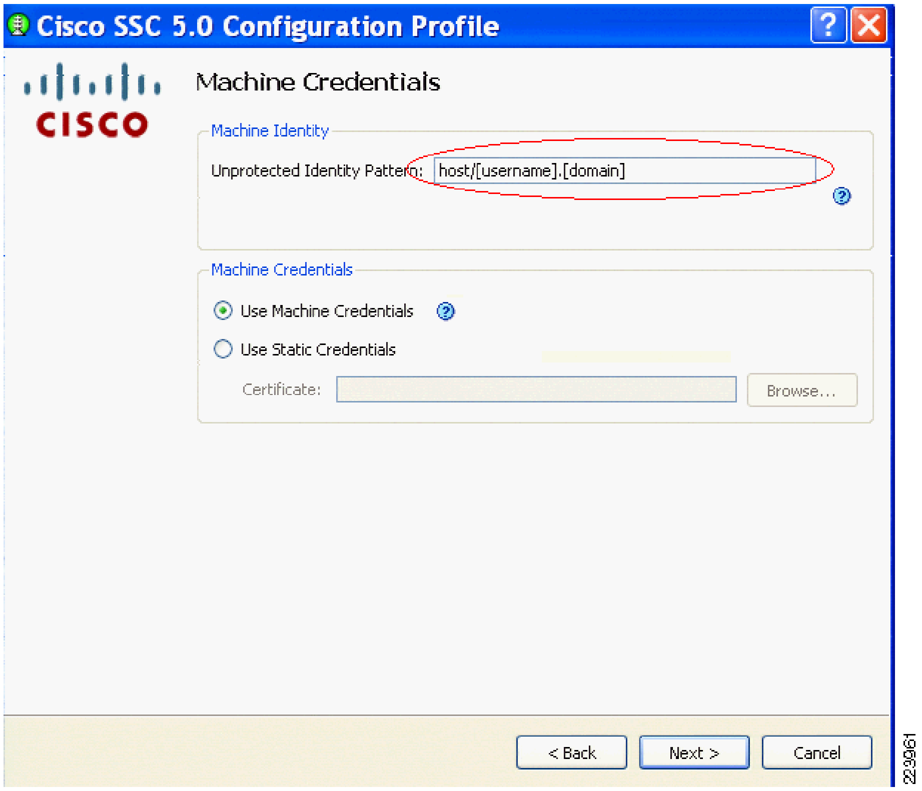
Trusted Certificate Authority

● Trust any Root Certificate Authority (CA) Installed on the OS

○ Include Root Certificate Authority (CA) Certificates

6. In the *Machine Credentials* window, add .[*domain*] to the *Unprotected Identity Pattern*. The Unprotected Identity Pattern refers to the identity that will be sent in the Identity field in the EAP messages. The client will replace [*username*] with the machine name and [*domain*] with the complete domain name. The *Machine Credentials* option instructs the client to use the machine certificate provided by Microsoft Active Directory. See Figure 3-104.

Figure 3-104 Machine Credentials Window



Unprotected Identity Pattern: host/[username].[domain]

● Use Machine Credentials

○ Use Static Credentials

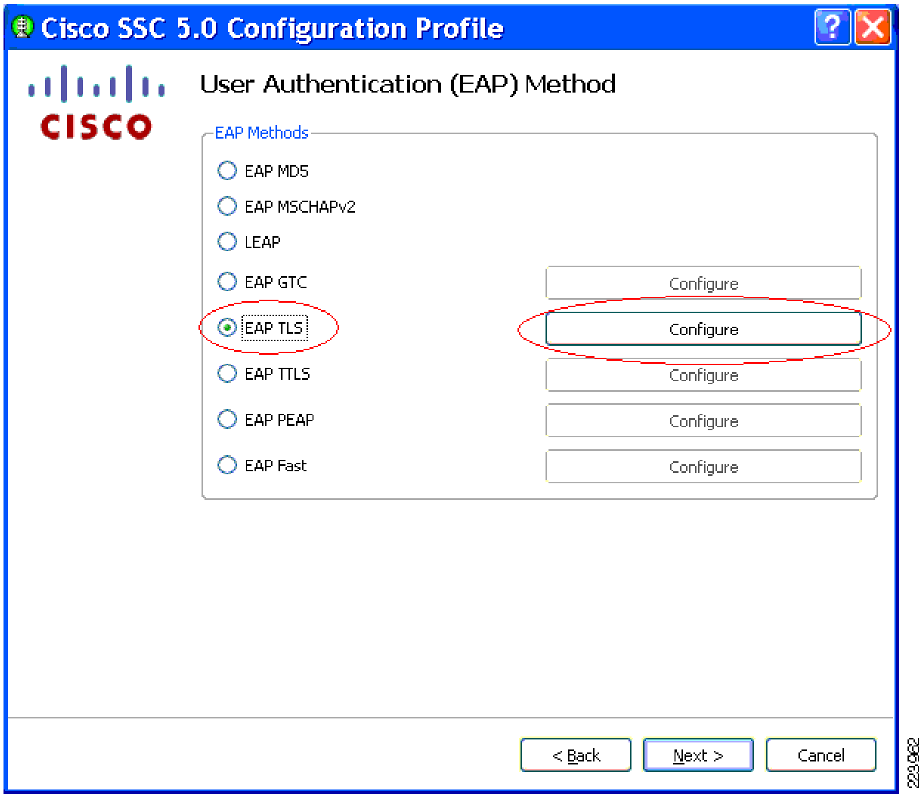
Certificate:

7. Click **Next** to begin configuring User Authentication.

Step 7 Configure User Authentication.

1. In the *User Authentication Method* window, select *EAP-TLS* and click **Configure**. See Figure 3-105.

Figure 3-105 User Authentication (EAP) Method Window



Cisco SSC 5.0 Configuration Profile

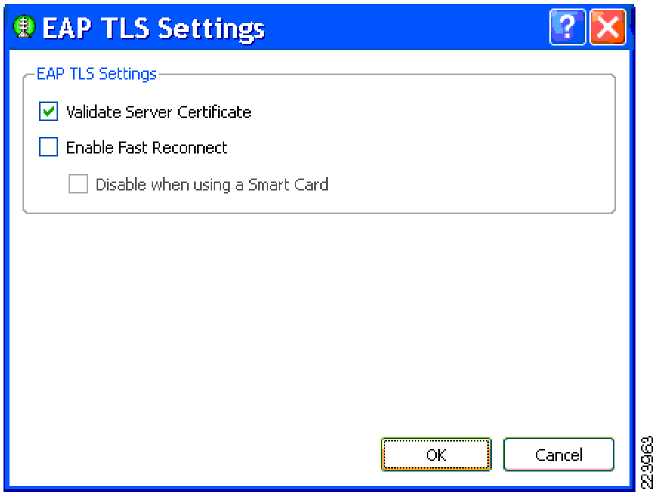
User Authentication (EAP) Method

EAP Methods

○ EAP MD5
○ EAP MSCHAPv2
○ LEAP
○ EAP GTC
● EAP TLS
○ EAP TTLS
○ EAP PEAP
○ EAP Fast

2. Check *Validate Server Certificate* and disable *Fast Reconnect*. Return to the main *User Authentication* window by clicking **OK**. See Figure 3-106.

Figure 3-106 EAP TLS Settings Window



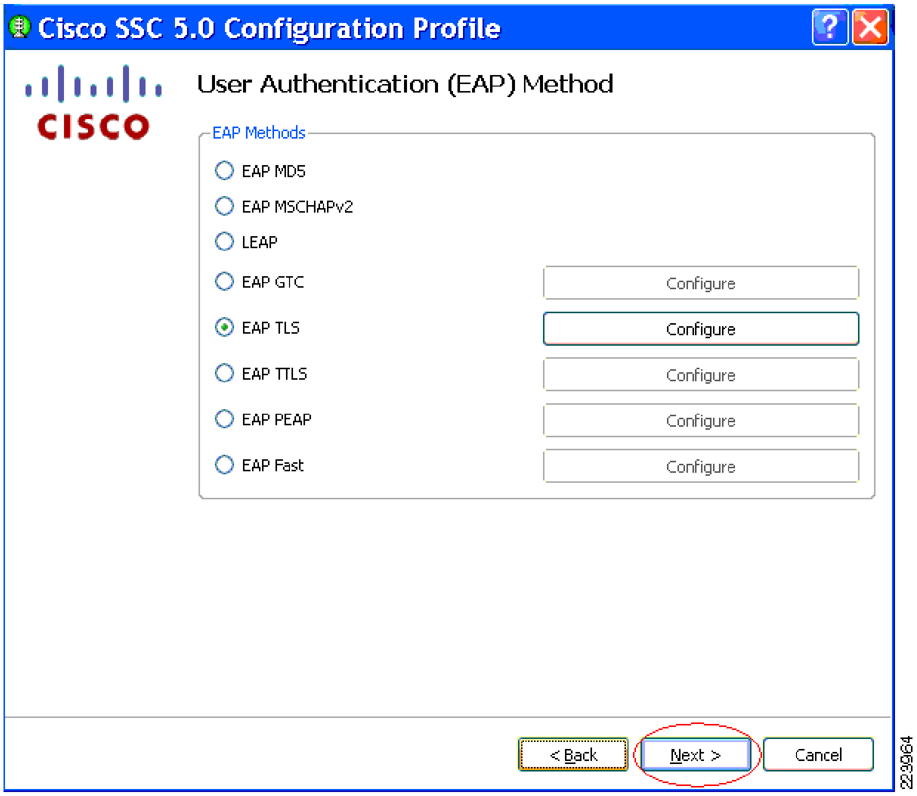
EAP TLS Settings

EAP TLS Settings

☑ Validate Server Certificate
□ Enable Fast Reconnect
□ Disable when using a Smart Card

3. In the main *User Authentication Method* window, click **Next**. See Figure 3-107.

Figure 3-107 User Authentication (EAP) Method Window



Cisco SSC 5.0 Configuration Profile

User Authentication (EAP) Method

EAP Methods

○ EAP MD5

○ EAP MSCHAPv2

○ LEAP

○ EAP GTC Configure

● EAP TLS Configure

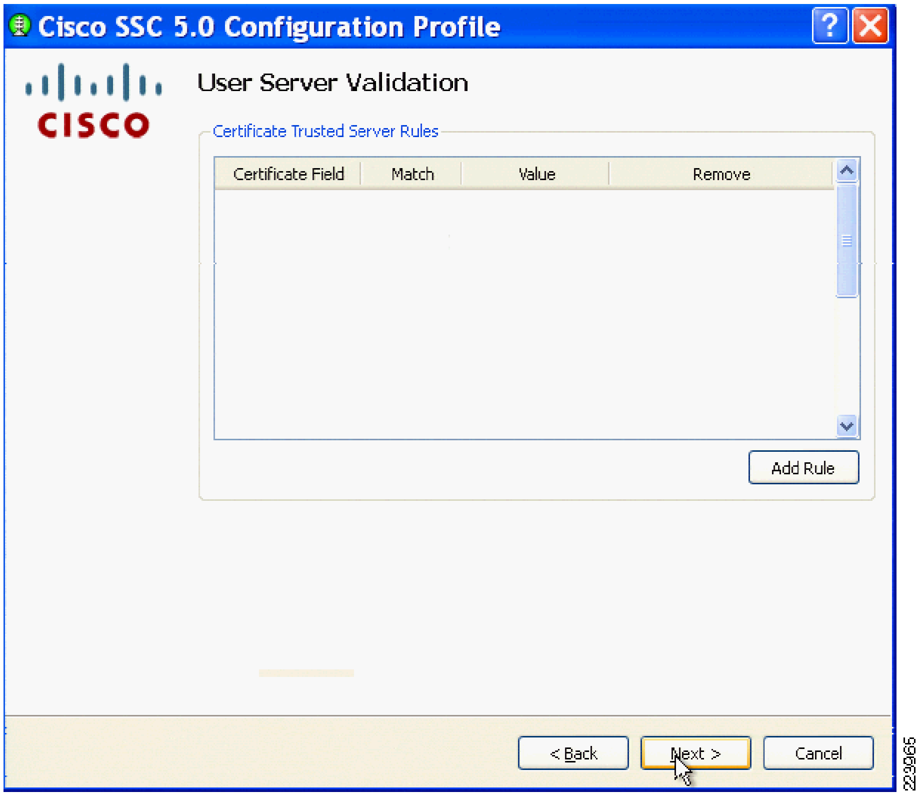
○ EAP TTLS Configure

○ EAP PEAP Configure

○ EAP Fast Configure

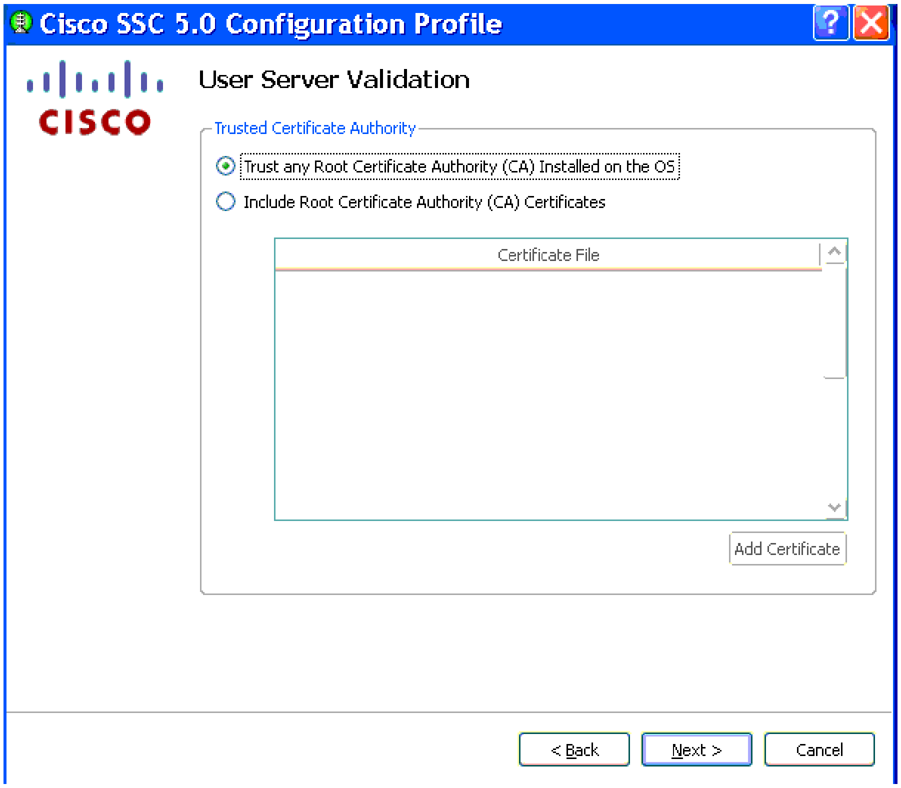
4. [Optional] The *User Server Validation* window can be used to restrict the ACS servers from which the client will accept a certificate authentication during user authentication. If no *Rule* is added in this window, the client will accept any server certificate that has been signed by a trusted root CA. See Figure 3-108.

Figure 3-108 User Server Validation Window



5. [Optional] If desired, use this window to restrict which root CAs the client will trust to sign the ACS server certificate during user authentication. Click **Next** to accept the default setting. See Figure 3-109.

Figure 3-109 User Validation Window (Trusted Certificate Authority)



Cisco SSC 5.0 Configuration Profile

User Server Validation

Trusted Certificate Authority

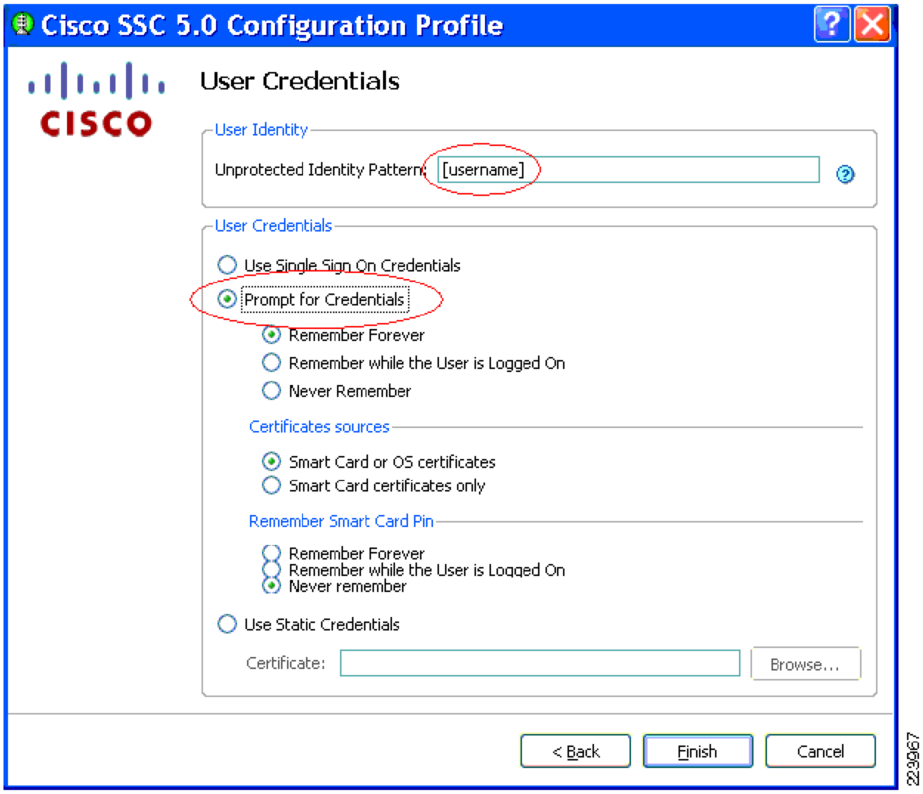
● Trust any Root Certificate Authority (CA) Installed on the OS

○ Include Root Certificate Authority (CA) Certificates

Certificate File

6. In the *User Credentials* window, leave [*username*] as the unprotected identity. CSSC will substitute the username from the certificate during user authentication. Select *Prompt for Credentials* and click **Finish**. The Validation window will appear. See Figure 3-110.

Figure 3-110 User Credential Window



User Credentials

User Identity

Unprotected Identity Pattern: [username]

User Credentials

○ Use Single Sign On Credentials

● Prompt for Credentials

● Remember Forever

○ Remember while the User is Logged On

○ Never Remember

Certificates sources

● Smart Card or OS certificates

○ Smart Card certificates only

Remember Smart Card Pin

○ Remember Forever

○ Remember while the User is Logged On

● Never remember

○ Use Static Credentials

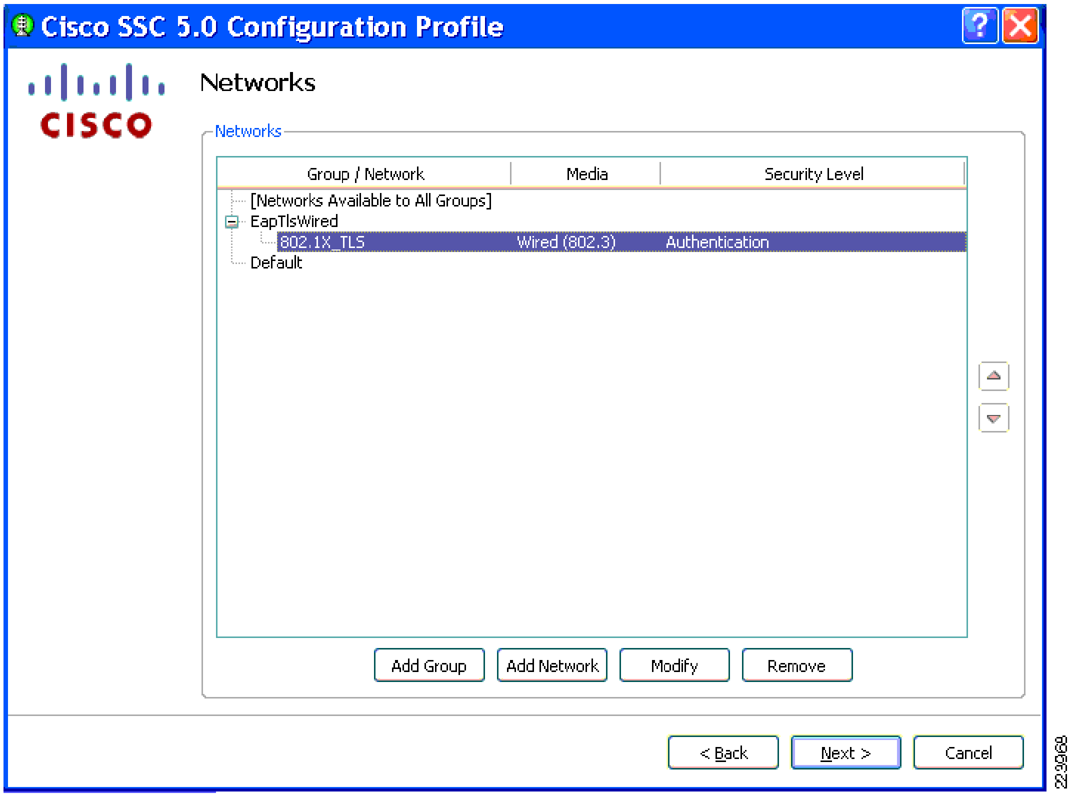
Certificate:

Note Do not select *Single Sign On Credentials* when using EAP-TLS with OS certificates. Single Sign-On can only be used with Smartcard credentials.

Step 8 Validate Configuration.

1. Verify that the group (*EapTlsWired*) has been successfully created with the configured profile (*802.1X_TLS*). Click **Next**. See Figure 3-111.

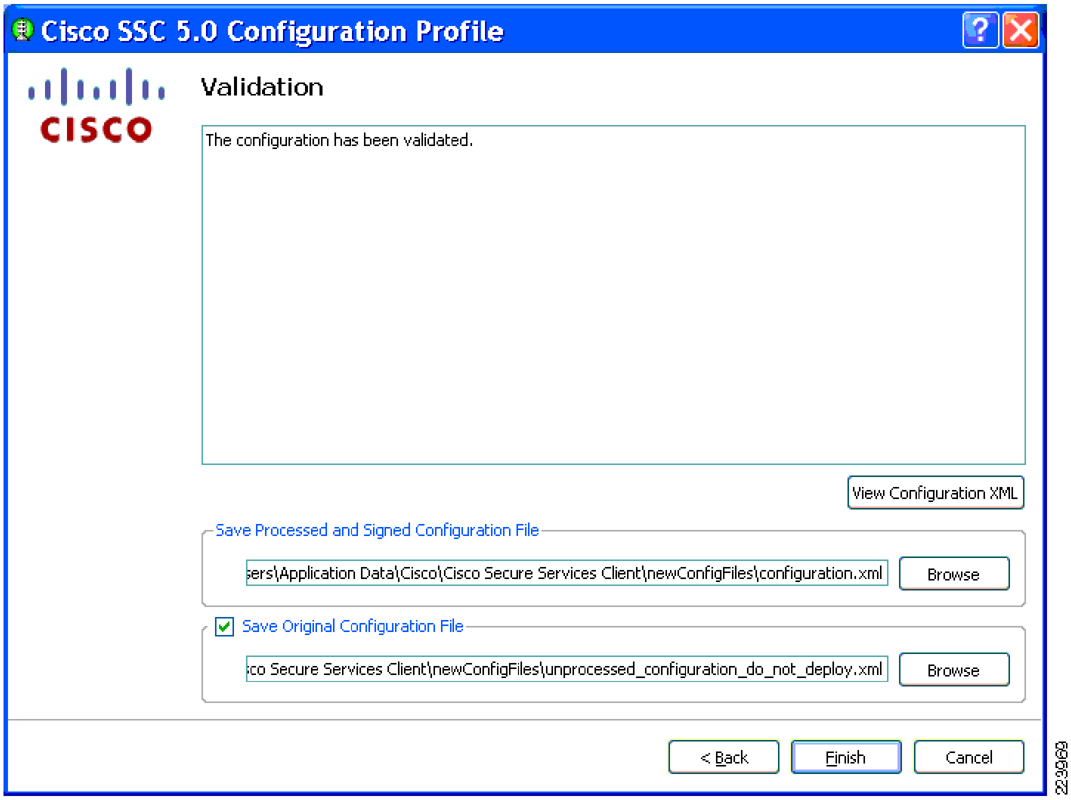
Figure 3-111 Verifying Group Creation in Networks Window



Group / Network	Media	Security Level
[Networks Available to All Groups]		
EapTlsWired		
802.1X_TLS	Wired (802.3)	Authentication
Default		

2. In the *Validation* window, click **Finish** to save the configuration files. The Processed Configuration file *configuration.xml* can be deployed to the client (this will happen automatically if the Management Utility is running on the same machine as the client software). The Unprocessed Configuration file *unprocessed_configuration_do_not_deploy.xml* should only be used to modify this profile as described in the following step. See Figure 3-112.

Figure 3-112 Validation Window



The configuration has been validated.

