Cisco Network Access Control for HP Thin Clients and CCI

Introduction

This white paper provides a reference implementation of layered security policy enforcement created by integrating HP thin clients and Consolidated Client Infrastructure (CCI) blade PCs with Network Admission Control (NAC) solutions from Cisco. The combination of HP thin clients and Consolidated Client Infrastructure (CCI) blade PCs provides a very robust, secure, and cost-effective computing solution that can be applied to any network. Like any other networked component, it is important to examine security issues associated with their operation. This paper addresses the use of network policy enforcement services with HP thin clients and blade PCs linked to Cisco Clean Access Manager and Clean Access Server NAC appliance built from HP ProLiant DL140 and DL360 serves respectively. This configuration provides strong network policy enforcement to ensure client devices on the network are properly configured; otherwise these clients can be quarantined and/or remediated. Overviews of NAC, as well as usage models and known working implementations, are provided.

The Components

HP PC Client Computing Solutions

HP PC client computing solutions consist of two major components: thin clients and blade PCs. A thin client is a computing device without a hard drive that provides display and input/output for applications running on remotely located servers or blade PCs. A basic thin client consists of a processor, flash memory for storing the embedded operating system, local RAM, a network adapter, and standard input/output for the display and other select peripherals. HP thin clients have no moving parts, offering higher reliability than a PC, lower ownership costs, enhanced security, and extended product life. These small, robust devices consume significantly less energy than a desktop PC, put out less heat into your office spaces, are made with much less material than a desktop, and are practically silent.

HP offers thin clients based on three operating systems: Windows XPe, Debian Linux, and Windows CE. Each operating system provides protection for the OS image housed within the flash device while creating a partition on that flash device to act as a virtual hard drive. Only an account with administrator privileges can make changes to the base image to add applications or operating system patches. With the Windows XPe operating system, HP also includes a Sygate firewall on the base image that locks down all ports except those necessary for typical Microsoft Remote Desktop Protocol (RDP) and Citrix-level connections and general Web browsing. The Sygate settings must be edited to unlock any additional ports on the thin client.

Consolidated Client Infrastructure (CCI) is the enterprise/data center computing architecture through which blade PCs can be allocated to end-users connecting on thin clients. The blade PCs are stored and managed in a centralized location, and are accessed through HP Remote Graphics Software (RGS) or RDP. A remote user can present credentials to the HP Session Allocation Management (SAM) service and be connected to a computing session on a blade PC with access to network resources such as applications and data. Unlike Terminal Services-, Citrix-, or VDI-hosted computing sessions, CCI computing sessions typically match up a connected user onto a blade PC that is not shared, which provides a stable computing experience that does not change as additional users are added to the array of blade PCs.

Although CCI blade PCs are housed in the data center for security, they are full-blooded PC systems running the latest operating systems. As such, it is assumed in this paper that images for blades are configured with a firewall and virus scanning software as a security baseline. For the usage models presented here, the blades were configured to use the native Windows XP firewall, as well as anti-malware software.

Network Access Control

Advancements in computer networking have significantly changed the way people and organizations communicate and access information. Networks have become critical resources in many organizations, providing real-time communications and access, through both the Internet and enterprise intranets. Much of the data available on internal business networks needs to be protected, either to follow data privacy regulations or to protect valuable information assets. As such, the need to provide reliable and secure network access has become a key challenge facing today's Information Technology (IT) organizations.

As organizations take advantage of the benefits of making information available, they also need to consider the security implications. They must protect valuable proprietary information. They also might be responsible for complying with government regulations related to data privacy. This leads to two business objectives that many IT organizations are striving to maximize: data availability and data security. While addressing each of these objectives individually can be straightforward, the methods used to address one often conflict with the other. Therefore, it is important for organizations to address these objectives together.

To meet these needs adequately requires a layered security approach, often defined as Defense in Depth. NAC is one component of such an approach, and should not be considered in isolation. The high level role of NAC is to protect the network and its resources from harmful users and devices or systems. It does this by restricting network access based on certain criteria and business policies. The policies may be quite simple, such as allowing access to a set of known users or devices while denying all others. Or, in order to model more intricate business policies, the policies may be much more complex.

NAC works together with other network security layers such as firewalls, Intrusion Detection and Prevention Systems (IDPS), endpoint security, and so forth to build a defensive posture in your environment. NAC should be used to minimize the risk associated with unauthorized, infected, or improperly configured devices trying to connect to your network.

In its most basic form, NAC allows a network administrator to restrict network access to authorized users and/or devices. However, many organizations have the need to provide, or can benefit from providing, different levels of access depending on the role of the user. For example, employees have access to internal network resources and the Internet while guest users are only provided access to the external Internet.

There is also a need for protection from malicious software, which is accomplished by evaluating the security posture of devices connecting to the network. The security posture required is defined by organizational policies and is based on checking for things such as operating system versions and patches, security software (antivirus, anti-spam, firewalls, etc.), security settings on common software, and other required or prohibited software.

There are many aspects to a complete network security implementation. This white paper addresses use of the Cisco Clean Access Network Admission Control (NAC) appliances and software as applied to HP thin clients and blade PCs to control their access to a production network and the information available on that network. We note here that the NAC acronym for Cisco products denotes "Network Admission Control" which in this paper is synonymous with "Network Access Control."

Cisco Network Admission Control

Cisco Clean Access NAC appliances provides an easily managed way to implement Network Access Control on any network. The NAC Appliance is made up of three components: The Clean Access Manager (CAM), the Clean Access Server (CAS), and the Clean Access Agents (CAA). The CAM serves a Web console allowing configuration of the CAS and CAA components. The CAS actively protects and enforces policy on the network.

Cisco Clean Access NAC appliance can function in Real-IP Gateway mode or Virtual-IP Gateway mode. This reference implementation uses the Virtual-IP Gateway mode of operation. A full description of all the possible choices is beyond the scope of this white paper. For detailed information on implementation choices, refer to detailed Clean Access documentation on the CISCO web site: http://www.cisco.com/en/US/netsol/ns466/networking_solutions_package.html

Implementation Prerequisites

For the purpose of this white paper, we assume a basic network infrastructure is already in place. The reference implementation consists of HP BladeSystem bc1500, bc2000 and bc2500 Blade PCs running Windows XP. HP **Compaq** t5720 Thin Clients (t5720) running Windows XPe are used as access devices.

The network topology for this reference implementation consists of a flat Class-A network setup with topology: 10.xxx.yyy.zzz/24, see Table 1 below.

Component	Operating System	Host Name	IP Address
CAM Server HP Proliant DL140	Linux	cam.cisco.com	10.3.3.3
CAS Server HP Proliant DL360	Linux	cas.cisco.com	10.4.4.4
Thin Client (t5720)	Windows XPe	hptc1.cisco.com	10.6.6.x
Blade PC (bc1500, bc2000, & bc2500)	Windows XP	hpbpc1.cisco.com	10.6.6.x

Table 1 -- Procurve NAC Reference Solution -- Network Topology

A CISCO 3560 layer-3 network switch is used so that 10.6.6.x addresses can be initially configured to a quarantined VLAN and then switched via SNMP upon successfully validating platform to CAS.

The Implementation

NAC Installation

This section covers use of a CISCO CAM and CAS appliances in conjunction with a CISCO layer 3 switch to ensure that thin clients and blade PCs meet configuration policy prior to connection with the trusted network segment. The network topology used in this reference implementation is found in Figure 1 below.

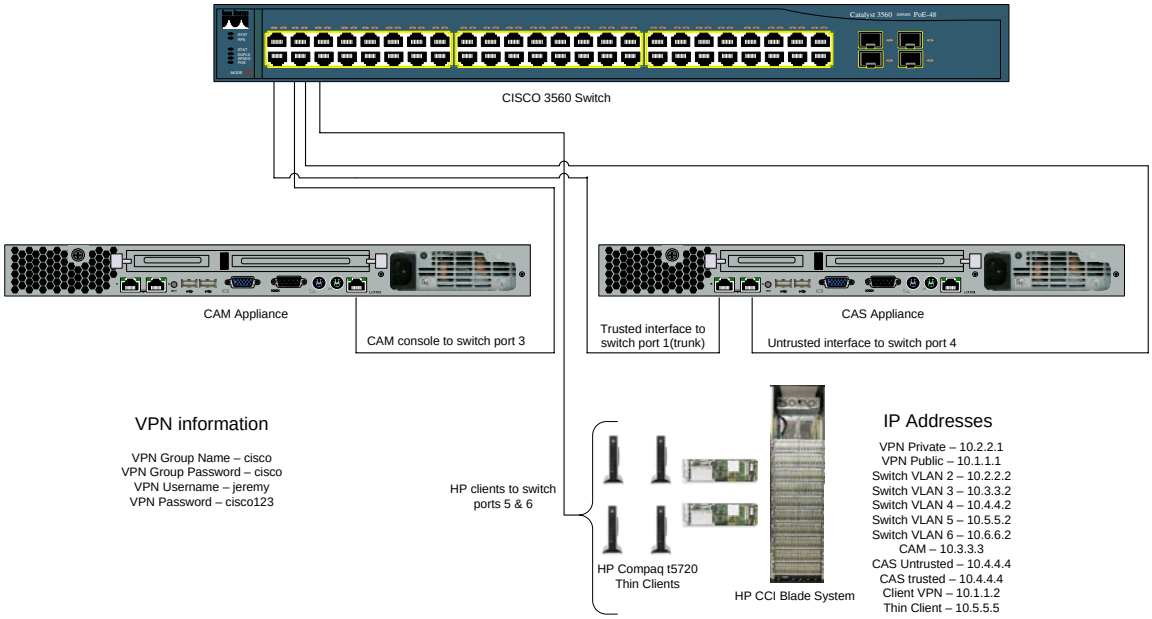


Figure 1 - Reference network topology

The Cisco 3560 switch is configured with VLANs assigned to ports 1 to 5, as shown in Figure 1 above. Full switch configuration settings can be found in Appendix A – CISCO 3560 Switch Configuration.

Configuring Policy Settings

As we are focusing on the integration of NAC into a CCI and thin client *network*, we are exploring only the network policy enforcement settings that are pertinent to thin clients and blade PCs. This does not exhaust all the features of the Cisco NAC solution. Likewise, in a production environment, you may wish to validate many more OS configuration components than are discussed in this reference white paper.

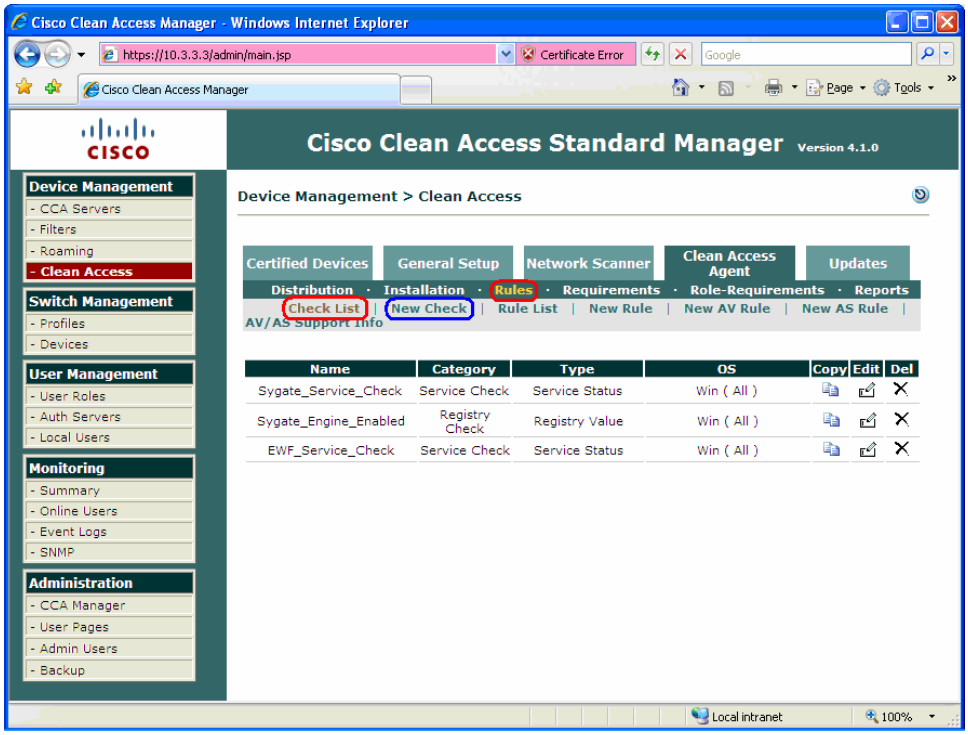
Testing Methods

Tests for compliance are configured in stages via the CAM console for CAS to enforce. First we define checks, each of a single Windows registry setting, service status, program run state, etc. We then define rules as a combination of checks using AND/OR logical operators. We then construct requirements assigned to user roles and encompassing any or all rules we've defined.

Thin Client Policy

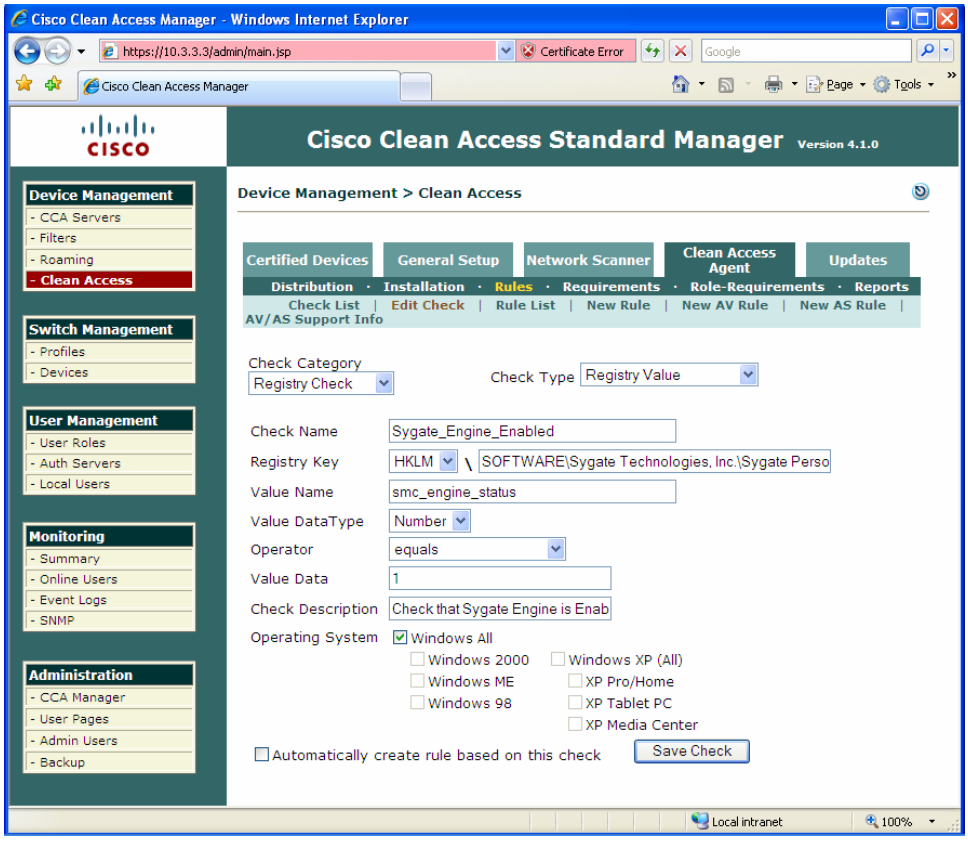
1. Use the Web browser to connect to the Clean Access Manager console at https://10.3.3.3.
2. Click **Clean Access** under **Device Management** in the left panel.
3. Click the **Clean Access Agent** tab, and then click **Rules**.

