# Global Information Assurance Certification Paper

# Auditing a Cisco Aironet Wireless Network From an Auditors Perspective

GSNA v2.1 PRACTICAL

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**Ryan Stall**
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Abstract/Summary

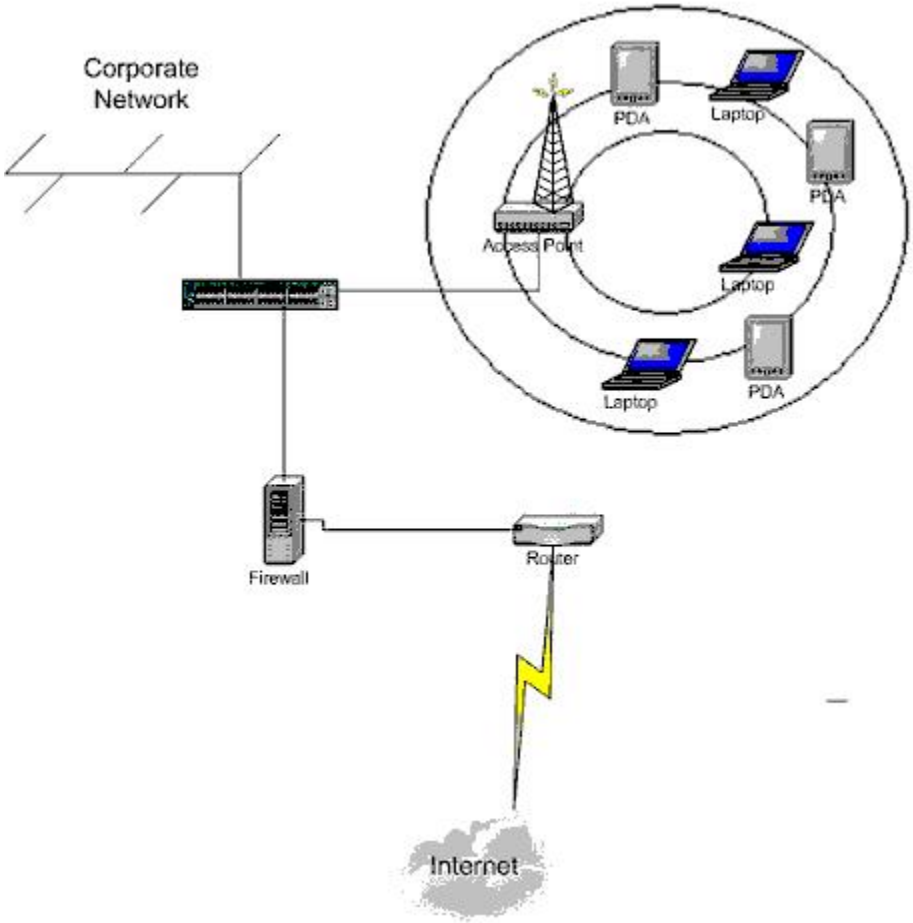
This paper is submitted as the requirement for a practical in the GSNA certification track. The subject of this audit is a wireless network that will be used in a corporate environment. Various devices such as laptops and PDA's will utilize the wireless network. Securing these devices is out of the scope of this audit. The wireless network is primarily used in conference rooms and training rooms. The eventual goal of wireless usage is to provide network access for workstations and access to wireless devices in the warehouses. Wireless devices in warehouses will be used for warehouse automation. The goal of the practical is to ensure the correct steps have been taken to secure this wireless LAN. The paper can then serve as a framework for future wireless LAN implementations.

OUTLINE

*Assignment 1*

*Identify the system to be audited*

This is an audit of a wireless LAN being in a corporate office environment. The wireless LAN consists of a Cisco Aironet 1200 (System Firmware v. 11.56, Radio Firmware v. 5.01.02), a Cisco Aironet 350, (System Firmware v. 11.42, Radio Firmware v. 4.99.38, 802.11a) and two Compaq Ipaq 3850s (Pocket PC 2002). The IPAQs connect to the AP via the Cisco 350 wireless card. This wireless network provides e-mail and internet access for PDA's in the corporate office. The information from this audit will be used in future wireless LAN implementations in the Company.




The figure above shows the placement of the access point on the network. The wireless AP's will connect to one of the core switches, and will be behind the corporate firewall. The wireless LAN will have internet access through the internet connection shown in the diagram. The internet access will provide the wireless users with browser access and access to email.

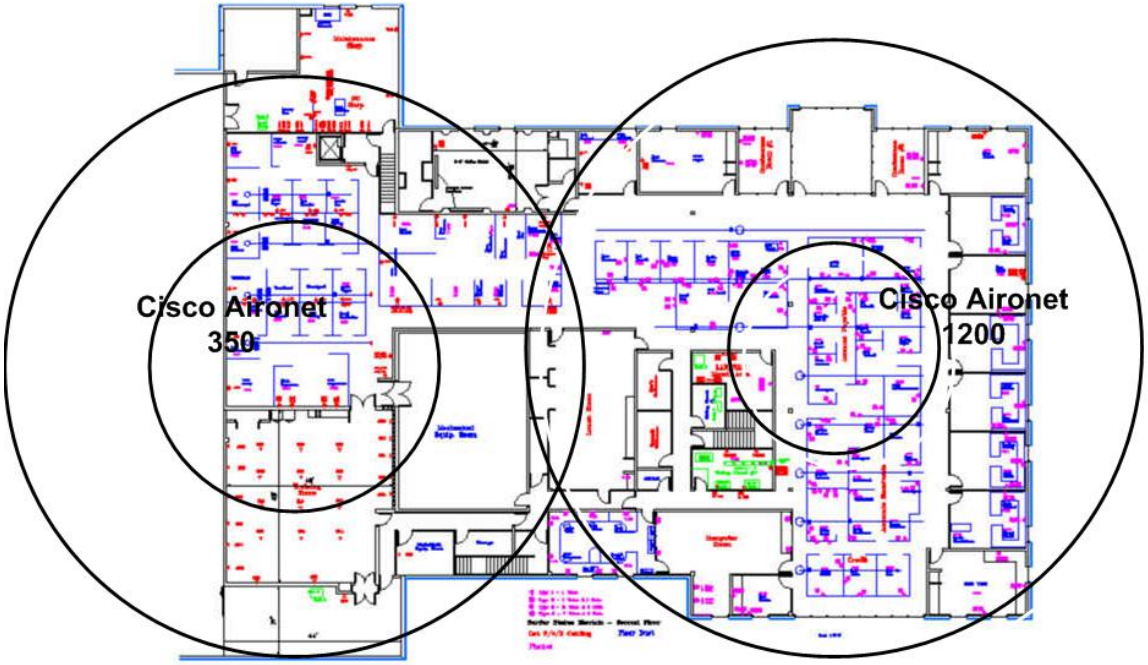



Figure 2 shows an architectural drawing of the building and the placement of the wireless access points. An access point has been placed at both ends of the building to provide coverage for the entire floor. This allows for use of wireless devices in all of the conference rooms on the east side of the building as well as a training room on the northwest corner of the building.

The scope of this audit is the Cisco Aironet 350 and 1200. The laptop computers and Compaq Ipaq's are out of the scope of the audit.

***Risks:***

| Risk | Probability | Consequences |
|---|---|---|
| Unauthorized LAN Access from outside the building | High | Loss of company data, data integrity, monetary loss |
| Unauthorized LAN Access from inside. | High | Loss of company data, interruption of service |
| Unauthorized Internet Access from the outside the building. | High | Loss of company data, loss of data integrity, privacy issues. |
| Accidental Association with the Access Point | Medium | Loss of company data, and data integrity |
| Disruption of Service to the Wireless Network | High | Loss of productivity, possible monetary loss. |
| Disruption of Service to | Medium | Loss of productivity, |

| | | |
|---|---|---|
| the Corporate Network | | potential loss of data, monetary loss. |
| Data Loss | High | Loss of productivity, and monetary loss. |
| Misconfigured access points. | High | Could allow unauthorized access to the corporate network and systems. Can also cause disruption of service. |
| Lack of Physical Security | High | Unauthorized individuals could gain access to the access point causing loss of service or unauthorized access to the corporate network. |

*Current State of Practice*

It seems everywhere you look, articles in trade magazines, newsgroups, press, wireless networking and security are a discussion. Wireless networks are gaining popularity and becoming much less expensive. Costs for equipment are making wireless LANs an attractive alternative to wired networks. There are still wireless standards being developed (802.llg, 802.11i), by the IEEE and IETF. Wireless network devices are also becoming increasingly easier to install. Most access points can be utilized out of the box with the default settings. Because of this and the lack of standard procedures and checklists, wireless networks pose a great security concern. There are many articles outlining wireless security vulnerabilities and risks, but not many with specifics on mitigating those risks. Most research was done using the internet and standard search engines such as www.google.com and www.msn.com. A search on wireless networks and wireless security produces a large number of hits. There were a few sites that provided information worth mentioning.

The auditor found two checklists pertaining to the Cisco access point. One is a GSNA practical by Mark Gryparis (http://www.giac.org/practical/GSNA/Mark_Gryparis_GSNA.pdf), and GSNA practical by Angela Loomis (http://www.giac.org/practical/Angela_Loomis_GSNA.doc) .