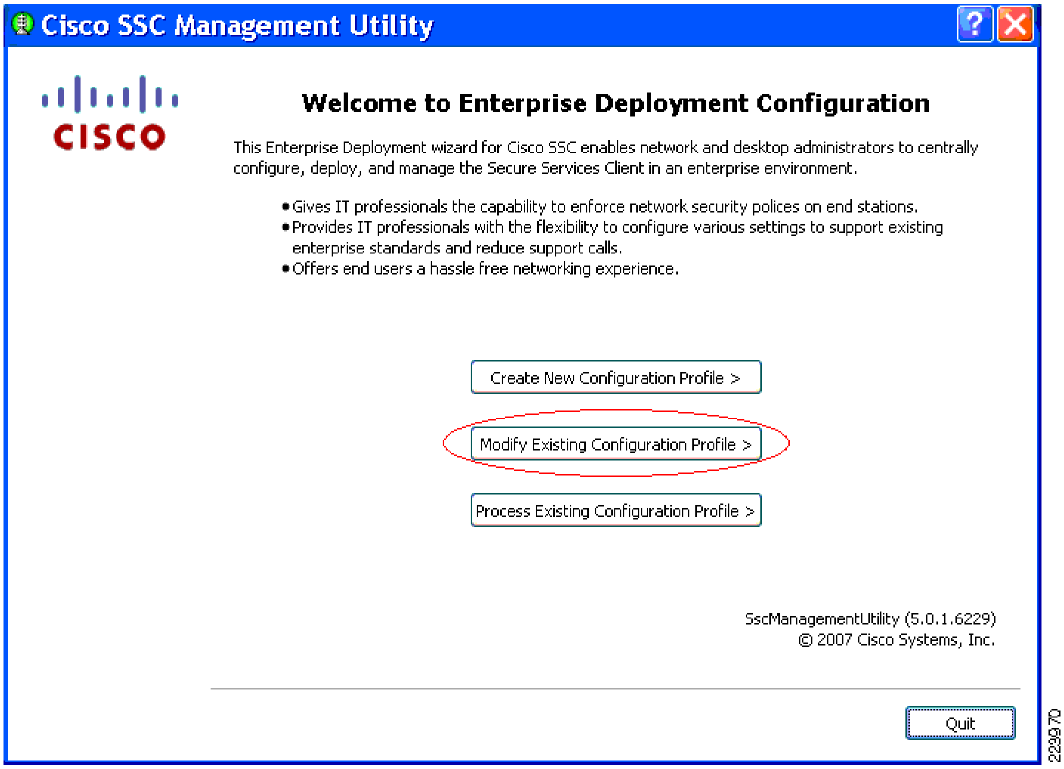
Save Processed and Signed Configuration File: sers\Application Data\Cisco\Cisco Secure Services Client\newConfigFiles\configuration.xml

☑ Save Original Configuration File: co Secure Services Client\newConfigFiles\unprocessed_configuration_do_not_deploy.xml

Step 9 Modify Configuration.

1. To modify the configuration that was just created, return to the main screen of the *Management Utility* and click **Modify Existing Configuration Profile**. See Figure 3-113.

Figure 3-113 Cisco SSC Management Utility Window



Cisco SSC Management Utility

Welcome to Enterprise Deployment Configuration

This Enterprise Deployment wizard for Cisco SSC enables network and desktop administrators to centrally configure, deploy, and manage the Secure Services Client in an enterprise environment.

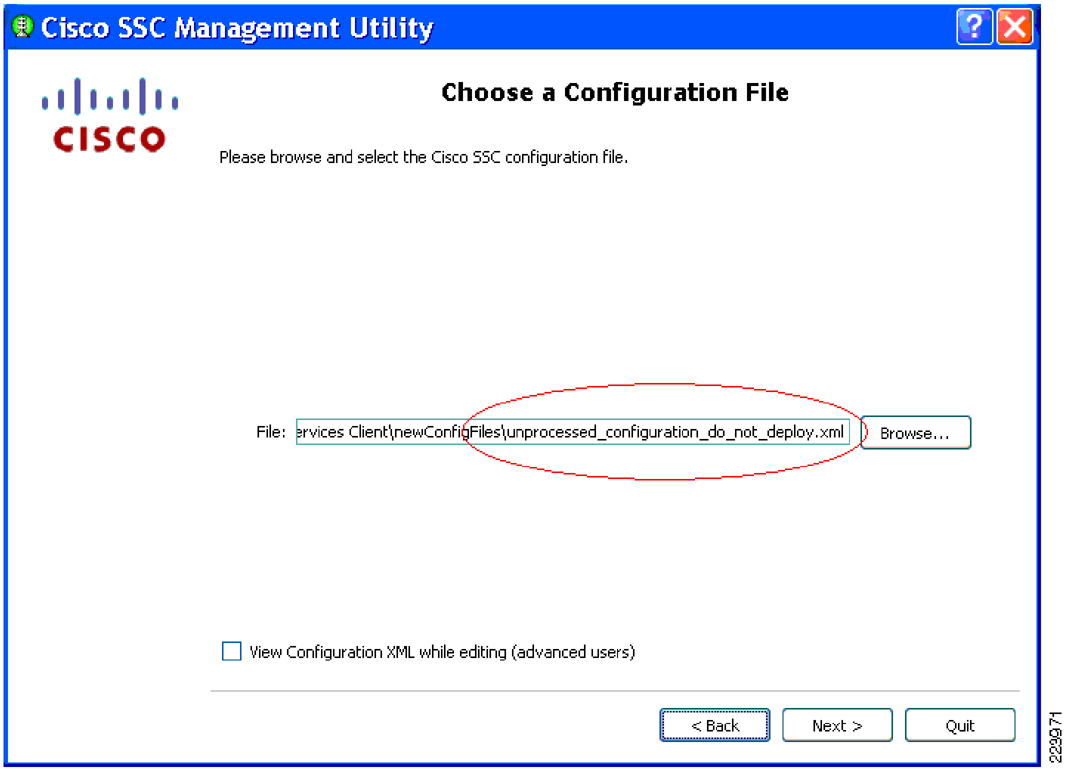
- Gives IT professionals the capability to enforce network security polices on end stations.
- Provides IT professionals with the flexibility to configure various settings to support existing enterprise standards and reduce support calls.
- Offers end users a hassle free networking experience.

SscManagementUtility (5.0.1.6229)
© 2007 Cisco Systems, Inc.

CISCO
Create New Configuration Profile >
Modify Existing Configuration Profile >
Process Existing Configuration Profile >
Quit
222970

2. Select the unprocessed configuration file created earlier. Click **Next**. See Figure 3-114.

Figure 3-114 Choosing a Configuration File Window



Choose a Configuration File

Please browse and select the Cisco SSC configuration file.

File: ervices Client\newConfigFiles\unprocessed_configuration_do_not_deploy.xml

□ View Configuration XML while editing (advanced users)

3. The *Client Policy* window appears with the previously configured settings. Step through the configuration and make any modifications. At the end of the profile validation, a new *configuration.xml* file will be created and can be deployed to the client.

Windows XP Client Configuration

The steps provided in this section explain how to configure the Windows XP native supplicant for EAP-TLS authentication on wired LAN networks.

Note The native client is running on Windows XP Service Pack 2.

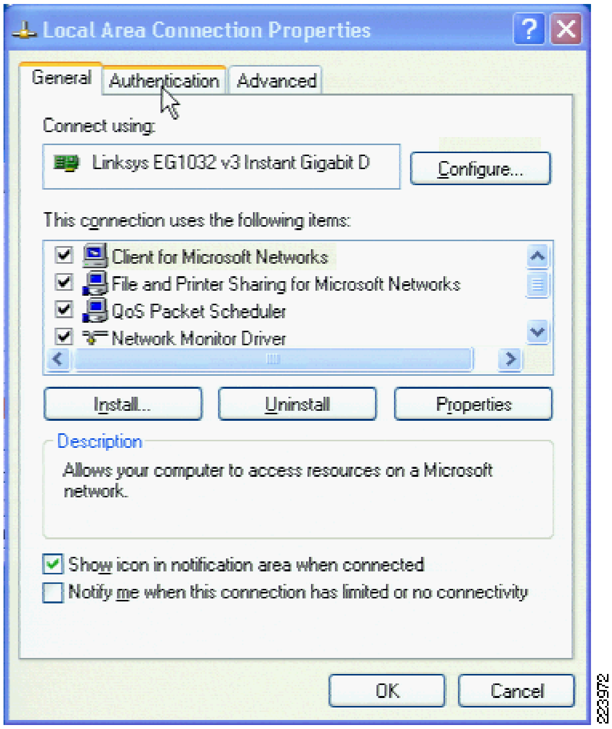
Prior to configuring the Windows XP supplicant, validate that the correct certificates exist in the Windows certificate stores as described in "Client Configuration for EAP-TLS" section on page 3-56.

Configure IEEE 802.1X Parameters

Step 1 To configure the IEEE 802.1X parameters, click **Start** > **Control Panel**, and the select **Network and Internet Connections**. Next, select **Network Connections**, then open the correct *Local Area Connection Properties* menu.

Step 2 From the *Local Area Connection Properties* window, select the *Authentication* tab. See Figure 3-115.

Figure 3-115 Select Authentication Tab



Connect using:

Linksys EG1032 v3 Instant Gigabit D

This connection uses the following items:

- ☑ Client for Microsoft Networks
- ☑ File and Printer Sharing for Microsoft Networks
- ☑ QoS Packet Scheduler
- ☑ Network Monitor Driver

Description

Allows your computer to access resources on a Microsoft network.

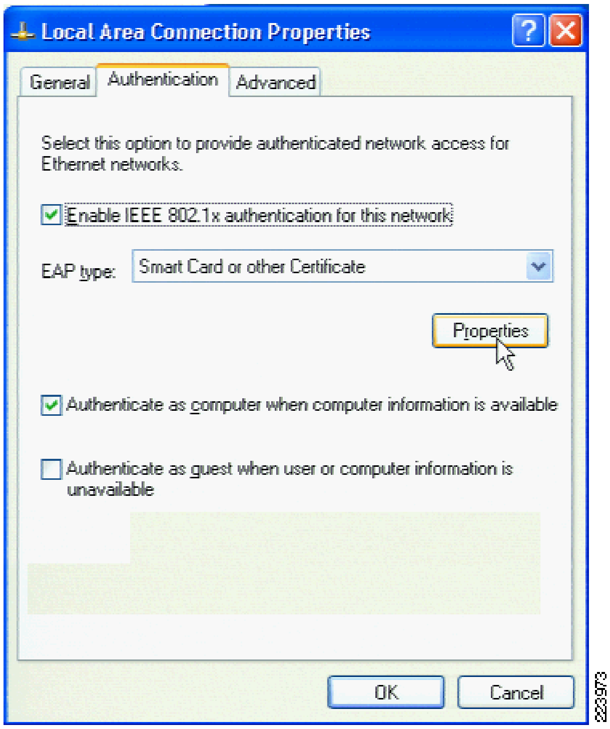
☑ Show icon in notification area when connected

☐ Notify me when this connection has limited or no connectivity

Note If the Authentication tab is not displayed, click **Start** > **All Programs** > **Administrative Tools** > **Services**. Right-click **Wireless Zero Configuration** and select **Start**.

Step 3 Check the *Enable IEEE 802.1X authentication for this network* box. Select *Smart Card or Other Certificate* from the drop-down menu for the EAP type. See Figure 3-116.

Figure 3-116 Enable 802.1X Authentication



Local Area Connection Properties

Select this option to provide authenticated network access for Ethernet networks.

☑ Enable IEEE 802.1x authentication for this network

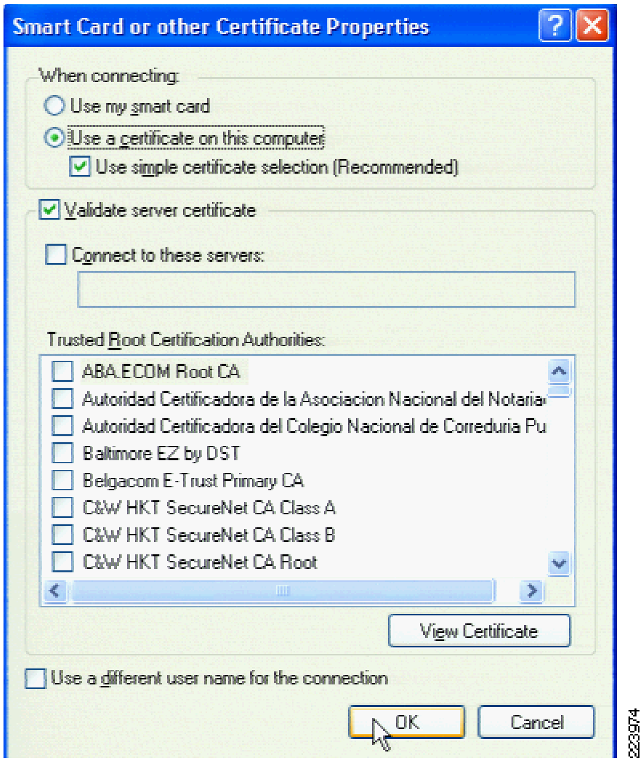
EAP type: Smart Card or other Certificate

☑ Authenticate as computer when computer information is available

□ Authenticate as guest when user or computer information is unavailable

Step 4 Click **Properties**. The *Certificate Properties* window appears. See Figure 3-117.

Figure 3-117 Certificate Properties



Smart Card or other Certificate Properties

When connecting:

○ Use my smart card

● Use a certificate on this computer

☑ Use simple certificate selection (Recommended)

☑ Validate server certificate

□ Connect to these servers:

Trusted Root Certification Authorities:

□ ABA.ECOM Root CA
□ Autoridad Certificadora de la Asociacion Nacional del Notaria
□ Autoridad Certificadora del Colegio Nacional de Correduria Pu
□ Baltimore EZ by DST
□ Belgacom E-Trust Primary CA
□ C&W HKT SecureNet CA Class A
□ C&W HKT SecureNet CA Class B
□ C&W HKT SecureNet CA Root

□ Use a different user name for the connection

Step 5 The top box on the *Certificate Properties* window refers to client-side certificates. Select *Use a certificate on the computer* and check *Use simple certificate selection*.

Note During EAP-TLS authentication, the user might be prompted to choose a certificate if multiple personal certificates have been issued to that user and are present in the local certificate storage. When simple certificate selection is enabled, Windows presents a simplified list of certificates when prompting the user. The certificates that are usable for EAP-TLS authentication are grouped by the user that was issued the certificate based on the Subject Alternative Name and Subject fields of the certificates. When *Use a certificate on this computer* is selected, simple certificate selection is enabled by default.

Step 6 The lower box on the *Certificate Properties* window configures how the client will process the certificate presented by the authentication server. Select *Validate Server Certificate*.

Tip If EAP-TLS authentication fails with *Validate Server Certificate* checked, but passes when this option is unchecked, this indicates that client does not have the root certificate of the CA that signed the ACS's certificate in the proper Trusted Root Authority store.

Step 7 [Optional] By default, the supplicant will accept any valid server certificate that has been signed by a trusted root CA. To restrict the server certificates that a supplicant will accept, check the *Connect to These Servers* box and enter the common name (CN) of the servers that the supplicant should accept. If the authentication server presents a server certificate with a CN that is not listed, the end user will be prompted to accept the unknown CN. If the user clicks **OK**, then the CN will be automatically added to the trusted servers list and the user will not be prompted again.

Step 8 Click **OK** in the *Certificate Properties* window to return to the main *Authentication* tab window.

Step 9 Check *Authenticate as computer when computer information is available to enable machine authentication*.

Step 10 Leave the *Authenticate as Guest* option unchecked. Click **OK**.

Note Enabling the *Authenticate as Guest* option can cause unpredictable behavior with EAP-TLS and has no effect on other EAP methods. Leave the option unchecked.

Step 11 The supplicant will begin authentication.

Machine Authentication, EAP-TLS & User Certificate Auto-Enroll

It is possible for a user with valid Windows credentials to log into a machine that does not have a certificate for the user. For example, suppose Alice logs into Bob's PC. Alice has a valid Window's username and password which allow her to log into the PC at the Windows GINA. At this point, the supplicant begins 802.1X user authentication by sending an EAPoL-Start to the authenticator (assuming that the SupplicantMode registry setting has been set as recommended previously). The authenticator sends an Identity Request, but the supplicant cannot find a certificate for Alice in the user certificate storage. The supplicant will ignore the Identity Request and not send any more messages. The authenticator, knowing there is an 802.1X-capable supplicant on the port, retries authentication indefinitely. Since the PC cannot get access to the network to acquire a certificate for Alice, Alice is permanently denied access to the network. This may not be the desired behavior. One option in this situation is to configure **dot1x guest-vlan supplicant** on the authenticator. This command instructs the authenticator to move the port to the guest VLAN when the 802.1X supplicant becomes non-responsive in this scenario.

Another option is to leverage the network connectivity provided by machine authentication to do certificate auto-enrollment for the user. If machine authentication is enabled, a PC that has previously completed machine authentication will remain connected to the network for a brief period of time after a user without a certificate has logged into the Windows GINA. This only occurs if a user enters a valid Windows username and password, but has no certificate on the machine. Without the valid username and password, the user would not have been able to log into the machine in the first place. After the valid user logs into the Windows GINA, the supplicant will send an EAPoL-Start message and the switch will send three EAP-Request messages. During this period, the user has the same network access as the machine did after machine authentication. With the default 30-second timeout for each EAP Request message, this results in a 90-second window during which the switch allows the device to send packets to the network.

In some situations, the behavior of the Windows XP supplicant can be beneficial for user certificate auto-enrollment in a network that has 802.1X enabled. Depending on the configuration of the network, the 90 seconds of access might be enough for the user to update the group policy and auto-enroll a user certificate. If the user successfully acquires a certificate during this period, then the supplicant can subsequently authenticate using EAP-TLS and the user will continue to have access to the network. If the user cannot acquire a certificate, the switch will move the port to the default security status (deny all packets except EAPoL or deploy the Guest VLAN if configured) after 90 seconds.

Using the Guest VLAN to provide access to users without certificates and using the machine-authentication access window to auto-enroll user certificates are both valid design options. Security and guest access policies will help determine which one is best for any particular network.

Deploying PEAP-MSCHAPv2

The section describes how to configure PEAP-MSCHAPv2 on the ACS and on the supplicant.

The password used for MSCHAPv2 is acquired from the user when he or she logs into Windows (Single Sign-On). ACS verifies this password with the user password stored in Active Directory.

PEAP-MSCHAPv2 deployment is presented as a series descriptions in the following two primary sections:

- Authentication Server Configuration for PEAP-MSCHAPv2, page 3-111
- Client Configuration for PEAP-MSCHAPv2, page 3-113

Authentication Server Configuration for PEAP-MSCHAPv2

There are multiple steps to complete when configuring the Cisco ACS to act as the Authentication Server for IEEE 802.1X PEAP-MSCHAPv2 authentications. The following steps are addressed in the sections that follow:

- Step 1: Obtain the Root CA Certificate on ACS, page 3-111
- Step 2: Configure Certificate Revocation, page 3-111
- Step 3: Obtain and Configure a Server Certificate for the ACS Server, page 3-111
- Step 4: Configure PEAP-MSCHAPv2 Settings on the ACS, page 3-112
- Step 5: Specify and Configure the Catalyst Switch as a AAA Client, page 3-113
- Step 6: Configure the External User Databases, page 3-113

Once Step 6 is completed, you must restart the Cisco ACS-based service.

Note These instructions are for Cisco Secure ACS on Windows. There is also an appliance version of ACS called the Solution Engine (SE). SE has functional and configuration differences compared with the ACS for Windows version, especially in the area of certificate management.

Step 1: Obtain the Root CA Certificate on ACS

The procedure is the same as described in the EAP-TLS section. See "Step 1: Obtain and Install the Root CA Certificate on Cisco Secure ACS" section on page 3-11 for details.

Step 2: Configure Certificate Revocation

The procedure is the same as described in the EAP-TLS section. See "Step 2: Configure Certificate Revocation" section on page 3-21 for details.

Step 3: Obtain and Configure a Server Certificate for the ACS Server

The procedure is the same as described in the EAP-TLS section. See "Step 3: Acquire and Configure Cisco Secure ACS Server Certificate" section on page 3-23 for details.

Step 4: Configure PEAP-MSCHAPv2 Settings on the ACS

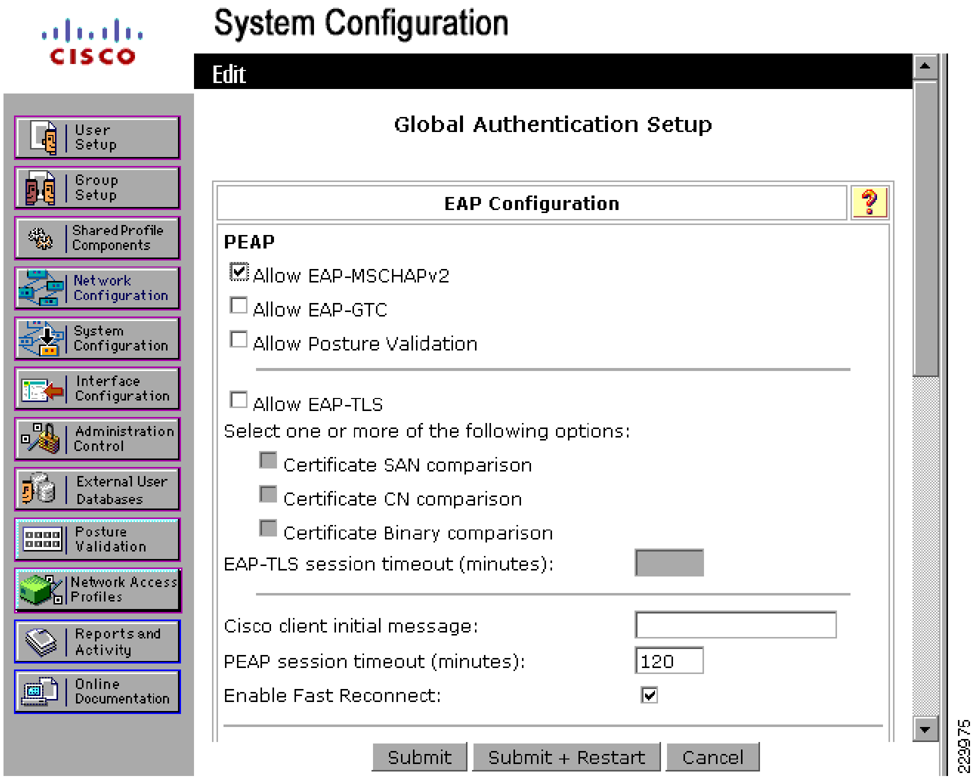
The PEAP-MSCHAPv2 settings are configured on the *Global Authentication Setup* window on the ACS.

Step 1 Open ACS Admin from the desktop shortcut created during the installation.

Step 2 Click **System Configuration**.

Step 3 Click **Global Authentication Setup**. See Figure 3-118.

Figure 3-118 Configuring ACS PEAP (ACS-PEAP-Config.bmp)



Global Authentication Setup

EAP Configuration

PEAP

☑ Allow EAP-MSCHAPv2

□ Allow EAP-GTC

□ Allow Posture Validation

□ Allow EAP-TLS

Select one or more of the following options:

□ Certificate SAN comparison

□ Certificate CN comparison

□ Certificate Binary comparison

EAP-TLS session timeout (minutes):

Cisco client initial message:

PEAP session timeout (minutes): 120

Enable Fast Reconnect: ☑

Step 4 Under PEAP, check *Allow EAP-MSCHAPv2*.

Note The Cisco client initial message is for Cisco Aironet clients only and is not applicable for CSSC or Windows XP supplicants.

Step 5 If using Fast Reconnect (see explanation that follows), select *Enable Fast Reconnect* and specify a timeout.

Step 6 Click **Submit** and **Restart**.

PEAP-MSCHAPv2 Fast Reconnect Explained

ACS supports an PEAP-MSCHAPv2 *session resume* feature that caches the session created during a new authentication. When a PEAP-MSCHAPv2 client reconnects, the cached session is used to restore the session, which improves performance. ACS deletes cached sessions when they time out.

PEAP-MSCHAPv2 fast reconnect is equivalent to EAP-TLS session resume. Fast reconnect is most appropriate in wireless environments where endpoints need to rapidly reauthenticate when roaming. The mechanism works the same way in wired environments, but the optimization is less important and it can be disabled without impacting the network. To disable the fast reconnect feature, set the timeout value to 0 (zero) or uncheck the *Enable Fast Reconnect* checkbox.

Note For fast reconnect to work, it must be supported and enabled on both the ACS and the supplicant. Not all supplicants support fast reconnect. See the "Configuring XP Supplicant for PEAP-MSCHAPv2" section on page 3-135 and/or Configuring CSSC for PEAP-MSCHAPv2, page 3-114 for more details.

Step 5: Specify and Configure the Catalyst Switch as a AAA Client

The procedure is the same as described in the EAP-TLS section. See "Step 5: Specify and Configure the Catalyst Switch as a AAA Client" section on page 3-50 for details.

Step 6: Configure the External User Databases

The procedure is the same as described in the EAP-TLS section. See "Step 6: Configure the External User Databases" section on page 3-51 for details.

Client Configuration for PEAP-MSCHAPv2

This section provides the following descriptions:

- Installation of Client Certificates, page 3-113
- Configuring CSSC for PEAP-MSCHAPv2, page 3-114
- Configuring XP Supplicant for PEAP-MSCHAPv2, page 3-135

Installation of Client Certificates

In PEAP-MSCHAPv2, ACS authenticates itself to the client by presenting a certificate that is signed by a Root CA that the client trusts. Therefore, every host and user that wishes to authenticate via PEAP-MSCHAPv2 must possess the Certificate Authority (CA) Root Certificate (to validate the ACS certificate).

Deploying this certificate to the end user or host is required regardless of whether you are using the Cisco Secure Services Client (CSSC), the XP native supplicant, or some other 802.1X client software. The installation of certificates is independent of the supplicant deployment process.

If the end host will be performing machine authentication and user authentication, then the Root CA certificate must be installed in the user's Trusted Root certificate store and in the machine's Trusted Root certificate store.

Root Certificate Required for Machine Authentication

The following describes how to verify and install the certificate needed to successfully complete PEAP-MSCHAPv2 machine authentication.

Note To verify and/or manipulate machine certificate stores, you must be logged into the machine as an Administrator.

Verifying Machine Root CA Certificate

The procedure is the same as described in the EAP-TLS section. See the "Certificates Required for User Authentication" section on page 3-67 for details

Root Certificate Required for User Authentication

The following describes how to verify and install the certificate needed to successfully complete PEAP-MSCHAPv2 user authentication.

Verifying User Root CA Certificate

The procedure is the same as described in the EAP-TLS section. See the "Certificates Required for User Authentication" section on page 3-67 for details.

Configuring CSSC for PEAP-MSCHAPv2

The steps provided in this section explain how to configure the Cisco Secure Services Client (CSSC) for PEAP-MSCHAPv2 authentication on wired LAN networks.