4. On the figure below, we have defined three checks on thin clients:
    - Status of Sygate Firewall service (Sygate_Service_Check)
    - Sygate Engine actively enabled (Sygate_Engine_Enabled)
    - Status of Enhanced Write Filter service (EWF_Service_Check)



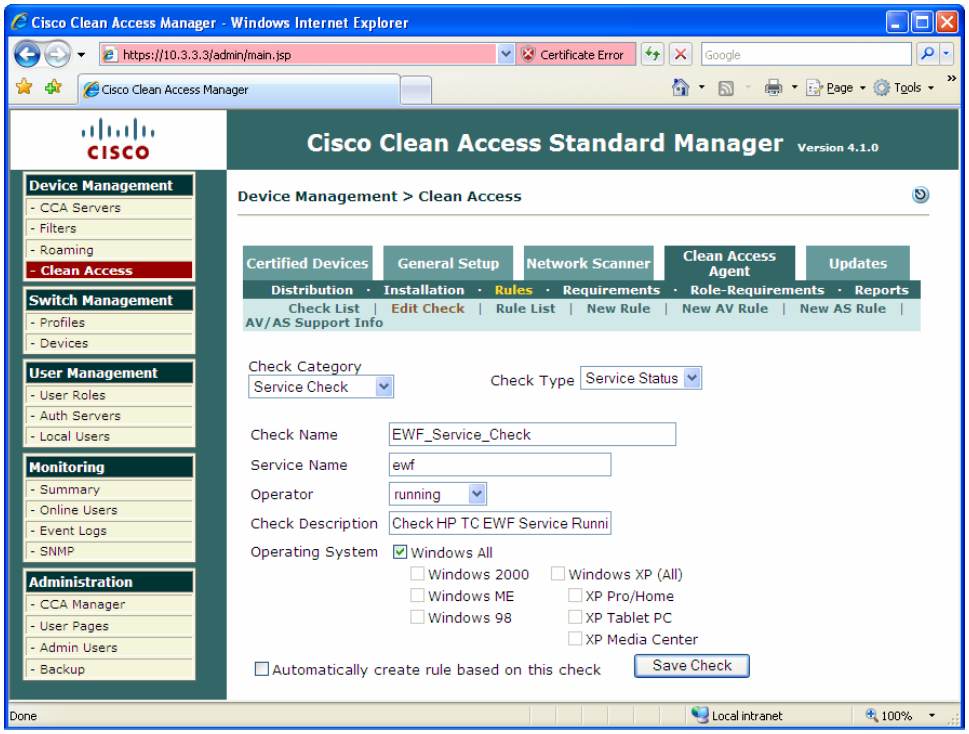
5. To add a Windows program/service/registry check, click **New Check**.

6. Select **Category** and **Type** of check from the respective drop-down menus. In the following illustration, we've selected **Registry Check** and **Registry Value** in order to validate that the Sygate Engine is Enabled.
   NOTE: This is in addition to another setting we'll define later to ensure that the service is running. Our goal is to ensure that Sygate is both running and enabled in order to access the network.

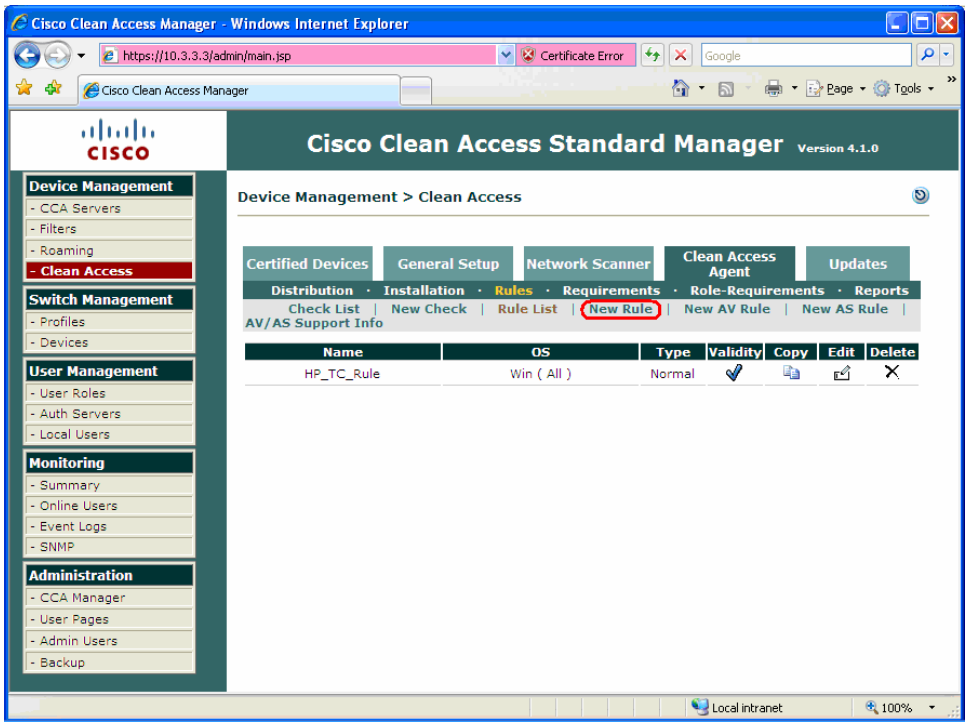


7. For this reference implementation, ensure that the option for creating rules based on this check is not selected. Click **Save Check**.

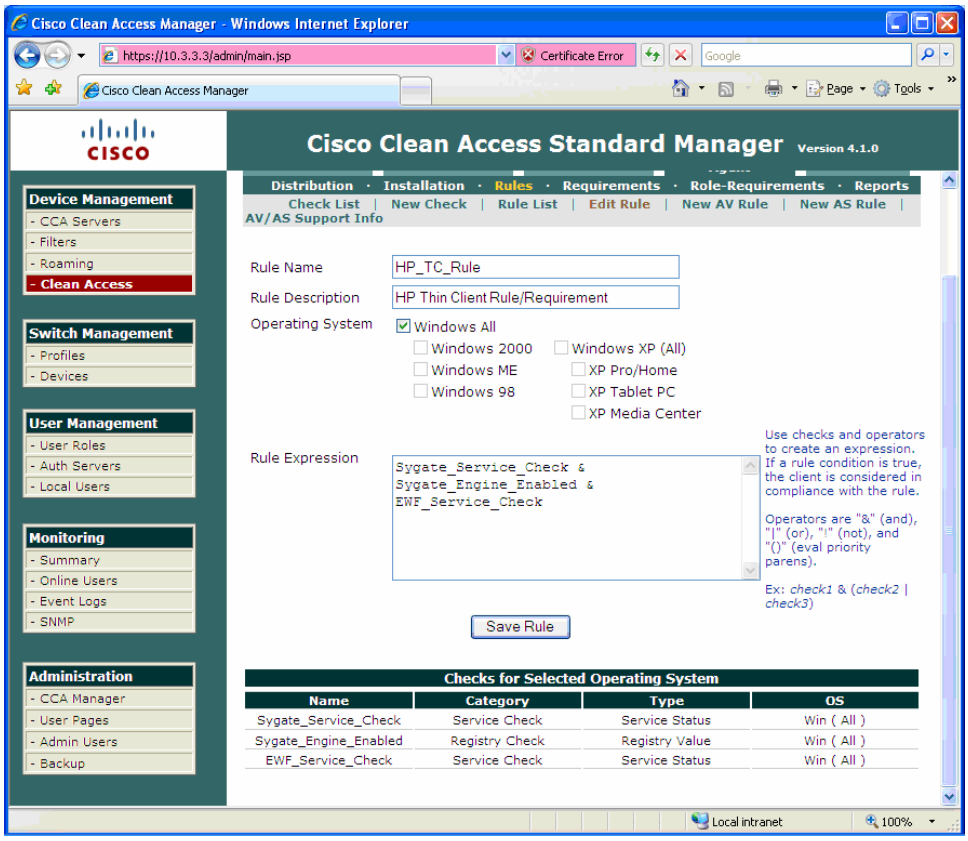
8. Repeat steps 5 – 7 to add a check for **Enhanced Write Filter (EWF) Service** and **Sygate Firewall Service**. The EWF final selections are indicated in the following illustration.



Next, set rules comprising the AND and OR policies of individual checks. For this white paper, we'll set an AND policy comprising all three checks defined so far: Sygate service running, Sygate service active, and EWF service running.

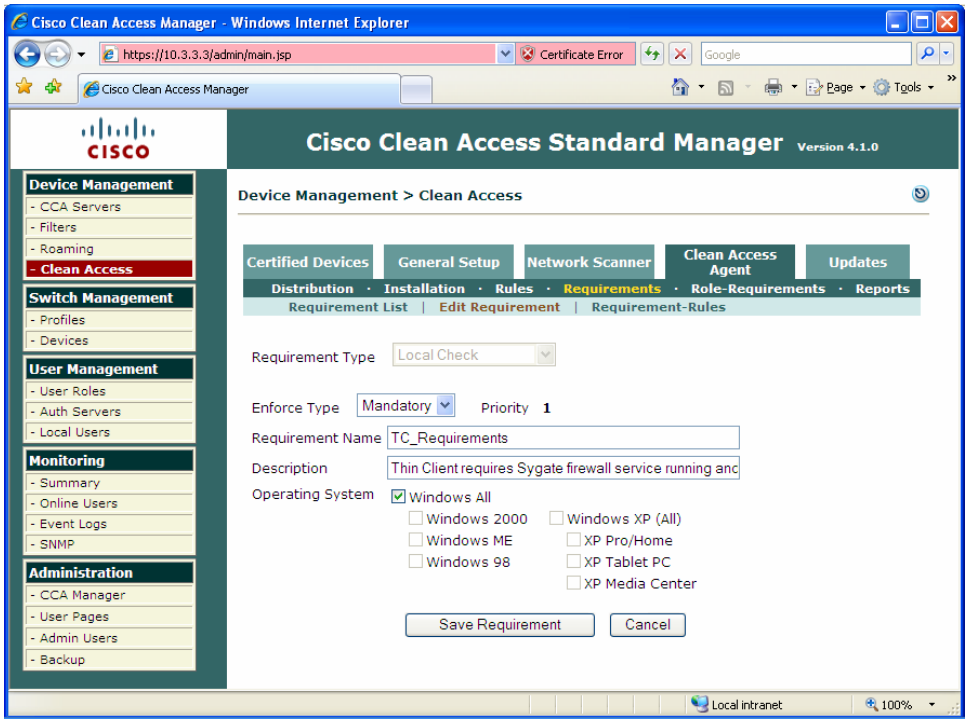


9. To set a **Rule**, click **New Rule**.



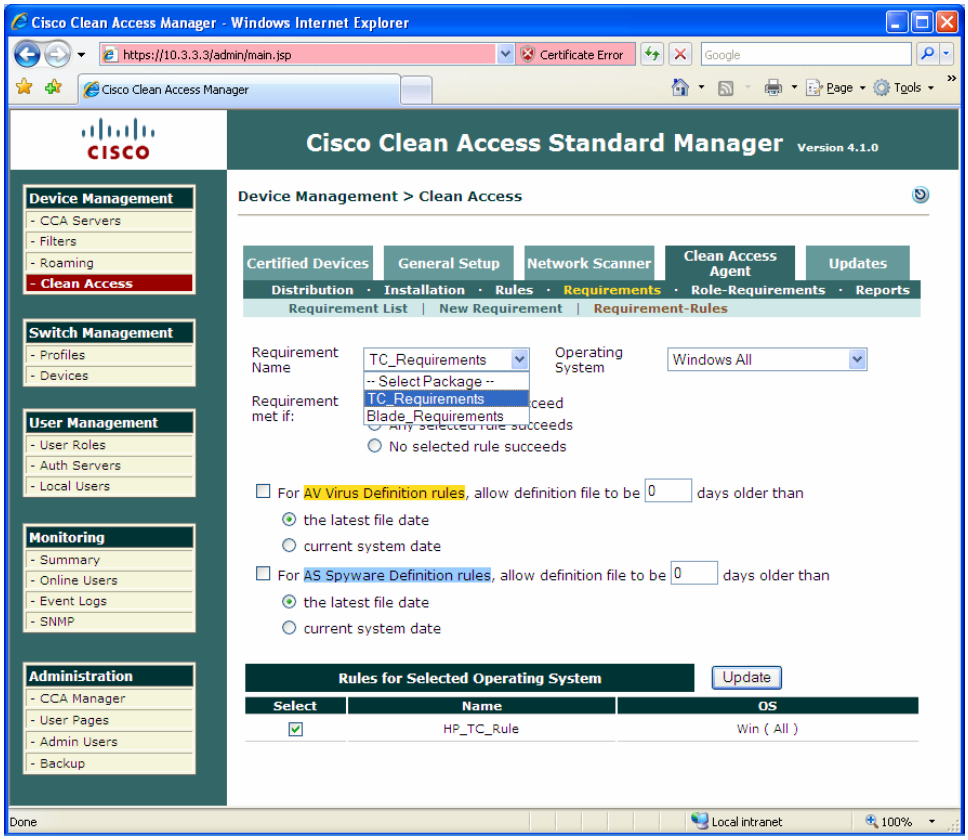
10. Type the **Rule Name** (`HP_TC_Rule`, in this example) and select the operating system. Enter the Rule Expression by leveraging the checks shown (copy and paste the text).
    NOTE: You can form complex expressions of AND/OR policies using parentheses. Refer to Blade PC Policy later in this document for an example.
11. Now, build a requirement from the Rules called **TC_Requirements** by clicking **Clean Access Agent/Requirements/New Requirements**.

12. Name this new rule **TC_Requirements** and type a description in the **Rule Description** field. In the following example, we're making the rule available for All Windows versions, although in this specific case, the t5720 thin client runs Windows XPe and is identified by CAS as XP Pro/Home.