The National Institute of Standards and Technology published a wireless security recommendations document in July 2002 (http://csrc.nist.gov/publications/drafts/draft-sp800-48.pdf)

The National Infrastructure Protection Center has put out a wireless 802.11b best practices document. (http://www.nipc.gov/publications/nipcpub/bestpract.html)

The equipment vendor site was also utilized (www.cisco.com). One article worth noting is the wireless LAN security overview. (http://www.cisco.com/en/US/products/hw/wireless/ps430/prod_brochure09186a0080088829.html) Cisco also has a compilation of wireless security articles at their wireless security website. (http://www.cisco.com/warp/public/779/smbiz/wireless/wlan_security.shtml)

**Assignment 2**

*Audit Checklist*

| **1. Obtain Permission to conduct the audit** | |
|---|---|
| Reference | Class material – 7.1 Auditing Principles and Concepts |
| Control Objective | Signed permission must be obtained to use audit tools and gain cooperation of the corporate staff. |
| Risk | Without signed permission the auditor may not get the cooperation he needs and may be held responsible for any problems, issues, or sensitive information that is found from performing the audit. |
| Compliance | Signed permission outlining the tools and methods to be used in the audit. |
| Testing | Obtain signed permission |
| Objective/Subjective | This is a objective step. |

| **2. Wireless LAN Policy** | |
|---|---|
| Reference | Security Basic Knowledge, Track 7 course material |
| Control Objective | Outline policies and standards for the implementation of a wireless network. |
| Risk | Clearly stated policies regarding wireless access leave nothing open to interpretation. With a known policy in place, management has more leverage in the case of an information security incident, like in the case of rouge access points. A policy is also a guideline for auditing. |
| Compliance | Does the company have a wireless LAN policy in place? |
| Testing | Interview IT management, and obtain a copy of the policy and procedure |

| | |
|---|---|
| | manual. Search the manual for wireless policies. |
| Objective/Subjective | Subjective, the policy should exist and leave nothing to interpretation |

| **3. Verify SSID broadcast is disabled** | |
|---|---|
| Reference | Cisco Wireless LAN security overview http://www.cisco.com/en/US/products/hw/wireless/ps430/prod_brochure09186a0080088829.html |
| Control Objective | Ensure the access point is not broadcasting the SSID in the beacon packets. The SSID would need to obtained by sniffing the probe packets. |
| Risk | Network access by unauthorized persons. |
| Compliance | SSID broadcast disabled in the access point configuration |
| Testing | Confirm SSID broad cast is disabled using the access point configuration web utility. The settings are found by clicking set properties on the AP Radio configuration screen. Allow broadcast of SSID should be set to no. Use wireless sniffer to verify SSID is not broadcasted in the access point beacon packet. |
| Objective/Subjective | Objective. |

| **4. Verify a strong non-trivial SSID is being used.** | |
|---|---|
| Reference | NIST |
| Control Objective | The SSID should not be an easily guessed phrase such as address, company name, or street name. |
| Risk | Association to the access point by unauthorized persons. |
| Compliance | A strong SSID should be used which contains at least 8 alpha and numeric characters and contains no dictionary words. |
| Testing | SSID configuration should be confirmed using the access point configuration utility. The settings are found by clicking set properties on the AP Radio configuration screen. Check the Service Set ID field. |
| Objective/Subjective | Objective |

| **5. Verify WEP Configuration** | |
|---|---|
| Reference | Cisco SAFE whitepaper |
| Control Objective | Client must use WEP to communicate with the access point. All communications with the access point should be encrypted. |
| Risk | Network and data compromise by an unauthorized person. |
| Compliance | Verify WEP is being used. |
| Testing | Verify WEP configuration using the configuration utility. The settings can be found by clicking on security on the setup page. Then follow the link for Radio Data Encryption. Use of data encryption should be set to full encryption. Note: This setting is only available if a WEP key is set. |
| Objective/Subjective | Objective |

| **6. Verify the use of MAC address filtering** | |
|---|---|
| Reference | NIST document |
| Control Objective | Ensure only authorized devices can associate with the access point |
| Risk | Unauthorized association causing network interruption and data loss. |
| Compliance | Verify MAC address filtering is being used and the MAC addresses of the authorized devices have been entered. |
| Testing | Check the configuration utility for configuration of MAC address filtering. These settings are found by clicking Address Filters on the setup page. MAC addresses of the authorized devices should be listed. Also attempt to associate an unauthorized device. This can be done by attempting to associate to the access point with a wireless card with a MAC address not listed. |
| Objective/Subjective | Objective |

| **7. Verify the access point is configured for the lowest possible power settings.** |
|---|

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|---|---|
| Reference | NIST Document (http://csrc.nist.gov/publications/drafts/draft-sp800-48.pdf), table 3-3 |
| Control Objective | Ensure the wireless signal is not being broadcasted to unauthorized areas |
| Risk | Unauthorized network access from outside of the building or in public areas such as the lobby. |
| Compliance | A wireless device should not be able to associate to the access point from outside the building or public areas. |
| Testing | Use Cisco client utilities to check signal strength in several areas. Cisco client utilities includes a site survey tool which measures signal strength and quality. Check signal strength especially in areas easily accessible to the public. In all of the unauthorized or public areas, the survey tool should either show very low signal strength or not associate. |
| Objective/Subjective | Subjective, it may not be possible to configure the access point for a lower setting and still provide an acceptable level of service. |

| **8. Verify secure placement of the access point.** | |
|---|---|
| Reference | NIST Document (http://csrc.nist.gov/publications/drafts/draft-sp800-48.pdf), table 3-3 |
| Control Objective | Prevent unauthorized physical access to the access point. |
| Risk | Unauthorized access by an unauthorized individual can cause disruption of service and loss of data. |
| Compliance | Verify the access point is mounted in a secure location. |
| Testing | Check each access point and verify it is mounted in a secure location. Identify who has access to the access points. |
| Objective/Subjective | Objective |

| **9. Verify default admin password has been changed.** | |
|---|---|
| Reference | Cisco SAFE white paper |
| Control Objective | Prevent unauthorized admin access to |

| | |
|---|---|
| | the access point due to lack of admin password. The default settings are well published and access can be gained easily with the defaults. |
| Risk | Unauthorized admin access leaves the door open to anyone who can determine the access point ip address. This can lead to network interruption and potential data loss. |
| Compliance | Verify the default admin password has been changed to a strong nontrivial passphrase. |
| Testing | Interview the network administrators and verify the admin password has been changed to a strong password. Verify the password contains eight alphanumeric characters and no dictionary words. |
| Objective/Subjective | Objective |

| **10. Verify that wireless access points have been hardened.** | |
|---|---|
| Reference | NIST wireless security document (http://csrc.nist.gov/publications/drafts/draft-sp800-48.pdf), table 3-3 |
| Control Objective | Prevent unauthorized access due to software issues or unneeded services. |
| Risk | Access to the network or access point could be gained through flaws in the software, firmware, or unneeded services. This is a moderate risk. |
| Compliance | Verify the software and firmware are at the most current levels. Also verify that any unneeded services that can be disabled are. |
| Testing | Verify with the configuration utility. Firmware level can be verified on the software page. Services are listed on the setup page. Each unneeded service should be set to disabled. |
| Objective/Subjective | Objective |

| **11. Verify access point placement does not allow for signal broadcast outside the authorized area.** | |
|---|---|
| Reference | NIST standards |

| | |
|---|---|
| Control Objective | Prevent unauthorized access from the outside. |
| Risk | Unauthorized access to the network, disruption of service and data loss. This is a high risk. Signal broadcast to the outside is the first thing an individual needs to begin attempting access to the network. |
| Compliance | Verify that there is no signal broadcast to unauthorized areas such as outside the building due to access point placement. The access point should not be placed next to windows or areas that would allow it's signal to be broadcast out of the authorized areas. |
| Testing | Verify the access point is not placed next to windows. Check signal strength at several locations. Signal strength should be verified with the Cisco client utilities site survey tool. Signal strength should be checked in public areas and outside of windows. |
| Objective/Subjective | Subjective, there may not be many options for access point placement to provide network access where needed. |

| **12. Check for the existence of rouge access points.** | |
|---|---|
| Reference | Cisco SAFE |
| Control Objective | Ensure that only access points meeting the security requirements are connected to the network. |
| Risk | Rouge, misconfigured access points can allow access to the network resulting in potential data loss, service disruption and data integrity issues. This is a high level risk. Rouge access points that are not configured properly are a high risk to any network. |
| Compliance | Use netstumbler to check for access point. Use switch cam tables to check for mac addresses of known access points. On a Cisco switch the command would be "sh cam dynamic" for dynamic entries or "sh cam static" for static entries. |
| Testing | Use netstumbler to check for access |

| | |
|---|---|
| | point. Use switch cam tables to check for mac addresses of known access points. |
| Objective/Subjective | Objective |

| **13. Verify access point network configuration has been changed from the defaults.** | |
|---|---|
| Reference | NIST Document (http://csrc.nist.gov/publications/drafts/draft-sp800-48.pdf), table 3-3 |
| Control Objective | Ensure unauthorized access cannot be gained because of pre-configured, well-known defaults. |
| Risk | Unauthorized network access |
| Compliance | Verify all default settings have been changed. |
| Testing | Compare current configurations settings with out of the box default settings. Record all settings from an access point that has been set to factory default. Compare those settings to the current configuration. |
| Objective/Subjective | Objective |

| **14. Verify the use of strong authentication such as RADIUS.** | |
|---|---|
| Reference | ExtremeTech wireless security tips |
| Control Objective | Verify a higher lever of authentication is in use on the wireless network. This gives another layer of protection from unauthorized individuals associating with the access points. |
| Risk | Unauthorized access to the corporate network resulting in data loss and loss of service. |
| Compliance | Verify RADIUS authentication is configured properly. |
| Testing | Verify with the configuration utility that RADIUS is configured and in use. These settings are found by clicking on Authentication on the setup page. |
| Objective/Subjective | Objective |

| **15. Verify the use of encryption beyond that of WEP** |
|---|

| | |
|---|---|
| Reference | NIST Document (http://csrc.nist.gov/publications/drafts/draft-sp800-48.pdf), table 3-3 |
| Control Objective | Verify an encryption scheme is used to make up for the weaknesses in WEP. |
| Risk | Unauthorized access to the network, potential data loss, and privacy issues. |
| Compliance | Verify the use of strong encryption such as a VPN. |
| Testing | Verify LAN topology with network administrators. Use network sniffer to verify encryption. |
| Objective/Subjective | Objective |

| **16. Verify access points are turned off when not in use.** | |
|---|---|
| Reference | NIST Document (http://csrc.nist.gov/publications/drafts/draft-sp800-48.pdf), table 3-3 |
| Control Objective | Reduce the risk of unauthorized access by shutting down the WLAN when it is not in use. |
| Risk | The risk on a person successfully gaining access to the access point increases over time. |
| Compliance | Verify procedures are in place to shut down the access point after hours and weekends. |
| Testing | Spot check the access points at times when they should be powered down. Verify IT policy. |
| Objective/Subjective | Objective |

| **17. Verify the use of static IP addressing.** | |
|---|---|
| Reference | ExtremeTech tips |
| Control Objective | Prevent unauthorized access to the network by providing IP addresses. |
| Risk | Unauthorized access to the network. |
| Compliance | Verify all authorized devices are assigned IP addresses and DHCP is disabled on the access point. |
| Testing | Verify the configuration of the access point. Also, attempt to use DHCP on the client. |
| Objective/Subjective | Objective. |

| **18. Verify SNMP configuration** | |
|---|---|
| Reference | NIST Document (http://csrc.nist.gov/publications/drafts/draft-sp800-48.pdf), table 3-3 |
| Control Objective | Ensure that SNMP, if needed, is configured Securely. |
| Risk | Unauthorized access to the network by vulnerabilities in SNMP |
| Compliance | Verify the use of strong community strings. Configure SNMP for read only if possible. Disable SNMP if it is not needed. |
| Testing | Determine the need for SNMP. Check for the use of strong community strings. Setting can be checked by using the configuration tool. The setting can be found on the setup page by clicking SNMP. From this form SNMP can be enabled or disabled. The community string is listed here. |
| Objective/Subjective | Objective - All necessary settings can be verified<br>Subjective – SNMP may or may not be needed. If the administrators use SNMP, it may be possible to configure for read only. |

| **19. Verify the use of a firewall between the corporate network and wireless network.** | |
|---|---|
| Reference | NIST Document (http://csrc.nist.gov/publications/drafts/draft-sp800-48.pdf), table 3-3 |
| Control Objective | Use of a firewall ensures only required traffic is transmitted to the corporate network. |
| Risk | Unauthorized access to the network., interruption of service |
| Compliance | Verify the existence of a firewall between the wireless network and the corporate network. |
| Testing | Use a port scanner and ping scanner to verify the existence of a firewall. |
| Objective/Subjective | Objective. |

| **20. Change the Default channel** | |
|---|---|
| Reference | NIST Document (http://csrc.nist.gov/publications/drafts/draft-sp800-48.pdf), table 3-3 |
| Control Objective | Changing from the default channel lowers the risk of interruption of service due to radio interference. |
| Risk | Disruption of service due to Radio interference. This is currently a low risk in this small wireless network. This will be given more consideration as the wireless network and the number of access points grow. |
| Compliance | Verify the channel setting has been changed from the default setting. |
| Testing | Verify the channel setting in the access point configuration. The setting can be found by clicking setup, then clicking on the AP Radio. Click set properties on the AP Radio page. Here the default radio channel can be set. Also use netstumbler to determine the current channel settings. |
| Objective/Subjective | Objective. |