Note CSSC version 5.0.1.8 is running on Windows XP operating system with Service Pack 2.

Note Prior to configuring CSSC, validate that the correct certificates exist in the Windows certificate stores as described in previous sections.

There are three components required to install and configure CSSC:

- CSSC client image (CSSC_SSC-XP2K)—802.1X client software that runs on the end host.
- Client Utilities (CiscoClientUtilities)—Troubleshooting tool that runs on the end host.
- Client Management Utility (SSCMgmtToolkit)—Management utility that configures user profiles that can be distributed to the entire organization through a single Extensible Markup Language (XML) file. This utility is typically run on a centralized server. For testing purposes, it can be run on the end client to modify and test the supplicant configuration on the fly.

Note The Cisco SSC Management Utility does not address client-side certificate management and distribution. Those tasks must be accomplished using Active Directory Group Policies or some other mechanism as described in previous sections. Client-side certificates are required for EAP-TLS.

This section discusses how to use the Management Utility to configure a PEAP-MSCHAPv2 profile for the CSSC client. Once created, the user profiles can be bundled with the client image into an *.msi* file which can be deployed using standard deployment tools—including Microsoft Active Directory GPOs, SMS, Altiris, and Novell Zenworks.

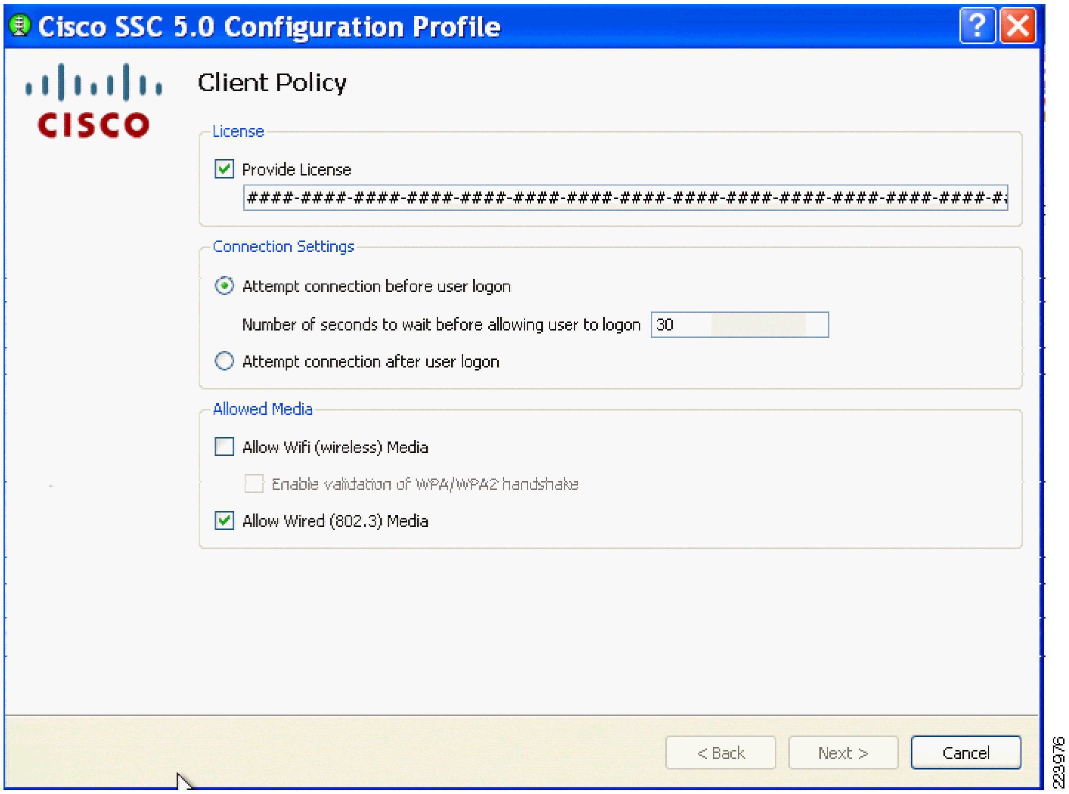
Step 1 Create a New Configuration Profile.

This is the same as Step 1 in "CSSC Configuration" section on page 3-82.

Step 2 Configure Client Policy.

In the *Client Policy* window, enter the license. Select *Attempt connection before user logon* and select *Allow Wired (802.3) Media*. See Click **Next**. Figure 3-119.

Figure 3-119 SSC Configuration Profile



Cisco SSC 5.0 Configuration Profile

Client Policy

License

☑ Provide License

####-####-####-####-####-####-####-####-####-####-####-####-####-####-#

Connection Settings

● Attempt connection before user logon

Number of seconds to wait before allowing user to logon 30

○ Attempt connection after user logon

Allowed Media

☐ Allow Wifi (wireless) Media

☐ Enable validation of WPA/WPA2 handshake

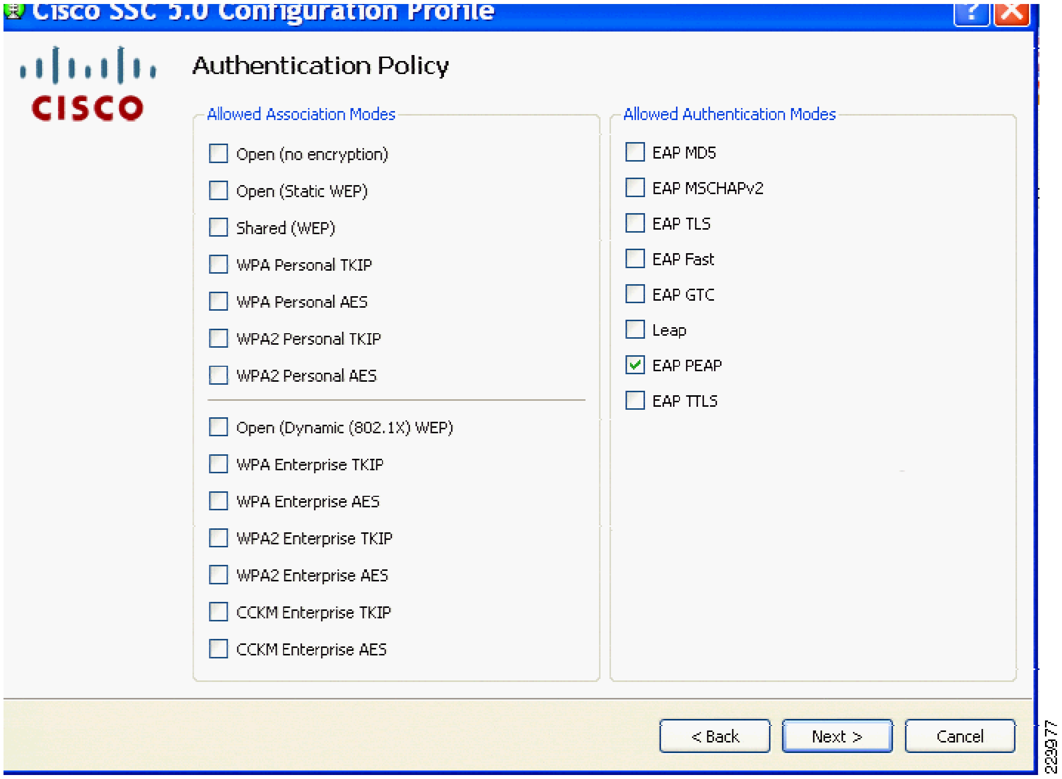
☑ Allow Wired (802.3) Media

Note The *Attempt connection before user logon* setting causes CSSC to delay the user login into the Windows domain until 802.1X authentication has completed. This ensures that the machine has complete network connectivity when performing Windows domain login and Group Policy download for the user.

Step 3 Configure Authentication Policy.

In the *Authentication Policy* window, select *EAP PEAP* under *Allowed Authentication Modes* and click **Next**. See Figure 3-120.

Figure 3-120 CSSC Authentication Policy



Cisco SSC 5.0 Configuration Profile

Authentication Policy

Allowed Association Modes

- ☐ Open (no encryption)
- ☐ Open (Static WEP)
- ☐ Shared (WEP)
- ☐ WPA Personal TKIP
- ☐ WPA Personal AES
- ☐ WPA2 Personal TKIP
- ☐ WPA2 Personal AES
- ☐ Open (Dynamic (802.1X) WEP)
- ☐ WPA Enterprise TKIP
- ☐ WPA Enterprise AES
- ☐ WPA2 Enterprise TKIP
- ☐ WPA2 Enterprise AES
- ☐ CCKM Enterprise TKIP
- ☐ CCKM Enterprise AES

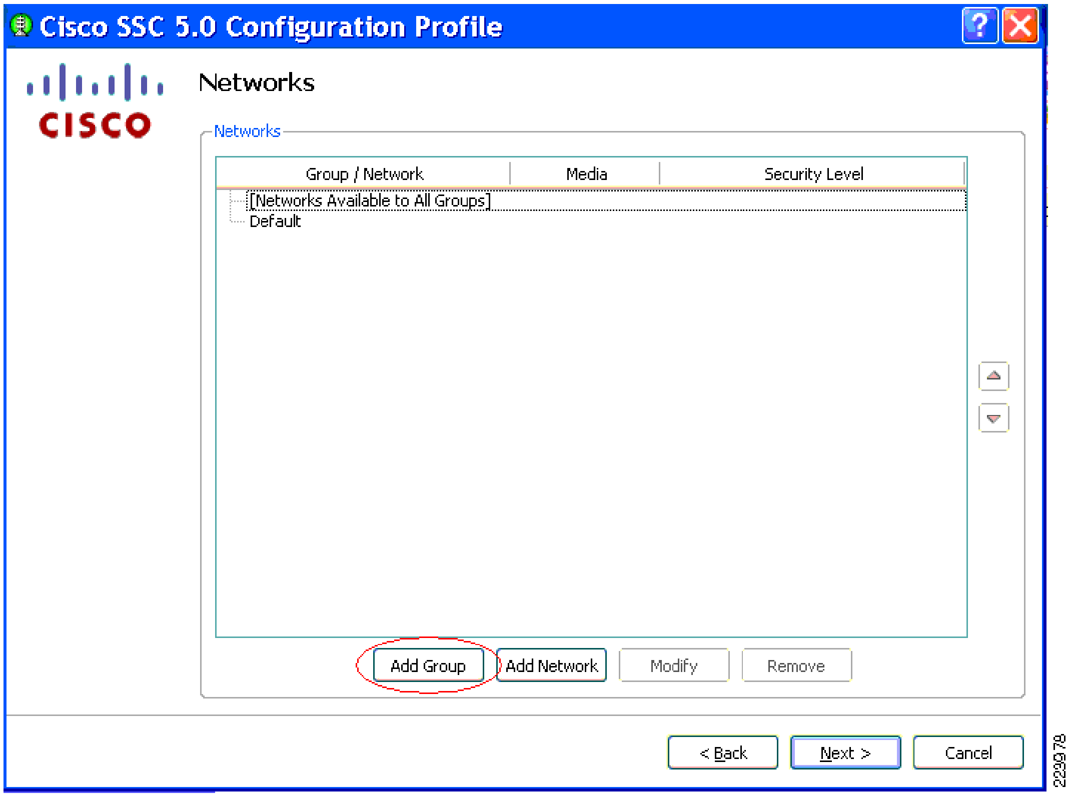
Allowed Authentication Modes

- ☐ EAP MD5
- ☐ EAP MSCHAPv2
- ☐ EAP TLS
- ☐ EAP Fast
- ☐ EAP GTC
- ☐ Leap
- ☑ EAP PEAP
- ☐ EAP TTLS

Step 4 Create a New Group.

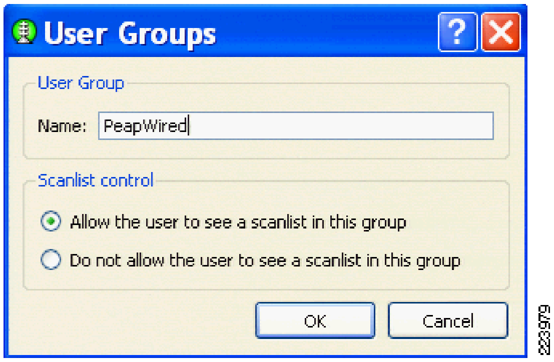
1. In the *Networks* window, create a new group by clicking **Add Group**. See Figure 3-121.

Figure 3-121 Add a Group



2. Enter a name for the new group and click **OK**. See Figure 3-122.

Figure 3-122 Naming the User Group



Name: PeapWired

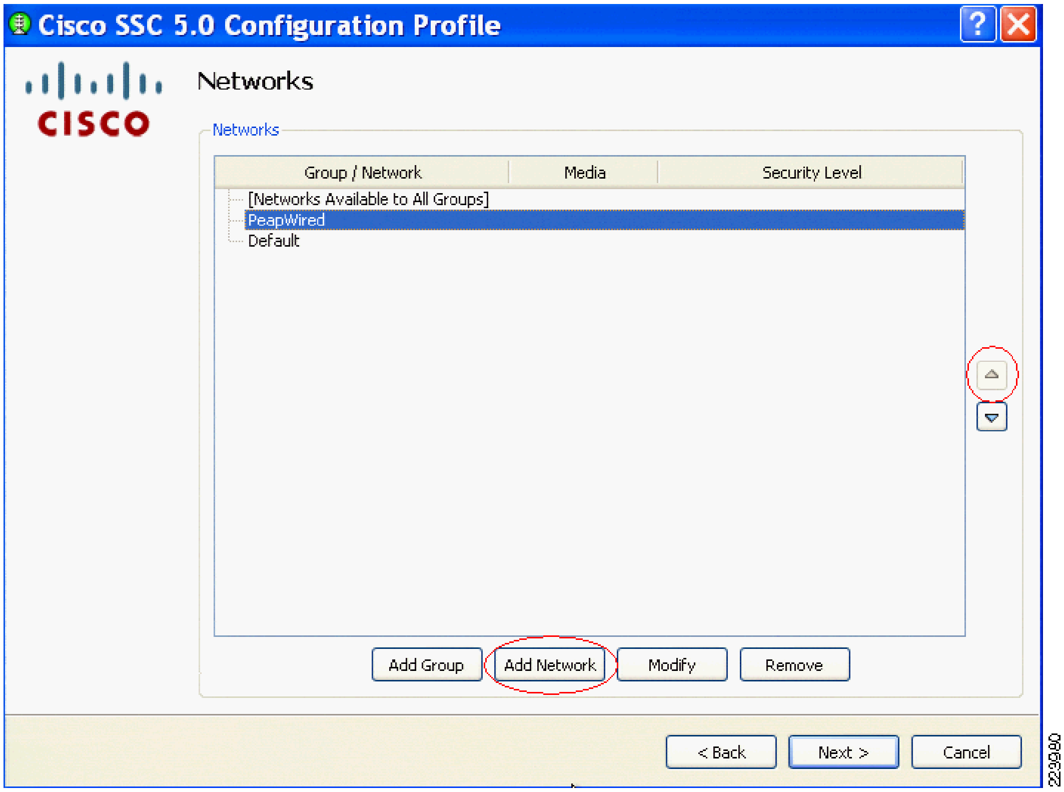
● Allow the user to see a scanlist in this group

○ Do not allow the user to see a scanlist in this group

Step 5 Add a Network to the Group

1. In the main *Networks* screen, use the **Up** arrow button on the right side of the screen to move the group that was just created (*PeapWired*) above the Default group. Select *PeapWired* and click **Add Network**. See Figure 3-123.

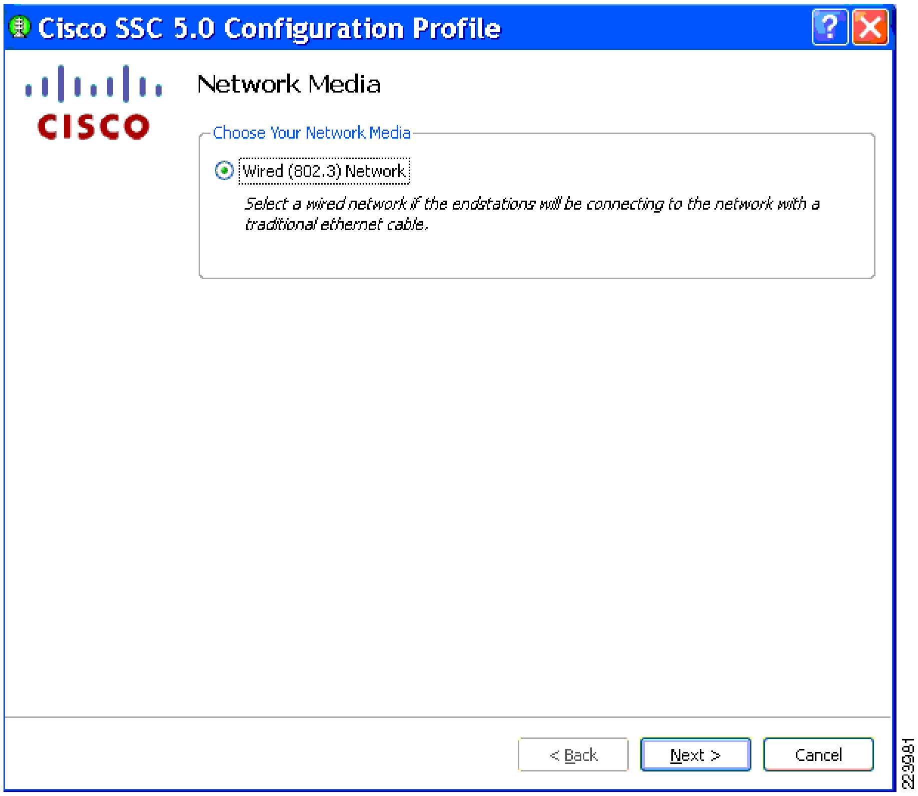
Figure 3-123 Adding a Network



Group / Network	Media	Security Level
[Networks Available to All Groups]		
PeapWired		
Default		

2. In the *Network Media* window, select *Wired (802.3) Network* and click **Next**. See Figure 3-124.

Figure 3-124 Select Network Media



Cisco SSC 5.0 Configuration Profile

Network Media

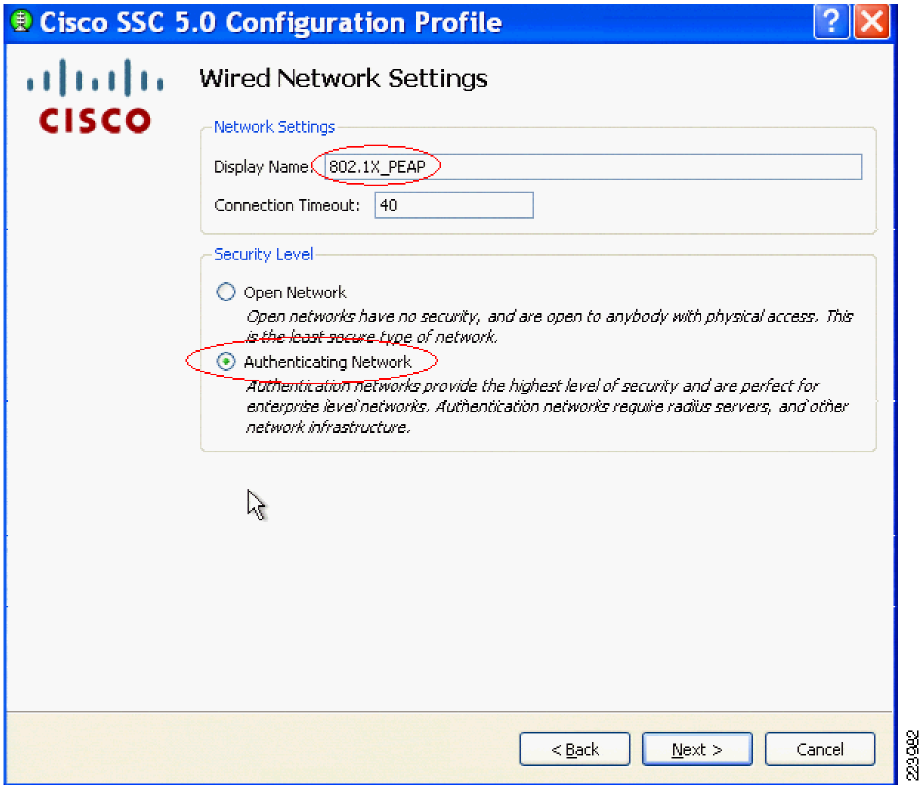
Choose Your Network Media

● Wired (802.3) Network

Select a wired network if the endstations will be connecting to the network with a traditional ethernet cable.

3. Provide a name for the profile and specify the *Authenticating Network* option. Leave the default Connection Timeout at 40 seconds. Click **Next**. See Figure 3-125.

Figure 3-125 Configuring Network Settings



Cisco SSC 5.0 Configuration Profile

Wired Network Settings

Network Settings

Display Name: 802.1X_PEAP

Connection Timeout: 40

Security Level

○ Open Network

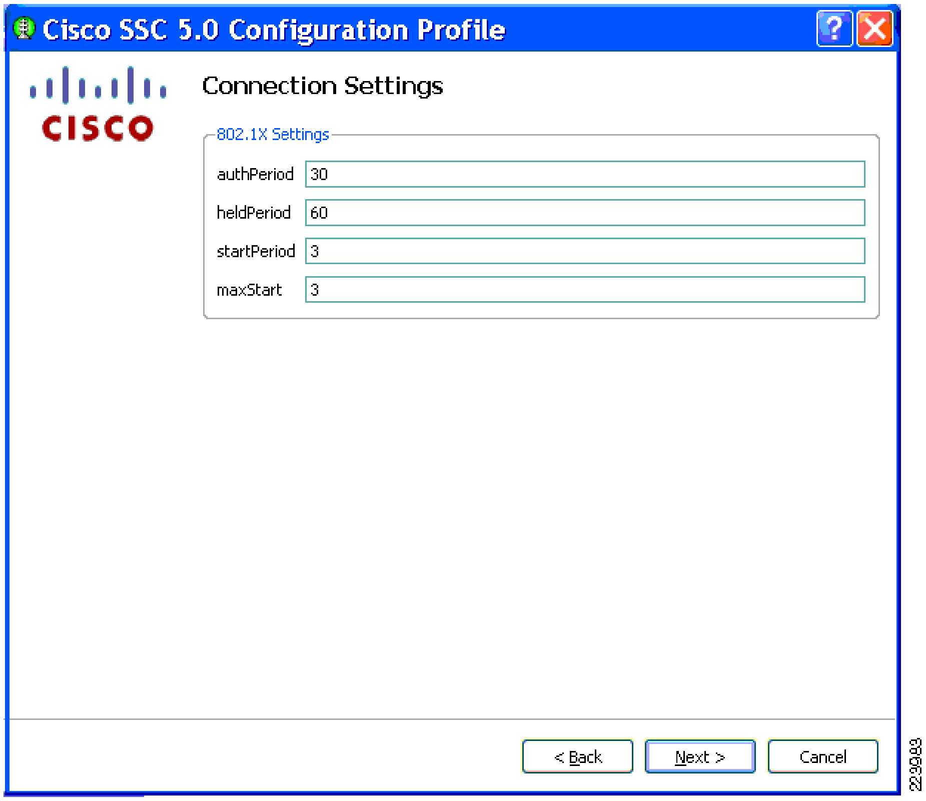
Open networks have no security, and are open to anybody with physical access. This is the least secure type of network.

● Authenticating Network

Authentication networks provide the highest level of security and are perfect for enterprise level networks. Authentication networks require radius servers, and other network infrastructure.

4. Leave the default *Connection Settings* and click **Next**. See Figure 3-126.

Figure 3-126 Connection Settings



Cisco SSC 5.0 Configuration Profile

Connection Settings

802.1X Settings

authPeriod 30

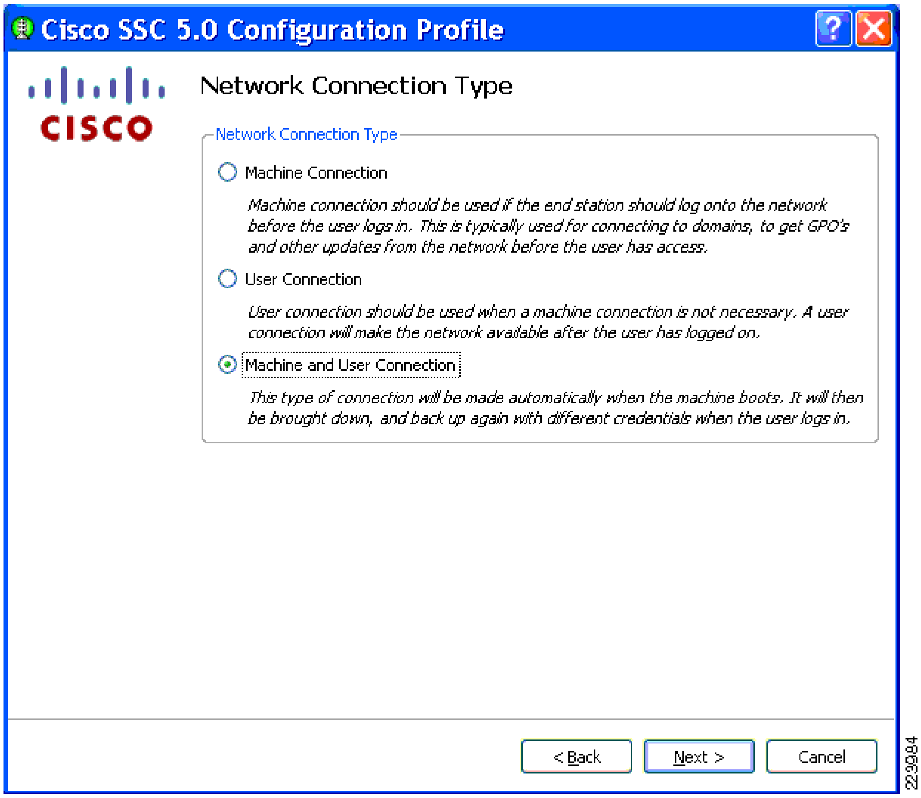
heldPeriod 60

startPeriod 3

maxStart 3

5. Select the type of authentication scenario. To perform machine authentication and user authentication, select the *Machine and User Connection* radio button. Clicking **Next** will initiate Machine Authentication configuration. See Figure 3-127.