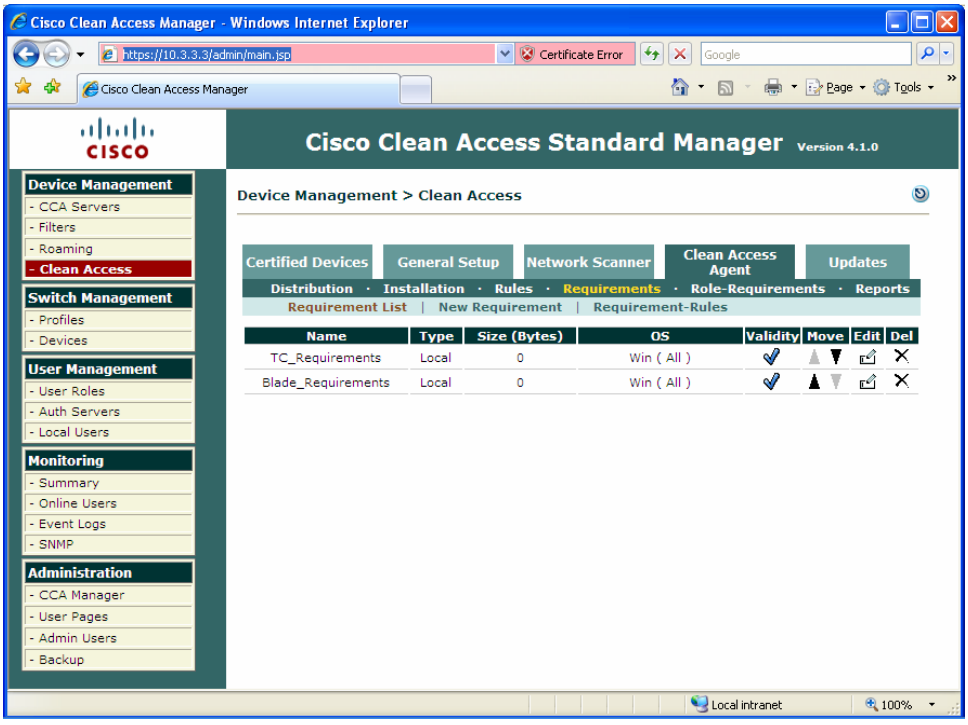


13. Click **Requirement Rules**.
14. In the **Requirement Name** list, click **TC_Requirements**.

15. Select the **HP_TC_Rule** check box to associate the thin client rule to the TC Requirement entry.

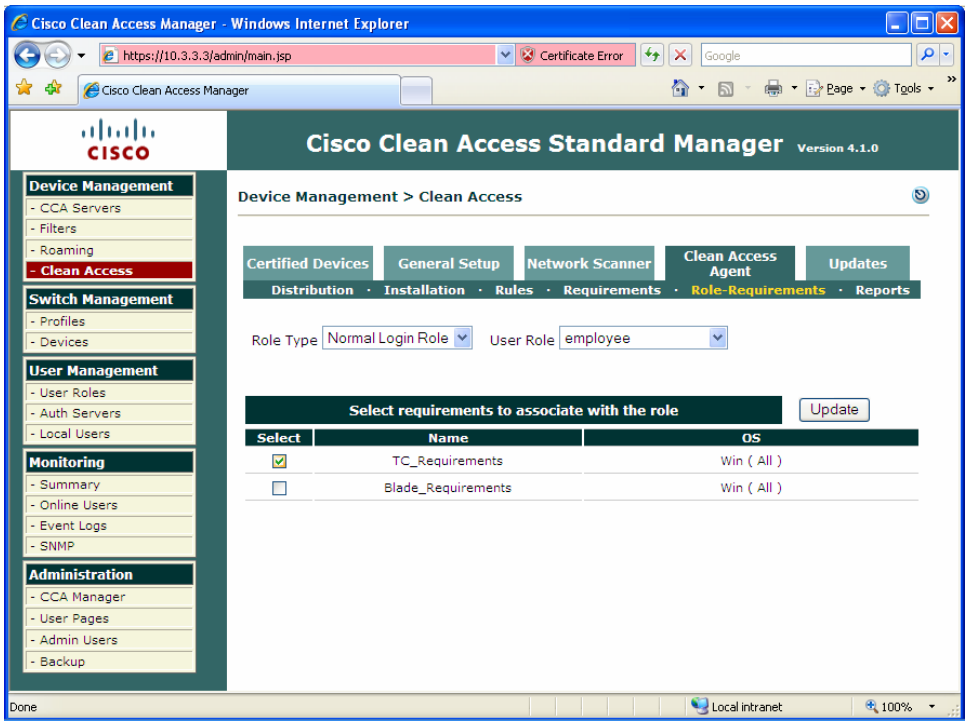


16. Ensure that the Requirements entry is indeed listed. If multiple requirements exist, click on the appropriate arrow in the Move column to order the requirements, as seen in the following illustration.



17. Next, we choose what user roles we want to assign the thin client requirement to. Click the **Clean Access Agent** tab, then click **Role-Requirements**.

18. Select **Employee** from the **User Role** selection list. Click the **TC_Requirements** check box in the **Select** column. This requires all users in the Employee role to be tested for TC_Requirements, as defined above.
19. Click **Update**.



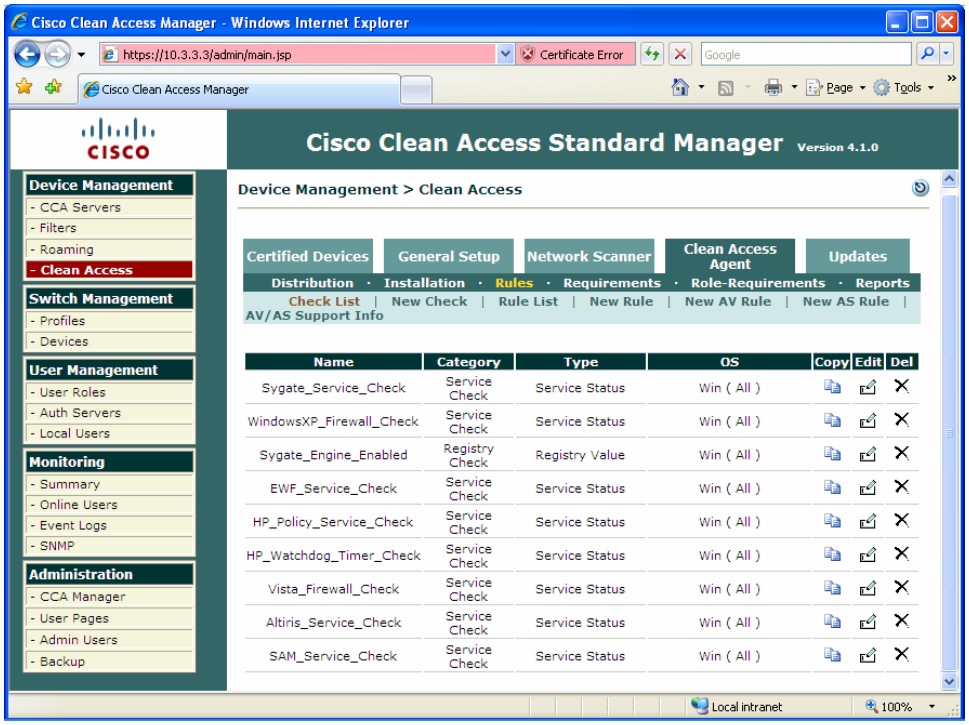
We're finished with thin client policy settings!

Blade PC Policy

The blade PC policy setting closely follows the steps previously covered for thin client, though different rules and policies are checked. In many illustrations, the HP blade PC policies/settings are shown together, since they are simultaneously selected. Also, several detail illustrations for settings (like registry checks) have been left out of this section, as they follow the same process previously documented for thin clients.

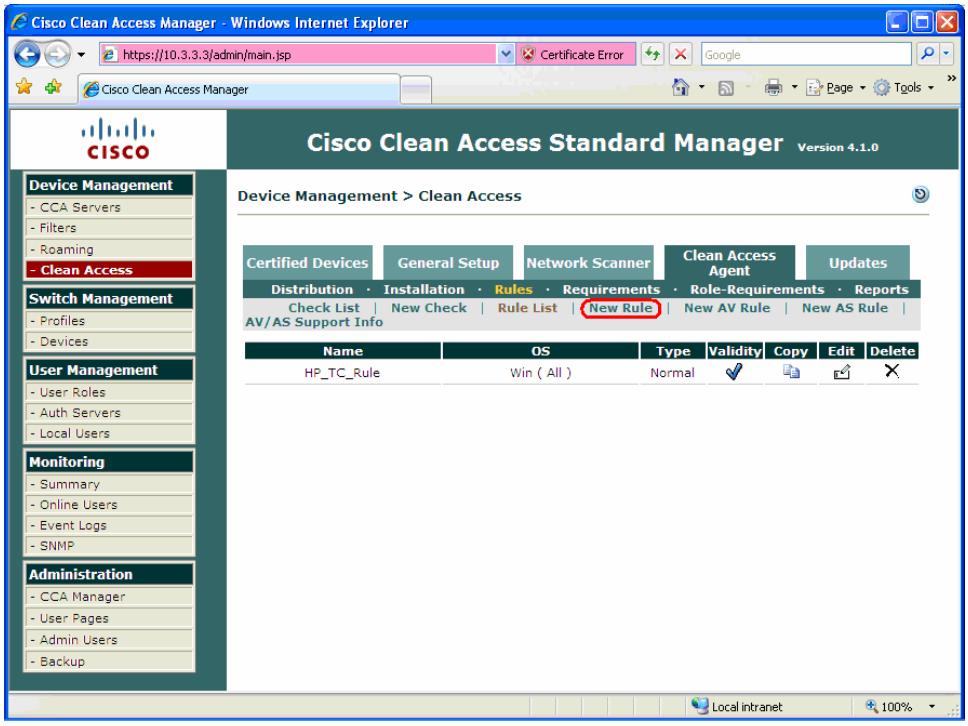
1. Use the Web browser to connect to the Clean Access Manager console at https://10.3.3.3.
2. Click Clean Access under Device Management in the left panel.
3. Click the Clean Access Agent tab, and then click Rules.

4. On the figure below we have added the following checks for blade PCs based on Windows Service names for each of the following:
    - Status of Windows Firewall service (WindowsXP_Firewall_Check and Vista_Firewall_Check)
    - Status of HP Watchdog Timer service (HP_Watchdog_Timer_Check)
    - Status of Altiris service for active patching (Altiris_Service_Check)
    - Status of HP SAM (Session Allocation Manager) service (SAM_Service_Check)

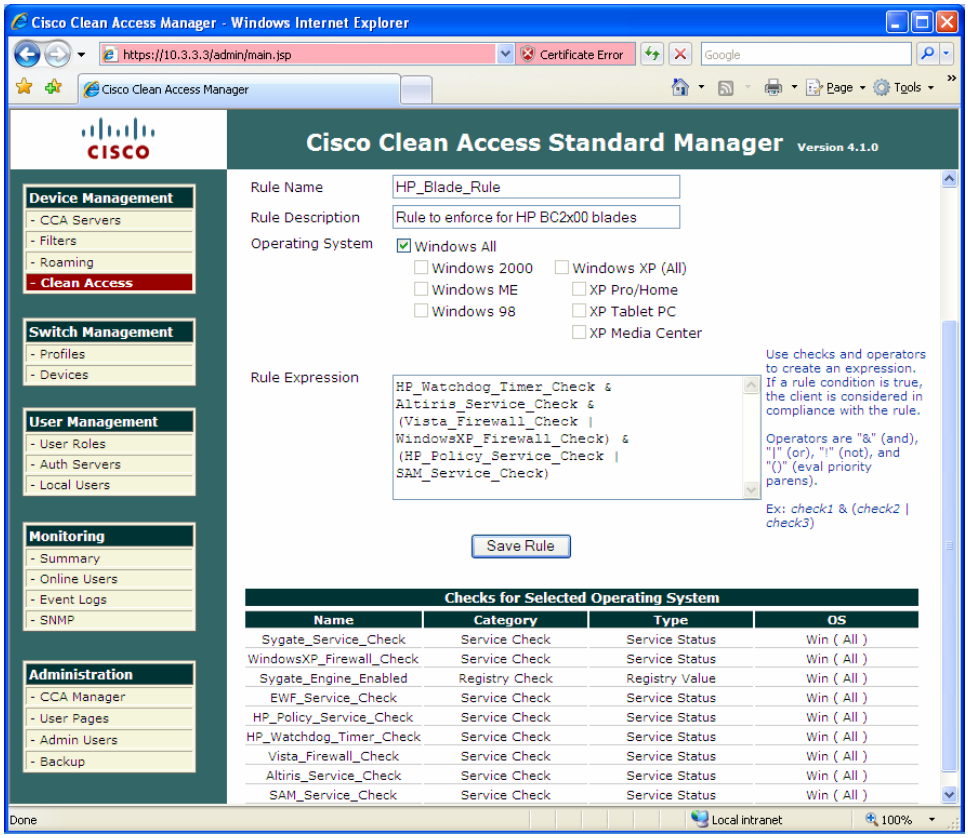


5. To add an additional Windows program/service/registry check, click **New Check**.

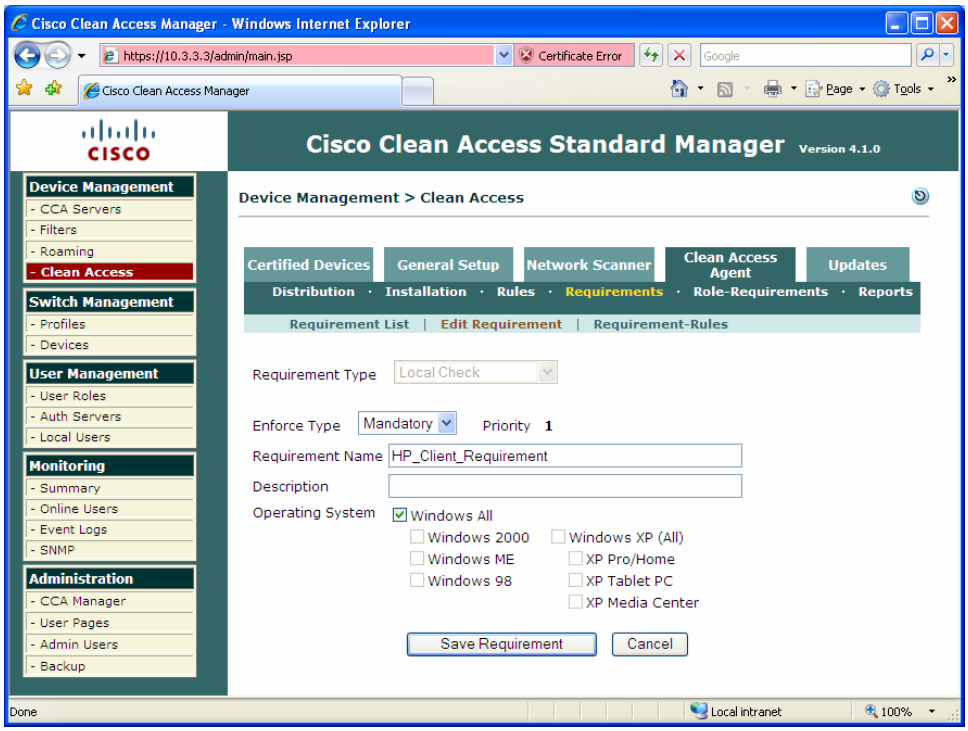
6. Next, create and set rules based on the AND and OR policies of individual checks previously defined.