*Assignment 3 – Audit Evidence, Conduct the Audit*

**Audit Step 1.Checklist Step 1 (A1.C1) – Obtain Permission**

The audit objectives were presented to the network team, IT Manager, and VP of Information Technology. We reviewed the need to have a username and password to the wireless access points and audit tools such as netstumber, NAI Sniffer, and Cisco Site Survey were reviewed. The need to interview network administrators was also discussed. Signed permission was given to perform the audit.

***Pass:*** Written permission was obtained

**A2.C2 – Determine company policy and procedures for wireless LANs**

The company policy and procedure manual was reviewed and the VP of IT, and HR manager were interviewed. The policy and procedure manual was in electronic format, and was searched for keywords such as wireless and access point. No matches were found. Network administrators were also interviewed for

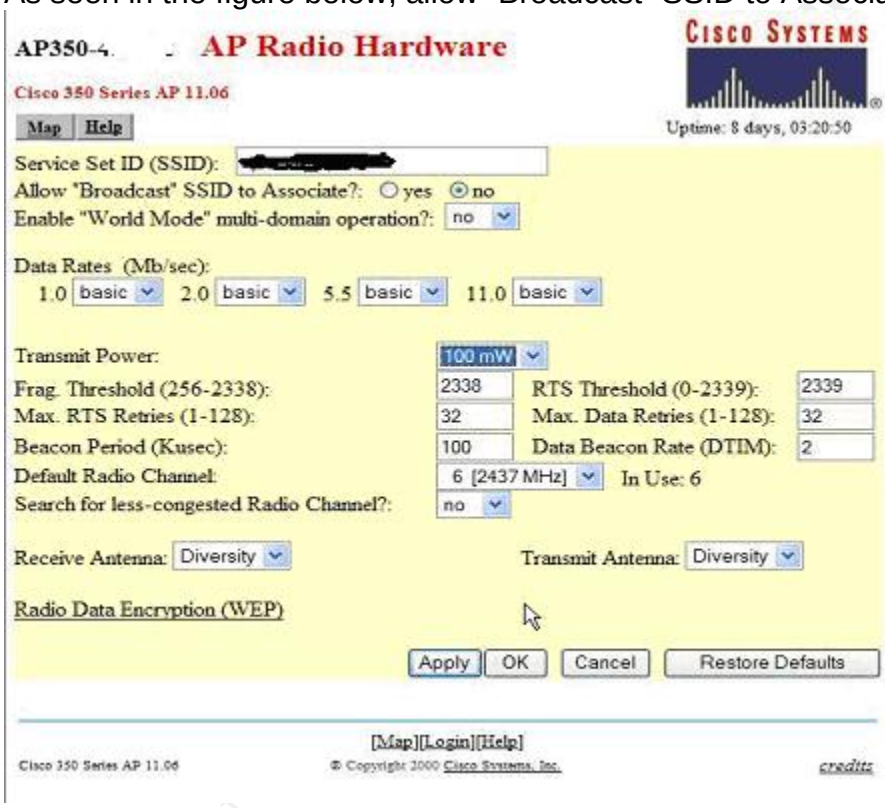
policy and know procedures. It was determined there is no wireless LAN policy in place.

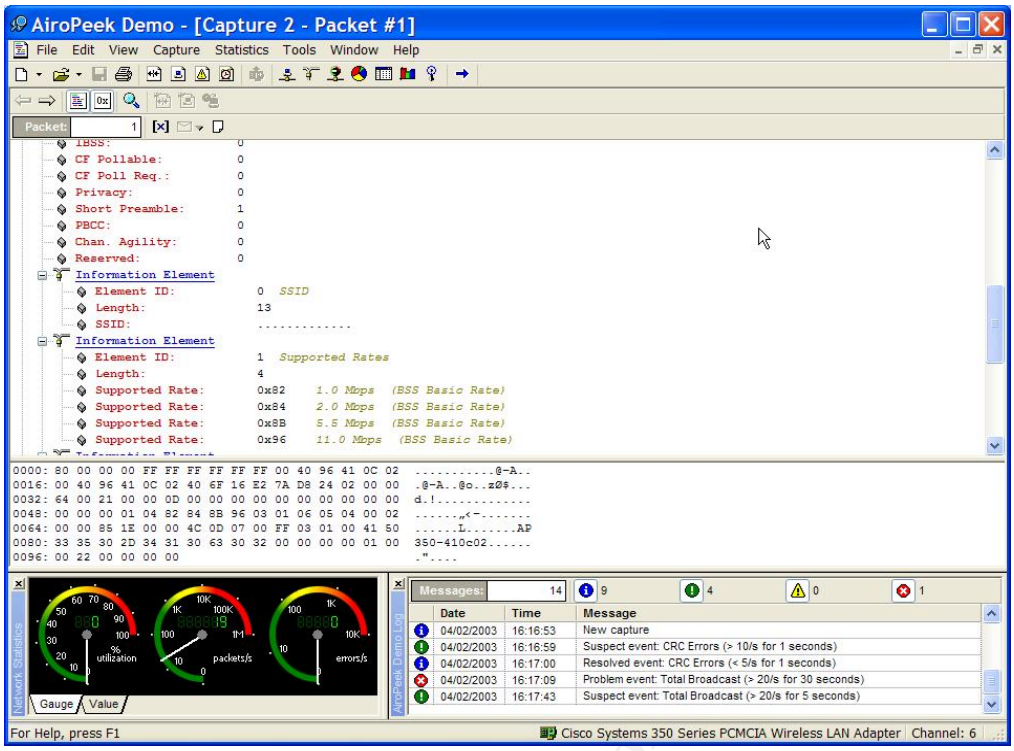
> *Fail:* There is currently no policy in place for wireless LAN's. A policy needs to be written.

### A3.C3 - Verify SSID broadcast is disabled

The configuration of the SSID broadcast parameter was verified with the cisco configuration utility.

As seen in the figure below, allow "Broadcast" SSID to Associate is set to no.