Figure 3-127 Network Connection Type



Network Connection Type

Network Connection Type

○ Machine Connection

Machine connection should be used if the end station should log onto the network before the user logs in. This is typically used for connecting to domains, to get GPO's and other updates from the network before the user has access.

○ User Connection

User connection should be used when a machine connection is not necessary. A user connection will make the network available after the user has logged on.

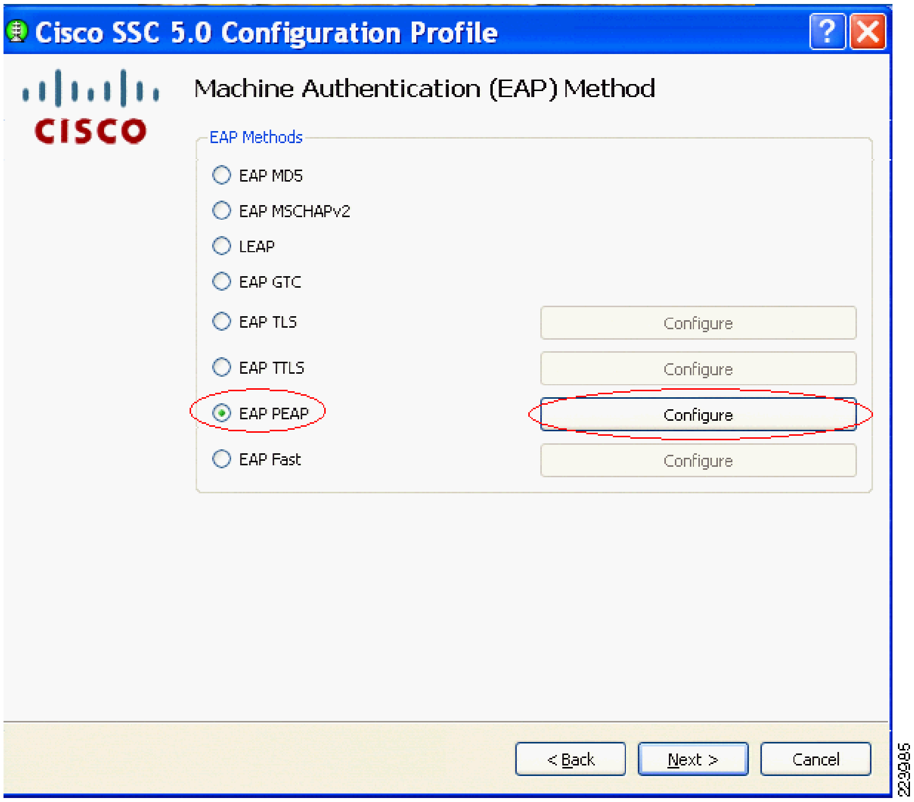
● Machine and User Connection

This type of connection will be made automatically when the machine boots. It will then be brought down, and back up again with different credentials when the user logs in.

Step 6 Configure Machine Authentication Parameters.

1. In the *Machine Authentication* window, select *EAP-PEAP* and click the **Configure** button. See Figure 3-128.

Figure 3-128 Machine Authentication Method



Cisco SSC 5.0 Configuration Profile

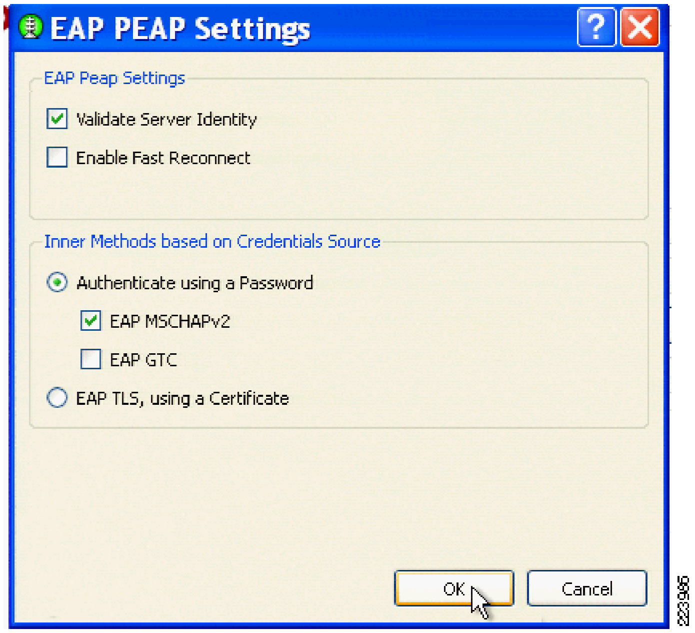
Machine Authentication (EAP) Method

EAP Methods

- ○ EAP MD5
- ○ EAP MSCHAPv2
- ○ LEAP
- ○ EAP GTC
- ○ EAP TLS
- ○ EAP TTLS
- ● EAP PEAP
- ○ EAP Fast

2. In the *EAP-PEAP Settings* window, select *Validate Server Certificate*. Deselect *Enable Fast Reconnect* because this feature is not required for wired scenarios. To use MSCHAPv2 as the inner method, select *Authenticate using a Password* and click the checkbox next to *EAP MSCHAPv2*. Click **Ok**. See Figure 3-129.

Figure 3-129 PEAP Settings For Machine Authentication



EAP PEAP Settings

EAP Peap Settings

☑ Validate Server Identity

□ Enable Fast Reconnect

Inner Methods based on Credentials Source

● Authenticate using a Password

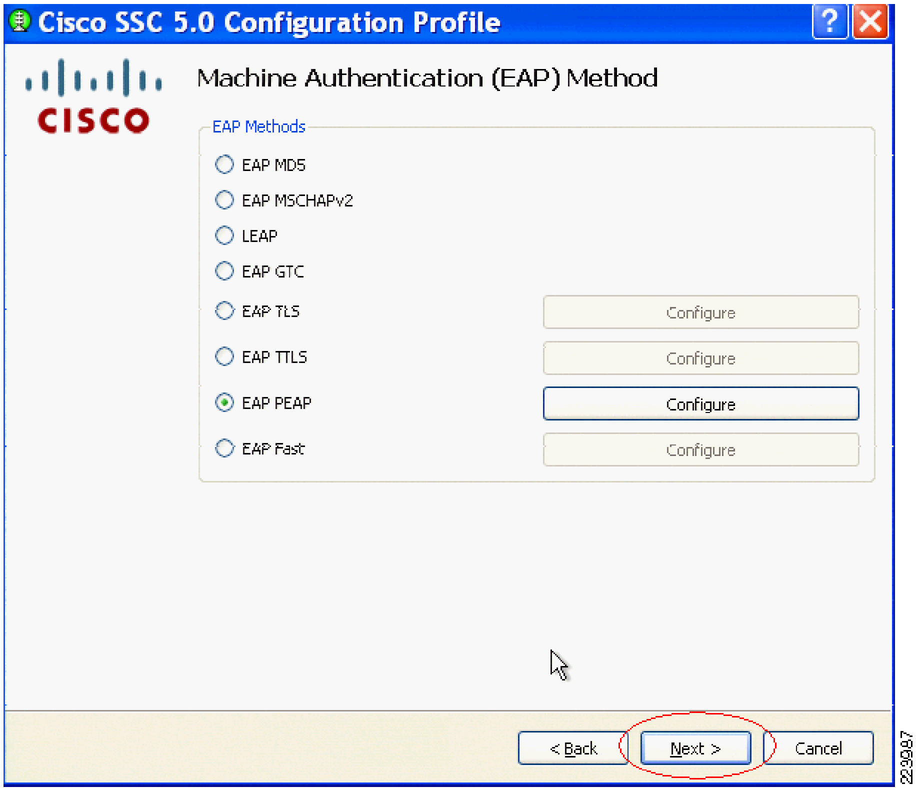
☑ EAP MSCHAPv2

□ EAP GTC

○ EAP TLS, using a Certificate

3. The configuration utility returns to the *Machine Authentication* window. Click **Next**. See Figure 3-130.

Figure 3-130 Machine PEAP Configuration Complete



Cisco SSC 5.0 Configuration Profile

Machine Authentication (EAP) Method

EAP Methods

○ EAP MD5

○ EAP MSCHAPv2

○ LEAP

○ EAP GTC

○ EAP TLS

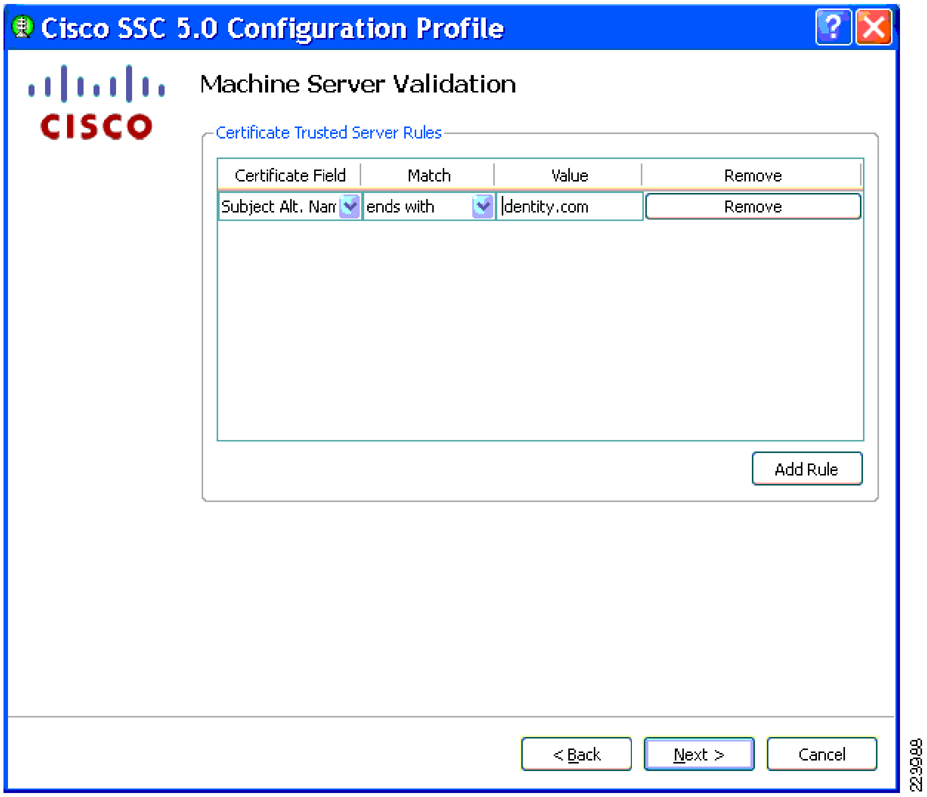
○ EAP TTLS

● EAP PEAP

○ EAP Fast

4. [Optional] The *Machine Server Validation* window can be used to restrict the ACS servers from which the client will accept a certificate authentication during machine authentication. If no *Rule* is added in this window, the client will accept any server certificate that has been signed by a trusted root CA. Click **Next**. See Figure 3-131.

Figure 3-131 Machine Server Validation



Cisco SSC 5.0 Configuration Profile

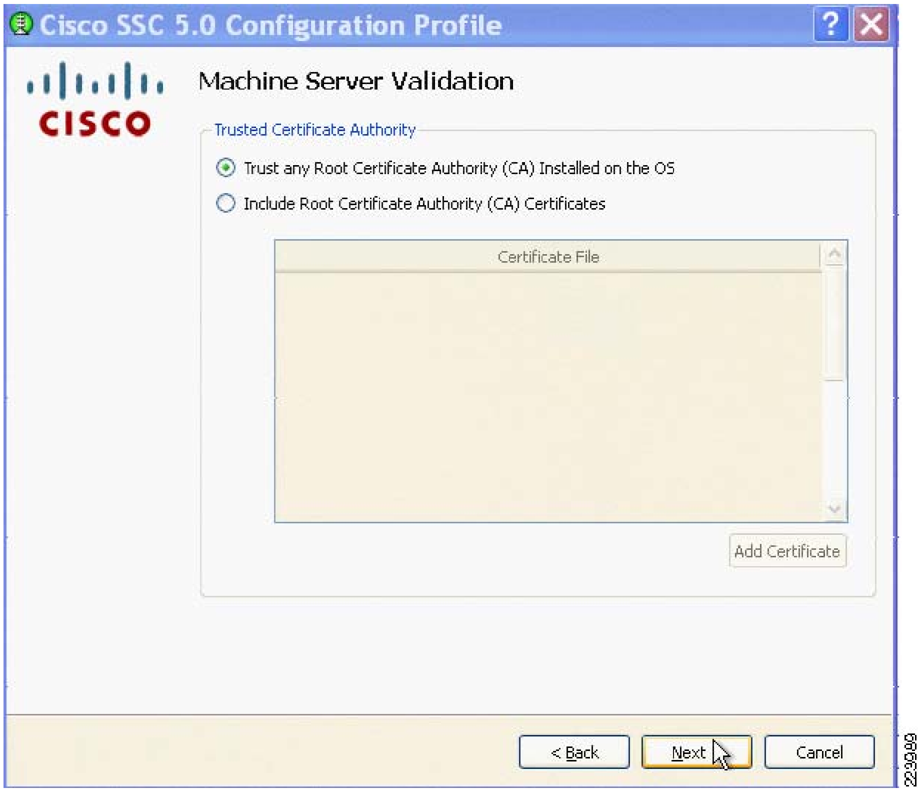
Machine Server Validation

Certificate Trusted Server Rules

Certificate Field	Match	Value	Remove
Subject Alt. Nan	ends with	|dentity.com	Remove

5. [Optional] If desired, use the window shown in Figure 3-132 to restrict which root CAs the client will trust to sign the ACS server certificate. Click **Next** to accept the default setting.

Figure 3-132 Machine Trusted CA



Machine Server Validation

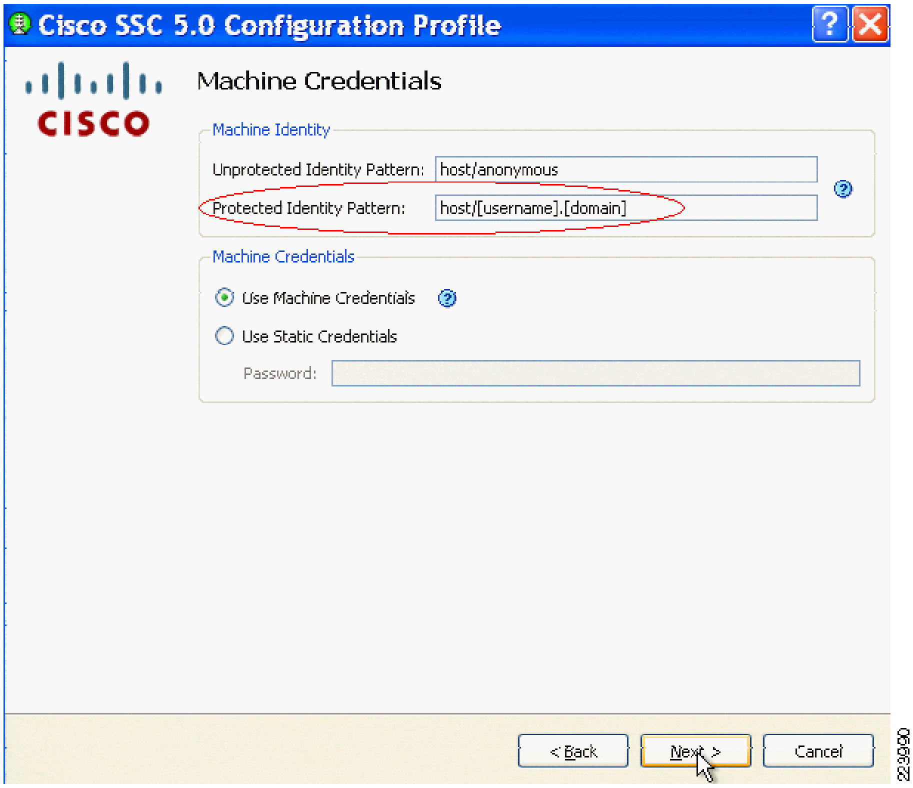
Trusted Certificate Authority

● Trust any Root Certificate Authority (CA) Installed on the OS

○ Include Root Certificate Authority (CA) Certificates

6. In the *Machine Credentials* window in Figure 3-133, leave the default for the unprotected identity and add .[*domain*] to the protected identity. The client will replace [*username*] with the machine name and [*domain*] with the complete domain name. The *Machine Credentials* option instructs the client to use the machine password provided by Microsoft Active Directory.

Figure 3-133 Machine Credentials



Cisco SSC 5.0 Configuration Profile

Machine Credentials

Machine Identity

Unprotected Identity Pattern: host/anonymous

Protected Identity Pattern: host/[username].[domain]

Machine Credentials

● Use Machine Credentials

○ Use Static Credentials

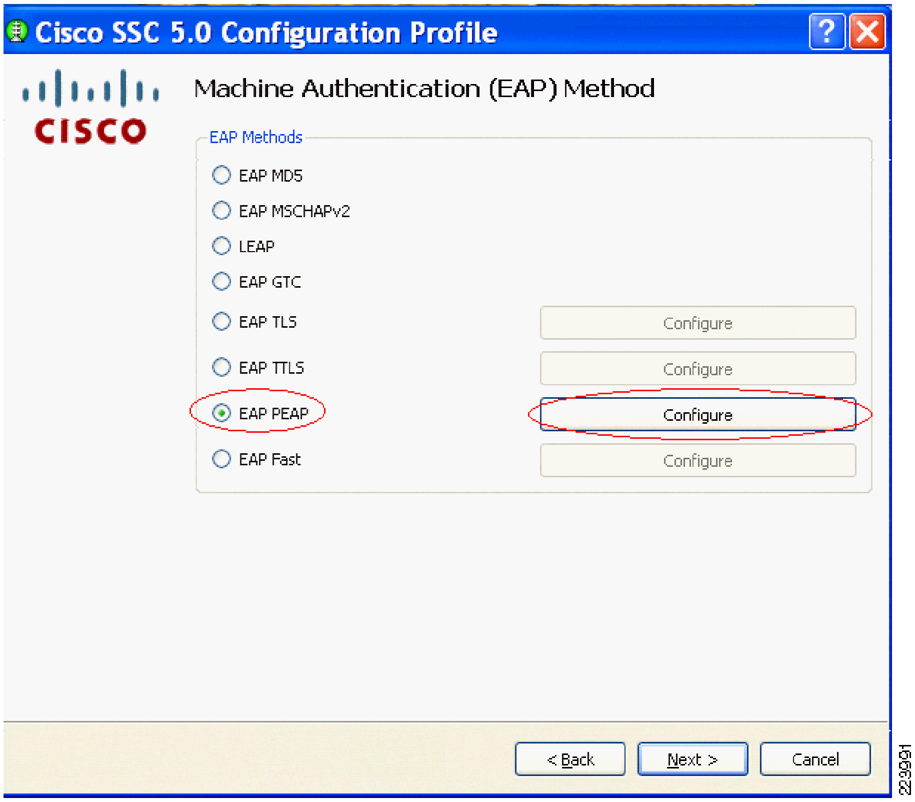
Password:

7. Click **Next** to begin configuring User Authentication.

Step 7 Configure User Authentication.

1. In the *User Authentication Method* window, select *EAP-PEAP* and click **Configure**. See Figure 3-134.

Figure 3-134 Configure User Authentication Method



Cisco SSC 5.0 Configuration Profile

Machine Authentication (EAP) Method

EAP Methods

○ EAP MD5

○ EAP MSCHAPv2

○ LEAP

○ EAP GTC

○ EAP TLS Configure

○ EAP TTLS Configure

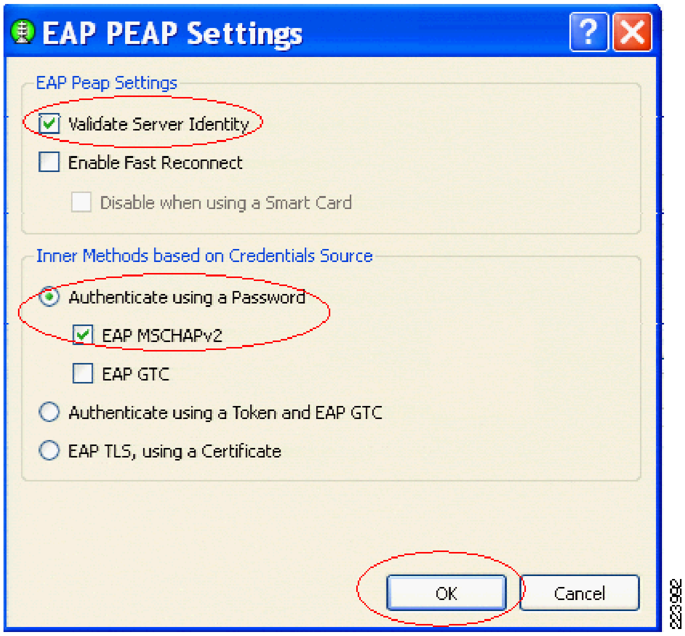
● EAP PEAP Configure

○ EAP Fast Configure

< Back Next > Cancel

2. See Figure 3-135. Check *Validate Server Certificate* and disable *Fast Reconnect*. Select *Authenticate using a Password and EAP MSCHAPv2*. Return to the main User Authentication window by clicking **OK**.

Figure 3-135 Configure User PEAP Settings



EAP PEAP Settings

EAP Peap Settings

☑ Validate Server Identity

□ Enable Fast Reconnect

□ Disable when using a Smart Card

Inner Methods based on Credentials Source

● Authenticate using a Password

☑ EAP MSCHAPv2

□ EAP GTC

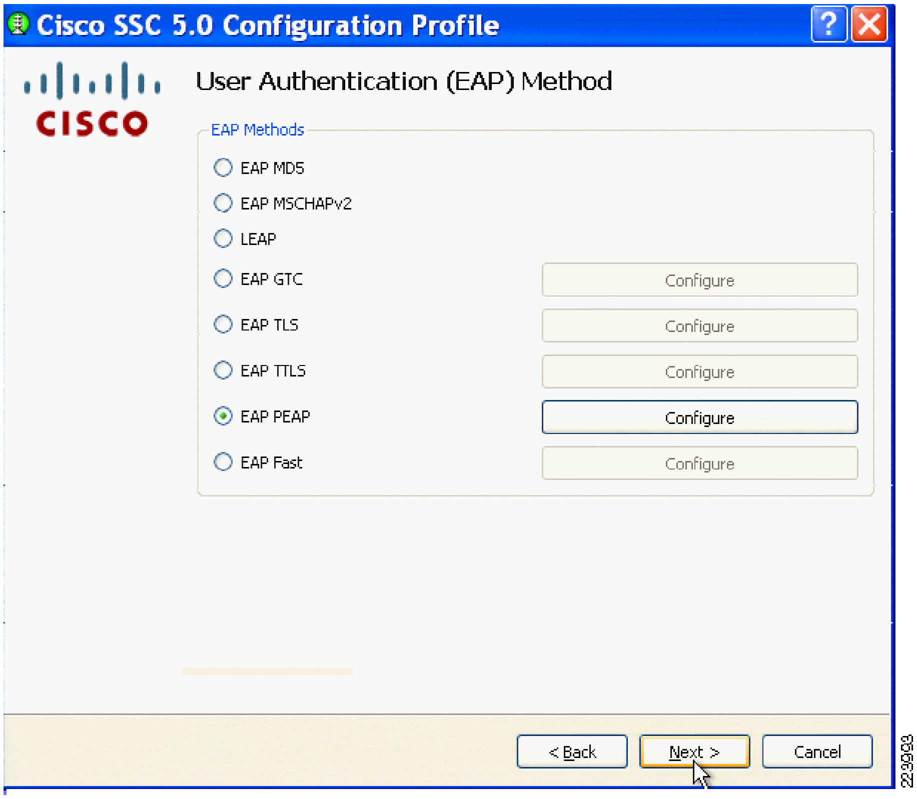
○ Authenticate using a Token and EAP GTC

○ EAP TLS, using a Certificate

Note If authentication passes when *Validate Server Identity* is unchecked but fails when it is checked, then the supplicant does not have the certificate for the Root CA that signed the ACS's certificate in the appropriate certificate store.

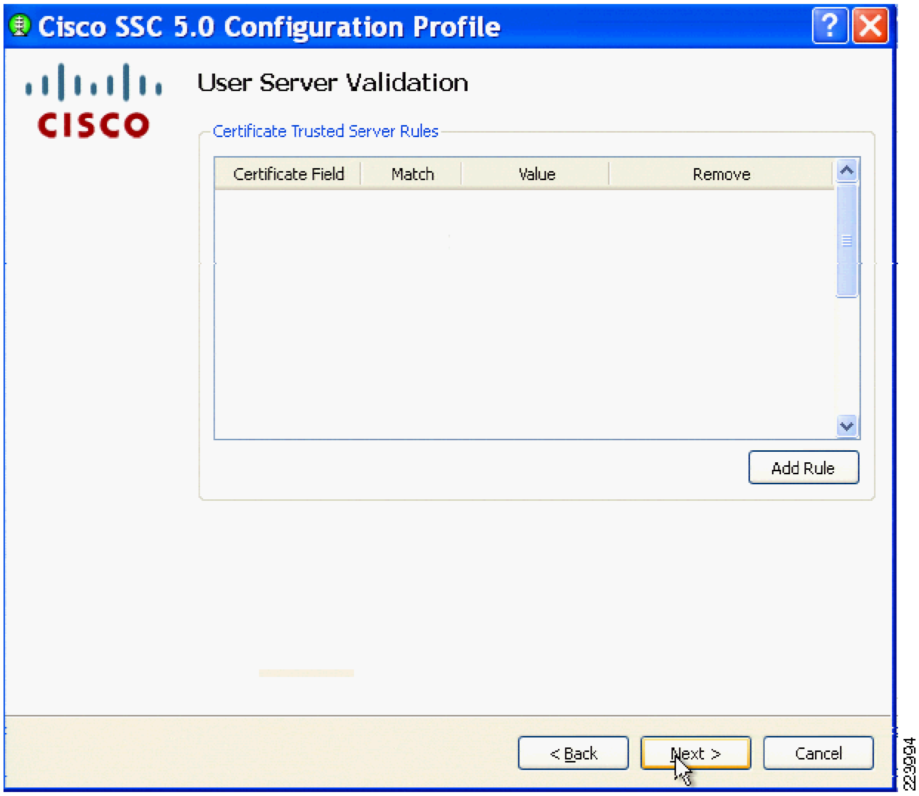
3. See Figure 3-136. In the main *User Authentication Method* window, click **Next**.