7. To set a Rule, click **New Rule**.

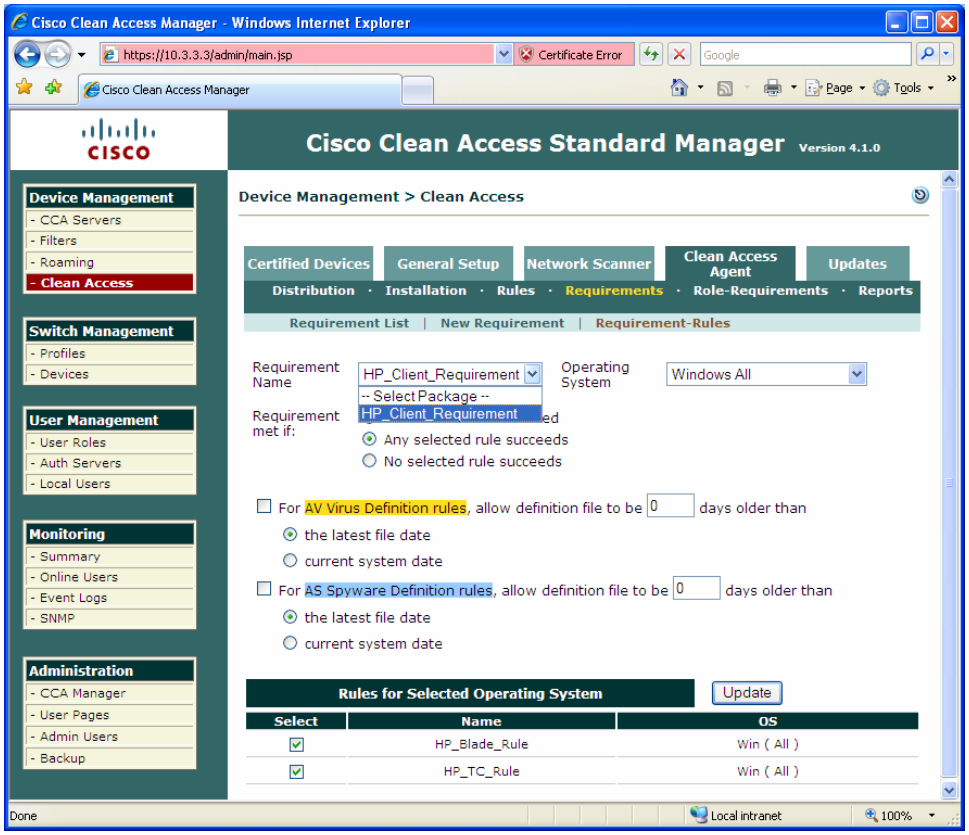


8. Type the Rule Name (HP_Blade_Rule, in this example) and select the operating system. Enter the Rule Expression by leveraging the checks shown (copy and paste the text). The policy for this reference implementation is to require:
   HP Watchdog Timer Service running AND
   Altiris Service running AND
   (Windows XP OR Vista Firewall service running) AND
   (HP Policy Service OR SAM Service running)
9. In building a requirement from these Rules, we see that we have the opportunity to have a single 'common' Requirement that includes both thin client and blade PC rules. Therefore, let's delete the existing TC_Requirements entry and create a new requirement to encompass all available client rules. Click Clean Access Agent/Requirements/New Requirements.
10. Name this new rule **HP_Client_Requirements** and type a description in the **Rule Description** field.

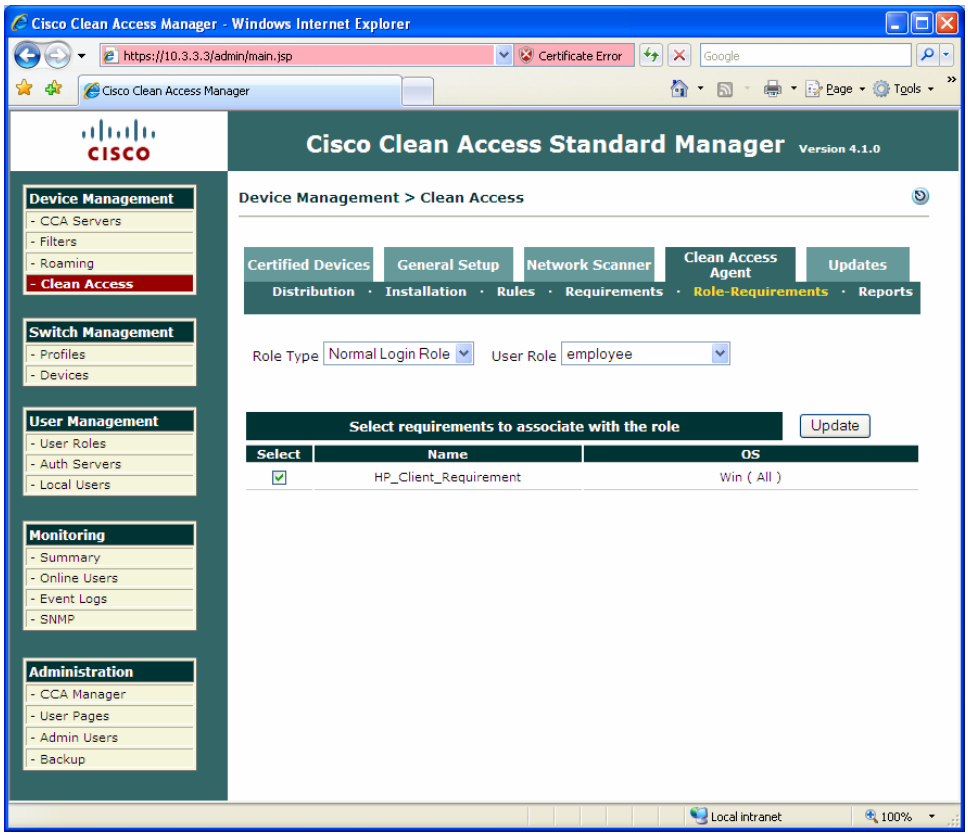


11. Click Requirement Rules.
12. In the Requirement Name list, click HP_Client_Requirements.

13. Select both the HP_Blade_Rule and HP_TC_Rule check boxes to associate the thin client and blade rules and fulfill HP client requirements.



14. Finally, click **Role-Requirements**. Select **employee** from the **User Role** selection list.
15. Ensure that the **HP_Client_Requirements** check box is selected.
16. Click **Update**.



We're finished with both blade and thin client policy settings!

End-Point Configuration

Thin Client Firewall Exceptions

The HP t5720 XPe-based Thin Client is configured by default with the Sygate firewall actively blocking all ports except those required for basic Web browsing and RDP connections. The t5720 thin clients used in this white paper also had firewall port exceptions added for RGS, which accelerates graphics in a manner superior to RDP.

In order to properly communicate with the NAC 800 and allow scans to the t5720, the Sygate firewall must be modified as follows:

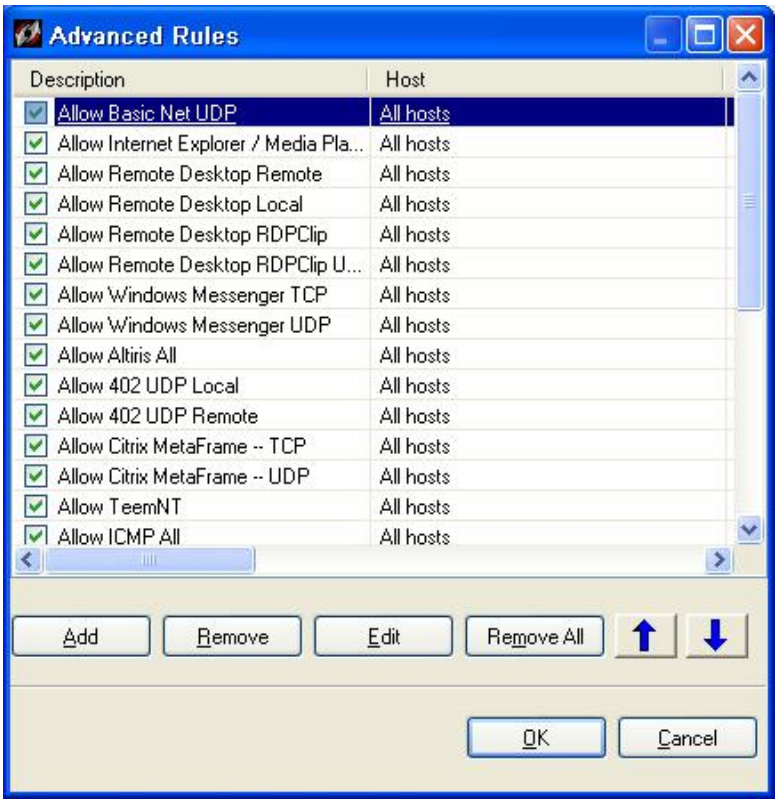
Description	IP Address	Remote Ports	Local Ports	Incoming/Outgoing
Allow NAC UDP	10.6.6.2 10.3.3.3 10.4.4.4	8905,8906		Both
Allow NAC TCP	10.6.6.2 10.3.3.3 10.4.4.4	443		Both

Set this firewall configuration as follows:

1. Reboot the HP t5720 thin client and log on using an account with administrator privileges. This ensures that the thin client is in a known, clean OS state.
2. In the **System Tray**, right-click the **Sygate** icon.
3. Select **Advanced Rules**.

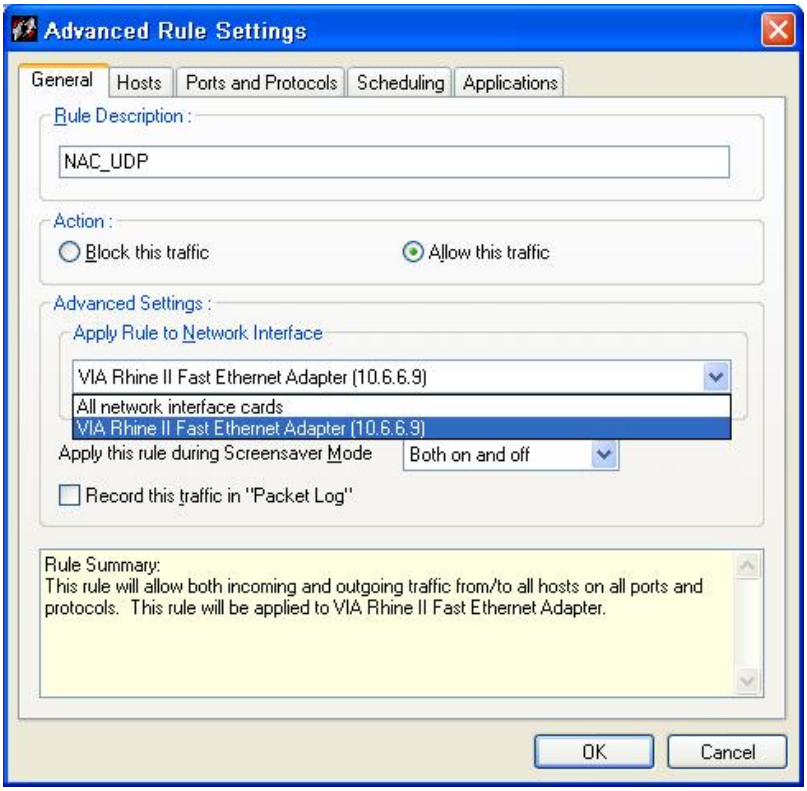
4. Read the warning notification and click **OK**.

5. In the **Advanced Rules** window, click **Add**.

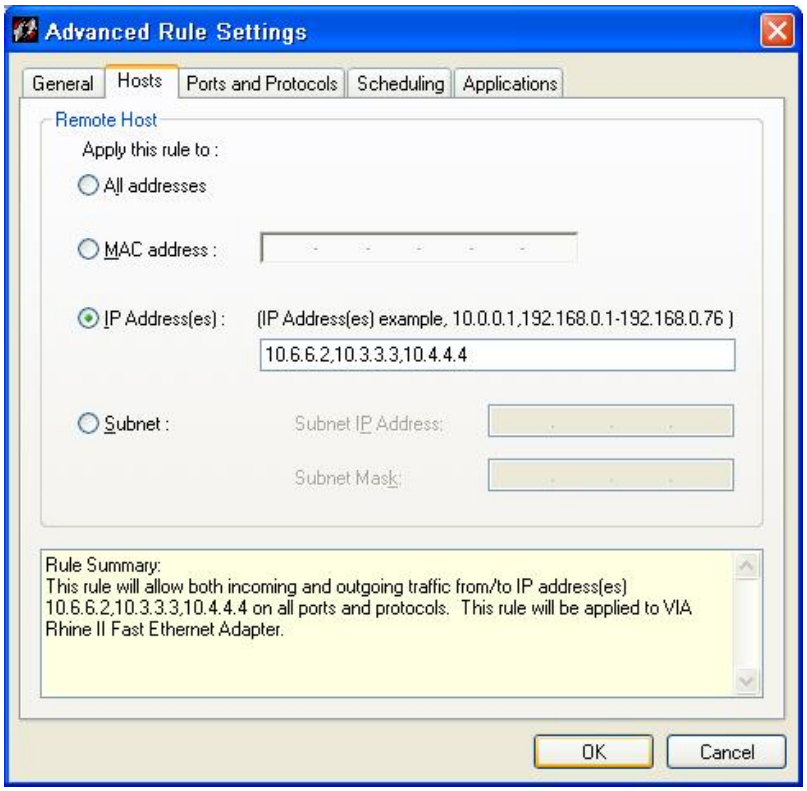


6. On the **General** tab, type `NAC UDP` in the **Rule Description** field.
7. Select **Allow this traffic**.

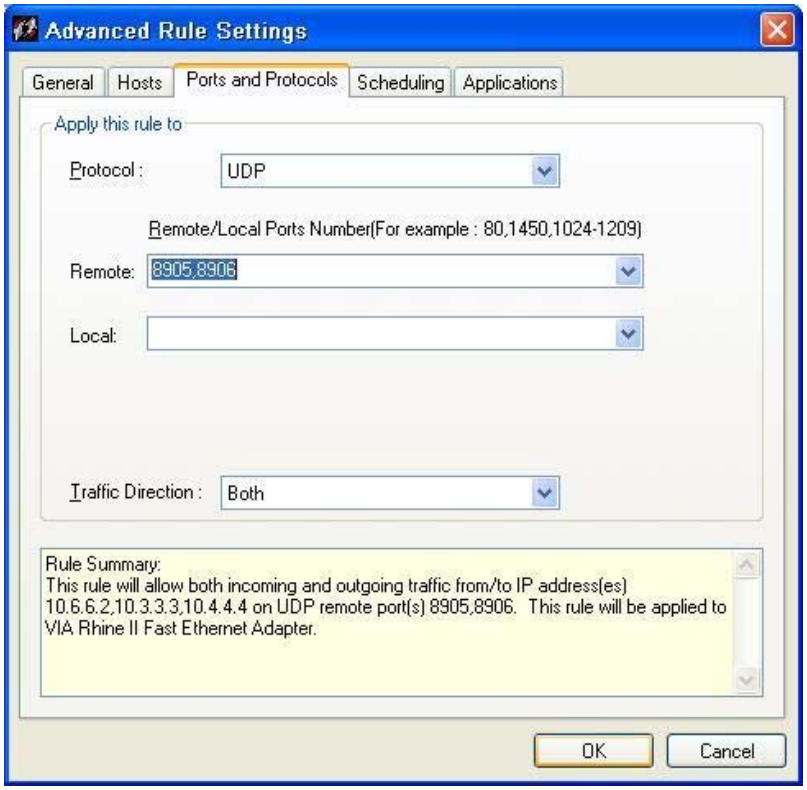
8. Select a specific network interface card or the default, **All network interface cards**.