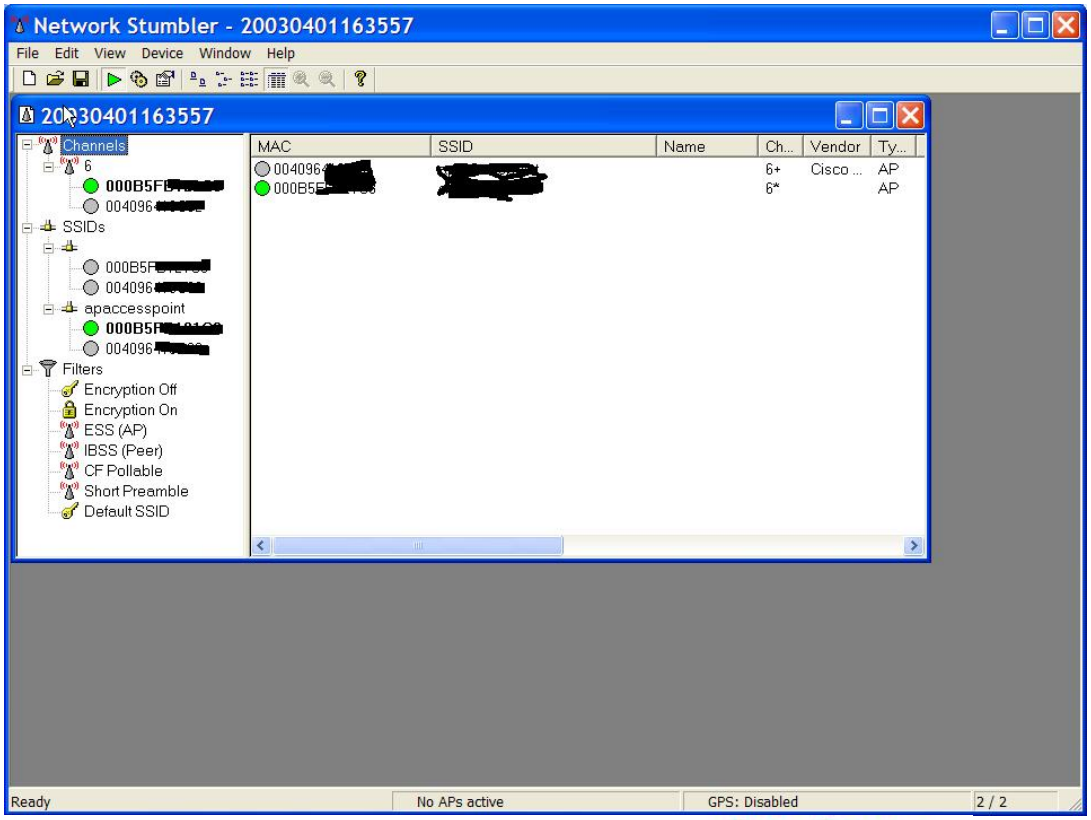


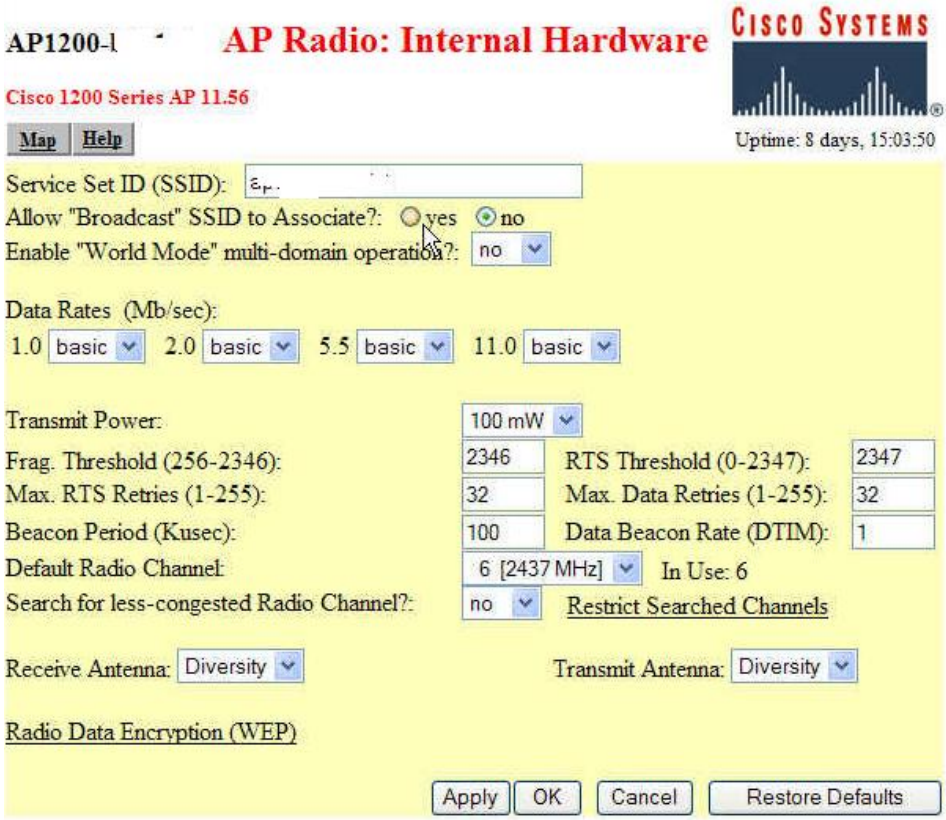

The setting was further verified by the use of a wireless sniffer. The results of the sniffer trace is shown in the figure above. The sniffer packet shown is a beacon packet. An analysis of the packet shows the SSID is not being broadcast.

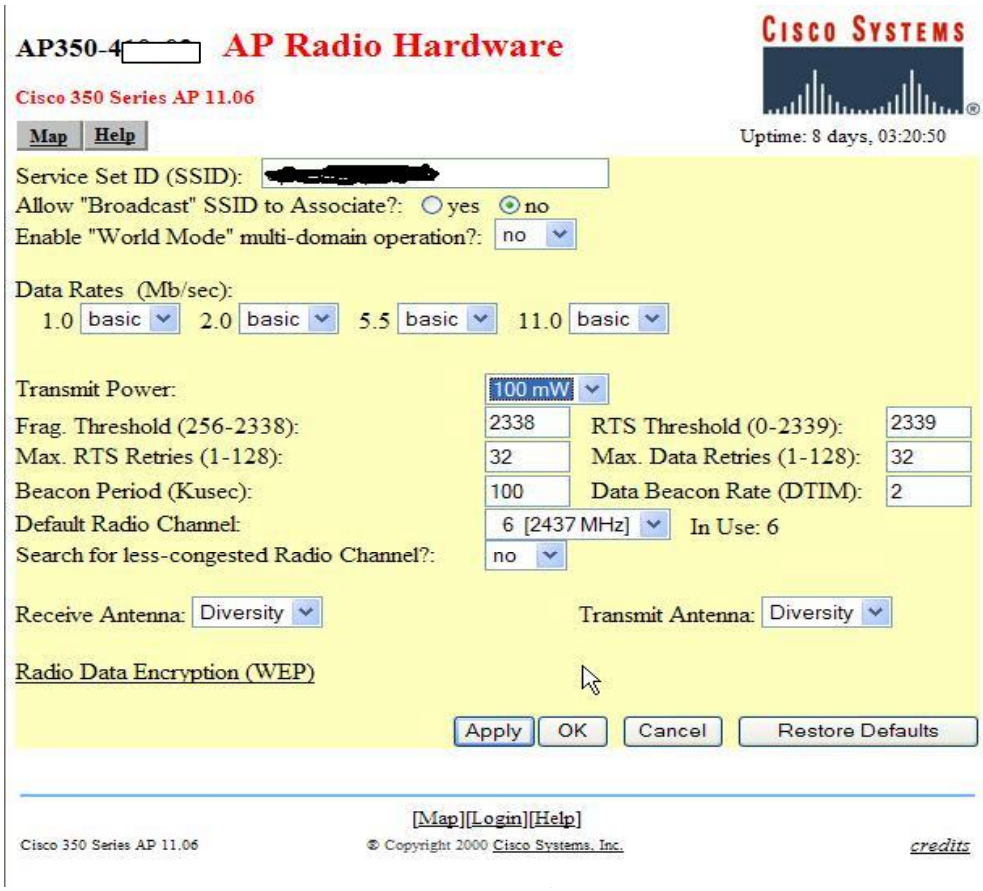
> ***PASS:*** The Allow Broadcast SSID setting in the configuration utility was set to no. The configuration was also verified by using AiroPeek. Beacon packets were captured and the auditor was not able to obtain the SSID.

## A4.C4 – Verify SSID Configuration

The WAP was manually checked using the web interface. SSID configuration was also verified with netstumbler.





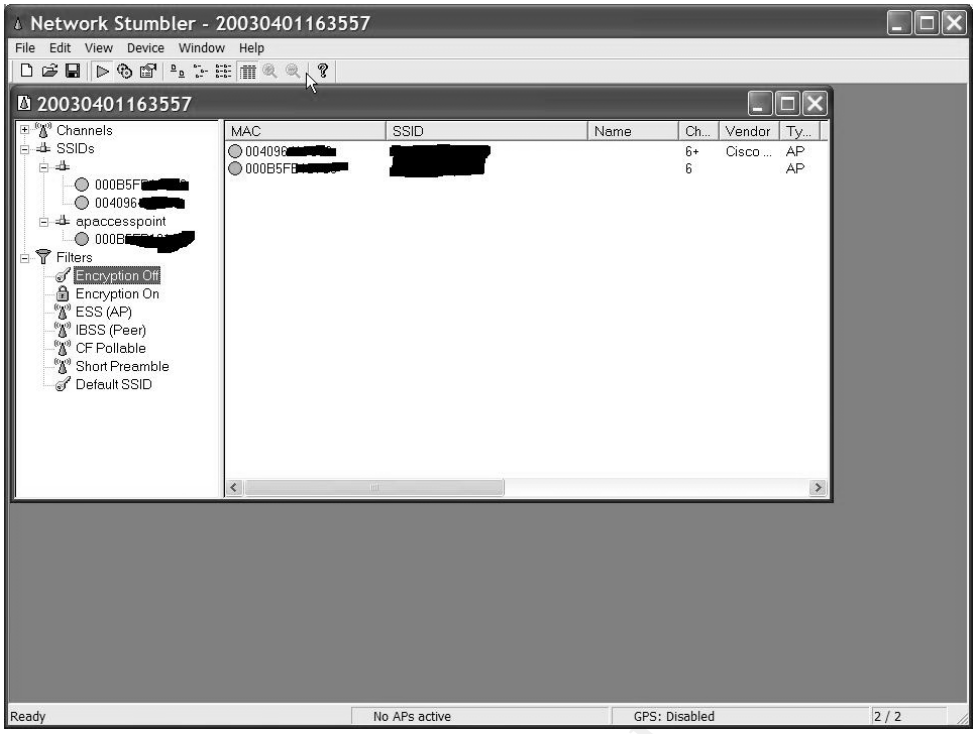

***Pass:*** The SSID was found to meet the strength requirements.

- SSID is not a dictionary word
- SSID contains more that eight alphanumeric characters

Attempting to associate a device without the correct SSID configured further tested the SSID configuration. The device did not associate.