Figure 3-136 User PEAP Settings Complete



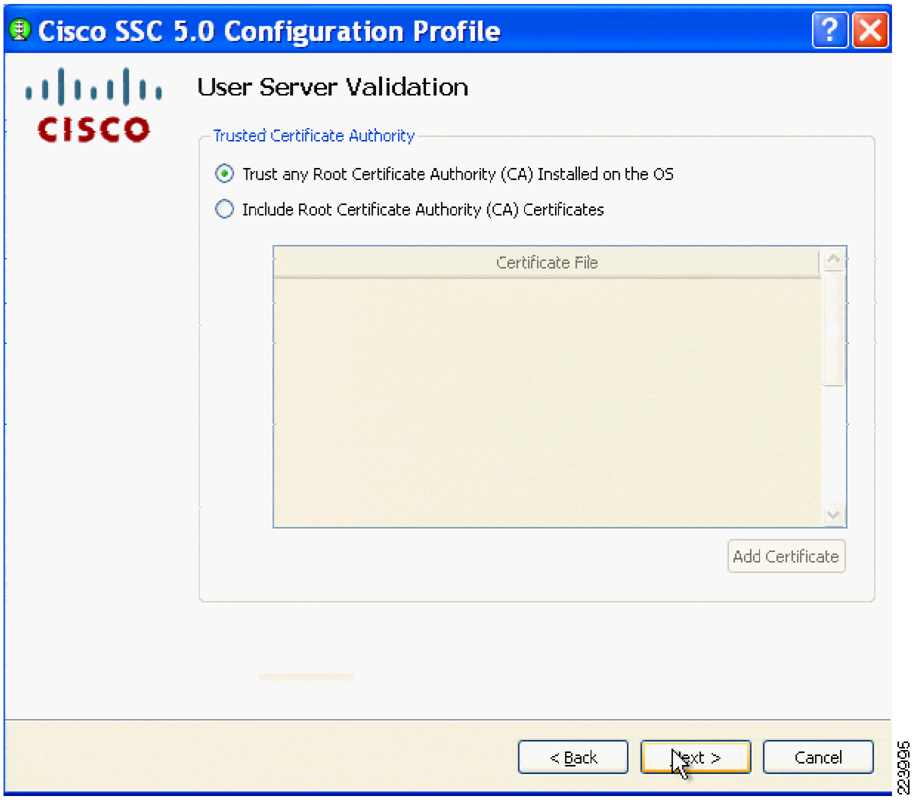
4. [Optional] See Figure 3-137. The *User Server Validation* window can be used to restrict the ACS servers from which the client will accept a certificate authentication during user authentication. If no *Rule* is added in this window, the client will accept any server certificate that has been signed by a trusted root CA. Click **Next**.

Figure 3-137 User Server Validation



5. [Optional] See Figure 3-138. If desired, use this window to restrict which root CAs the client will trust to sign the ACS server certificate during user authentication. Click **Next** to accept the default setting.

Figure 3-138 User Trusted CA



Cisco SSC 5.0 Configuration Profile

User Server Validation

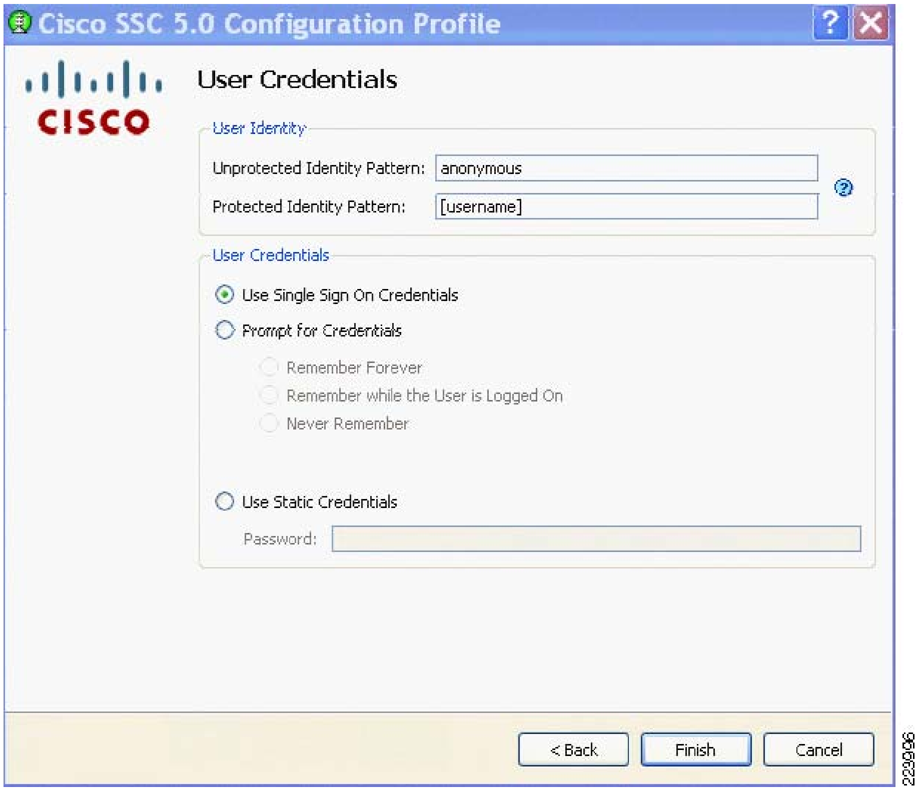
Trusted Certificate Authority

● Trust any Root Certificate Authority (CA) Installed on the OS

○ Include Root Certificate Authority (CA) Certificates

6. See Figure 3-139. In the *User Credentials* window, leave *anonymous* as the unprotected identity and [*username*] as the unprotected identity. Select *Use Single Sign On*. CSSC will automatically replace the [*username*] placeholder with the username that was entered during the Windows logon. Click **Finish**. The Validation window will appear.

Figure 3-139 User Credentials



Cisco SSC 5.0 Configuration Profile

User Credentials

User Identity

Unprotected Identity Pattern: anonymous

Protected Identity Pattern: [username]

User Credentials

● Use Single Sign On Credentials

○ Prompt for Credentials

○ Remember Forever

○ Remember while the User is Logged On

○ Never Remember

○ Use Static Credentials

Password:

Note about Protected and Unprotected Identity

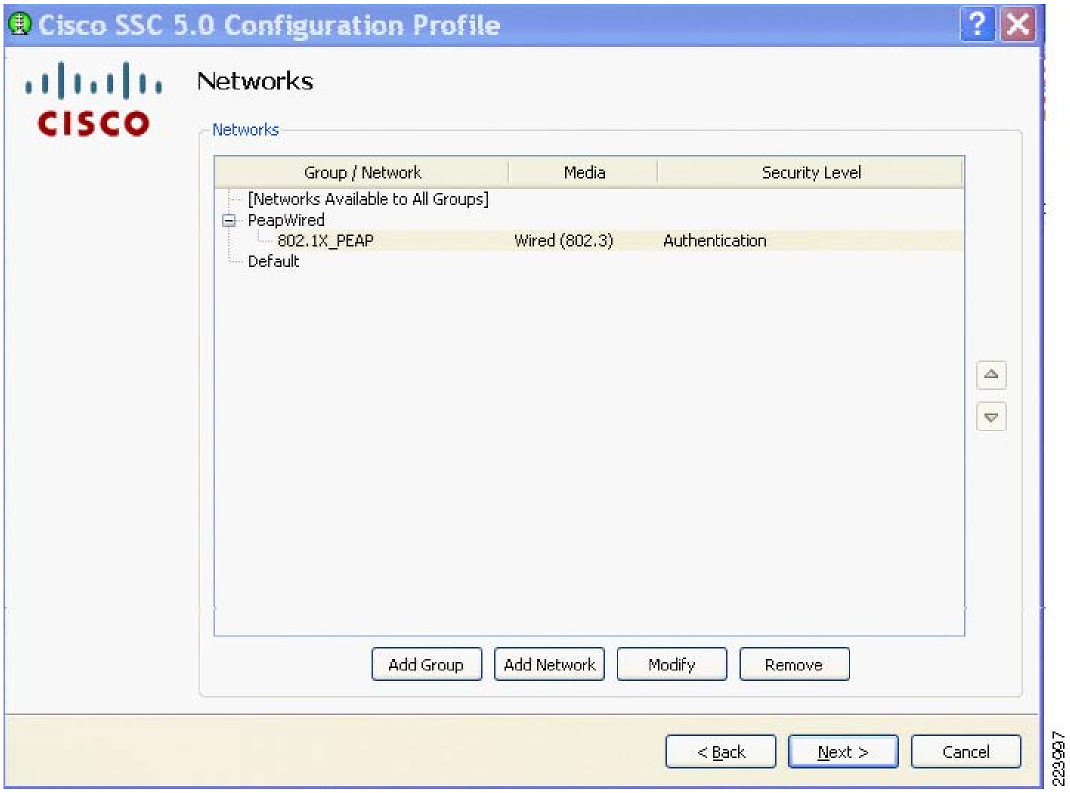
The EAP Identity field in EAP Identity Response messages is sometimes referred to as the *outer* or *unprotected* identity since it is sent in the clear, outside the protected TLS tunnel. PEAP has the option of sending *anonymous* instead of the actual username in the Identity field. If the outer identity is anonymous, the user's real identity is conveyed inside the protected tunnel, ensuring that a sniffer cannot detect the true username from the EAP exchange. When the outer identity is anonymous, the inner or *protected* identity is used to validate the user's credentials against the user database.

Although an anonymous outer identity is more secure, it can make RADIUS accounting more difficult since the authenticator has no knowledge of the protected identity. To alleviate this situation, ACS can send the protected username in the RADIUS Access Accept to the authenticator. Cisco switches reply with this username in RADIUS Accounting records.

Step 8 Validate Configuration.

1. Verify that the group (*PeapWired*) has been successfully created with the configured profile (*802.1X_PEAP*). Click **Next**. See Figure 3-140.

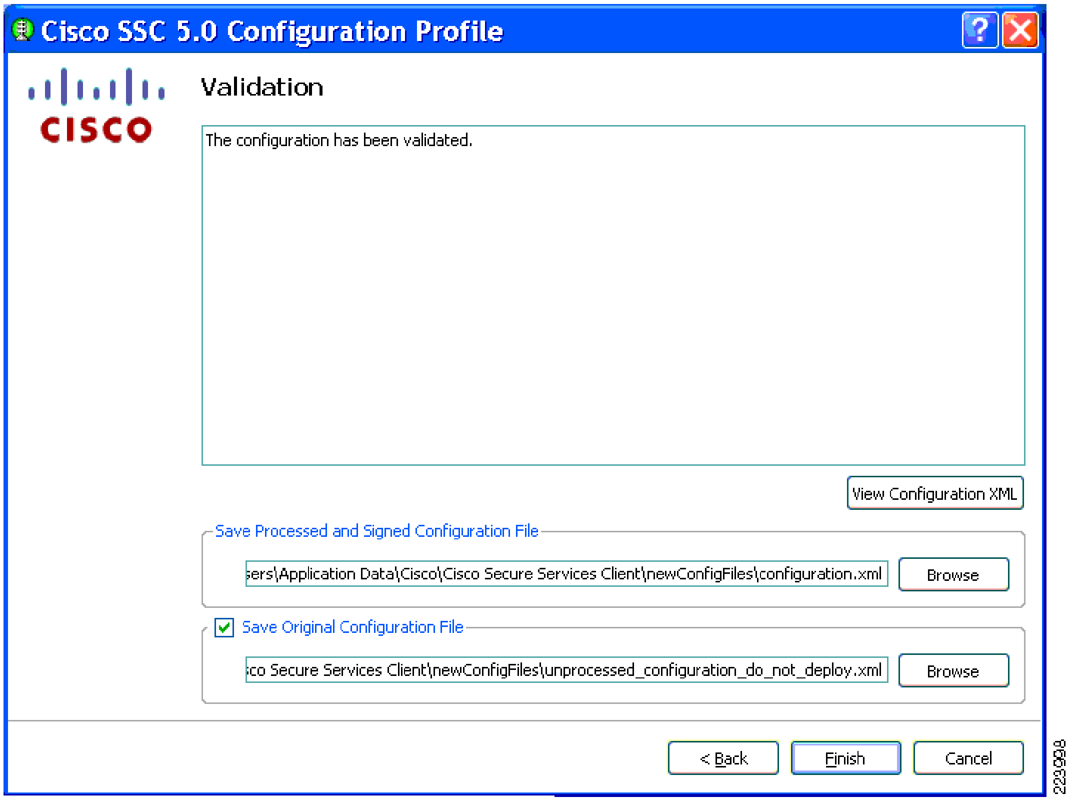
Figure 3-140 Verify Group Configuration



Group / Network	Media	Security Level
[Networks Available to All Groups]		
PeapWired		
802.1X_PEAP	Wired (802.3)	Authentication
Default		

2. In the *Validation* window (Figure 3-141), click **Finish** to save the configuration files. The Processed Configuration file *configuration.xml* can be deployed to the client (this will happen automatically if the Management Utility is running on the same machine as the client software). The Unprocessed Configuration file *unprocessed_configuration_do_not_deploy.xml* should only be used to modify this profile as described in the following step.

Figure 3-141 Validate Configuration



The configuration has been validated.

Save Processed and Signed Configuration File: ers\Application Data\Cisco\Cisco Secure Services Client\newConfigFiles\configuration.xml

☑ Save Original Configuration File: co Secure Services Client\newConfigFiles\unprocessed_configuration_do_not_deploy.xml

Step 9 Modify Configuration.

This is the same as Step 9 in "CSSC Configuration" section on page 3-82.

Configuring XP Supplicant for PEAP-MSCHAPv2

The steps provided in this section describe how to configure the Windows XP native supplicant for PEAP-MSCHAPv2 authentication on wired LAN networks.

Note The native client is running on Windows XP Service Pack 2.

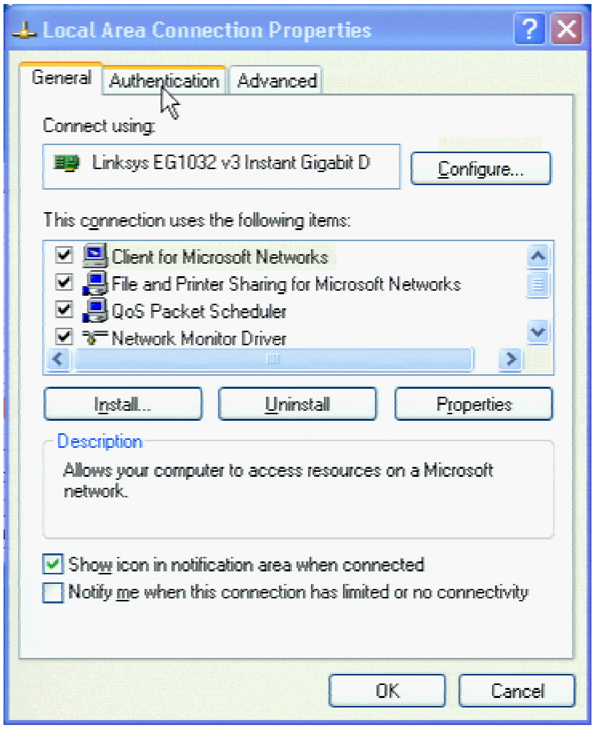
Prior to configuring the XP supplicant, validate that the correct certificates exist in the Windows certificate stores as described in "Installation of Client Certificates" section on page 3-56.

Configure IEEE 802.1X Parameters

Step 1 To configure the IEEE 802.1X parameters, click **Start** > **Control Panel**, and then select **Network and Internet Connections**. Next, select **Network Connections** and open the correct *Local Area Connection Properties* menu.

Step 2 From the *Local Area Connection Properties* window, select the *Authentication* tab. See Figure 3-142

Figure 3-142 Selection Authentication Tab



Local Area Connection Properties

General | Authentication | Advanced

Connect using:

Linksys EG1032 v3 Instant Gigabit D

This connection uses the following items:

- ☑ Client for Microsoft Networks
- ☑ File and Printer Sharing for Microsoft Networks
- ☑ QoS Packet Scheduler
- ☑ Network Monitor Driver

Description

Allows your computer to access resources on a Microsoft network.

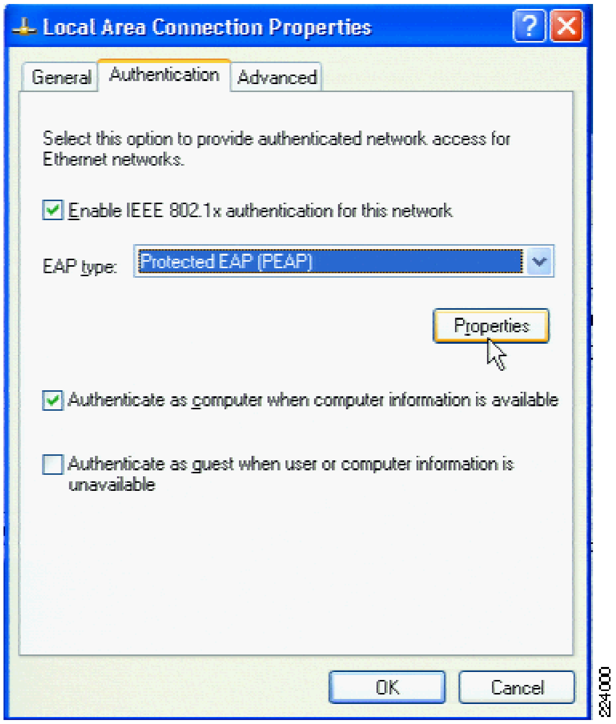
☑ Show icon in notification area when connected

□ Notify me when this connection has limited or no connectivity

Note If the *Authentication* tab is not displayed, click **Start** > **All Programs** > **Administrative Tools** > **Services**. Right-click **Wireless Zero Configuration** and select **Start**.

Step 3 See Figure 3-143. Check the *Enable IEEE 802.1X authentication for this network* box. Select *Protected EAP* from the drop-down menu for the *EAP type*.

Figure 3-143 Configure PEAP Authentication



Local Area Connection Properties

General | Authentication | Advanced

Select this option to provide authenticated network access for Ethernet networks.

☑ Enable IEEE 802.1x authentication for this network

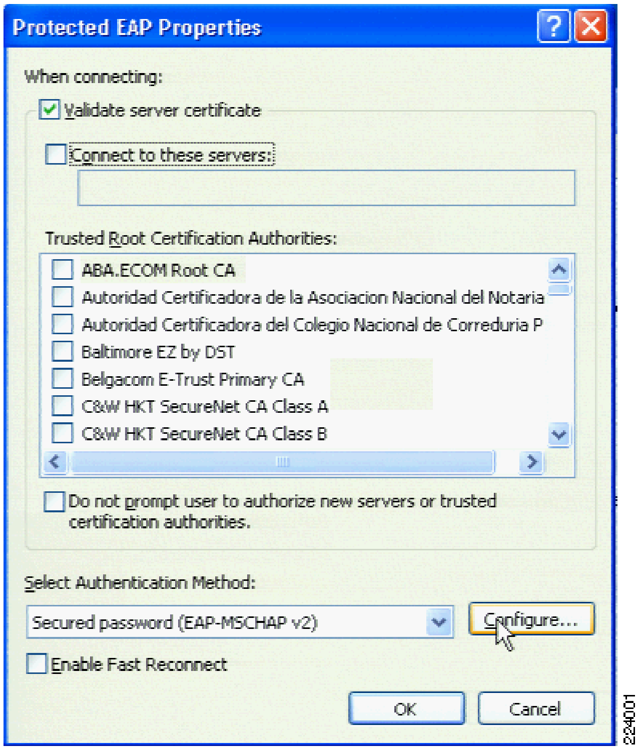
EAP type: Protected EAP (PEAP)

☑ Authenticate as computer when computer information is available

□ Authenticate as guest when user or computer information is unavailable

Step 4 Click **Properties**. The *Protected EAP Properties* window appears. See Figure 3-144.

Figure 3-144 Configure PEAP Properties



Protected EAP Properties

When connecting:

☑ Validate server certificate

□ Connect to these servers:

Trusted Root Certification Authorities:

□ ABA.ECOM Root CA
□ Autoridad Certificadora de la Asociacion Nacional del Notaria
□ Autoridad Certificadora del Colegio Nacional de Correduria P
□ Baltimore EZ by DST
□ Belgacom E-Trust Primary CA
□ C&W HKT SecureNet CA Class A
□ C&W HKT SecureNet CA Class B

□ Do not prompt user to authorize new servers or trusted certification authorities.

Select Authentication Method:

Secured password (EAP-MSCHAP v2)

□ Enable Fast Reconnect

Step 5 Select *Validate Server Certificate*.

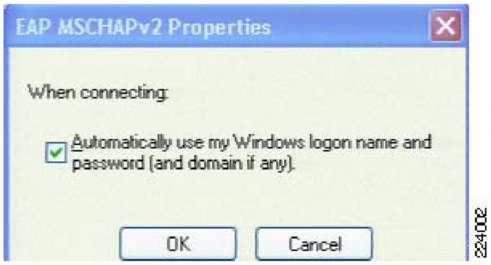
Tip If PEAP-MSCHAPv2 authentication fails with Validate Server Certificate checked—but passes when this option is unchecked, the client does not have the root certificate of the CA that signed the ACS's certificate in the proper Trusted Root Authority store.

Step 6 [Optional] By default, the supplicant will accept any valid server certificate that has been signed by a trusted root CA. To restrict the server certificates that a supplicant will accept, check the *Connect to These Servers* box (Figure 3-144) and enter the CN of the servers that the supplicant should accept.

Step 7 [Optional] If your security policy requires it, prevent the supplicant from prompting the user to accept certificates from unknown servers by checking the *Do not prompt user to authorize new servers or trusted certification authorities* option (Figure 3-144). This command only takes effect if the *Connect to These Servers* checkbox has been configured in the previous step. If this box is checked, a certificate from an unknown server will always result in failed authentication even if the certificate is signed by a trusted CA. If your security policy allows users to choose which servers can be authenticated against, then leave the box unchecked. If this box is not checked and an unknown ACS presents a certificate signed by a trusted CA, the end user will be prompted to accept the unknown server's certificate. If the user clicks **OK**, then the CN will be automatically added to the trusted servers list and the user will not be prompted again.

Step 8 In the *Protected EAP Properties* window (Figure 3-144), under *Select Authentication Method*, select *Secured password* (*EAP-MSCHAP v2*) from the dropdown menu and click **Configure**. The *EAP MSCHAPv2 Properties* window appears. See Figure 3-145.

Figure 3-145 Configure MSCHAPv2 Properties



EAP MSCHAPv2 Properties

When connecting:

☑ Automatically use my Windows logon name and password (and domain if any).

Step 9 Select *Automatically use my Windows logon name password* and click **OK** to return to the *Protected EAP Properties* window. This enables the supplicant to use the username, password and domain entered at the Windows login screen for the MSCHAPv2 exchange without having to prompt the user for credentials a second time (Single Sign-On).

Step 10 [Optional] If you wish to enable Fast Session Reconnect and it was previously configured on the ACS (see "Step 4: Configure PEAP-MSCHAPv2 Settings on the ACS" section on page 3-112), check *Enable Fast Reconnect*. Click **OK** to return to the main *Authentication* tab.

Caution A known defect with the native supplicant in the Microsoft XP SP2 operating system can cause PEAP to fail when fast-reconnect is enabled on the ACS. For a hotfix, contact Microsoft and reference KB885453. As a workaround, disable fast reconnect on both the ACS and on the supplicant.

Step 11 In the *Authentication* tab, check *Authenticate as computer when computer information is available to enable machine authentication*. Click **OK**.

Note *Authenticate as Guest* has no effect when using PEAP-MSCHAPv2 with Windows Single Sign-On. Leave this option unchecked.

Step 12 The supplicant will begin authentication.

Deploying EAP-FAST

The section describes how to configure EAP-FAST with Automatic Anonymous PAC provisioning. As discussed in the "Deployment Recommendations (EAP-TLS)" section on page 2-4, Anonymous provisioning enables rapid deployment of EAP-FAST without the complexities of certificates and PKI. The deployment recommendations section also discussed important security considerations associated with this type of EAP-FAST deployment that should be carefully reviewed prior to deploying EAP-FAST in this way.

The following inner methods are configured in this section:

- Anonymous Phase 0 provisioning with inner method of MSCHAPv2
- Phase 2 with inner method of EAP-GTC

The password used for both phases is acquired from the user when he or she logs into Windows (Single Sign-On). ACS verifies this password with the user password stored in Active Directory during both phases.