9. On the **Hosts** tab, select **IP Addresses** and then type the IP address of the 3960 internal switch port and CAM/CAS server addresses (`10.6.6.2`, `10.3.3.3`, and `10.4.4.4`, respectively).

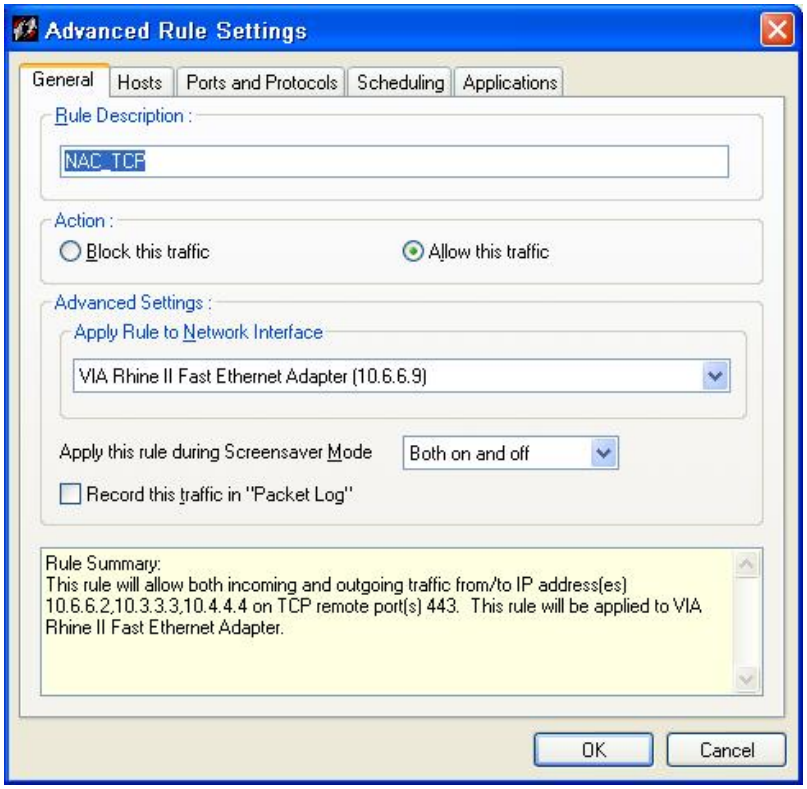


10. On the **Ports and Protocols** tab in the **Protocol** list, click **UDP**.
11. In the **Local** field, type `8905,8906`.

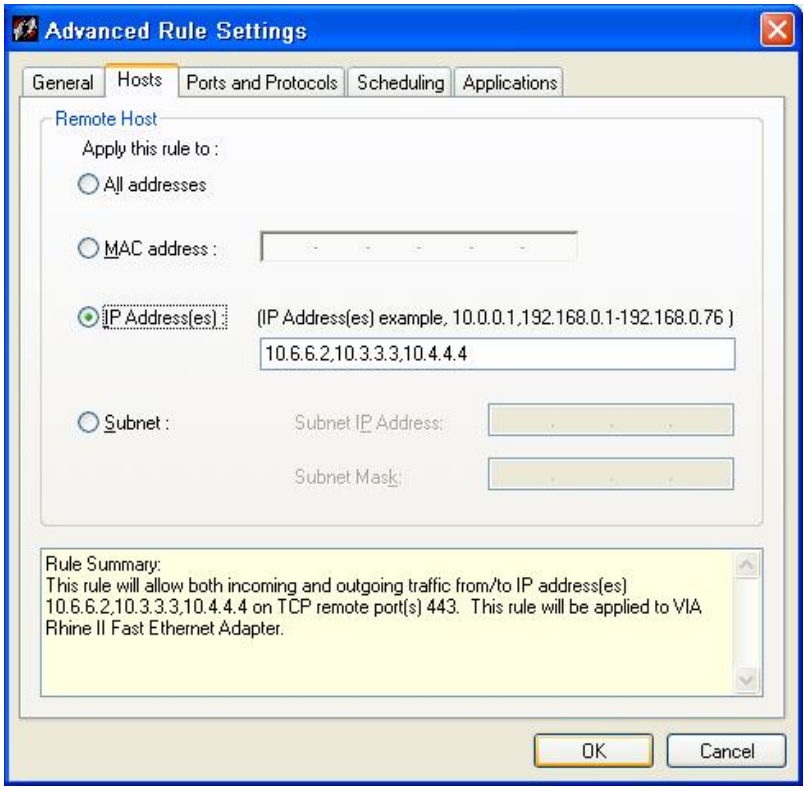


12. In the **Traffic Direction** list, click **Both**.
13. Click **OK**.
14. Next, to add a rule for TCP traffic, click **Add** in the **Advanced Rules** window.
15. In the **Advanced Rule Settings** dialog box on the **General** tab, type NAC TCP in the **Rule Description** field.
16. In the **Action** area, select **Allow this traffic**.

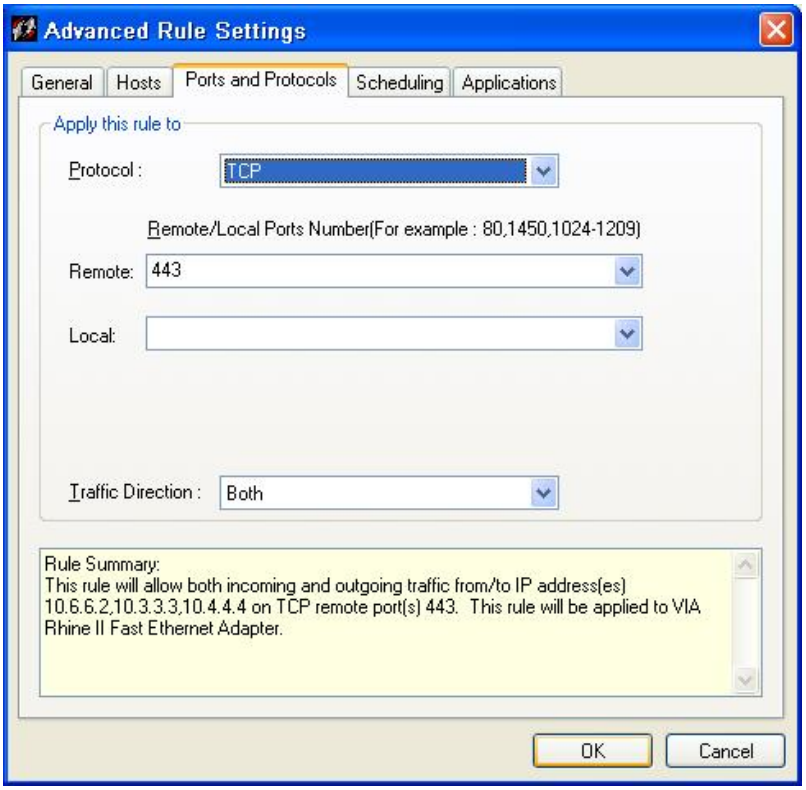
17. In the **Apply Rule to Network Interface** field, ensure that the proper network interface card is selected.



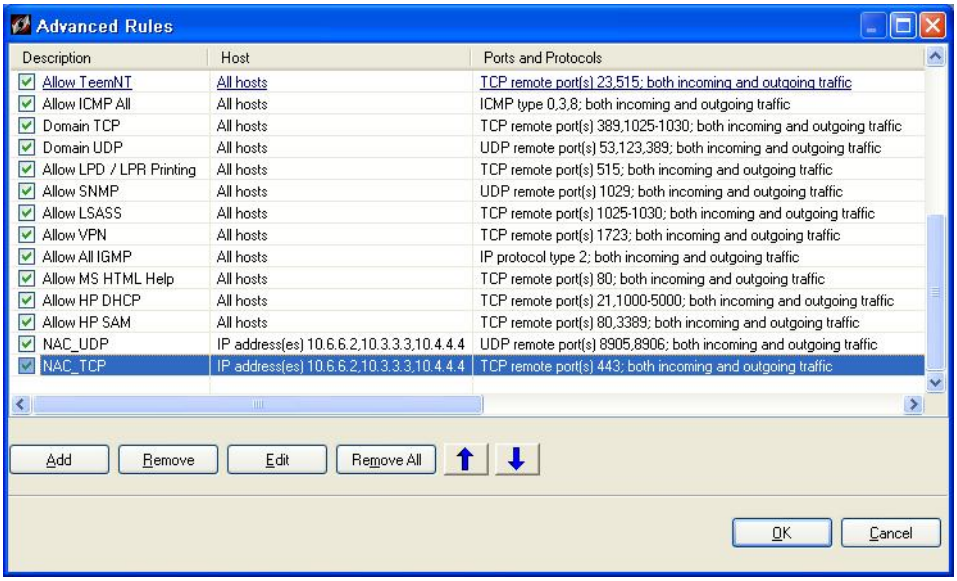
18. On the **Hosts** tab, select **IP Addresses** and type the IP address of the 3960 internal switch port and CAM/CAS server addresses in the field (`10.6.6.2`, `10.3.3.3`, and `10.4.4.4`, respectively).



19. On the **Ports and Protocols** tab in the **Protocol** list, select **TCP**.
20. Type `443` in the **Local** field.



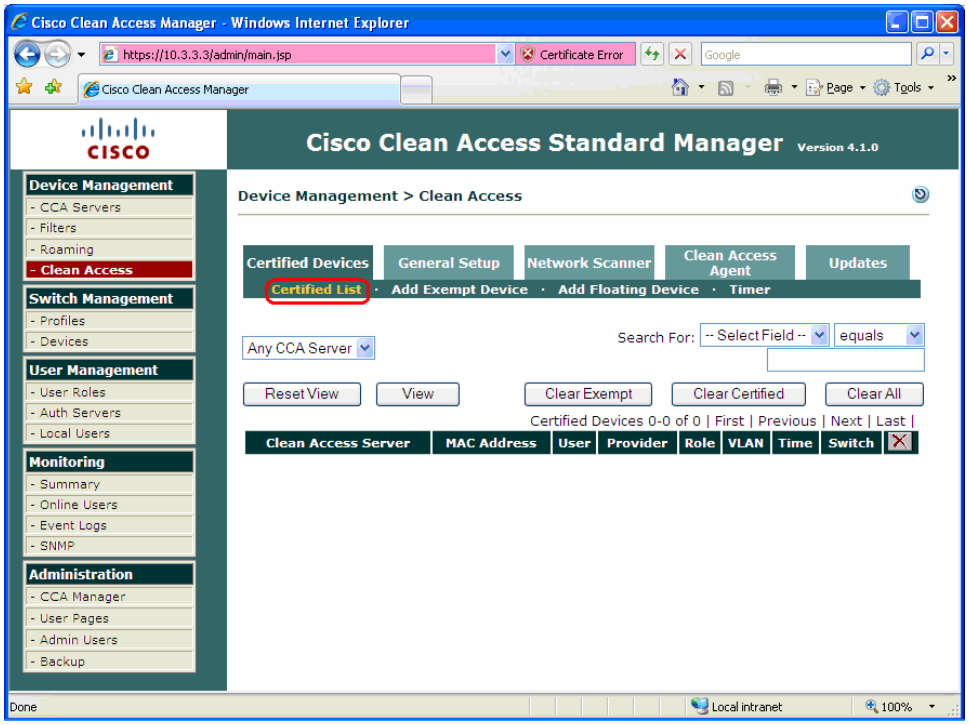
21. In the **Traffic Direction** list, select **Both**.
22. Click **OK**.
23. At this point, scroll down in the Sygate **Advanced Rules** window and ensure that the two new NAC policies are defined and active.



Policy Enforcement Using Clean Access Agent

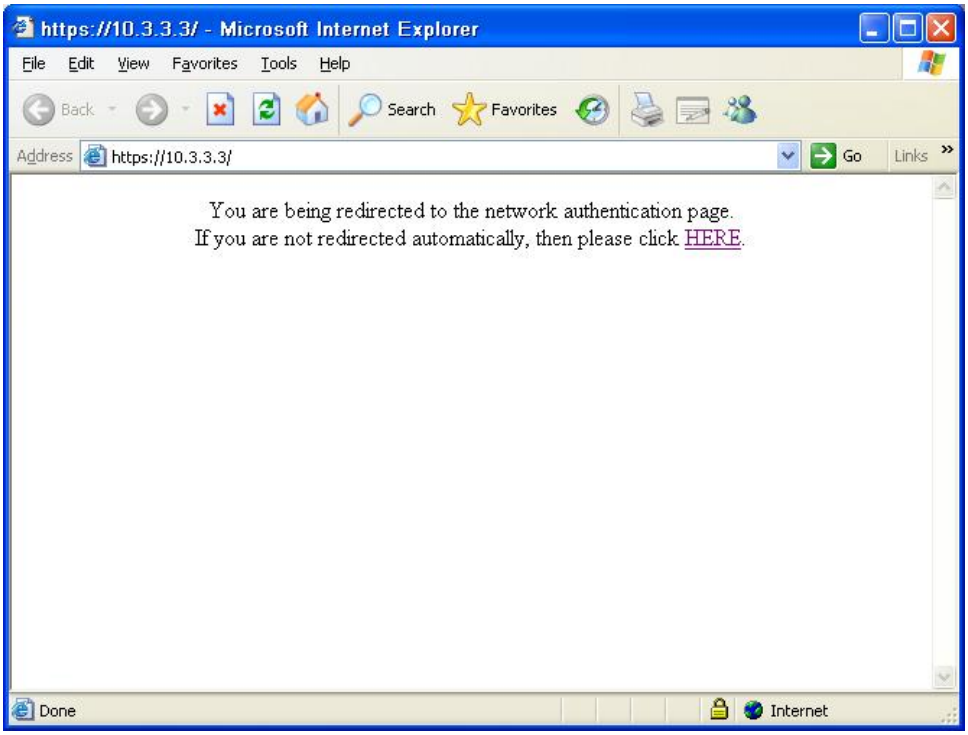
Now that the Clean Access and thin client firewall policies are defined, we will demonstrate policy enforcement for both thin client and HP blade PCs using Cicso Clean Access Agent. We begin by ensuring that none of the blades or thin clients being tested is on the list of certified clients.