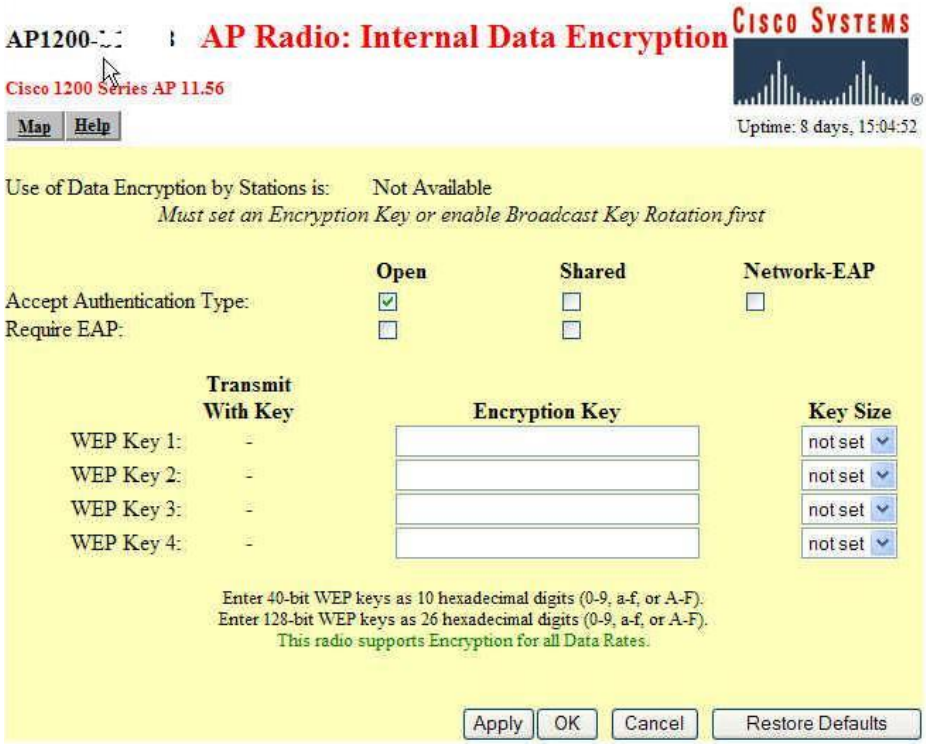
### A5.C5 – Verify WEP configuration

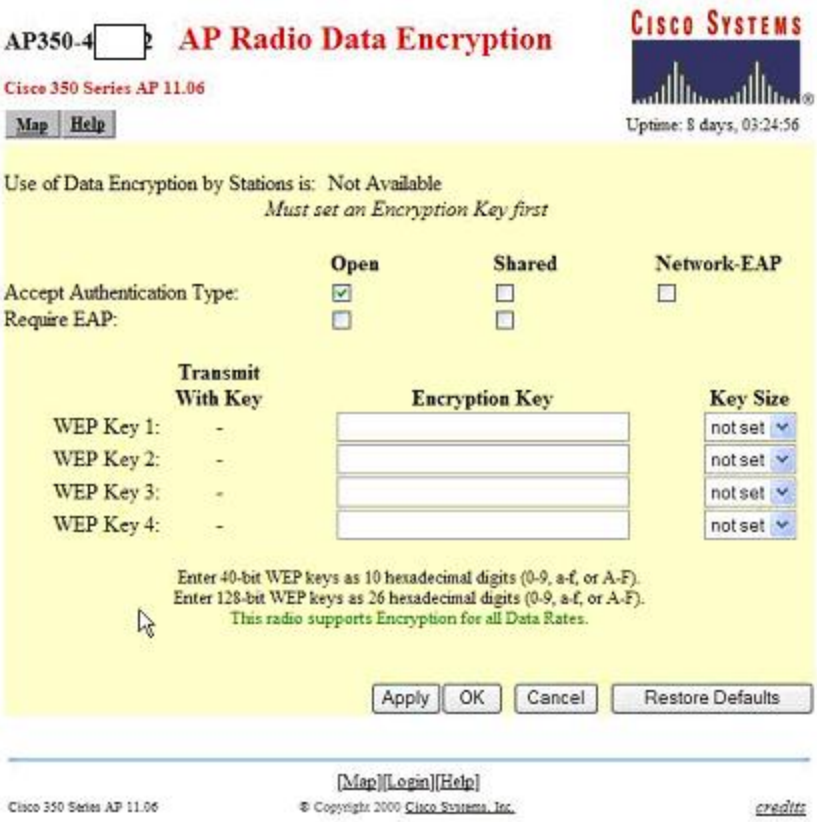
WEP configuration was verified by using both the configuration utility and netstumbler. Netstumbler was used to detect any access points not using encryption.




The results show that both the access points are not using encryption.

The follows screen shots show the WEP configuration on the access points.





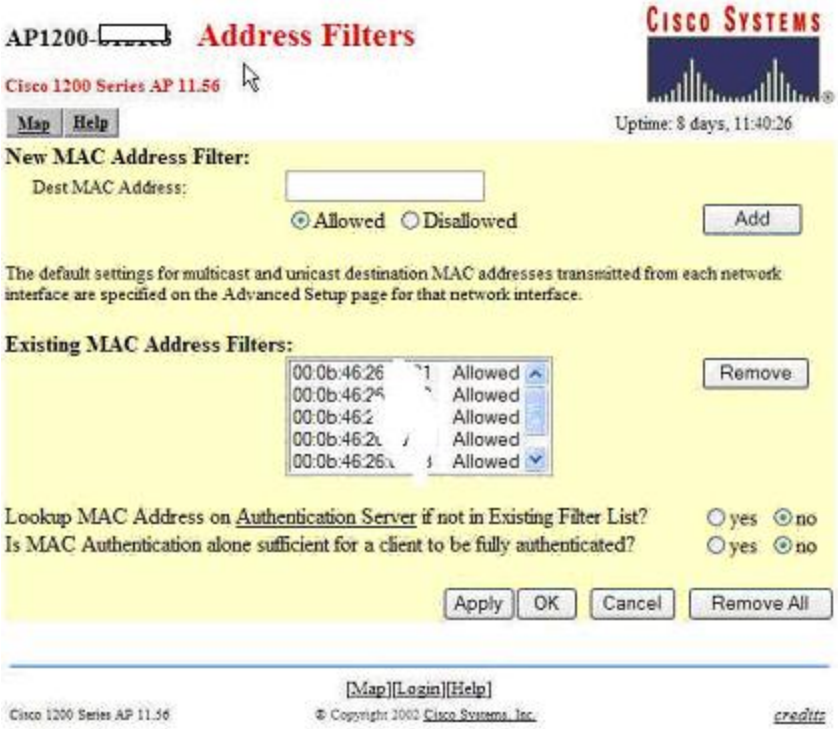

The configuration utility further verifies encryption is not being used.

> *Fail:* The configuration utility shows that WEP is not configured and not being used. Netstumbler was able to find both access points and also shows encryption is not being used.

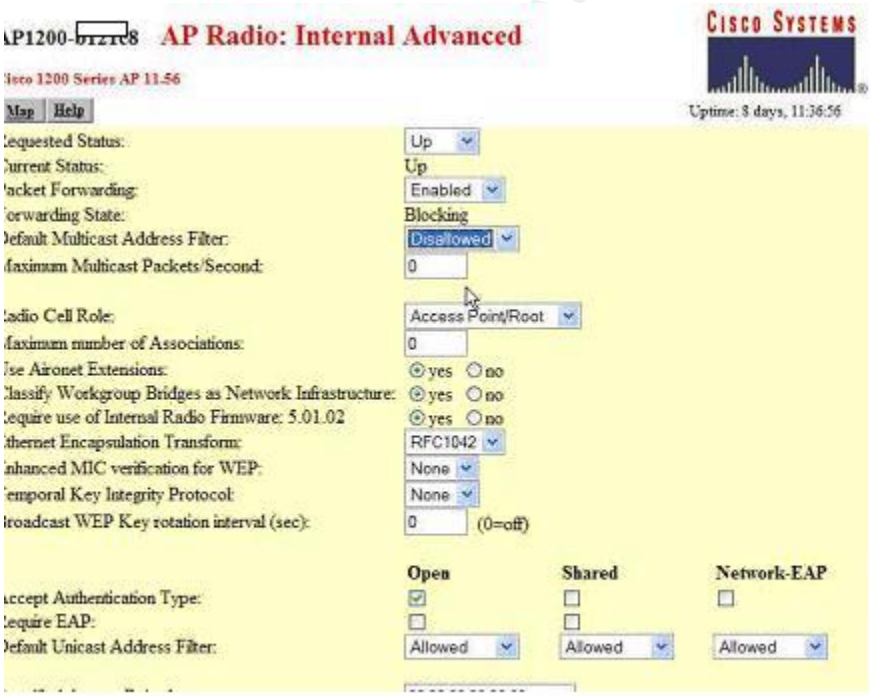
### A6.C6 – Verify The use of MAC address filtering

The WAP was manually checked using the web interface. The use of filtering was further verified by attempting to associate authorized and unauthorized devices.

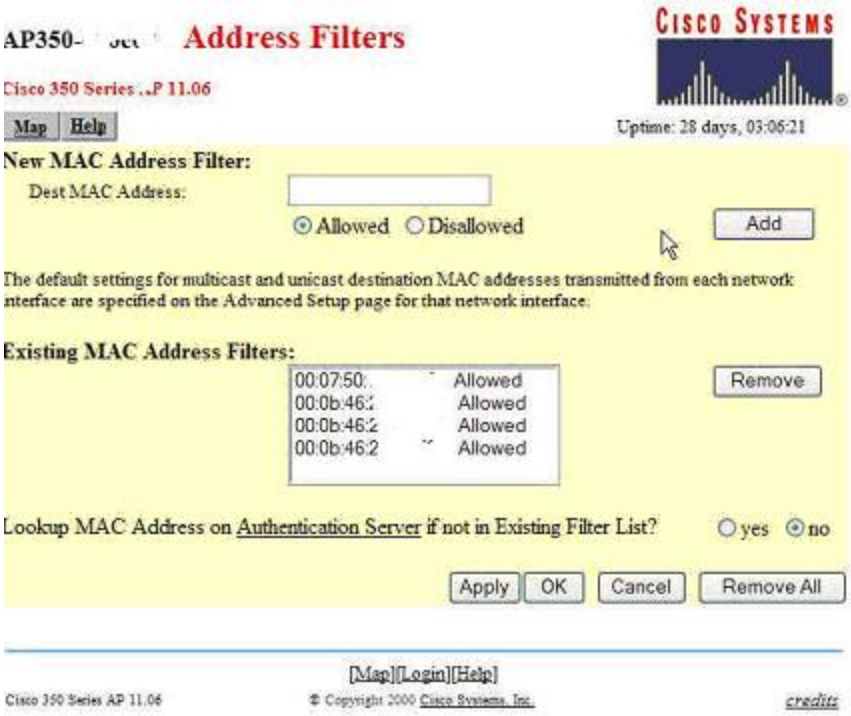
MAC address filtering was verified to be in use and the MAC addresses of all authorized devices have been entered. A device with an unlisted MAC address was unable to associate.



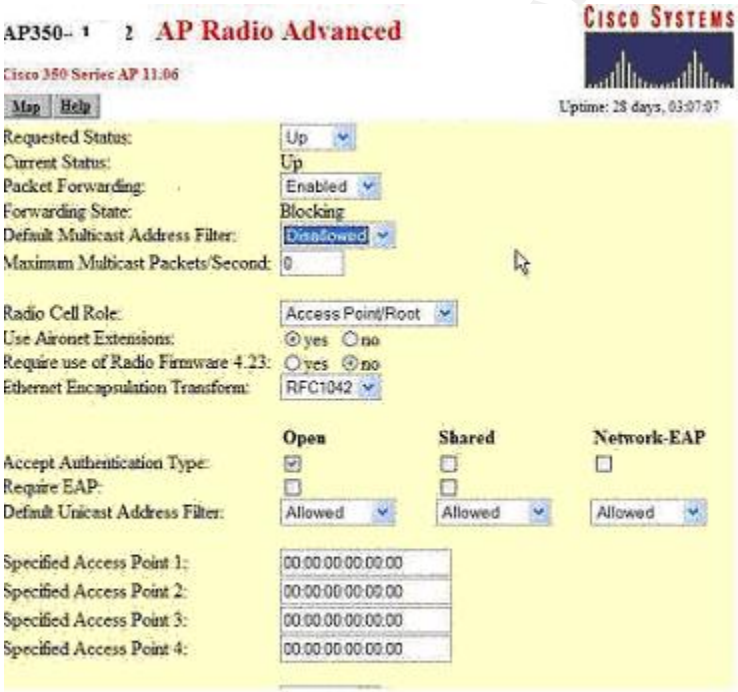

The screen shot above shows the entered MAC addresses on the Aironet 1200.




This screen shot shows the filter settings on the 1200 access point.