EAP-FAST Configuration Steps

Configuring EAP-FAST consists of the following steps:

- Step 1: Configure EAP-FAST Settings on the ACS, page 3-139
- Step 2: Specify and Configure the Catalyst Switch as a AAA Client, page 3-142
- Step 3: Configure the External User Databases, page 3-142
- Step 4: CSSC Client Configuration for EAP-FAST, page 3-142

Step 1: Configure EAP-FAST Settings on the ACS

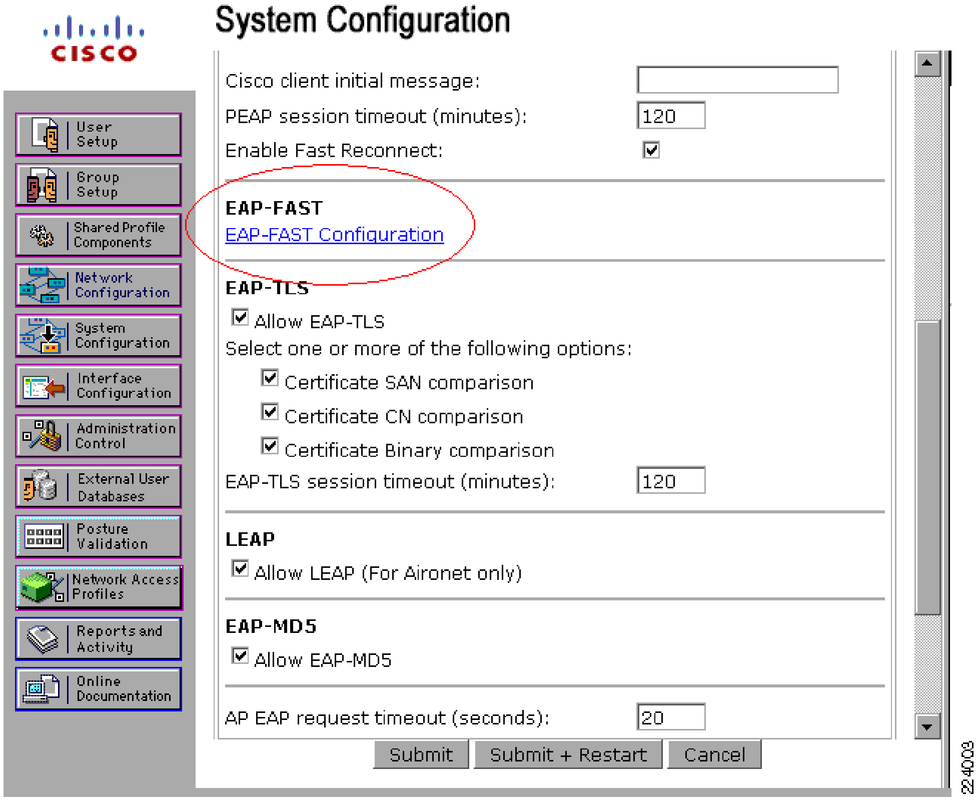
The EAP-FAST settings are configured on the Global Authentication Setup page on the ACS.

Step 1 Open ACS Admin from the desktop shortcut created during the installation.

Step 2 Click **System Configuration**.

Step 3 Click **Global Authentication Setup**. This results in the window presented in Figure 3-146.

Figure 3-146 EAP-Fast Global Configuration



System Configuration

Cisco client initial message:

PEAP session timeout (minutes): 120

Enable Fast Reconnect: ☑

EAP-FAST

EAP-FAST Configuration

EAP-TLS

☑ Allow EAP-TLS

Select one or more of the following options:

☑ Certificate SAN comparison

☑ Certificate CN comparison

☑ Certificate Binary comparison

EAP-TLS session timeout (minutes): 120

LEAP

☑ Allow LEAP (For Aironet only)

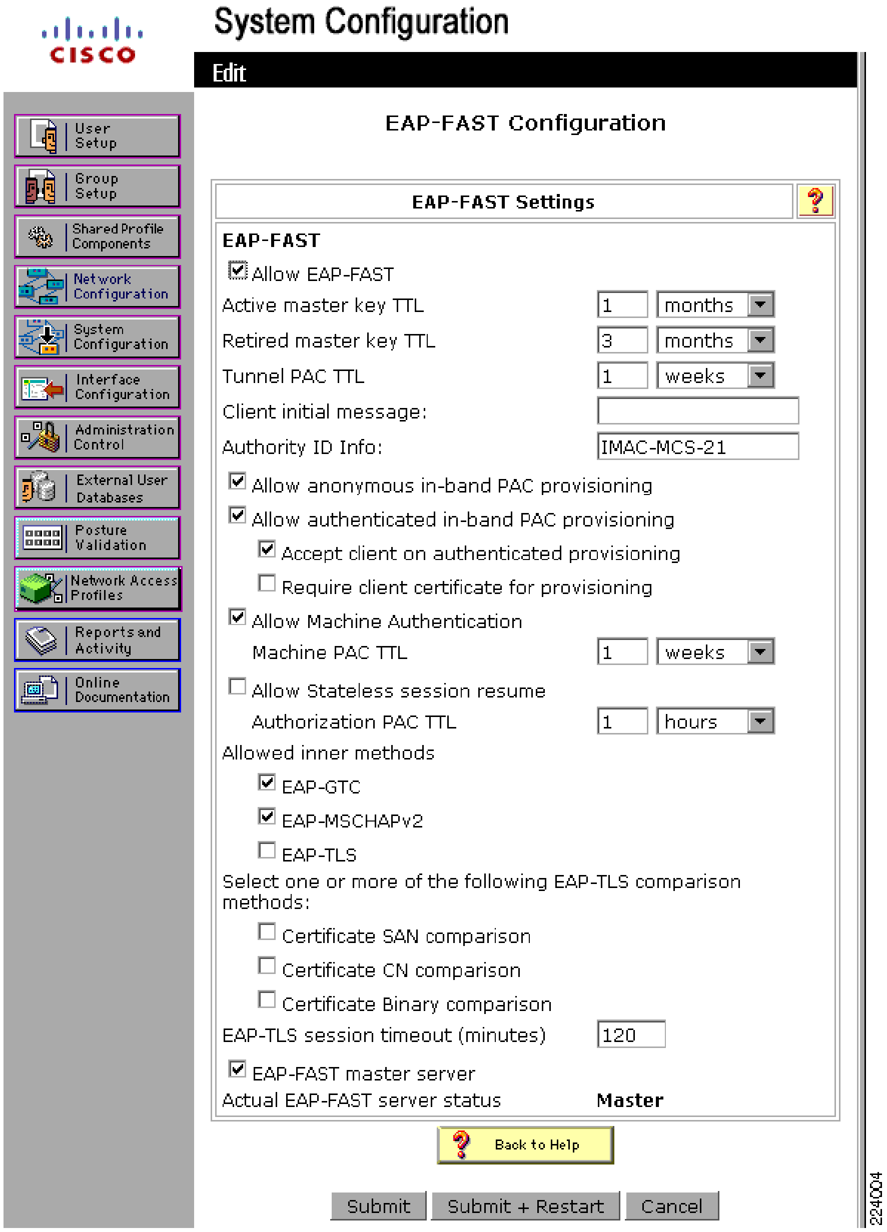
EAP-MD5

☑ Allow EAP-MD5

AP EAP request timeout (seconds): 20

Step 4 Under *EAP-FAST*, click **EAP-FAST Configuration**. The *EAP-FAST Configuration* window appears. See Figure 3-147.

Figure 3-147 EAP Fast Configuration



EAP-FAST Configuration

EAP-FAST Settings	
EAP-FAST	
☑ Allow EAP-FAST	
Active master key TTL	1 months
Retired master key TTL	3 months
Tunnel PAC TTL	1 weeks
Client initial message:	
Authority ID Info:	IMAC-MCS-21
☑ Allow anonymous in-band PAC provisioning	
☑ Allow authenticated in-band PAC provisioning	
☑ Accept client on authenticated provisioning	
□ Require client certificate for provisioning	
☑ Allow Machine Authentication	
Machine PAC TTL	1 weeks
□ Allow Stateless session resume	
Authorization PAC TTL	1 hours
Allowed inner methods	
☑ EAP-GTC	
☑ EAP-MSCHAPv2	
□ EAP-TLS	
Select one or more of the following EAP-TLS comparison methods:	
□ Certificate SAN comparison	
□ Certificate CN comparison	
□ Certificate Binary comparison	
EAP-TLS session timeout (minutes)	120
☑ EAP-FAST master server	
Actual EAP-FAST server status	**Master**

Step 5 Select *Allow EAP-FAST.*

Step 6 Configure the *PAC TTL* (time to live) expiration timers in accordance with your security policy.

Step 7 Configure the *Authority-ID*. This is a mandatory field that can be used by the client to determine which ACS server is to be authenticated against.

Step 8 Select *Allow Machine Authentication* to enable EAP-FAST machine authentication.

Step 9 [Optional] Select *Allow Stateless Session resume* and an *Authorization PAC TTL* expiration time.

Note Similar to EAP-TLS Session Resume and PEAP-MSCHAPv2 Fast Reconnect, EAP-FAST Stateless Session Resume shortcuts the reauthentication process by having the client present a special *Authorization PAC* in place of a full Phase 2 inner-method authentication. This Authorization PAC, which is completely separate from the Tunnel PAC which is used to create the Phase 1 tunnel, is provisioned on the client by the ACS. If a client attempts to reauthenticate with a valid Authorization PAC in the time period specified by the Authorization PAC TTL, then the Phase 2 inner method is skipped and the client is allowed access. This optimization is most useful in wireless environments where fast reauthentication is required for roaming.

Step 10 Under *Allowed Inner Methods*, select *EAP-MSCHAPv2* and *EAP-GTC*. For back-compatibility reasons, ACS requires that both methods be configured when using Anonymous PAC provisioning.

Note The list of allowed inner methods applies to both Phase 0 and Phase 2. ACS always uses the first method in the inner method list that is enabled and supported. EAP-GTC is not supported in Phase 0 when Anonymous PAC Provisioning is enabled, so EAP-MSCHAPv2 will be used for Phase 0. EAP-GTC is supported in Phase 2, so EAP-GTC will be used for Phase 2 since it comes before EAP-MSCHAPv2 on this list.

Step 11 Select *EAP-FAST master server*. This permits other ACS servers to utilize this server as the master PAC authority to avoid having to provision unique Master keys for each ACS in a network.

Step 12 Click **Submit + Restart**.

Note All the other settings on this page are used for PKI-enabled environments that can do Authenticated PAC Provisioning and/or EAP-TLS inner methods. They are not required for Anonymous PAC Provisioning with EAP-MSCHAPv2 and EAP-GTC.

Step 2: Specify and Configure the Catalyst Switch as a AAA Client

The procedure is the same as described in the EAP-TLS section. See the "Step 5: Specify and Configure the Catalyst Switch as a AAA Client" section on page 3-50 for details.

Step 3: Configure the External User Databases

The procedure is the same as described in the EAP-TLS section. See the "Step 6: Configure the External User Databases" section on page 3-51 for details.

Step 4: CSSC Client Configuration for EAP-FAST

The steps provided in this section explain how to configure the Cisco Secure Services Client (CSSC) for EAP-FAST authentication with Anonymous provisioning on wired LAN networks.

Note CSSC version 5.0.1.8 is running on Windows XP operating system with Service Pack 2.

There are three components required to install and configure CSSC:

- CSSC client image (CSSC_SSC-XP2K)—802.1X client software that runs on the end host.
- Client Utilities (CiscoClientUtilities)—Troubleshooting tool that runs on the end host.
- Client Management Utility (SSCMgmtToolkit)—Management utility that configures user profiles that can be distributed to the entire organization through a single Extensible Markup Language (XML) file. This utility is typically run on a centralized server. For testing purposes, it can be run on the end client to modify and test the supplicant configuration on the fly.

This section discusses how to use the Management Utility to configure an EAP-TLS profile for the CSSC client. Once created, the user profiles can be bundled with the client image into an *.msi* file which can be deployed using standard deployment tools, including Microsoft Active Directory GPOs, SMS, Altiris, and Novell Zenworks.

Note No certificates are required on the CSSC client for EAP-FAST with Anonymous PAC Provisioning.

Note The Microsoft Windows XP native supplicant does not support EAP-FAST.

Step 1 Create a New Configuration Profile:

This is the same as Step 1 in the "Configuring CSSC for PEAP-MSCHAPv2" section on page 3-114

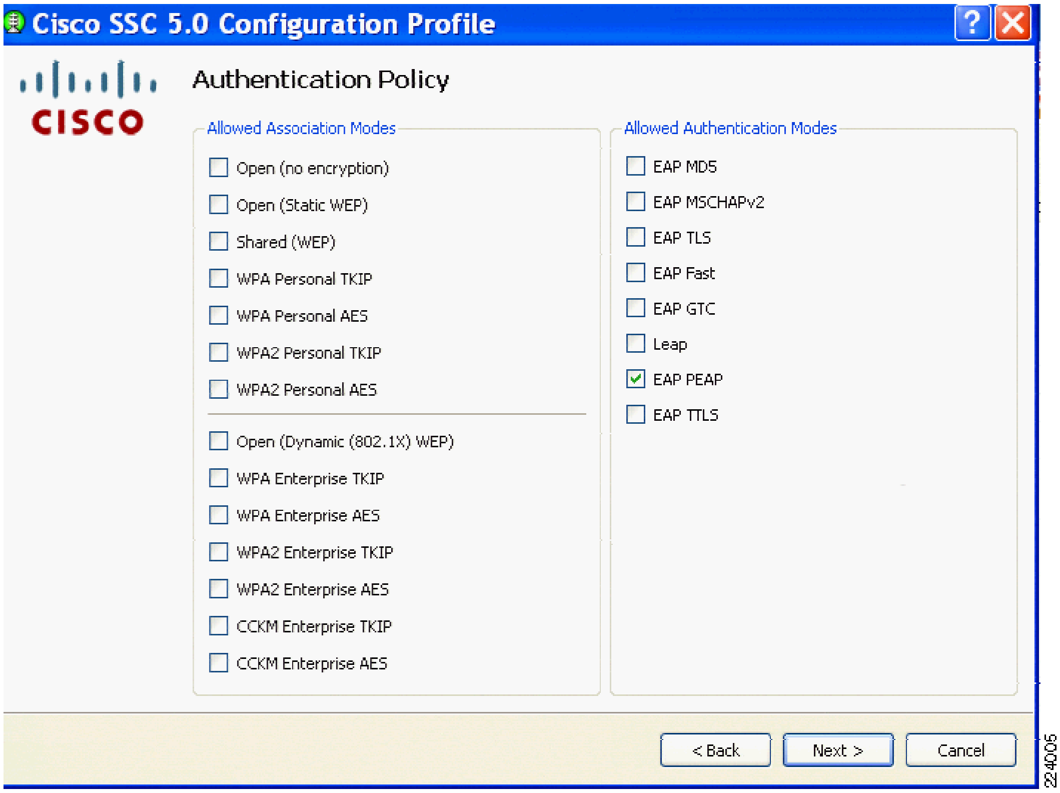
Step 2 Configure Client Policy

This is the same as Step 2 in the "Configuring CSSC for PEAP-MSCHAPv2" section on page 3-114.

Step 3 Configure Authentication Policy

In the *Authentication Policy* window, select *EAP FAST* under *Allowed Authentication Modes* and click **Next**. See Figure 3-148.

Figure 3-148 Configure Authentication Policy



Authentication Policy

Allowed Association Modes

- □ Open (no encryption)
- □ Open (Static WEP)
- □ Shared (WEP)
- □ WPA Personal TKIP
- □ WPA Personal AES
- □ WPA2 Personal TKIP
- □ WPA2 Personal AES
- □ Open (Dynamic (802.1X) WEP)
- □ WPA Enterprise TKIP
- □ WPA Enterprise AES
- □ WPA2 Enterprise TKIP
- □ WPA2 Enterprise AES
- □ CCKM Enterprise TKIP
- □ CCKM Enterprise AES

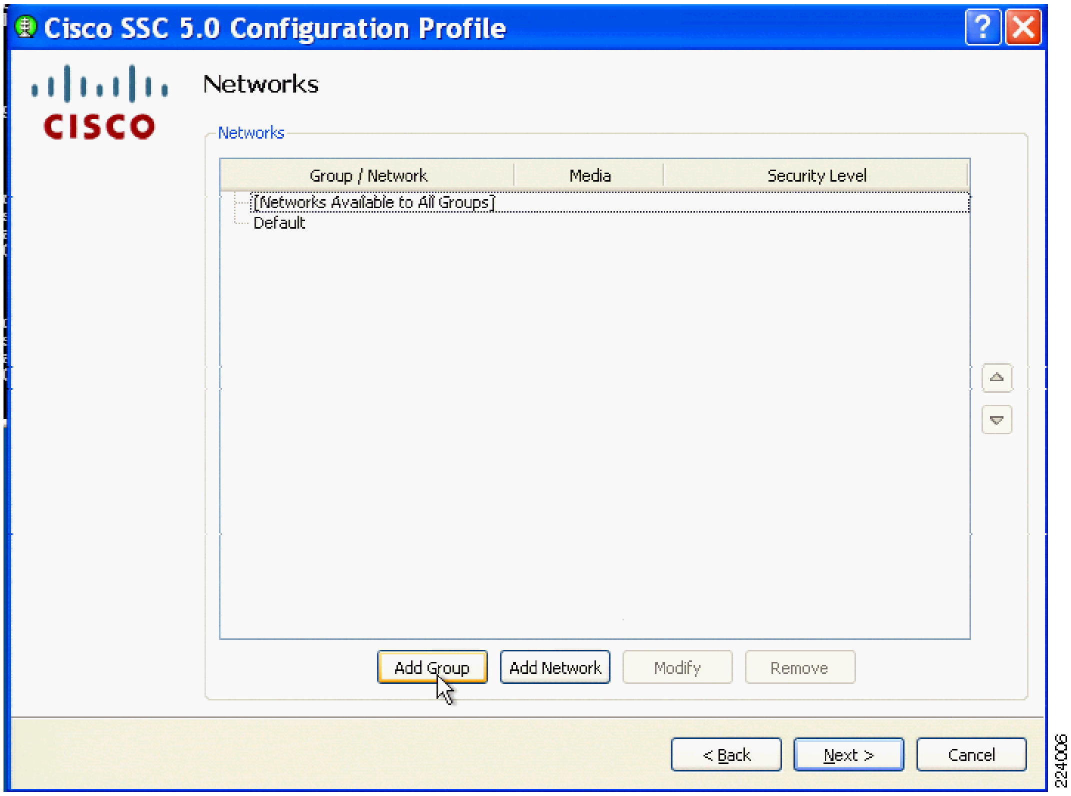
Allowed Authentication Modes

- □ EAP MD5
- □ EAP MSCHAPv2
- □ EAP TLS
- □ EAP Fast
- □ EAP GTC
- □ Leap
- ☑ EAP PEAP
- □ EAP TTLS

Step 4 Create a New Group

1. In the *Networks* window, create a new group by clicking **Add Group**. See Figure 3-149.

Figure 3-149 Add Group



Cisco SSC 5.0 Configuration Profile

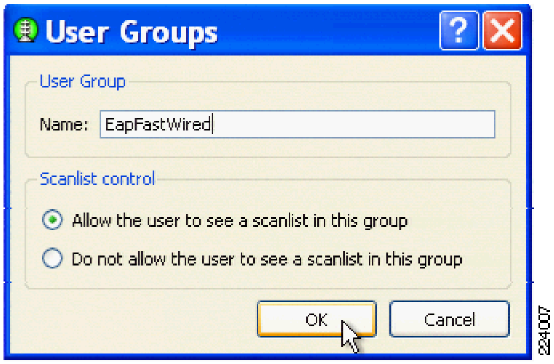
Networks

Networks

Group / Network	Media	Security Level
[Networks Available to All Groups]		
Default		

2. Enter a name for the new group (*EapFastWired* in Figure 3-150) and click **OK**.

Figure 3-150 Add a New Group



User Groups

User Group

Name: EapFastWired

Scanlist control

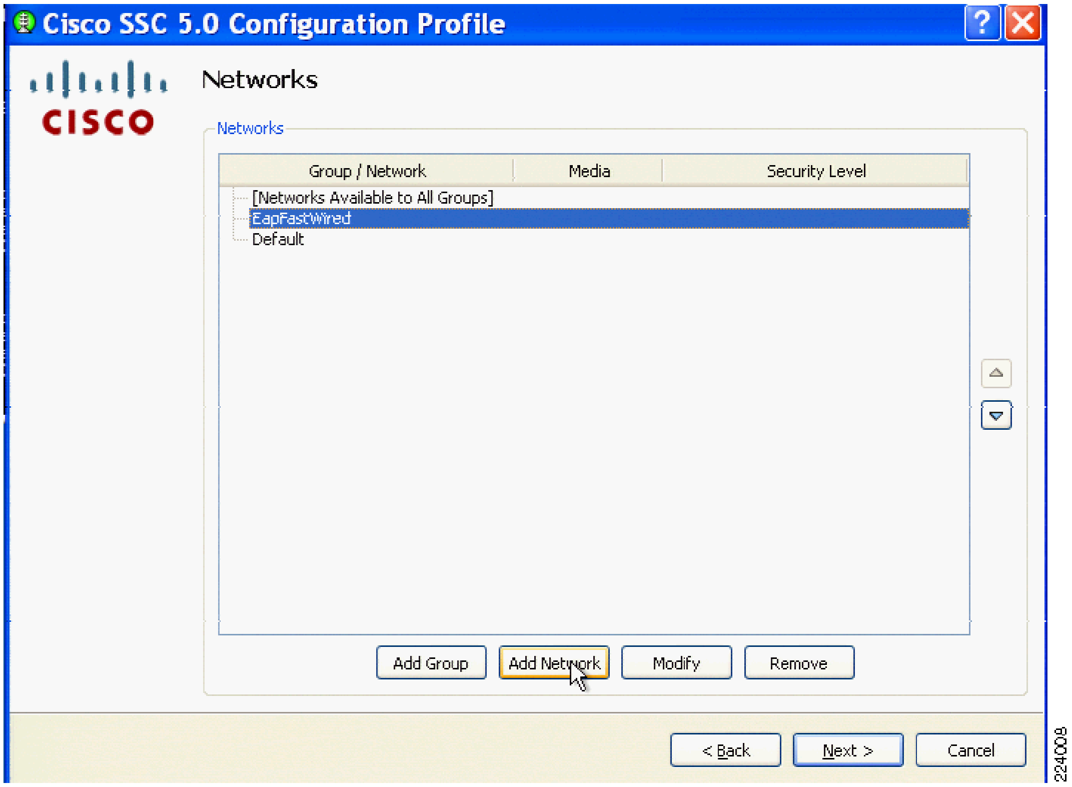
● Allow the user to see a scanlist in this group

○ Do not allow the user to see a scanlist in this group

Step 5 Add a Network to the Group

1. In the main *Networks* window, use the **Up** arrow button on the right side of the window to move the group that was just created (*EapFastWired*) above the *Default* group. Select *EapFastWired* and click **Add Network**. See Figure 3-151.

Figure 3-151 Adding A Network


Cisco SSC 5.0 Configuration Profile

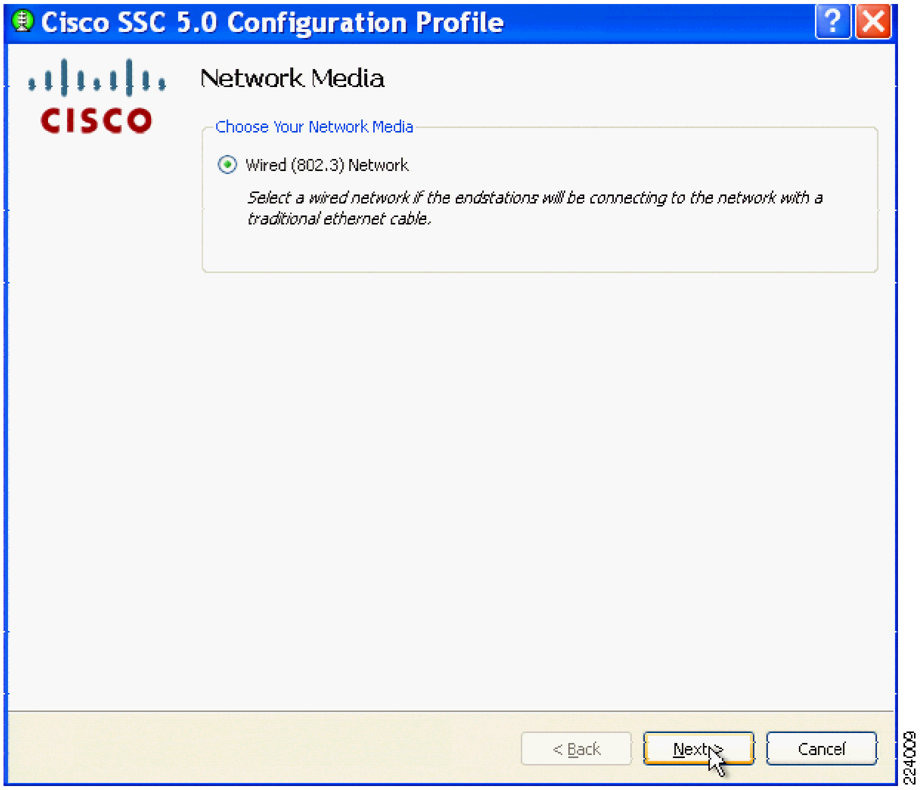
Networks

Networks

Group / Network	Media	Security Level
[Networks Available to All Groups]		
EapFastWired		
Default		

2. In the *Network Media* window, select *Wired (802.3) Network* and click **Next**. See Figure 3-152.

Figure 3-152 Network Media



Network Media

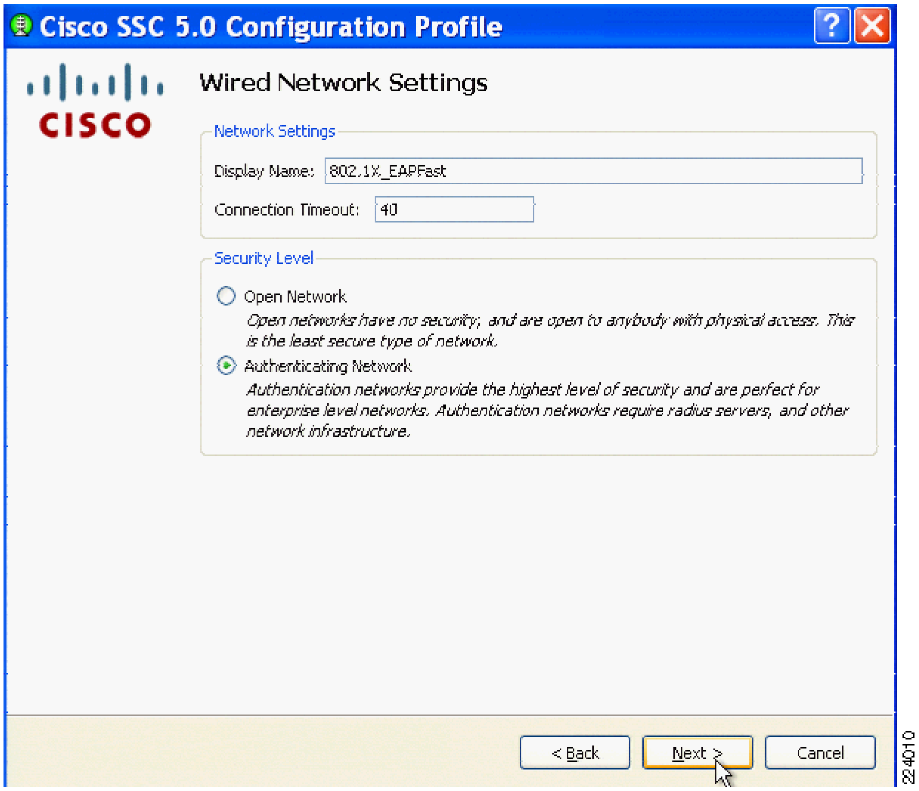
Choose Your Network Media

● Wired (802.3) Network

Select a wired network if the endstations will be connecting to the network with a traditional ethernet cable.