Open the CAM console (http://10.3.3.3 on your Web browser, in this reference implementation). Click **Clean Access** under **Device Management** in the left panel. Click the **Certified Devices** tab, and then click **Certified List**. Click **Clear Certified** to ensure the system is checked upon clean access agent connection to the network. The following illustration shows the default configuration after clearing system entries.



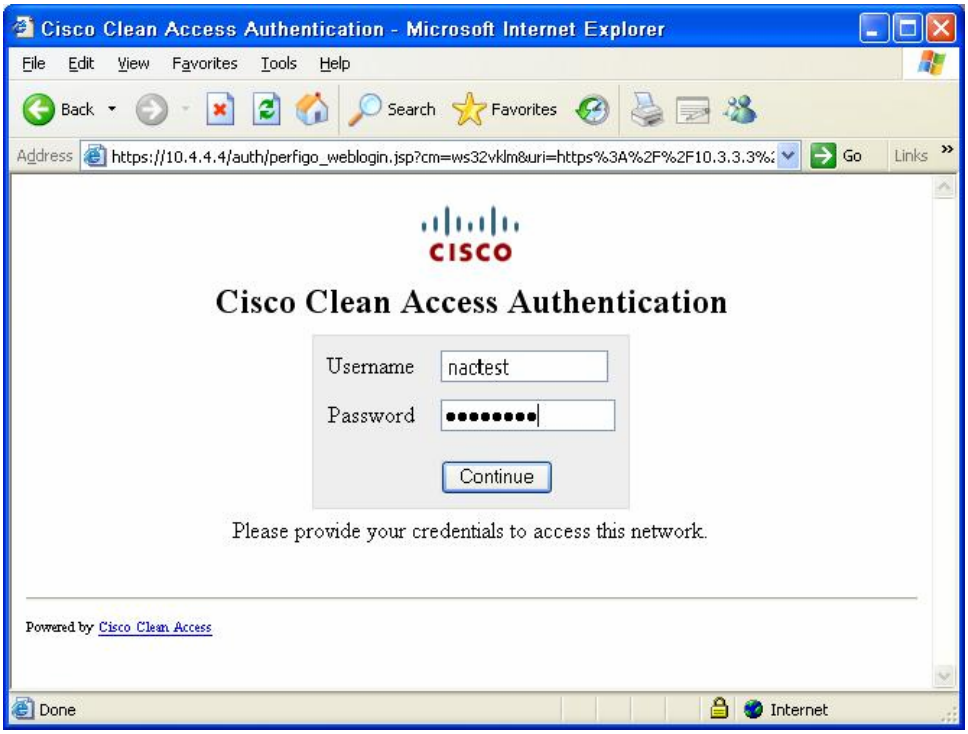
Thin Client Policy Enforcement

1. Turn on the thin client connected to switch port 10 or 11; these ports are configured to start up in quarantine vlan6.
2. Ensure that the firewall and write filters are running.
3. Go to https://10.3.3.3 on your browser; this is the CAM configuration site on the trusted side of the network. The CAS server attempts to connect to CISCO Clean Access Agent and to validate the platform. If Clean Access Agent is not present or not started, you are redirected to a Web site hosted on the CAS.



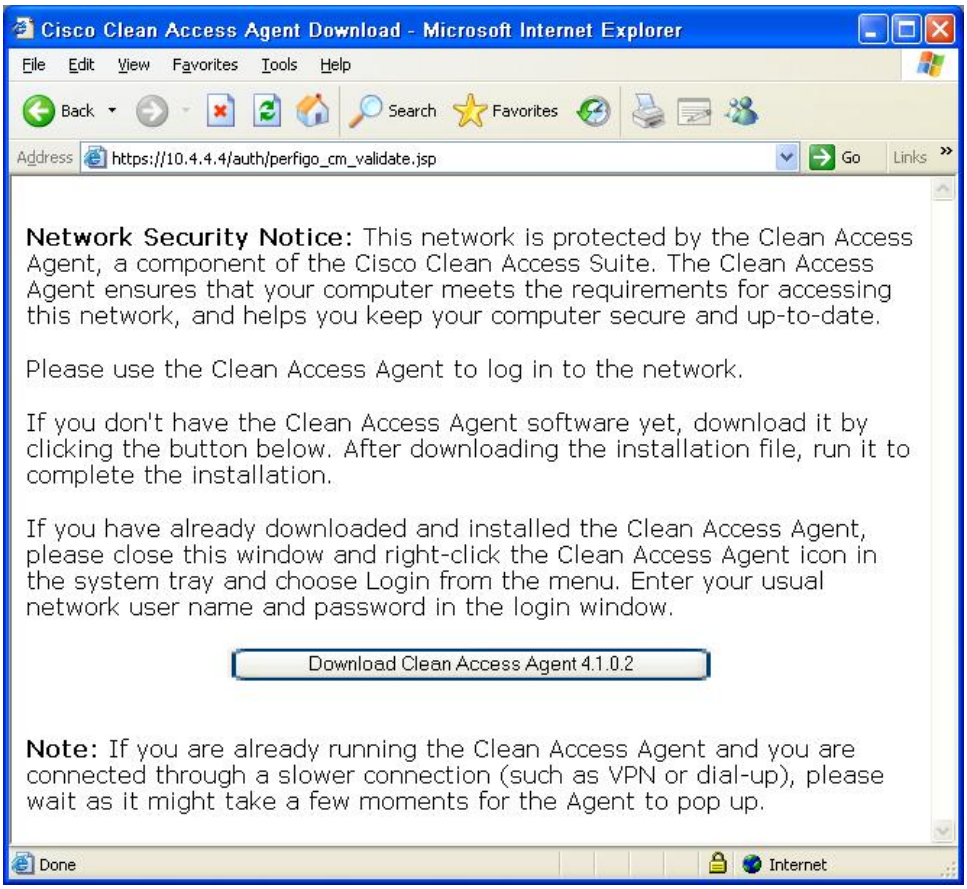
4. In this case, the thin client is not yet configured with Clean Access Agent and the platform is not already listed on the Clean Access list of approved platforms. The URL is then intercepted by CAS and redirected automatically after several seconds, or you can click **HERE** to initiate redirection.

5. Since the user authentication policy was selected during the initial NAC setup, you can type a valid username and password, and then press **Enter** or click **Continue**.



Upon successful user authentication, a Network Security Notice appears to inform you that either Clean Access Agent is not already loaded on the target platform or the user has not authenticated through the agent.

6. For this reference solution, the agent has not been pre-populated on the thin client. Click **Download Clean Access Agent 4.1.0.2**.



7. Click **Run** when prompted to Save (download) or **Run the clean access agent** if the following window indicates that the wizard is ready to install the agent.
8. Depending on the certificates installed on your thin client, you may receive another warning. Click **Run** and the InstallShield wizard opens the **Clean Access Agent Installer**.

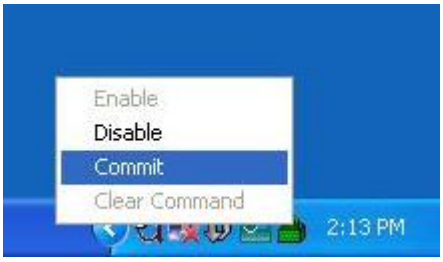
9. Click **Next** when prompted to install the version 4.1.0.2 Clean Access Agent.

   NOTE: Ensure that the version of the Clean Access Agent matches the version of the CAS software. For purposes of this white paper, the CAS server was version 4.1.0.

10. Click **Next** to accept the default installation directory.
11. Click **Install** to install the agent.
12. Click **Finish** to complete the installation.

Special Thin Client Consideration: Committing Image Changes

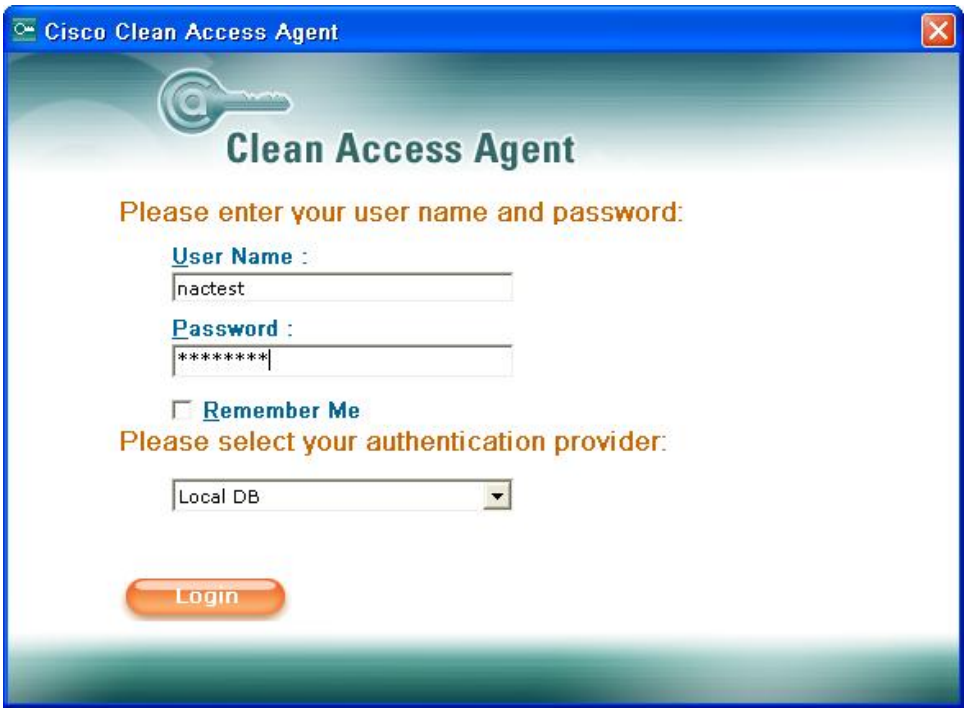
At this point, the Clean Access Agent is installed on the HP t5720 Thin Client. Note, however, that these image changes are not permanent. If you wish to permanently enable the agent on the thin client, please select **Commit** on the **EWF** taskbar icon or in the Control Panel EWF applet.



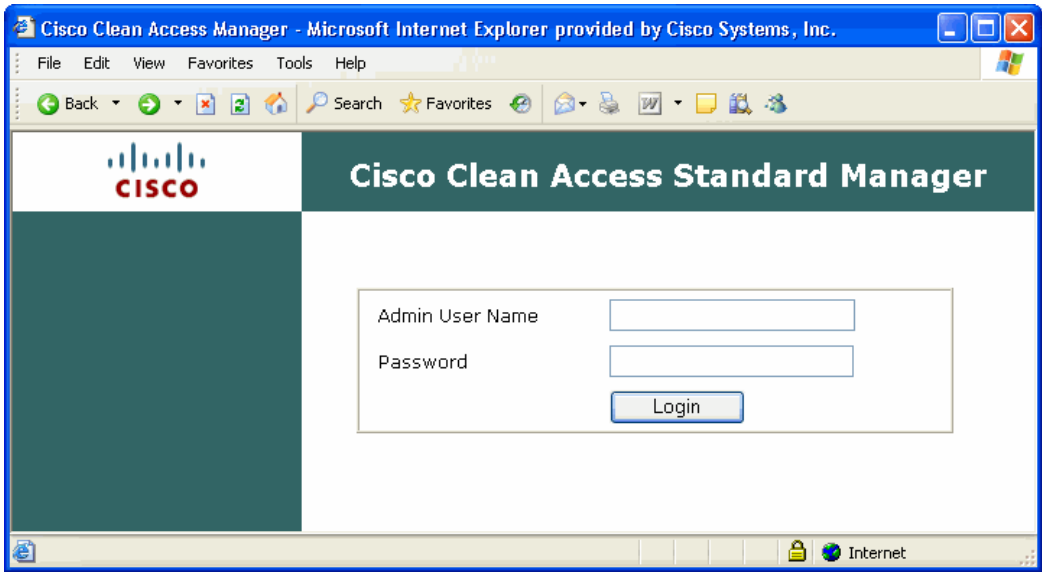
After restarting the thin client, the changes are permanent. The Clean Access Agent can now authenticate the user for network access and scan the user's device for software configuration compliance.

Upon installation, Clean Access Agent is added to the Startup folder automatically.

13. To test Clean Access Agent operation, log on to the thin client, complete user authentication, and click **Login**. For this reference implementation, log on using the "nactest" account that has the employee role assigned. Logging on in this role requires Clean Access Agent to verify compliance with the requirements we set previously.



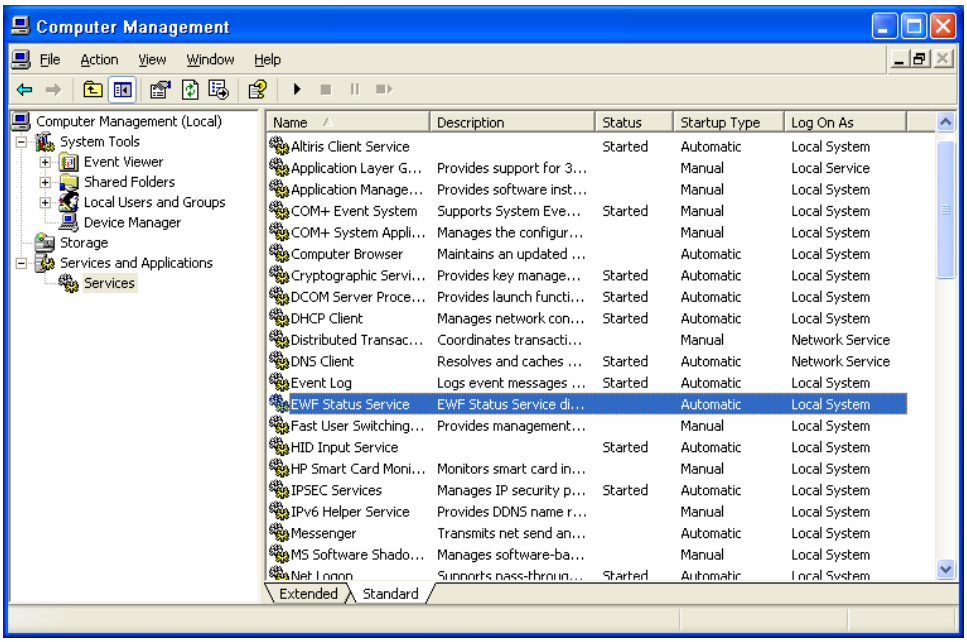
14. We can validate that network connection is successful by once again attempting to connect to any device on the network, or in this case, we'll connect again to the CAM Web site (at https://10.3.3.3), which should now be resolved without redirection.



Now, let's defeat one of the thin client requirements to force a failure of the clean access policy check.