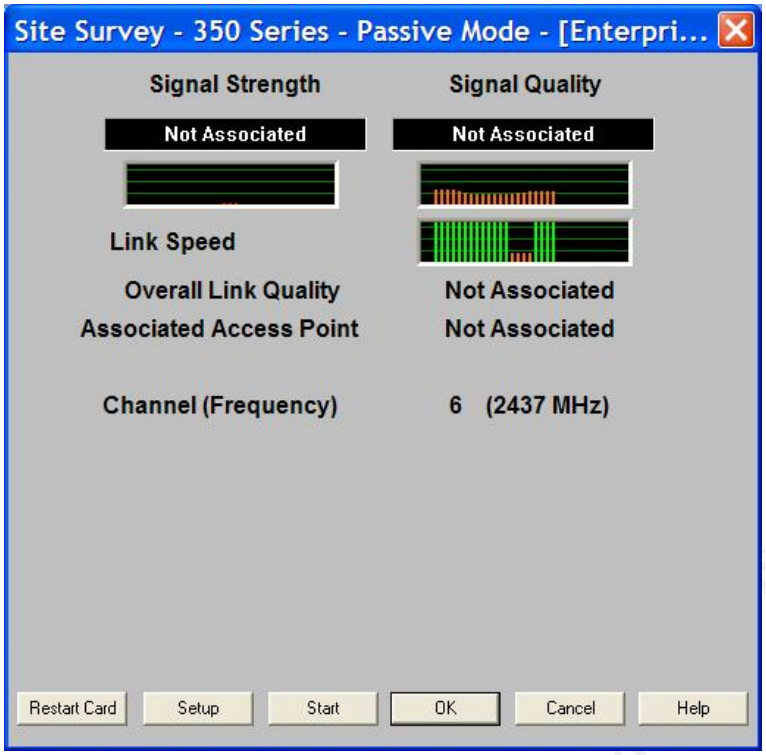



This shot shows the filters in use on the Aironet 350.




This shows the MAC filter settings on the Aironet 350.

An attempt was made to associate a device which was not listed in the access list.



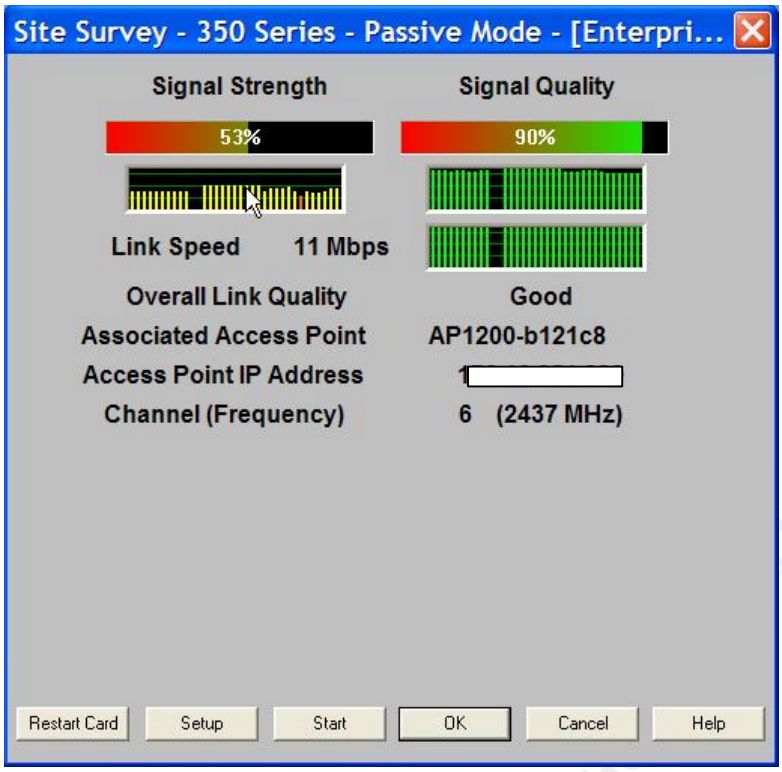

As seen from the configuration above, MAC address filtering is in use. It was also verified that unlisted devices could not associate.

> ***PASS:*** MAC address filtering was shown to be in use. The configuration utility listed all of the MAC addresses of authorized devices. An attempt was also made to associate an unauthorized device. The device could not associate

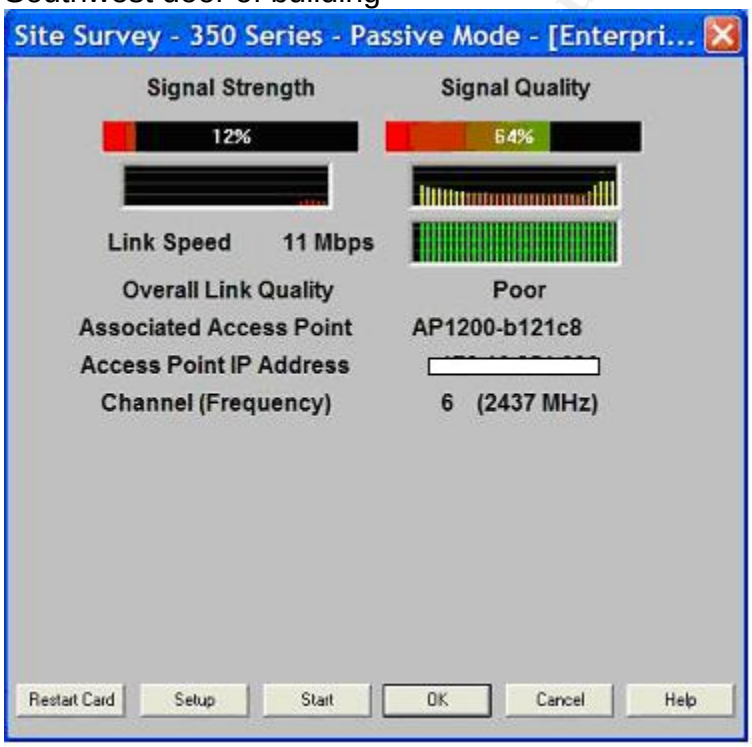
**A7.C7 – Verify access point is configured for the lowest possible setting.**

Coverage are was checked with a laptop and a Cisco aironet 340 pcmcia card. Signal strength was tested with the Cisco client utilities. Signal strength was tested at several areas inside and outside the building. Screen shots of the results are shown below.

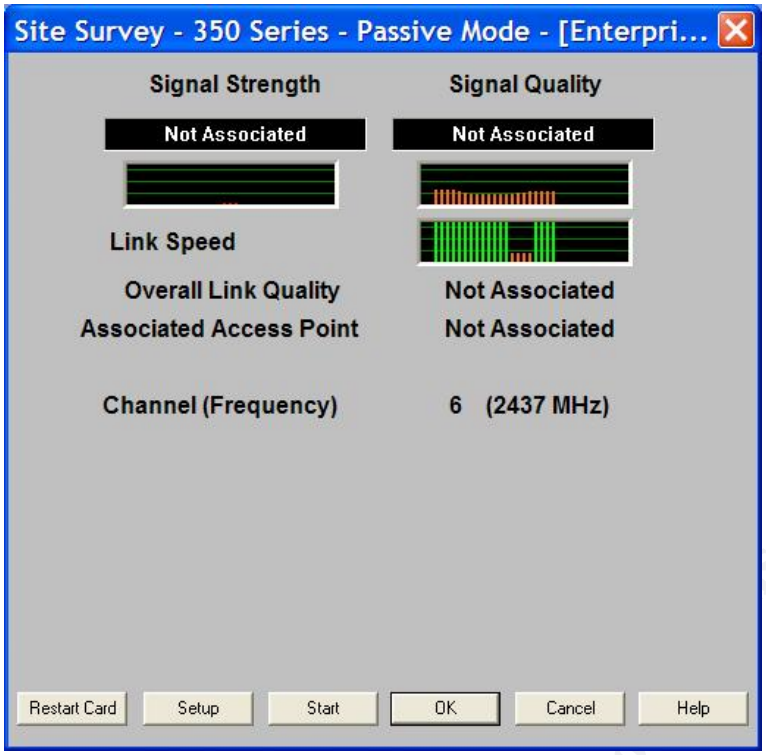
Outside the front main door on the southeast side



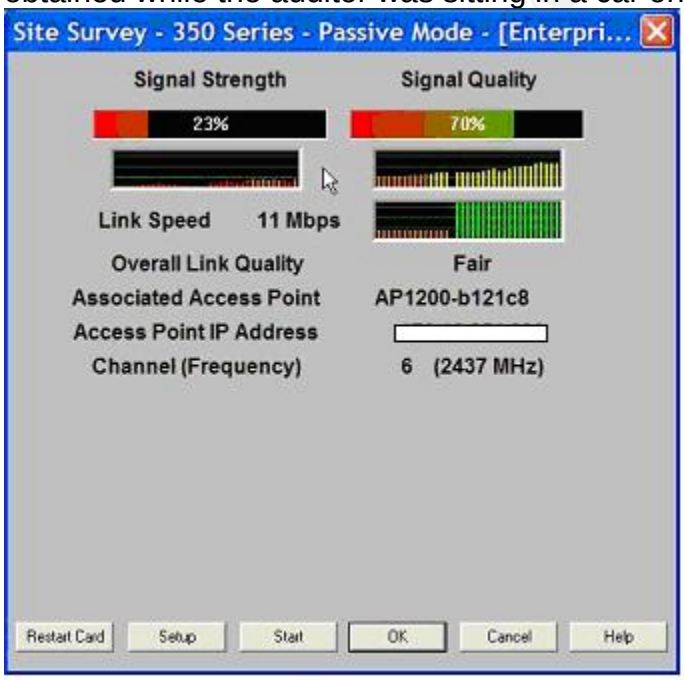

Southwest door of building




From the parking lot on the southwest side




The image below is from the street on the south side of building. This data was obtained while the auditor was sitting in a car on the opposite side of the street.



***Fail:*** The Aironet 1200 access point was found to be configured for the highest setting. This configuration is allowing for associating with the access point at unauthorized points. As seen from the screen shots above, the access point Cisco 1200 access point is broadcasting a signal far beyond the areas it is being used. The auditor was able to associate with the access point outside the building at various locations. These locations included the parking lot in front of the building, in the back of the building, and on the street both to the south of the building and east of the building. The signal from the Aironet 350 access point was not broadcast outside of the building.