3. Provide a name for the profile and specify the *Authenticating Network* option. Leave the default *Connection Timeout* at 40 seconds. See Figure 3-153.

Figure 3-153 Wired Network Settings



Wired Network Settings

Network Settings

Display Name: 802.1X_EAPFast

Connection Timeout: 40

Security Level

○ Open Network

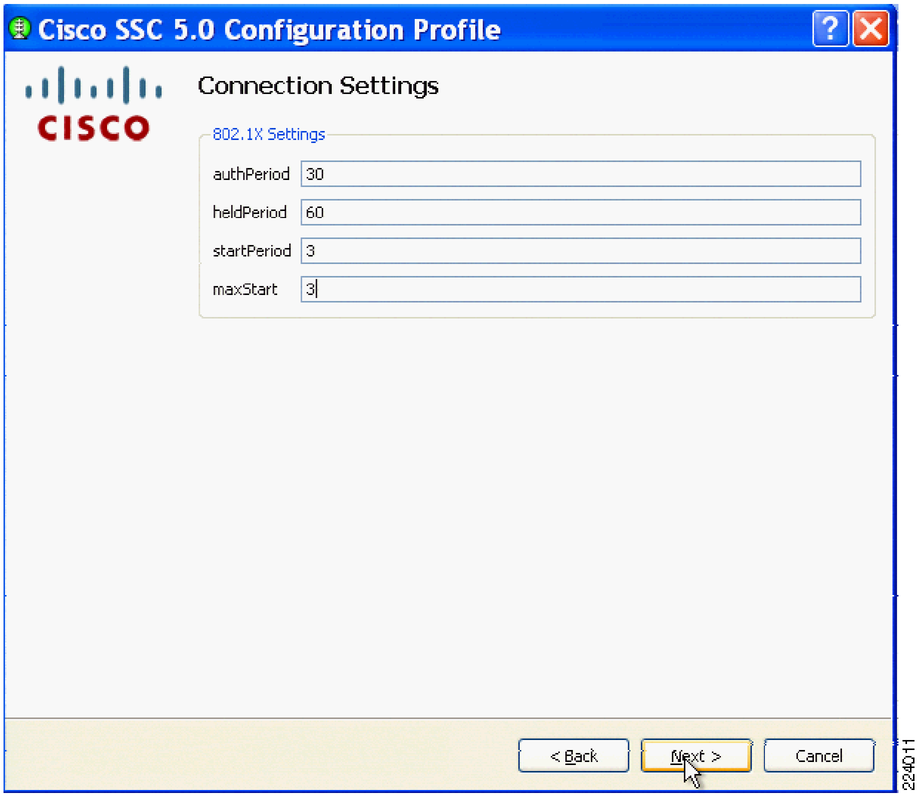
Open networks have no security, and are open to anybody with physical access. This is the least secure type of network.

● Authenticating Network

Authentication networks provide the highest level of security and are perfect for enterprise level networks. Authentication networks require radius servers, and other network infrastructure.

4. See Figure 3-154. Leave the default *Connection Settings* and click **Next**.

Figure 3-154 Connection Settings



Connection Settings

802.1X Settings

authPeriod 30

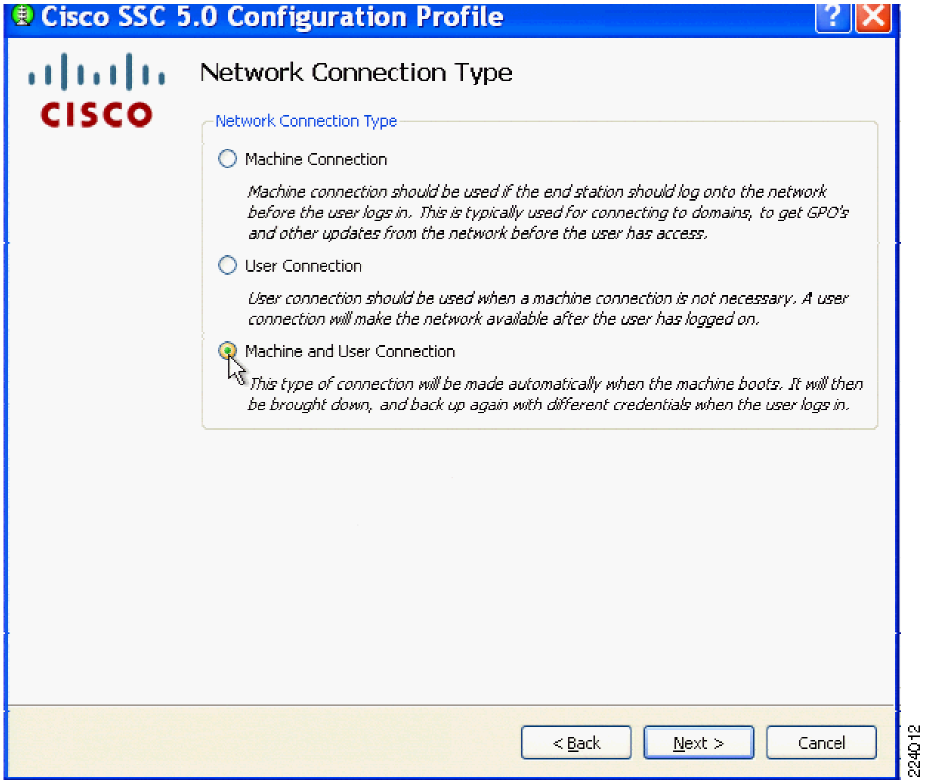
heldPeriod 60

startPeriod 3

maxStart 3

5. See Figure 3-155. Select the type of authentication scenario. To perform machine authentication and user authentication, select the *Machine and User Connection* radio button. Clicking **Next** will initiate Machine Authentication configuration.

Figure 3-155 Network Connection Type



Cisco SSC 5.0 Configuration Profile

Network Connection Type

Network Connection Type

○ Machine Connection

Machine connection should be used if the end station should log onto the network before the user logs in. This is typically used for connecting to domains, to get GPO's and other updates from the network before the user has access.

○ User Connection

User connection should be used when a machine connection is not necessary. A user connection will make the network available after the user has logged on.

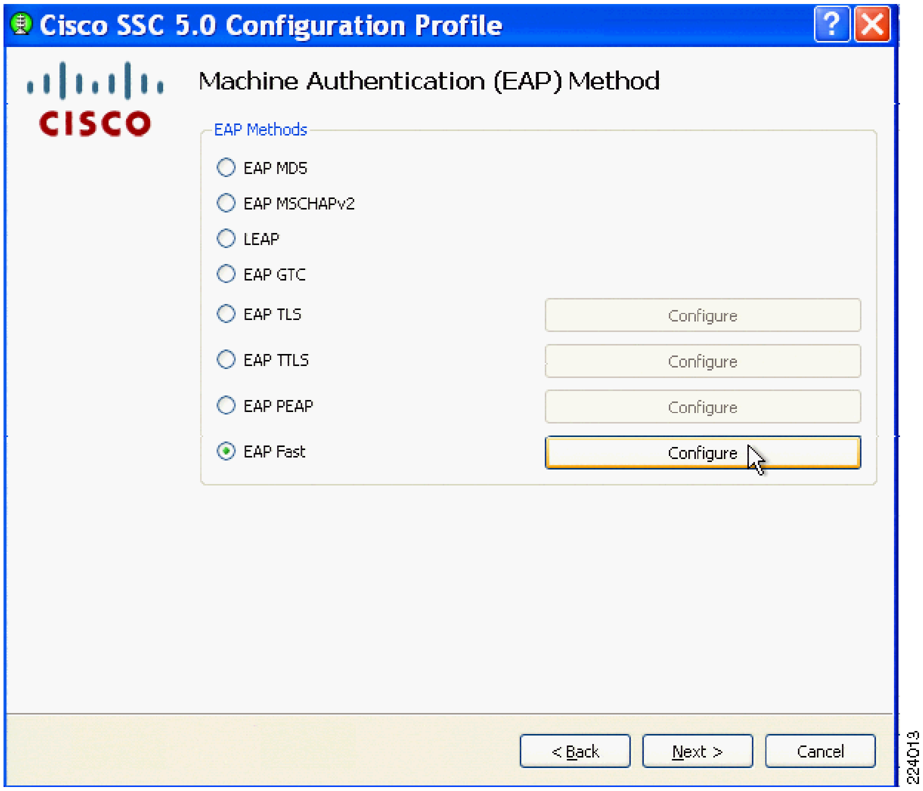
● Machine and User Connection

This type of connection will be made automatically when the machine boots. It will then be brought down, and back up again with different credentials when the user logs in.

Step 6 Configure Machine Authentication Parameters.

1. In the *Machine Authentication* window, select *EAP-Fast* and click the **Configure** button. See Figure 3-156.

Figure 3-156 Machine Authentication Method



Cisco SSC 5.0 Configuration Profile

Machine Authentication (EAP) Method

EAP Methods

○ EAP MD5

○ EAP MSCHAPv2

○ LEAP

○ EAP GTC

○ EAP TLS

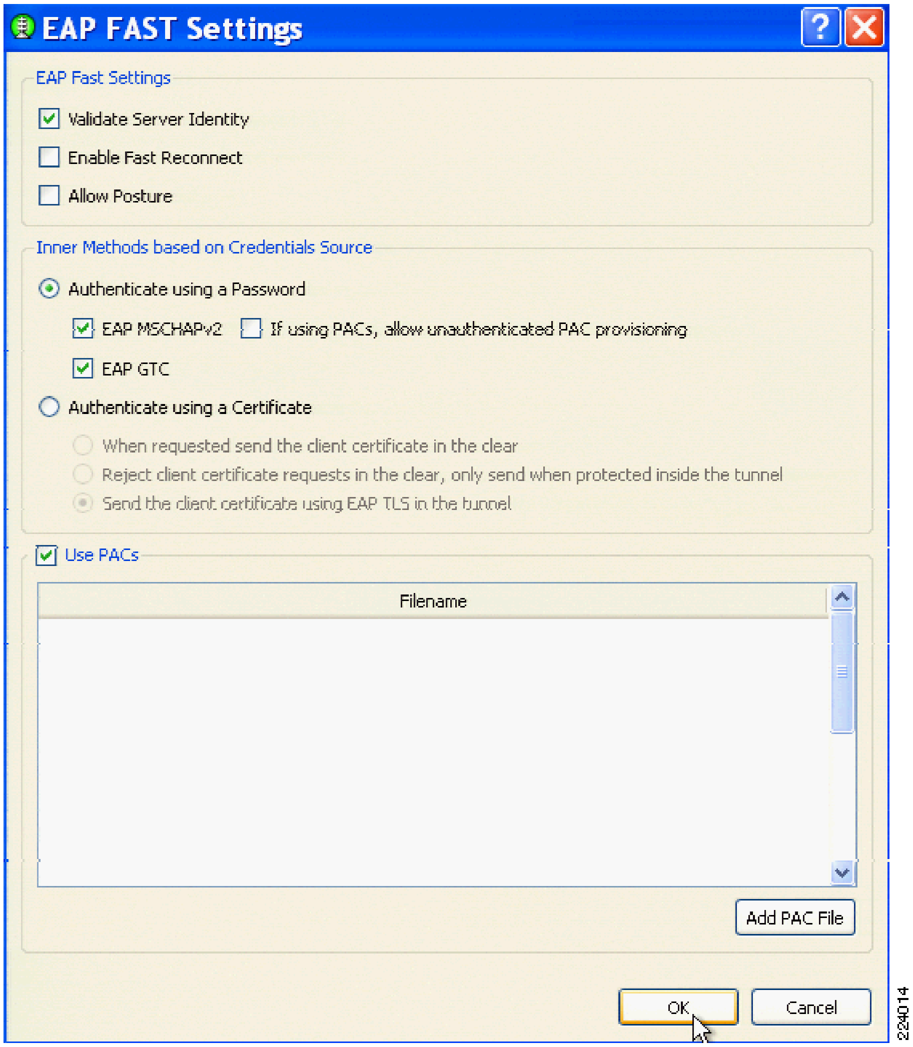
○ EAP TTLS

○ EAP PEAP

● EAP Fast

2. In the *EAP-FAST Settings* window, select *Validate Server Certificate*. Deselect *Enable Fast Reconnect* because this feature is not required for wired scenarios. Deselect *Allow Posture*. Select *Authenticate Using a Password*. Select *Use PACs*. See Figure 3-157.

Figure 3-157 Machine EAP-FAST Settings



EAP FAST Settings

EAP Fast Settings

☑ Validate Server Identity

□ Enable Fast Reconnect

□ Allow Posture

Inner Methods based on Credentials Source

● Authenticate using a Password

☑ EAP MSCHAPv2 □ If using PACs, allow unauthenticated PAC provisioning

☑ EAP GTC

○ Authenticate using a Certificate

○ When requested send the client certificate in the clear

○ Reject client certificate requests in the clear, only send when protected inside the tunnel

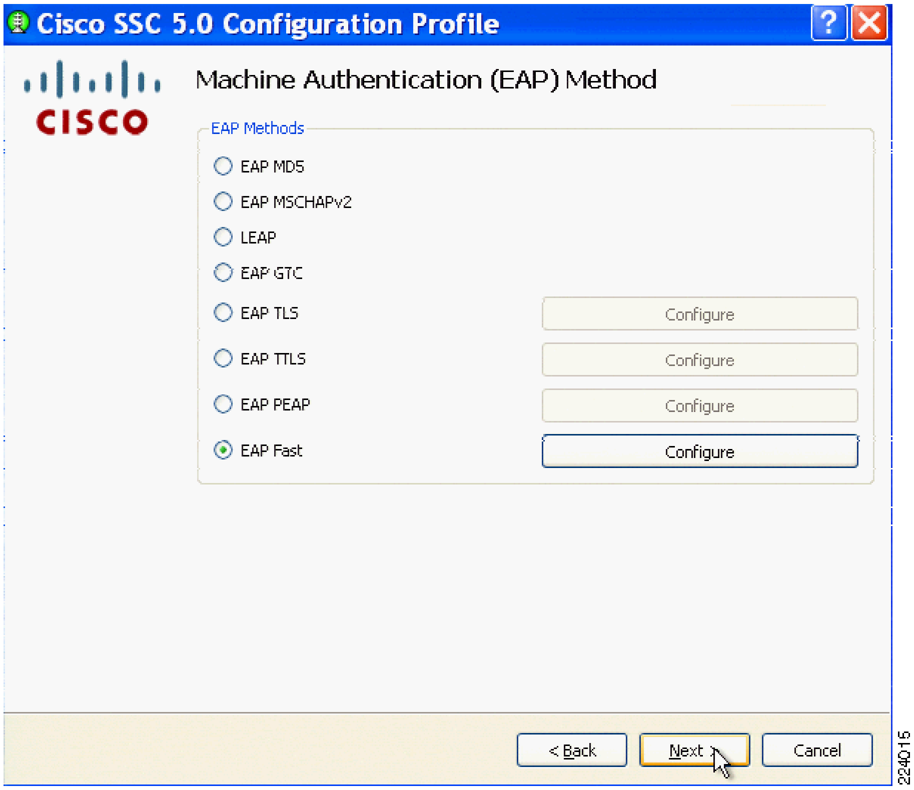
● Send the client certificate using EAP TLS in the tunnel

☑ Use PACs

Filename

3. The configuration utility returns to the *Machine Authentication* window. Click **Next**. See Figure 3-158.

Figure 3-158 Machine Authentication Method Complete



Cisco SSC 5.0 Configuration Profile

Machine Authentication (EAP) Method

EAP Methods

○ EAP MD5

○ EAP MSCHAPv2

○ LEAP

○ EAP GTC

○ EAP TLS

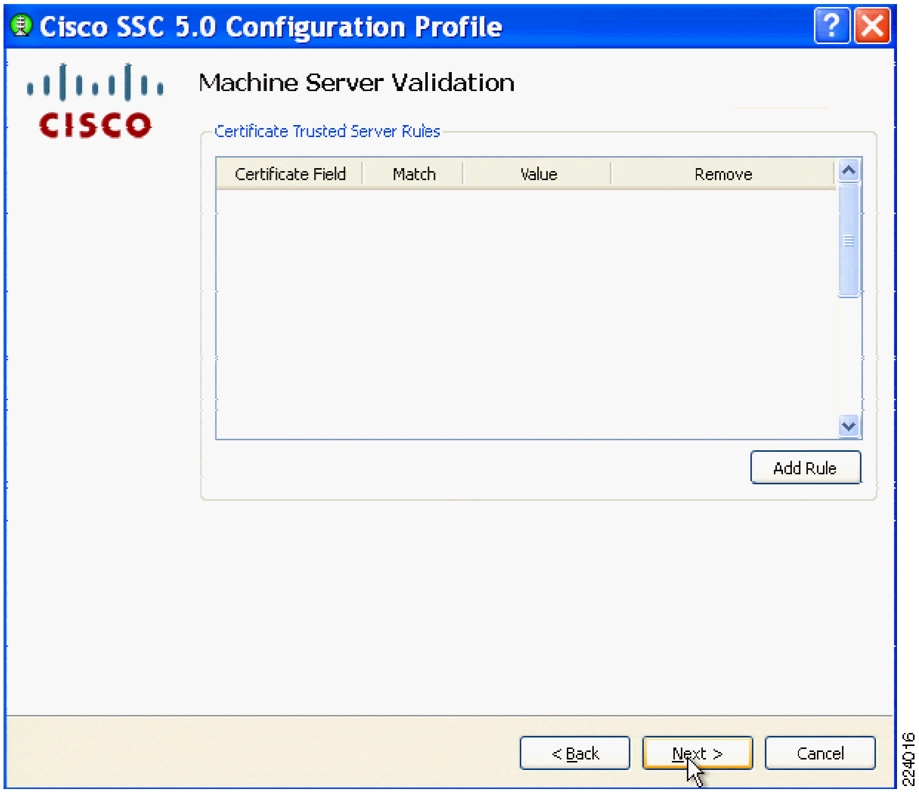
○ EAP TTLS

○ EAP PEAP

● EAP Fast

4. [Optional] The *Machine Server Validation* window can be used to restrict the ACS servers from which the client will accept a certificate authentication during machine authentication. If no *Rule* is added in this window, the client will accept any server certificate that has been signed by a trusted root CA. Click **Next**. See Figure 3-159.

Figure 3-159 Machine Server Validation



Cisco SSC 5.0 Configuration Profile

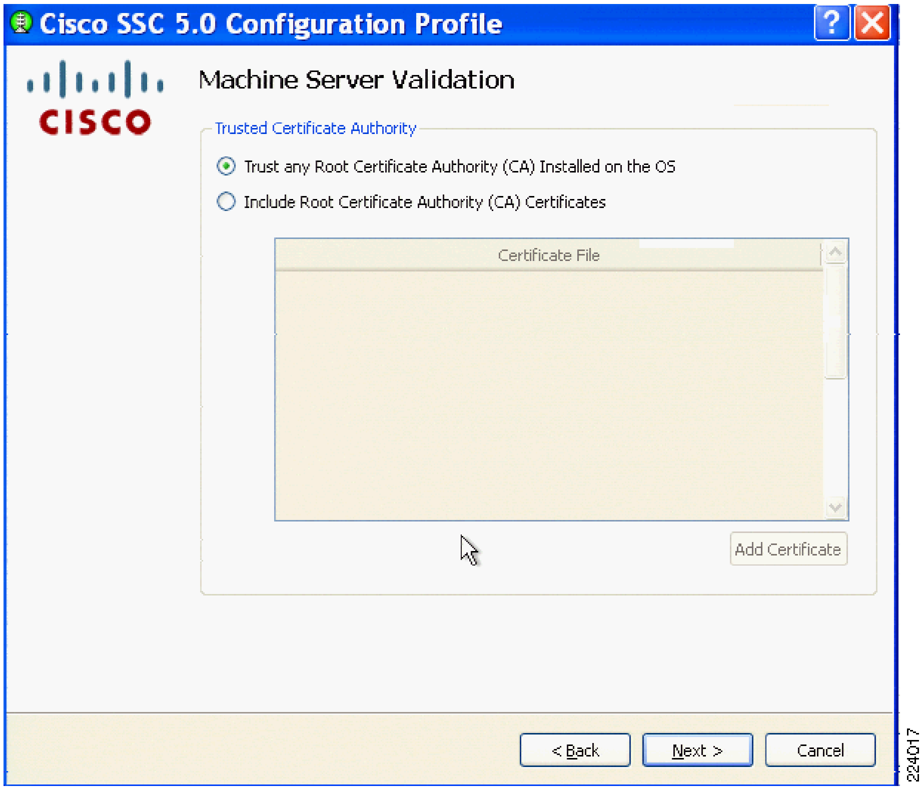
Machine Server Validation

Certificate Trusted Server Rules

Certificate Field	Match	Value	Remove

5. [Optional] If desired, use this window to restrict which root CAs the client will trust to sign the ACS server certificate. Click **Next** to accept the default setting. See Figure 3-160.

Figure 3-160 Machine CA Selection



Cisco SSC 5.0 Configuration Profile

Machine Server Validation

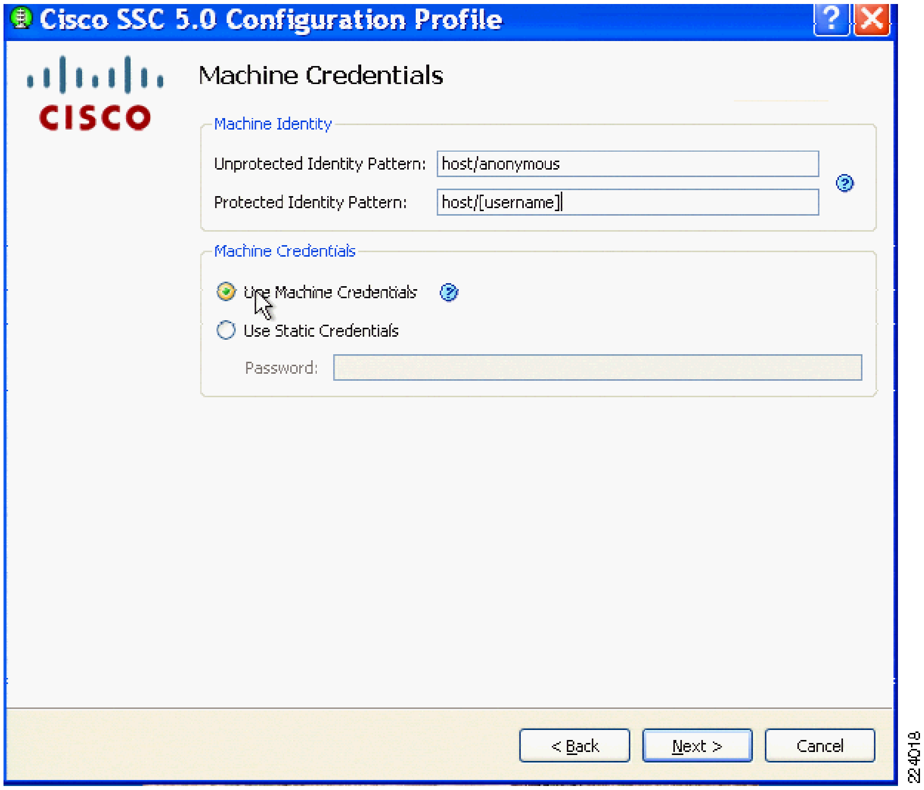
Trusted Certificate Authority

● Trust any Root Certificate Authority (CA) Installed on the OS

○ Include Root Certificate Authority (CA) Certificates

6. In the *Machine Credentials* window, leave the default for the unprotected identity and the protected identity. The client will replace [*username*] with the machine name. The *Machine Credentials* option instructs the client to use the machine password provided by Microsoft Active Directory. See Figure 3-161.