15. Right-click **My Computer**.
16. Click **Manage**.

17. Click **Services and Applications**.
18. Click **Services**.



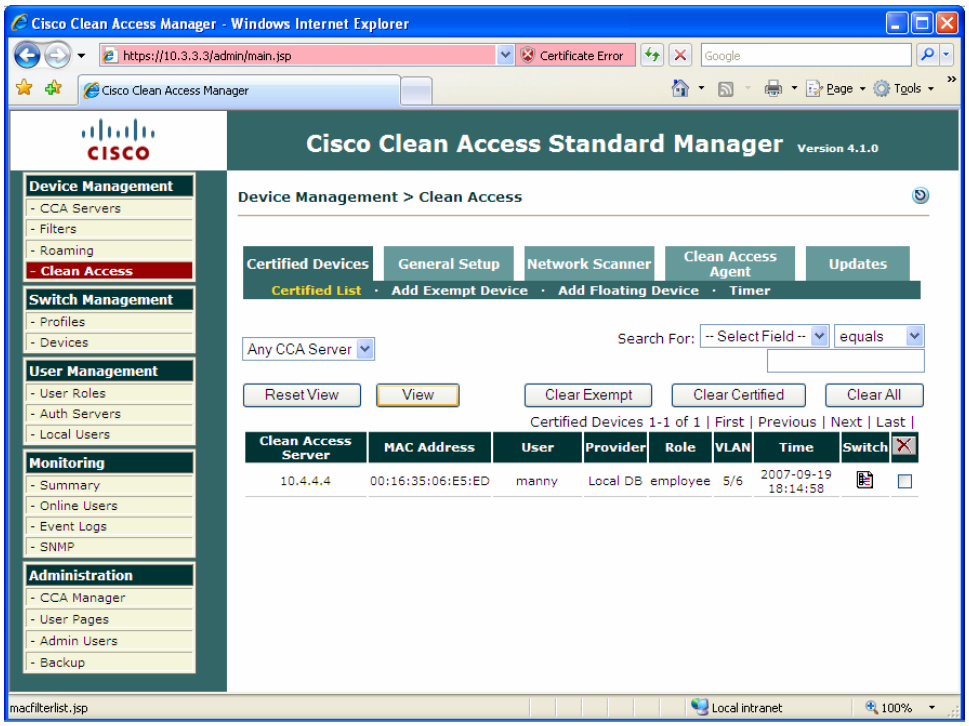
19. Disable **EWF Status Service** by right-clicking on the entry and selecting **Stop**.
20. Log on again (through the CAM Web site at https://10.3.3.3) with user credentials for "nactest" account.

21. The Clean Access Agent test should now find the machine out of policy. The machine is either kept in quarantine LAN or temporary access can be granted to the trusted LAN (if required for remediation). For purposes of this reference implementation, we have configured a temporarily network access of 4 minutes to allow any required access to any remediation resources that may exist on the trusted network and to demonstrate the flexibility of clean access enforcement.

    NOTE: This is a configurable policy and there are security consequences in allowing any temporary access to the trusted/production network. If remediation servers are present on the untrusted LAN, there is no need to grant temporary access.

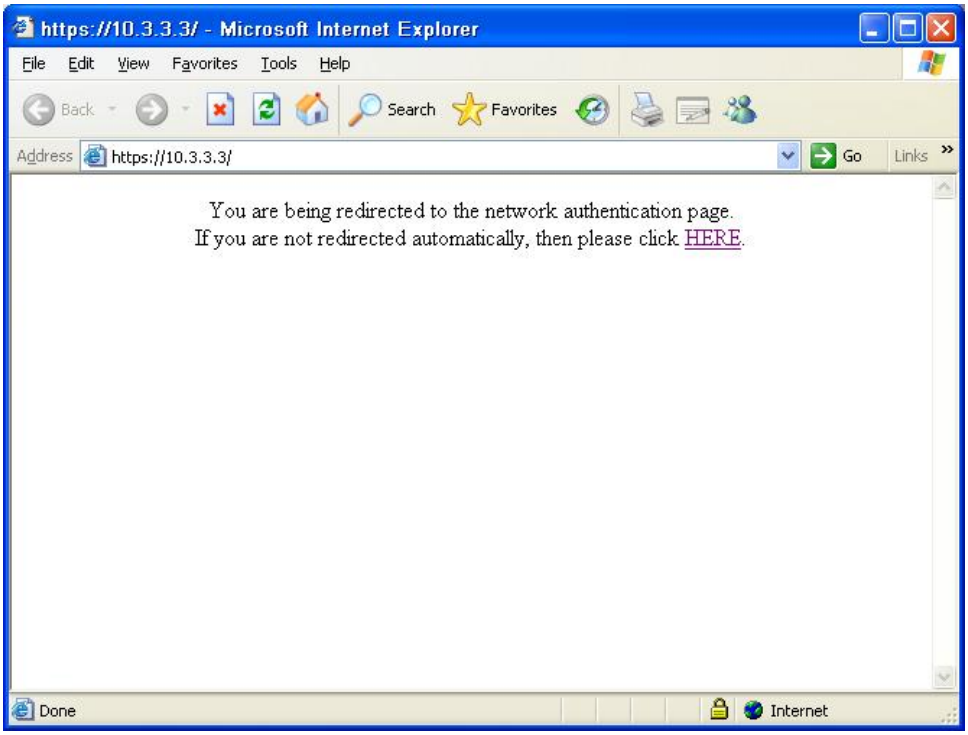
22. Click **Continue** to see more information on the missing requirements.

23. Click **Next** to re-scan. Clean Access Agent displays information on the missing requirements after each re-scan until the policy requirements are corrected. Click **Cancel** to close this screen and end the temporary access.
24. For purposes of our example, if you re-enable EWF service and click **Next** within the time limit, the scan succeeds and full access is granted to the trusted network VLAN.



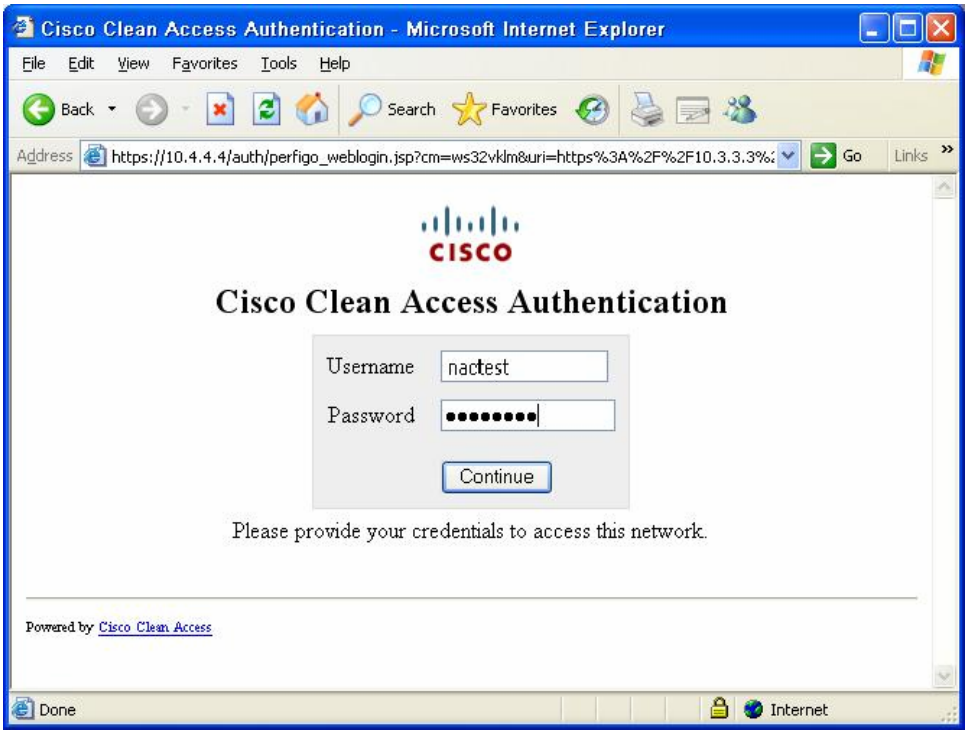
Blade PC Policy Enforcement

1. Turn on a PC Blade connected via CISCO 3560 switch port 10 or 11; these ports are configured to start up in quarantine vlan6.
2. Ensure that the firewall and write filters are running.
3. Go to https://10.3.3.3 on your browser. This is the CAM configuration site on the trusted side of the network. The CAS server attempts to connect to CISCO Clean Access Agent and validate the platform. If the agent is not present or not started, you are redirected to a Web site hosted on the CAS.



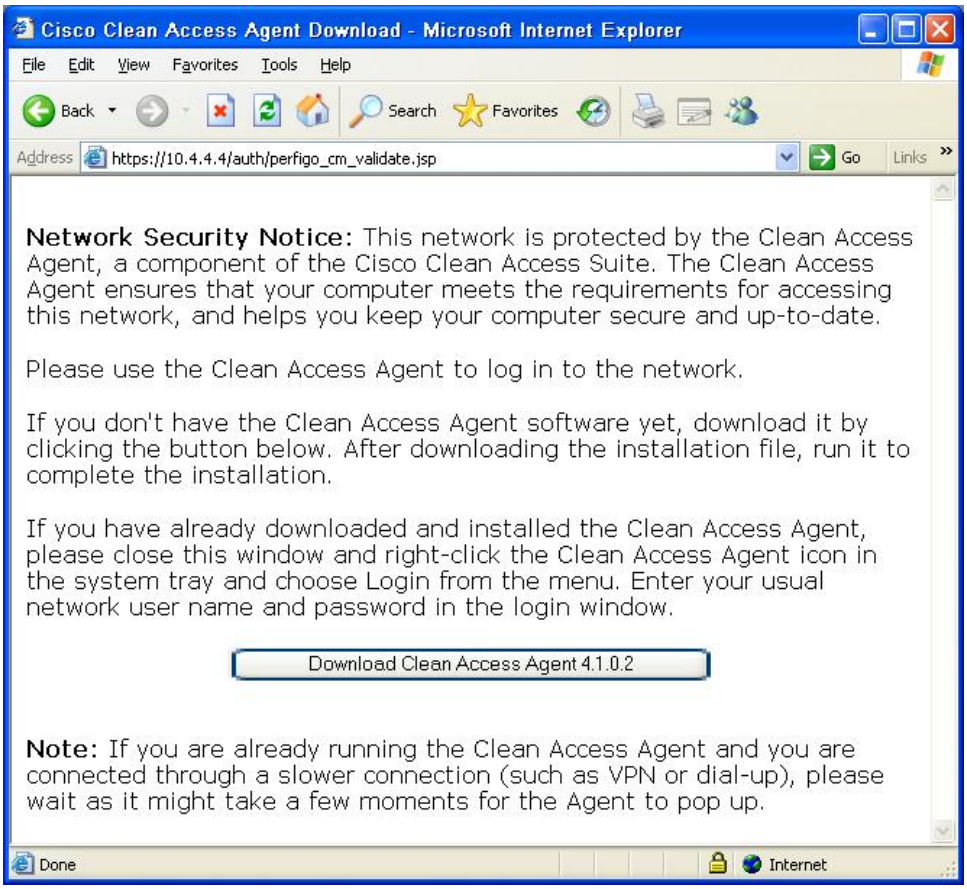
4. In this case the blade PC is not yet configured with Clean Access Agent and the platform is not already listed on the Clean Access list of approved platforms. The URL is then intercepted by CAS and redirected automatically after several seconds to CAS at 10.4.4.4, or you can click **HERE** to initiate redirection.

5. Since the user authentication policy was selected during the initial NAC setup, you can type a valid username and password, and then press **Enter** or click **Continue**.



Upon successful user authentication, a Network Security Notice appears to inform you that either Clean Access Agent is not already loaded on the target platform or the user has not authenticated through the agent.

6. For this reference solution, the agent has not been pre-populated on the thin client. Click **Download Clean Access Agent 4.1.0.2**.



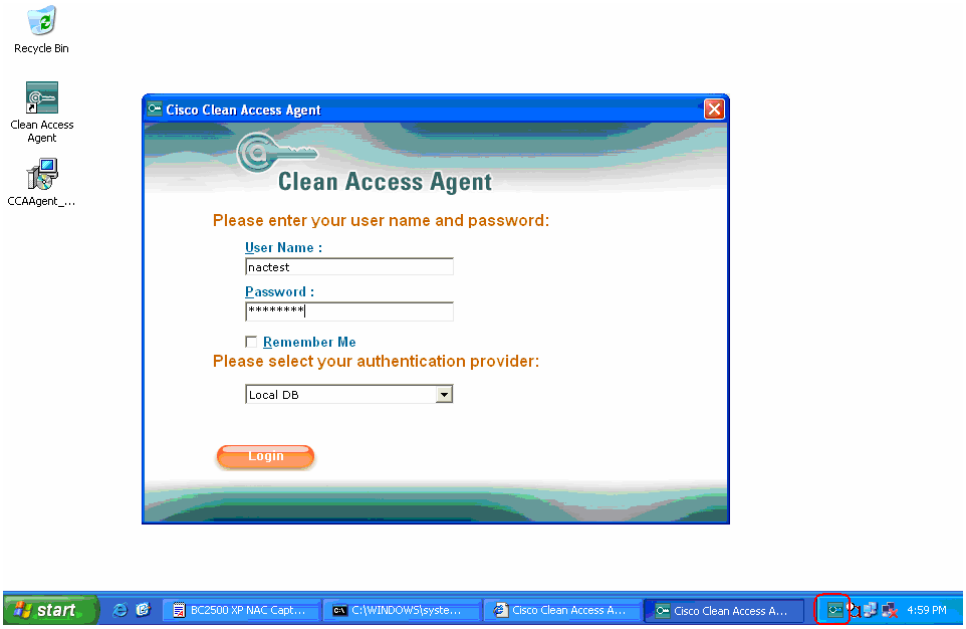
7. Click **Run** when prompted to Save (download) or **Run the clean access agent** if the following window indicates that the wizard is ready to install the agent.
8. Depending on the certificates installed on your thin client, you may receive another warning. Click **Run** and the InstallShield wizard opens the Clean Access Agent Installer.

9. Click **Next** when prompted to install the version 4.1.0.2 Clean Access Agent.

   NOTE: Ensure that the version of the Clean Access Agent matches the version of the CAS software. For purposes of this white paper, the CAS server was version 4.1.0.

10. Click **Next** to accept the default installation directory.
11. Click **Install** to install the agent.
12. Click **Finish** to complete the installation.

    The Clean Access Agent should automatically start after a short time and the icon should be visible on the task bar.