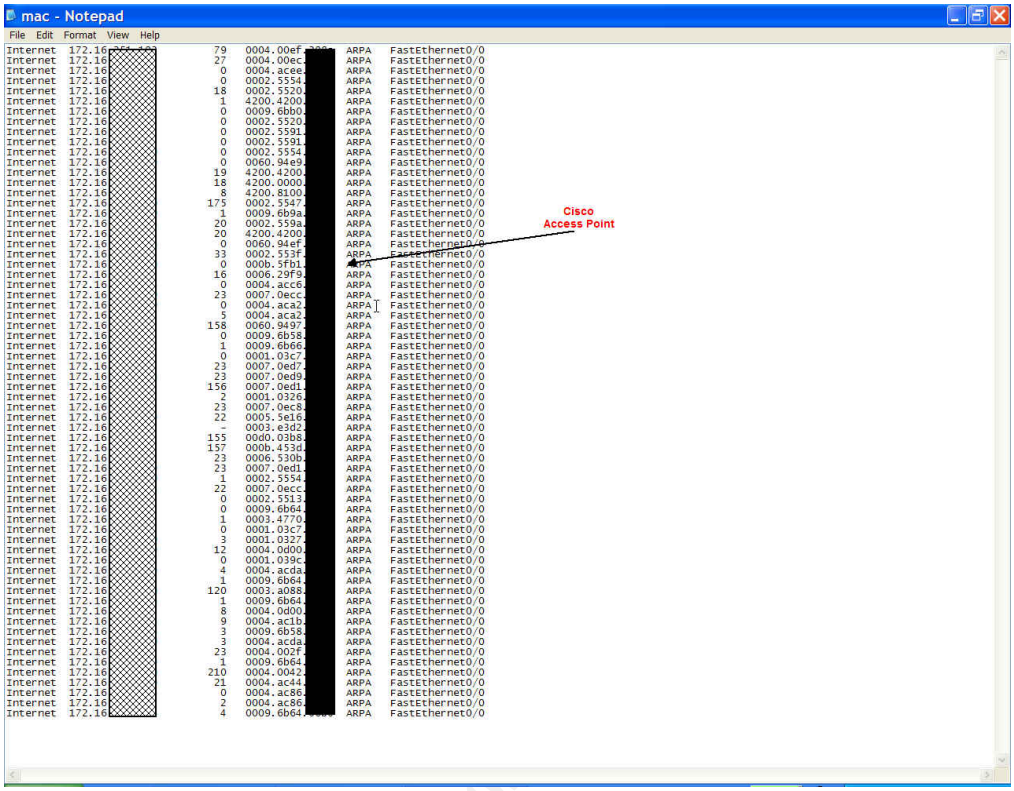
### A8.C12 - Check for the existence of rouge access points.

To check for the existence of rouge access points the core network switch's MAC address tables, and the router arp tables were checked for know MAC addresses of popular access points. The command on a Cisco router is "sh arp" . The command on a Cisco switch is "sh cam dynamic"mA list of access point MAC addresses is shown below.

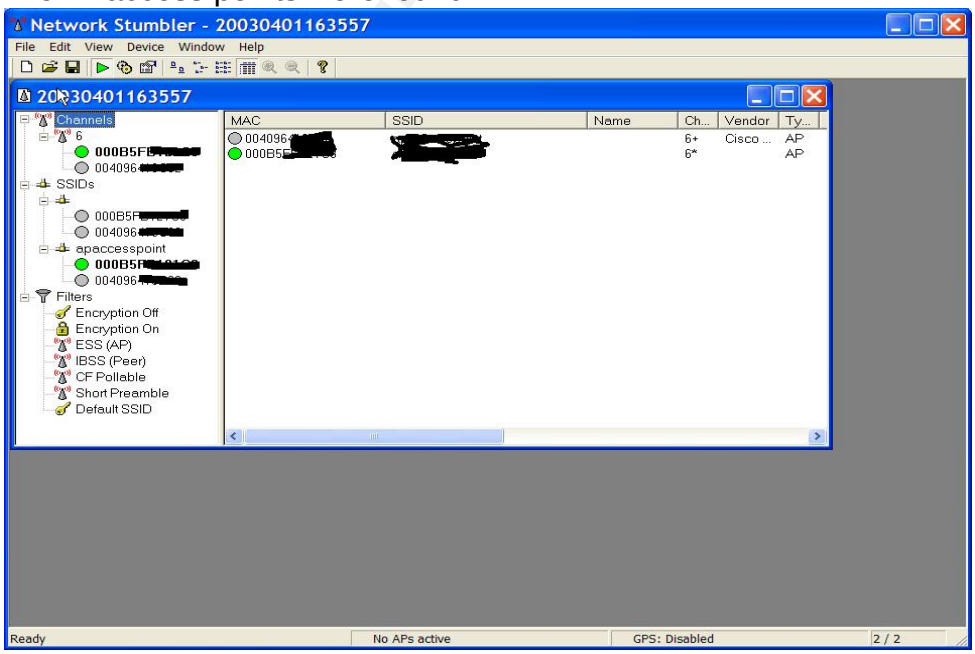
.

**3Com** 0001.03|0004.76|0050.da|0800.02
**Addtron** 0040.33|0090.d1
**Advanced Multimedia Internet**
0050.18
**Apple** 0030.65
**Atmel** 0004.25
**Bay Networks** 0020.d8
**BreezeNet** 0010.e7
**Cabletron (Enterasys)** 0001.f4|00e0.63
**Camtec** 0000.ff
**Cisco Aironet** 0040.96|000b.5f
**Compaq** 0050.8b
**D-Link** 0005.5d|0040.05|0090.4b
**Delta Networks** 0030.ab
**Intel** 0002.b3
**Linksys** 0003.2f|0004.5a
**Lucent** 0002.2d|0060.1d|0202.2d
**Nokia** 00e0.03
**Samsung** 0000.f0|0002.78
**Senao Intl** 0002.6f
**SMC** 00e0.29|0090.d1
**SOHOware** 0080.c6
**Sony** 0800.46
**Symbol** 00a0.f8|00a0.0f
**Z-Com** 0060.b3
**Zoom** 0040.36

The arp table of the core router was captured. This was done by issuing the "show arp" command on the router. This method should also be used all of the company's other locations periodically to search for rouge access points.




Netstumbler was also used to find rouge access points. As seen below, only the known access points were found.

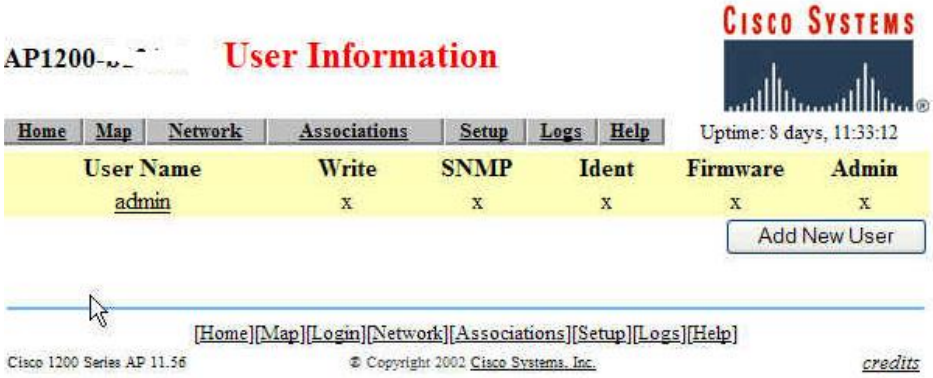


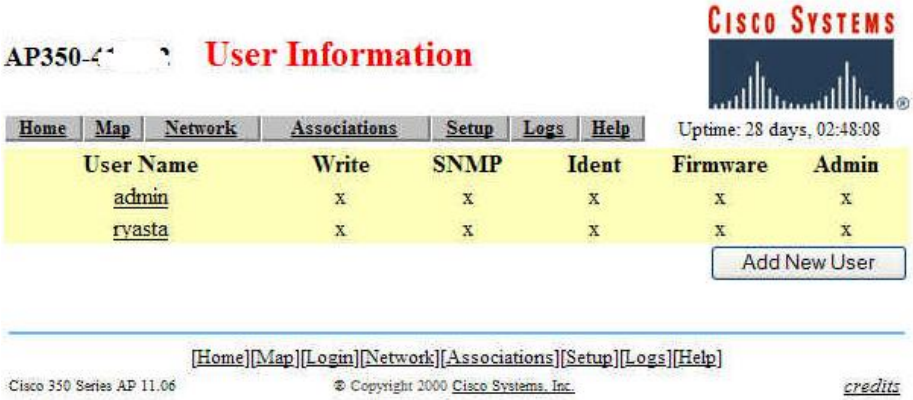
***Pass:*** The router tables were compared to the list of known access points. Only the MAC addresses of the two Cisco access points were found. Similar results were obtained using NetStumbler. Only the know Cisco access points were found

### A9.C9 – Verify admin access.

Admin access was verified with the configuration utility. The password procedure used by the access point administrators was also verified.

The figures below shows an admin user has been created on the access points.





The above images show the user manager is enabled and login is required.

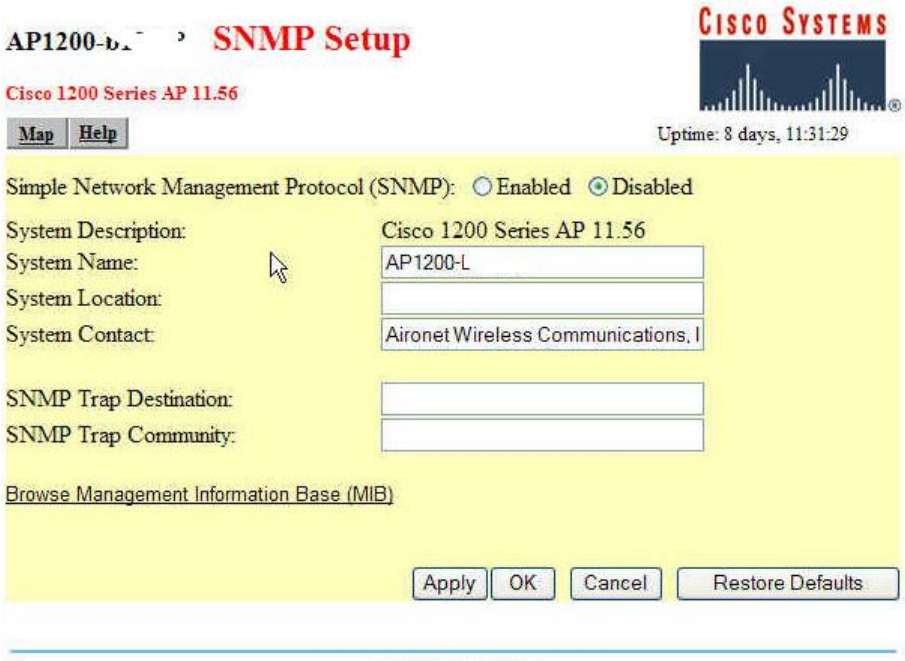
The procedure in place for password creation is using randpass.com. The Randpass web site is configured to produce a password of 8 alphanumeric characters containing special symbols. The site can be found at www.randpass.com.