Figure 3-161 Machine Credentials



Cisco SSC 5.0 Configuration Profile

Machine Credentials

Machine Identity

Unprotected Identity Pattern: host/anonymous

Protected Identity Pattern: host/[username]

Machine Credentials

● Use Machine Credentials

○ Use Static Credentials

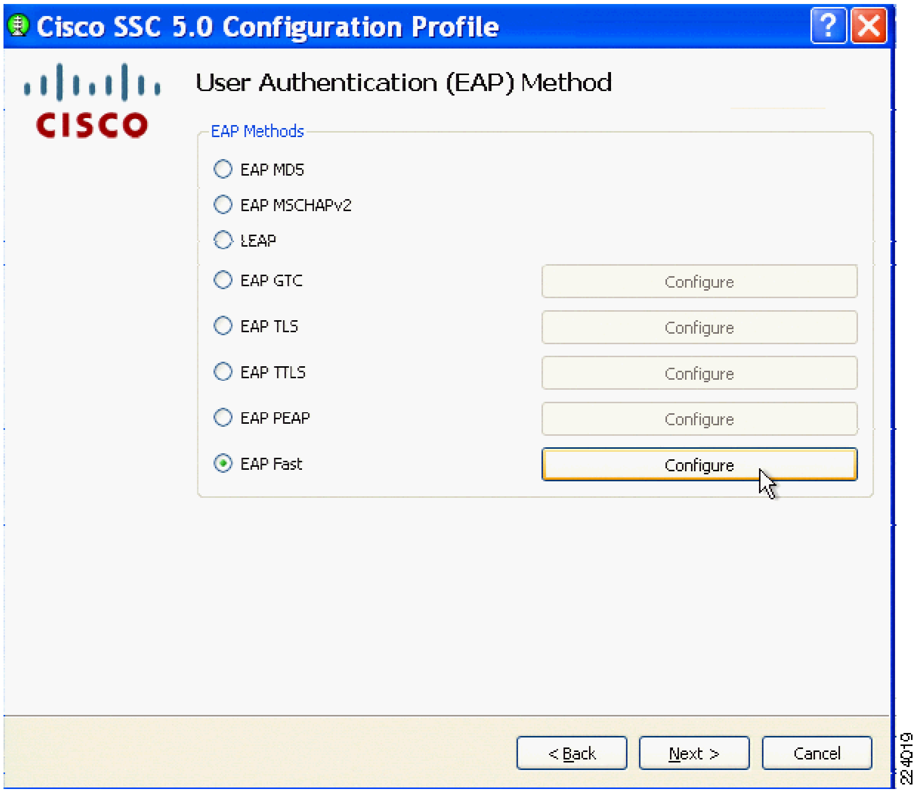
Password:

7. Click **Next** to begin configuring User Authentication.

Step 7 Configure User Authentication.

1. In the *User Authentication Method* window, select *EAP-Fast* and click **Configure**. See Figure 3-162.

Figure 3-162 User Authentication Method



Cisco SSC 5.0 Configuration Profile

User Authentication (EAP) Method

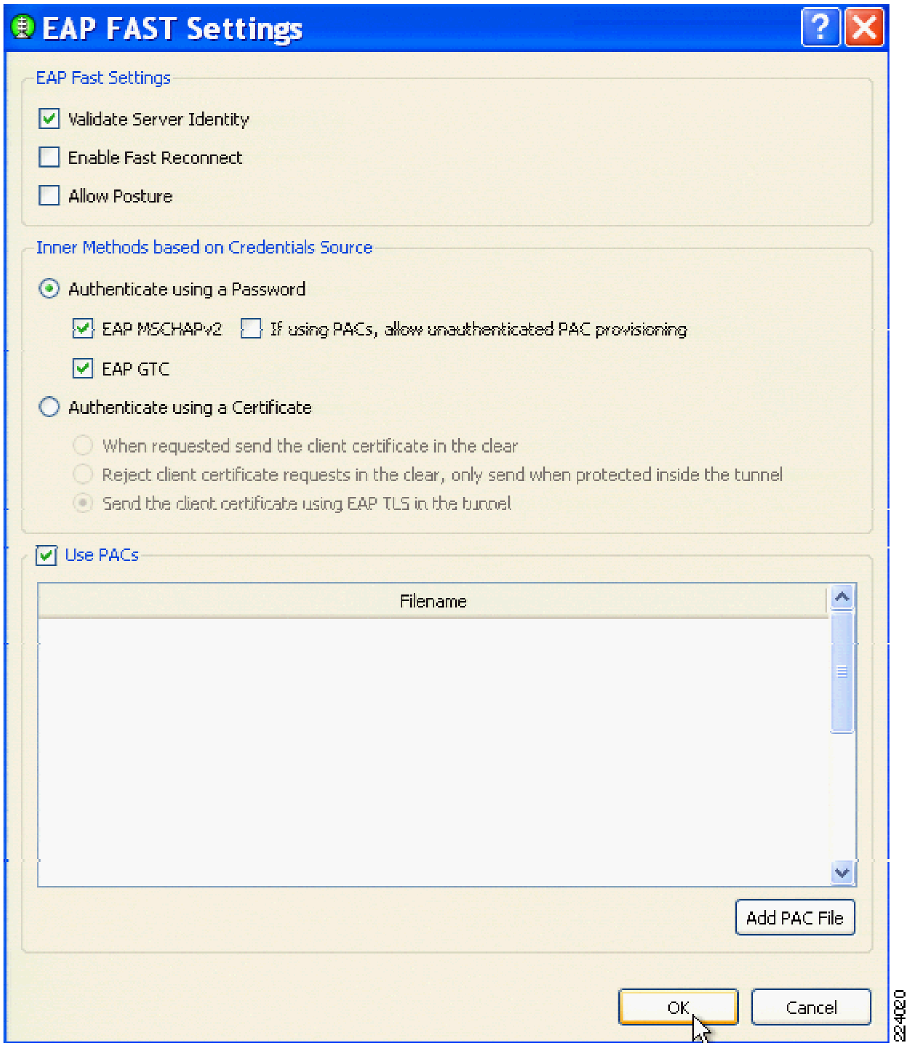
EAP Methods

○ EAP MD5
○ EAP MSCHAPv2
○ LEAP
○ EAP GTC Configure
○ EAP TLS Configure
○ EAP TTLS Configure
○ EAP PEAP Configure
● EAP Fast Configure

< Back | Next > | Cancel

2. In the *EAP-FAST Settings* window, select *Validate Server Certificate*. Deselect *Enable Fast Reconnect* since this feature is not required for wired scenarios. Deselect *Allow Posture*. Select *Authenticate Using a Password*. Select *Use PACs*. Click **OK**. See Figure 3-163.

Figure 3-163 User EAP-FAST Settings



EAP FAST Settings

EAP Fast Settings

☑ Validate Server Identity

□ Enable Fast Reconnect

□ Allow Posture

Inner Methods based on Credentials Source

● Authenticate using a Password

☑ EAP MSCHAPv2 □ If using PACs, allow unauthenticated PAC provisioning

☑ EAP GTC

○ Authenticate using a Certificate

○ When requested send the client certificate in the clear

○ Reject client certificate requests in the clear, only send when protected inside the tunnel

● Send the client certificate using EAP TLS in the tunnel

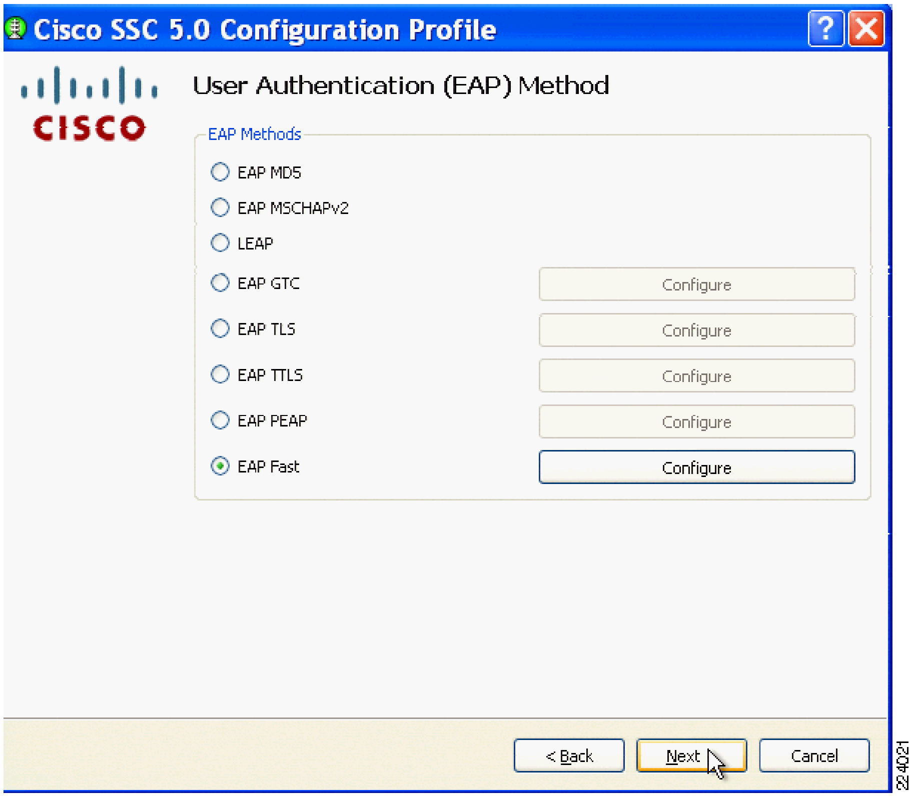
☑ Use PACs

Filename

Note If authentication passes when *Validate Server Identity* is unchecked but fails when it is checked, then the supplicant does not have the certificate for the Root CA that signed the ACS's certificate in the appropriate certificate store.

3. In the main *User Authentication Method* window, click **Next**. See Figure 3-164.

Figure 3-164 User Authentication Method Complete



Cisco SSC 5.0 Configuration Profile

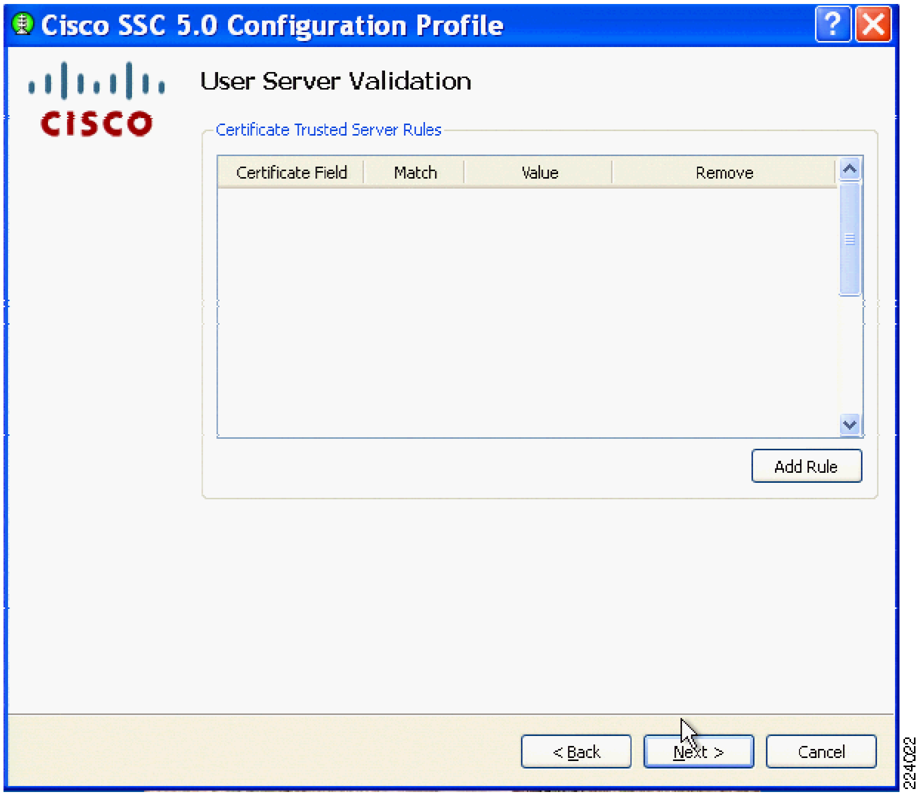
User Authentication (EAP) Method

EAP Methods

○ EAP MD5
○ EAP MSCHAPv2
○ LEAP
○ EAP GTC
○ EAP TLS
○ EAP TTLS
○ EAP PEAP
● EAP Fast

4. [Optional] The *User Server Validation* window can be used to restrict the ACS servers from which the client will accept a certificate authentication during user authentication. If no *Rule* is added in this window, the client will accept any server certificate that has been signed by a trusted root CA. Click **Next**. See Figure 3-165.

Figure 3-165 User Server Validation



Cisco SSC 5.0 Configuration Profile

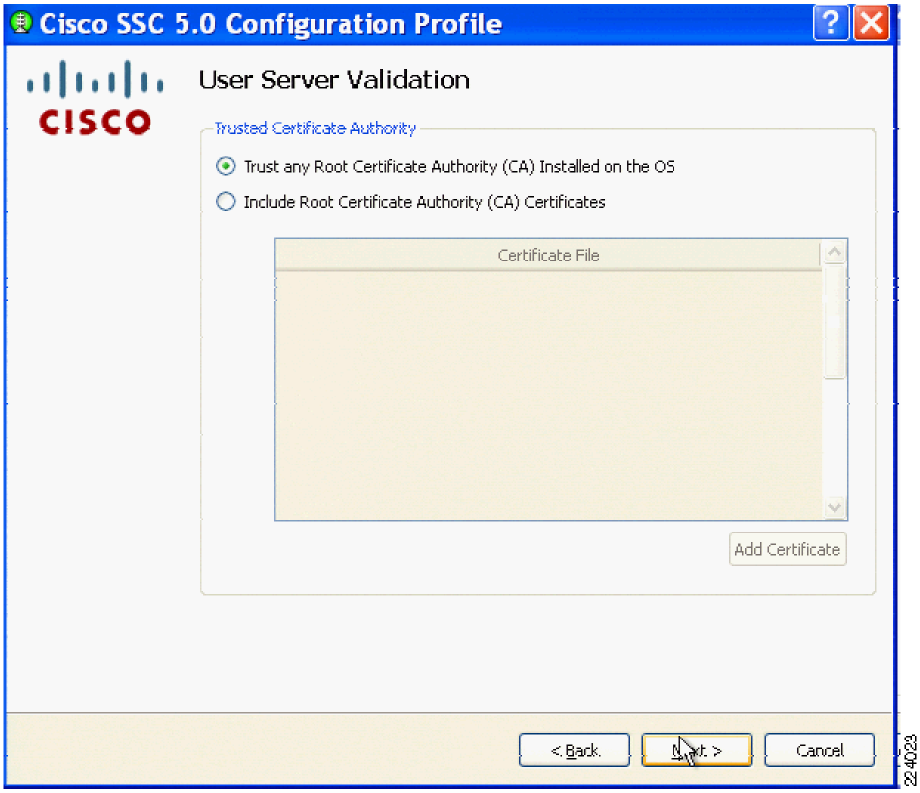
User Server Validation

Certificate Trusted Server Rules

Certificate Field	Match	Value	Remove

5. [Optional] If desired, use this window to restrict which root CAs the client will trust to sign the ACS server certificate during user authentication. Click **Next** to accept the default setting. See Figure 3-166.

Figure 3-166 User CA Validation



User Server Validation

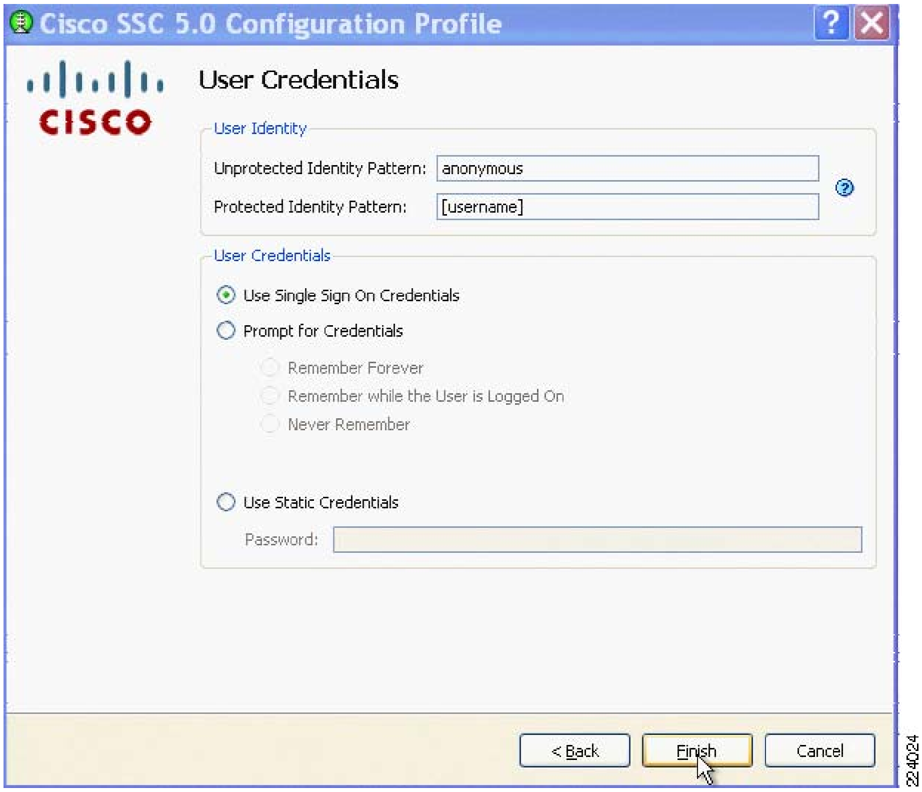
Trusted Certificate Authority

● Trust any Root Certificate Authority (CA) Installed on the OS

○ Include Root Certificate Authority (CA) Certificates

6. In the *User Credentials* window, leave *anonymous* as the unprotected identity and [*username*] as the unprotected identity. Select *Use Single Sign On*. CSSC will automatically replace the [*username*] placeholder with the username that was entered during the Windows logon. Click **Finish**. The Validation window will appear. See Figure 3-167.

Figure 3-167 User Credentials



Unprotected Identity Pattern: anonymous

Protected Identity Pattern: [username]

● Use Single Sign On Credentials

○ Prompt for Credentials

○ Remember Forever

○ Remember while the User is Logged On

○ Never Remember

○ Use Static Credentials

Password:

Note about Protected and Unprotected Identity

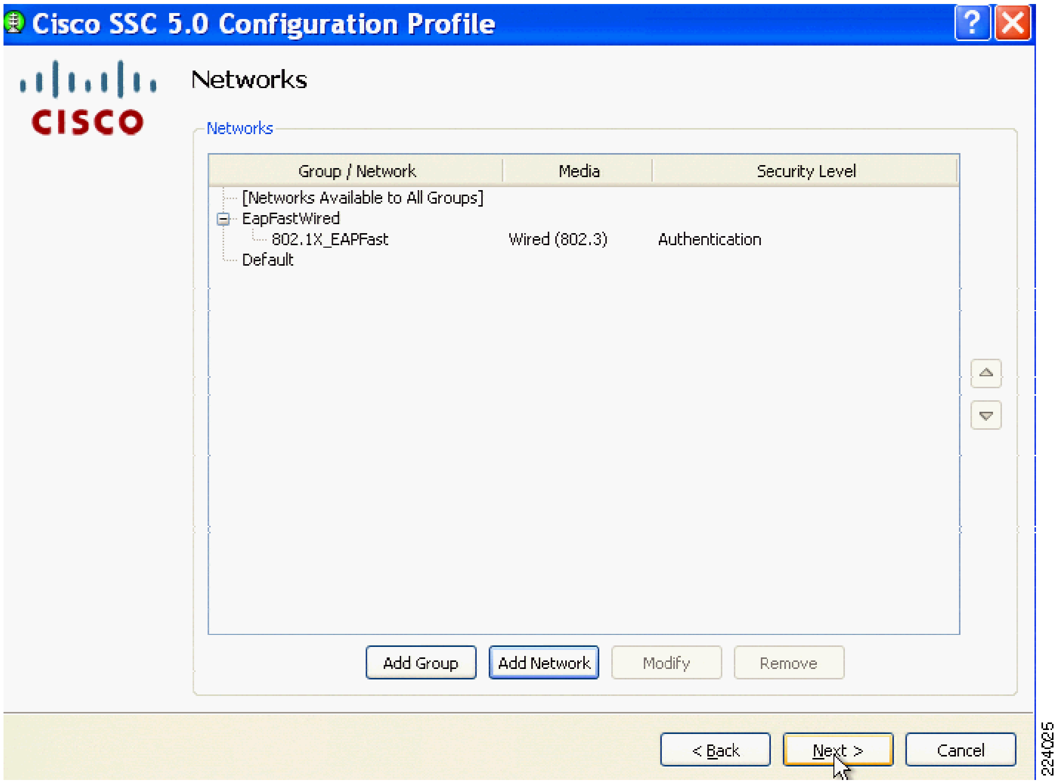
The EAP Identity field in EAP Identity Response messages is sometimes referred to as the outer or *unprotected* identity since it is sent in the clear, outside the protected TLS tunnel. PEAP has the option of sending *anonymous* instead of the actual username in the Identity field. If the outer identity is anonymous, the user's real identity is conveyed inside the protected tunnel, ensuring that a Sniffer cannot detect the true username from the EAP exchange. When the outer identity is anonymous, the inner or *protected* identity is used to validate the user's credentials against the user database.

Although an anonymous outer identity is more secure, it can make RADIUS accounting more difficult since the authenticator has no knowledge of the protected identity. To alleviate this situation, ACS can send the protected username in the RADIUS Access Accept to the authenticator. Cisco switches reply with this username in RADIUS Accounting records.

Step 8 Validate Configuration.

1. Verify that the group (*EAPFastWired*) has been successfully created with the configured Network (*802.1X_EAPFast*). Click **Next**. See Figure 3-168.

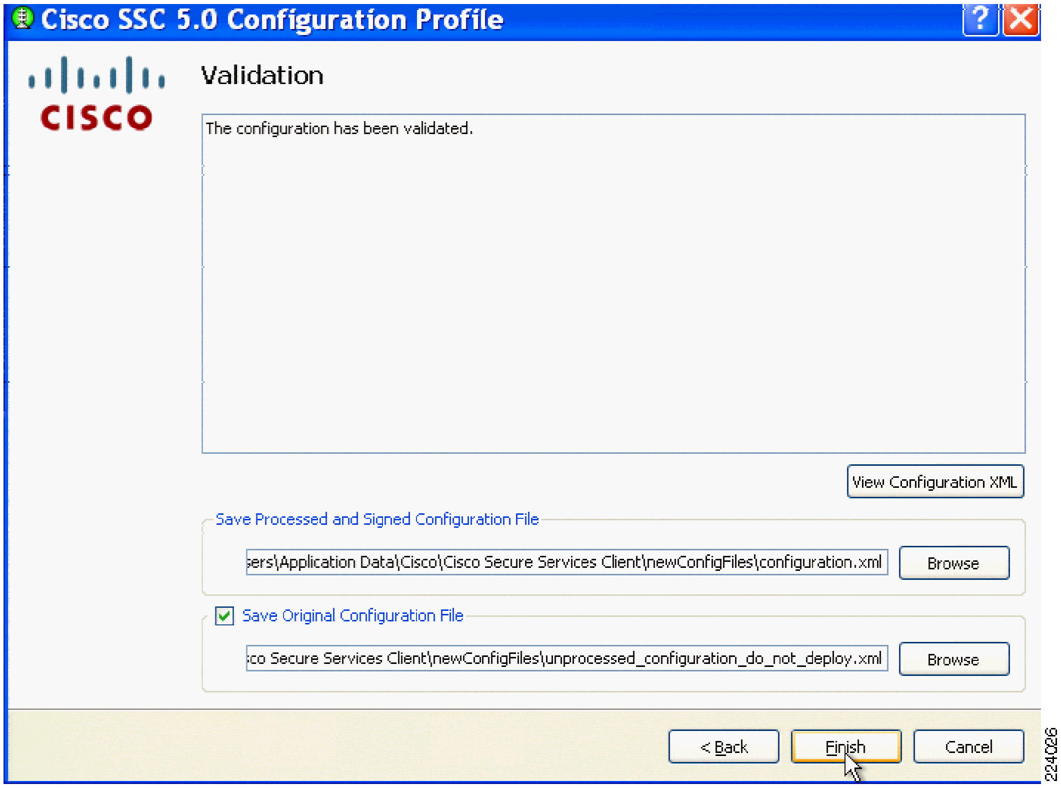
Figure 3-168 Confirm Group Creation



Group / Network	Media	Security Level
[Networks Available to All Groups]		
EapFastWired		
802.1X_EAPFast	Wired (802.3)	Authentication
Default		

2. In the *Validation* window, click **Finish** to save the configuration files. The Processed Configuration file *configuration.xml* can be deployed to the client (this will happen automatically if the Management Utility is running on the same machine as the client software). The Unprocessed Configuration file *unprocessed_configuration_do_not_deploy.xml* should only be used to modify this profile as described in the following step. See Figure 3-169

Figure 3-169 Finish Configuration



Cisco SSC 5.0 Configuration Profile

Validation

The configuration has been validated.

Save Processed and Signed Configuration File

ers\Application Data\Cisco\Cisco Secure Services Client\newConfigFiles\configuration.xml

☑ Save Original Configuration File

co Secure Services Client\newConfigFiles\unprocessed_configuration_do_not_deploy.xml

Step 9 Modify Configuration.

This is the same as Step 9 in "CSSC Configuration" section on page 3-82.

Conclusion and Next Steps

Deploying IEEE 802.1X ensures secure, identity-based access control at the network edge. By authenticating users and known assets with IEEE 802.1X on wired ports, network administrators can ensure that only valid users can access the network.

This publication describes the steps necessary to deploy IEEE 802.1X, from the supplicant on the end host to the switch to the ACS RADIUS server. This paper has also discussed how to integrate commonly used components, such as Microsoft Active Directory and PKI infrastructure, to simplify the deployment and management of the solution.

After deploying IEEE 802.1X as described in this paper, further steps might be required to realize a true end-to-end solution. These steps could include:

- Authenticating users and devices that do not support an 802.1X supplicant
- Assigning granular network access through authorization techniques such as VLAN assignment
- Configuring the solution to support IP Telephony

These topics will be addressed in detail in subsequent documents.