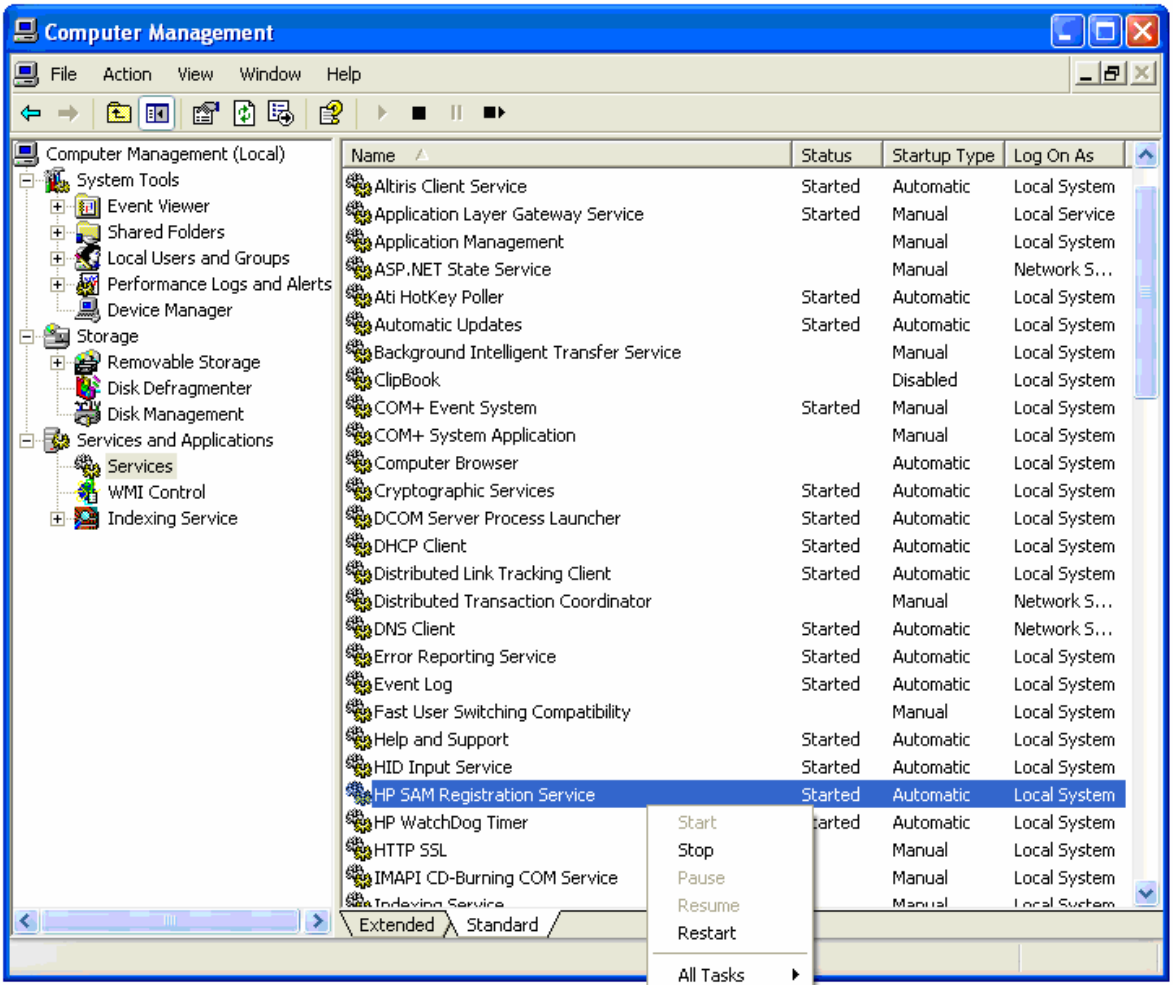
NOTE: you may get a certificate warning message. Continue to log on.

A successful logon notification appears.

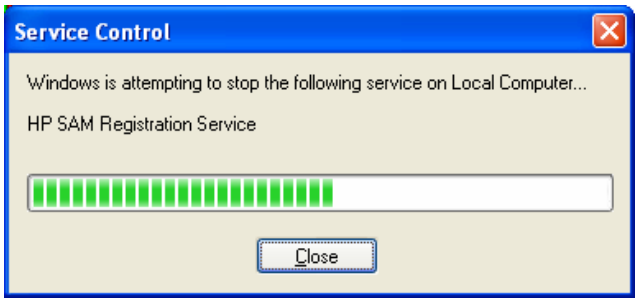
13. We can validate that network connection is successful by once again attempting to connect to any device on the network, or in this case, we'll connect again to the CAM Web site (at https://10.3.3.3), which should now be resolved without redirection.

    Next, let's defeat one of the blade pc client requirements to force a failure of the clean access policy check.

14. Log out of the Clean Access Session by right-clicking the CCA icon in the taskbar.
15. Click **Manage**.
16. Click **Services and Applications**.
17. Click **Services**.



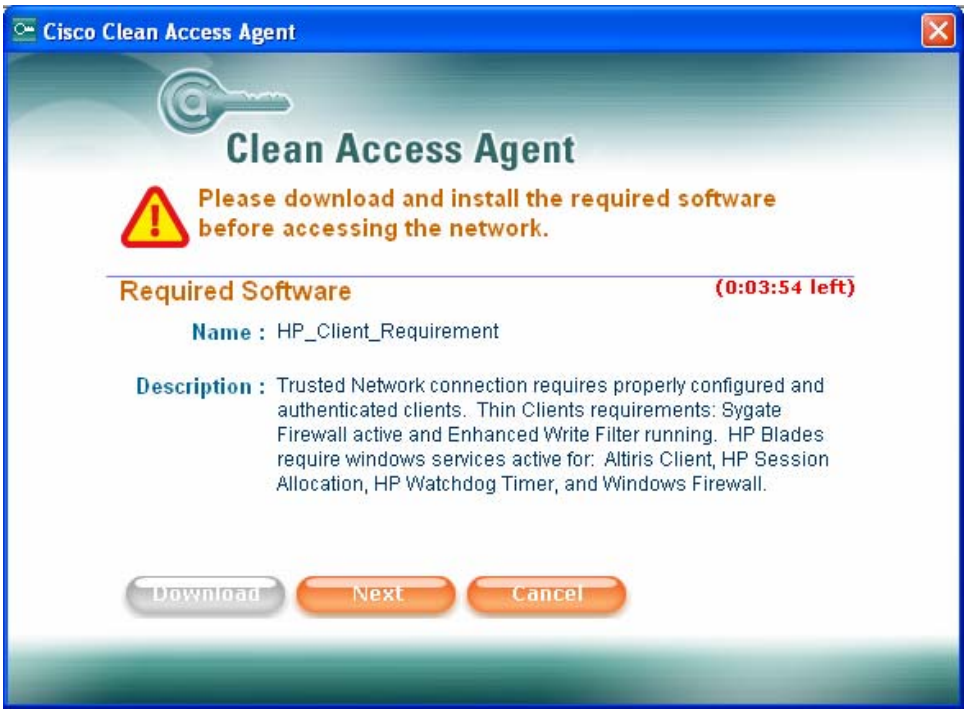
18. Disable **HP SAM Registration Service** by right-clicking on the entry and selecting **Stop**.



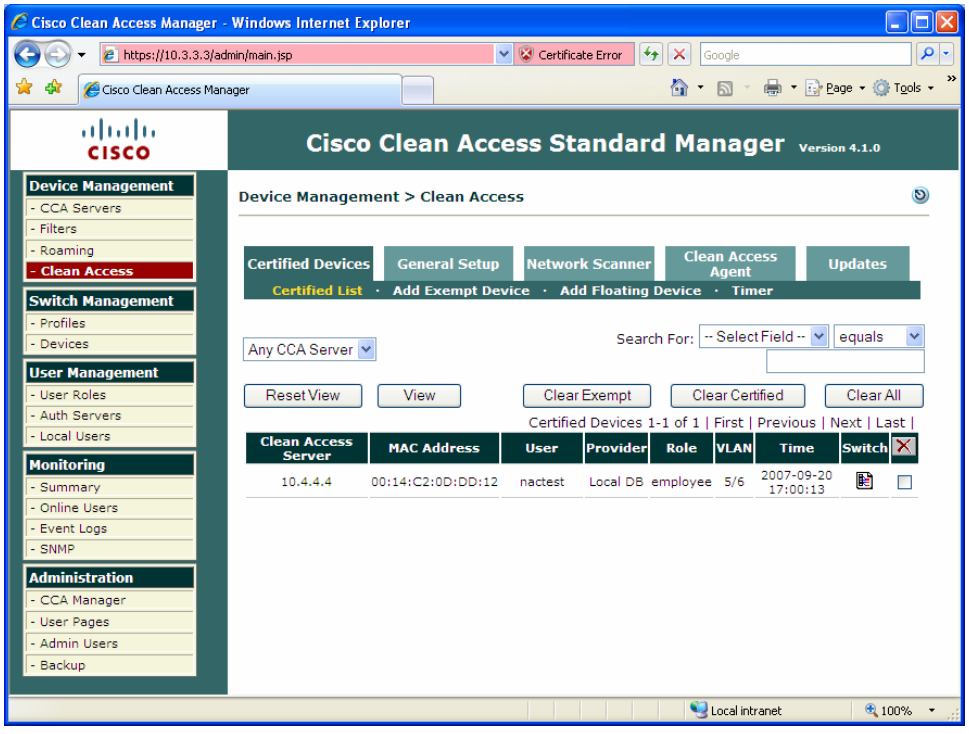
19. Log on again (through the CAM Web site at https://10.3.3.3) with user credentials for the "nactest" account.
20. The Clean Access Agent test should now find the machine out of policy. The machine is either kept in quarantine LAN or temporary access can be granted to the trusted LAN (if required for remediation). For purposes of this reference implementation, we have configured a temporarily network access of 4 minutes to allow any required access to any remediation resources that may exist on the trusted network and to demonstrate the flexibility of clean access enforcement.

    NOTE: This is a configurable policy and there are security consequences in allowing any temporary access to the trusted/production network. If remediation servers are present on the untrusted LAN, there is no need to grant temporary access.

21. Click **Continue** to see more information on the missing requirements.



22. Click **Next** to re-scan. Clean Access Agent displays information on the missing requirements after each re-scan until the policy requirements are corrected. Click **Cancel** to close this screen and end the temporary access.
23. For purposes of our example, if you re-enable HP SAM Registration Service and click **Next** within the time limit, the scan succeeds and full access is granted to the trusted network VLAN.



Closing Observations

In this reference implementation, CISCO Clean Access NAC appliance has been used to gate access of HP t5720 Thin Clients and Blade HP blade PCs. We have used NAC agents on each client device to validate device configuration and user access to the network. In effect, the CAS bridges the production and quarantine networks and works along with CAS agents on client devices to ensure that configuration policy is met and that users are authorized to access the network.

In this example, we've used a Cisco 3560 Layer 3 switch and set policies to move client ports (ports 10 and 11, in this implementation) from quarantine VLAN as a default startup state to the production VLAN. The switchover is accomplished (per settings in Appendix A) by sending SNMP messages (controlled by CAS policy) to the 3560 switch.

HP blade PCs did not require special handling prior to loading Clean Access Agent. In the case of t5720 thin clients, the default Sygate firewall is provided by HP in a locked-down mode and ports must be opened to allow traffic between CAS/CAM server appliances and the thin clients. We have walked through the Firewall setup and committing write changes via the EWF.

Appendix A – CISCO 3560 Switch Configuration

```
Switch#show configuration
Using 4021 out of 524288 bytes
!
version 12.2
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname Switch
!
no aaa new-model
vtp mode transparent
ip subnet-zero
ip routing
ip dhcp excluded-address 10.5.5.1 10.5.5.5
ip dhcp excluded-address 10.6.6.1 10.6.6.5
!
ip dhcp pool DHCP
 network 10.5.5.0 255.255.255.0
 default-router 10.5.5.2
!
ip dhcp pool DHCP6
 network 10.6.6.0 255.255.255.0
 default-router 10.6.6.2
!
no file verify auto
spanning-tree mode pvst
spanning-tree extend system-id
!
vlan internal allocation policy ascending
!
vlan 2
 name Vlan2
!
vlan 3
 name Vlan3
!
vlan 4
 name Vlan4
!
vlan 5
 name Vlan5
!
vlan 6,100,200
!
interface FastEthernet0/1
 description **TRUSTED INTERFACE ON CAS**
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 100
 switchport trunk allowed vlan 4,6,100
 switchport mode trunk
!
interface FastEthernet0/2
 switchport access vlan 2
 spanning-tree portfast
!
interface FastEthernet0/3
 switchport access vlan 3
 spanning-tree portfast
!
interface FastEthernet0/4
 description **UNTRUSTED INTERFACE ON CAS**
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 200
 switchport trunk allowed vlan 5,200
 switchport mode trunk
 spanning-tree portfast
!
interface FastEthernet0/5
 switchport access vlan 5
 spanning-tree portfast
!
interface FastEthernet0/6
 switchport access vlan 6
```

```
 spanning-tree portfast
!
interface FastEthernet0/10
 description **CAS CLIENT INTERFACE**
 switchport access vlan 5
 snmp trap mac-notification added
 spanning-tree portfast
!
interface FastEthernet0/11
 switchport access vlan 6
 switchport mode access
 snmp trap mac-notification added
 spanning-tree portfast
!
interface Vlan1
 no ip address
!
interface Vlan2
 ip address 10.2.2.2 255.255.255.0
!
interface Vlan3
 ip address 10.3.3.2 255.255.255.0
!
interface Vlan4
 ip address 10.4.4.2 255.255.255.0
!
interface Vlan6
 ip address 10.6.6.2 255.255.255.0
!
interface Vlan100
 no ip address
!
interface Vlan200
 no ip address
!
ip classless
ip http server
!
access-list 101 permit udp any any
access-list 101 permit ip any host 10.4.4.4
snmp-server community public RO
snmp-server community private RW
snmp-server trap-source Vlan4
snmp-server enable traps snmp linkdown linkup
snmp-server enable traps mac-notification
snmp-server enable traps stpx root-inconsistency loop-inconsistency
snmp-server host 10.3.3.3 public mac-notification snmp
!
end
```

For more information

For more information about the HP thin clients or any other HP product, contact your HP Authorized Reseller or visit these online locations to learn more about HP products, services, and support:

HP Links:

- HP home page: www.hp.com/sbso/busproducts.html
- HP desktop, blade PC, or thin client information: www.hp.com/desktops
- HP workstations information: www.hp.com/workstations
- HP notebook information: www.hp.com/notebooks
- HP security: www.hp.com/go/security
- HP Proliant and Integrity Server information www.hp.com/servers
- HP notebooks options information: www.hp.com/notebooks/options
- HP desktop options information: www.hp.com/desktops/options
- HP Services: www.hp.com/go/services
- HP support: www.hp.com/go/support
- HP Care Pack: www.hp.com/hps/carepack
- "How to buy": www.hp.com/buy/howtobuy

CISCO NAC Links:

- Network Admission Control At-a-Glance
  http://www.cisco.com/en/US/netsol/ns466/networking_solutions_package.html
- Cisco Security Agent (CSA)
  http://www.cisco.com/en/US/products/sw/secursw/ps5057/index.html
- Clean Access Appliance Configuration Guide
  http://www.cisco.com/en/US/docs/security/nac/appliance/configuration_guide/413/cam/cam413ug.pdf

General NAC Links

- Introduction to Network Access Protection
  http://www.microsoft.com/technet/network/nap/napoverview.mspx
- Thin Client Product Overview
  http://h20202.www2.hp.com/Hpsub/downloads/t5000%20PO_Jan06_clean-emea.pdf

466208-001, January 2008