> ***PASS:*** The access points were found to require a login for admin access. The password procedure was also verified and the password criteria was found to follow the strength requirments

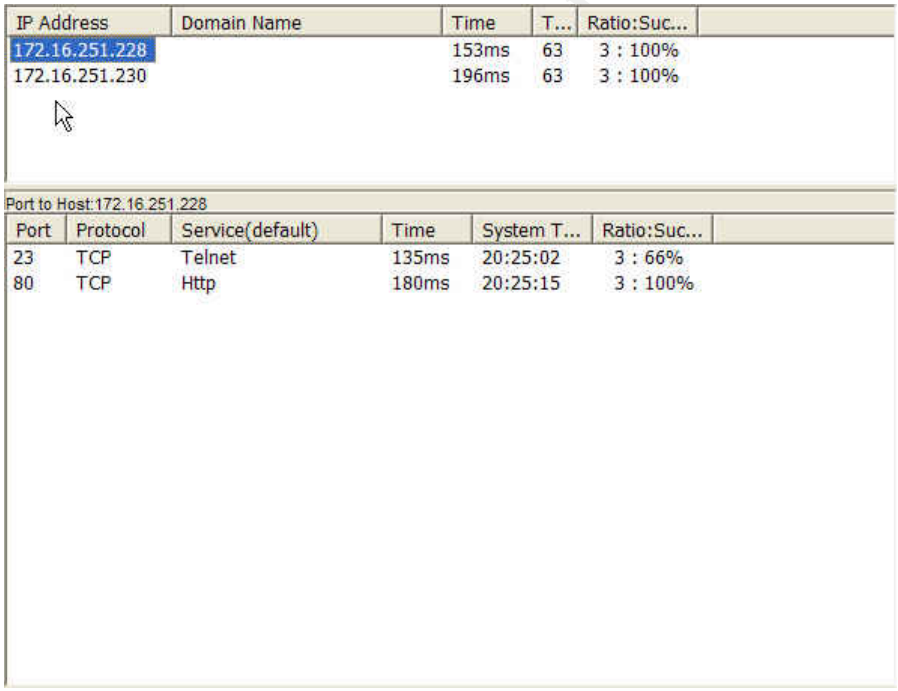
### A10.C18 – Verify SNMP configuration

SNMP configuration was verified with the configuration utility and also by performing port scans.

The image below shows SNMP is disabled on the Aironet 1200.




This image shows SNMP is disabled on the Aironet 350.



| IP Address | Domain Name | Time | T... | Ratio:Suc... |
|---|---|---|---|---|
| 172.16.251.228 | | 153ms | 63 | 3 : 100% |
| 172.16.251.230 | | 196ms | 63 | 3 : 100% |

Port to Host:172.16.251.230

| Port | Protocol | Service(default) | Time | System T... | Ratio:Suc... |
|---|---|---|---|---|---|
| 23 | TCP | Telnet | 165ms | 20:28:44 | 3 : 66% |
| 80 | TCP | Http | 190ms | 20:28:58 | 3 : 100% |

Both access points were port scanned using the hostscan port scanner. The auditor obtained host scan at http://www.cnetseek.com/eng/hostscan/index.html. The entire local subnet was configured in the tool and scanned. The tool was set up to scan the well know port range. Both access points have only telnet and Http services enabled.

> ***PASS:*** SNMP was found to be disabled in the configuration utility. The access points were port scanned using the Ostrosoft port scanner. The port scanner only found telnet and http open. Both ports are used for administration puposes.

**Measure Residual Risk**

Even with all of the checklist steps complete there is still a certain amount of residual risk. Some of the risk is related to the ongoing revision and creation of wireless standards. There are also risks involved in the very security measures being put into place. Encryption is not unbreakable.

The highest residual risk exists in the broadcast of the wireless signal itself. As shown in audit step 7, the signal is currently being broadcast outside the perimeter of the building. Even with controls in place, an individual with a powerful antenna could intercept the signal.

A recommendation to mitigate some of the risk would be to first lower the power settings of the access point. Lowering the signal strength of the access points

may require the purchase of additional access points. Another recommendation would be to locate the Cisco Aironet 1200 in a more interior location in the building.
These changes would be at a minimal cost compared to the cost of data loss or interruption of the wireless network. The wireless networks primary use is in meeting rooms. The meeting rooms are primarily utilized for conferences and web conferences with customers and vendors. At less than $1000 per access point, the cost to mitigate some of this risk is much lower than the potential interruption or loss of customer data.

**Is the System auditable?**
The Cisco wireless access point is mostly auditable. Audit tools such as sniffers can be used as objective test of the WAP security. Most settings can be verified using the access point configuration utility and tools such as netstumbler, and a wireless sniffer. For this audit, the auditor had access to a LAN sniffer, and a wireless sniffer. The auditor used AiroPeek by WildPackets, which supports the Cisco Aironet pcmcia card.

Some of the steps to secure a Cisco WAP are subjective. Some subjective areas include signal strength. While signal strength is measurable with the Cisco client utilities, it may not possible to set at the recommended setting and remain usable.

The objective of this audit was to certify the security of the Cisco wireless access points. The system consists of laptops and PDAs that would also need to be audited.

**Audit Report**

**Executive Summary**

The wireless network at ABC Company was audited in the spring of 2003. The audit examined the risk and vulnerabilities involved when implementing and utilizing a wireless LAN. Below is a summary of findings.

- There is no written company policy regarding wireless networks - ***FAIL***
- SSID configuration was found to be of sufficient strength (2.1) – ***PASS***
- SSID broadcast is disabled – ***PASS***
- WEP has not been configured –***FAIL***
- MAC address filtering is being used and is configured properly – ***PASS***

- The current power settings broadcast the signal to unauthorized areas – ***FAIL***
- The current access point placement allows for the signal to be broadcast to unauthorized areas - ***FAIL***
- The default admin password has been changed to a password of sufficient strength – ***PASS***
- The access points have been placed in an area the secures physical access – – ***PASS***
- The wireless access points have been updated to the most current release of the software and firmware. All unnecessary services have been disabled. – ***PASS***
- No rouge access points were found on the network – ***PASS***
- Access point default configurations have been changed – ***PASS***
- DHCP is disabled on the access point and it has been assigned a static IP address – ***PASS***
- Strong authentication such as RADIUS is not being used – ***FAIL***
- Encryption beyond WEP is not being used. – ***FAIL***
- Access points are being turned off after business hours and weekends - ***PASS***
- SNMP is disabled - ***PASS***
- A firewall between the LAN and access point is not being used – ***FAIL***
- The access points are configured on the default channel - ***FAIL***

The WLAN in use at ABC Company was found to have several weaknesses, which in turn expose ABC Company to several risks. These risks include unauthorized access to the corporate LAN, unauthorized use of the internet, data integrity, network disruption, and data loss. The risk could result in monetary loss.

The security weaknesses in the wireless network can mostly be attributed to the lack of written policies for wireless networks.

This audit process can also be used to audit wireless networks that are planned to be added in the coming year.

*Audit Findings*

The audit examined the configuration of two wireless access point recently implemented on the corporate network. The IT Manager, Administrators, and IT Staff were interviewed on the current policies, and the configuration of the wireless access points. It was found the no policies or procedures were currently in place for the configuration of wireless networks.

The configuration of the wireless access points was also verified. By viewing the access point configuration, it was found that the default SSID was changed and a strong SSID was in place. The access points were also configured to not broadcast the SSID. It was also verified that encryption was not being utilized.

The auditor also examined signal strength and placement of the wireless access points. The auditor used the Cisco client utilities and a laptop to check signal strength in public areas and areas outside of the building. The auditor found that the Aironet 350 access point was placed in a location surrounded mostly by windows. The Aironet 1200 access point was placed in a location surrounded by cement walls. Both access points were also set at the highest signal strength. The auditor was able to detect a signal outside of the building at both the front and back entrances. The auditor was able to associate with the Aironet 350 across the street in the employee parking lot, and also on the south and west streets. These strength settings coupled with the access point placement create a high risk of an unauthorized individual associating with the access point.

*Background/risk*

There were a number of audit findings with a rating of fail. The first item with significant risk is the lack of a written policy on wireless network. The absence of this policy makes the audit steps and recommendations unenforceable. The audit also shows WEP is not in use. Without the utilization of WEP, any individual with a piece of software such as netstumbler or a wireless sniffer can easily gain access to the network. A strong authentication such as RADIUS is also not in use. The lack of both WEP and strong authentication make it fairly easy to gain access to the access points. At this point, only a MAC address and the correct SSID are needed to gain access to the access point. Both of these are obtainable with a sniffer.

Another component that was found to be unsatisfactory is signal strength. Currently the power settings and access point placement are allowing the signal to be broadcast outside of the building. This opens a high risk to an individual outside the building to attempt to gain access.

*Audit Recommendations*

First, a clearly written policy that addresses wireless needs to be developed. From the policies, procedures should be written on configuration and operation of the wireless access points. Administrators who will be involved in the setup access points should receive training on the policies and procedures.

ABC Company should consider moving the access point to a more interior location. The access points could then be adjusted to broadcast to the windows and not past. Also, the company should consider installing additional access

points. This would allow for better placement of the access points and the ability to set the signal strength at a lower level. If access point placement next to the glass portion of the building is necessary, the access point should be set at the lowest level.

Encryption should be used on the wireless networks. WEP should be configured at the very least and a VPN solution should be considered.

ABC Company should also consider an implementation of RADIUS authentication. This would ensure only authenticated users could associate to the access point.

*Costs*

Additional access points would be the majority of the costs involved. A Cisco Aironet 350 costs less that $1000. ABC Company would require at least one additional access point, one more would be recommended.

Other recommendation would only require configuration of the access points and time. Configuration of WEP would take about two days. The implementation of additional access points and adjusting the signal strength accordingly on the existing access point would take about 4 days.

Policies and Procedures could be written in less than 2 weeks.

*Compensating Controls*

If ABC Company decides not to purchase additional access points, implementing WEP and moving the access points can mitigate some of the risk. SSID configuration is in place as well as MAC address filtering. The addition of WEP would put another control on top of what is already in place making it difficult to associate with the access points without those three pieces of information (WEP key, SSID, and correct MAC address). Moving the access points to a more interior location would also help to mitigate some of the risk with no additional cost.

Informal verbal procedures within the IT department may somewhat compensate for the lack of formal policy. There are no other compensating controls for the lack of written policy and procedures.

***References***

Loomis, Angela, “Auditing the Wireless environment: A mobile wireless LAN used for training in multiple sites on a corporate WAN- An Auditor’s perspective”, September 2002

Convery, Sean and Darrin Miller. “SAFE: Wireless LAN Security in Depth” undated Cisco white paper. 8/2002
URL: http://www.cisco.com/warp/public/cc/so/cuso/epso/sqfr/safwl_wp.htm

Ellison, Craig, “Exploiting and Protecting 802.11b Wireless Networks”, September 2001
URL: http://www.extremetech.com/article2/0,3973,11400,00.asp

“Cisco Aironet Wireless LAN Security Overview” undated white paper 8/2002.
URL: http://www.cisco.com/warp/public/cc/pd/witc/ao350ap/prodlit/a350w_ov.htm

“Best Practices for wireless fidelity (802.11b) Network Vulnerabilities”, National Infrastructure Protection Center.
URL: http://www.nipc.gov/publications/nipcpub/bestpract.html

Special Publication 800-48, National Institute of Standards and Technology, July 2002. (August 2002)
URL:http://csrc.nist.gov/publications/drafts/draft-sp800-48.pdf