



Access/One[™] Network

User Guide

ACCESS/ONE™ NETWORK

User Guide

Part Number: 210-0007-01
Revision B, June 2005

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FCC Notice

The enclosed wireless network device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

This wireless network device has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This wireless network device generates, uses, and radiates radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this wireless network device does cause harmful interference to radio or television reception, which can be determined by turning the wireless network device off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the wireless network device and the affected receiver.
- Connect the wireless network device into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Industry Canada Notice

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

VCCI Notice

This is a Class B wireless network device based on the standard of the Voluntary Control Council for Interference from Information Technology Equipment (VCCI). If this wireless network device is used near a radio or television receiver in a domestic environment, it may cause radio interference. Install and use the wireless network device according to the instruction manual.

European Community (EC) Directives and Conformity

This wireless network device is in conformity with the Essential Requirements of R&TTE Directive 1999/5/EC of the European Union.

Radio Frequency Interference Requirements

This wireless network device is restricted to indoor use due to its operation in the 5.15 to 5.25 GHz frequency range. FCC regulations require this device to be used indoors to reduce the potential for harmful interference.

High power radars are allocated as primary users of the 5.25 to 5.35 GHz and 5.65 to 5.85 GHz bands. These radar transmitters can cause interference with and/or damage to the enclosed device.

RF Exposure Requirements

To ensure compliance with FCC RF exposure requirements, the antenna used for this wireless network device must be installed to provide a separation distance of a minimum of 20 cm (7.9 inches) or more from all persons, and must not be co-located or operated in conjunction with any other antenna or radio transmitter. Installers and end-users must follow these installation instructions.

The Access/One™ Network contains a Lithium battery in the BME base module which is NOT replaceable by the user



CAUTION:

Discard used batteries according to manufacturer's instructions.



ATTENTION:

Mettre au rebut les batteries usagées conformément aux instructions du fabricant.



VORSICHT:

Entsorgung gebrauchter Batterien nach Angaben des Herstellers.

Installation Warning

Warning Read the installation instructions before you connect the wireless network device to its power source.

Warning You must only use the UL Listed power supply supplied with this wireless network device.

Lightning Activity Warning

Warning Do not connect or disconnect cables during periods of lightning activity.

Explosive Device Proximity Warning

Warning Do not operate your wireless network device near unshielded blasting caps or in an explosive environment.

Important Note:

Intentional or unintentional changes or modifications to this wireless network device are prohibited. Any such modifications will void the user's authority to operate the wireless network device, and will void the manufacturer's warranty.

For additional information, please refer to Strix Systems, Inc., at <http://www.strixsystems.com>.

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Introduction

This User Guide describes the Strix Access/One Network and its elements. Access/One Network is a wireless LAN infrastructure that is designed to be simple and secure. This guide follows the same approach. It is comprised and written as a series of short, simple and largely independent sections that can be read in any order. This user guide covers wireless network installation, configuration, security and management. Appendices reference module management, technical specifications, CLI commands, FAQs and a security overview.

Access/One Network comprises multiple physical network elements – Network Nodes – that interconnect using either wired 10/100 Ethernet or wireless 802.11 RF links. Every Node in turn consists of several distinct modules, each serving a different function or enabling a different device wireless RF technology.

Each Network Node within the Access/One Network supports any combination of end user wireless devices that utilize 802.11b, 802.11g and 802.11a RF technologies. Introduction of one of these technologies into the network is a simple matter of adding an appropriate Wireless Module to each Network Node in the desired coverage area.

Access/One Network requires one Network Server Module to be present for every eight Network Nodes in the network fabric to handle a variety of internal network protocols and facilitate distribution of the network control logic.

Each Network Node uses a Base Module that provides power via an external AC adapter and between 0 and 4 10/100 Ethernet ports for network connectivity. When present, one of the Ethernet ports provides support for PoE (Power-over-Ethernet).

Logically, the network intelligence is fully distributed between its elements. There is no single point of control and failure. Each network Node is aware of its neighbors and will redirect user traffic in case of the adjacent Node's failure or overload.

Access/One Network is managed through a web browser and the Strix Manager/One™ software application. A full network view is presented regardless of the point of browser attachment. One may configure or monitor the full network, any group of Network Nodes, or a specific Node down to the individual module level. Telnet is also supported to any module with use of CLI (Command Line Interface) commands and scripts to manage or monitor it.

A Manager/One plug-in is available for download from the Strix web site. When installed, it is launched by clicking the Strix icon on the browser's toolbar. Manager/One will automatically discover all Strix Access/One Network elements and list them in its window. Double-click on any listed Network Server and log in – the network is now yours to manage.

Installation

This chapter provides instructions on how to assemble the Nodes and to install and use Manager/One utility. It also lists the services/servers which Access/One Network expects to be present in the host wired network infrastructure.

ASSEMBLY AND SELF IDENTIFICATION

Each Network Node arrives in its own well-marked box that contains its disassembled and individually wrapped constituent modules. The assembly instructions are as simple as ‘snapping’ modules together and plugging the Network Node into a power outlet and, where necessary, attaching an Ethernet cable. We enclose a four-page Quick Start Guide into every box to walk you through the process.

If the Strix Architect/One™ application was used to design your network, you should have received two individualized documents. The first is an inventory list that shows all the Network Nodes, their names (or numbers), the modules that make up each Node and the modules’ serial numbers. The second is the coverage area map showing all the purchased Nodes and their names/numbers. Keep the inventory handy to verify that all Nodes are present and contain the correct modules, and use the map as a guide to mount/place them in their designated areas.

Assemble the Network Nodes per instructions in the Quick Start Guide, mount or place them according to the coverage map, and connect all the wires. Your network is assembled and ready. Please be patient and wait for LEDs on all modules to turn solid green. It will also take several minutes for the network to go through the self-discovery sequence, assign roles to all the Wireless Modules, scan the channels for the optimal performance and coverage, and obtain IP addresses, etc.

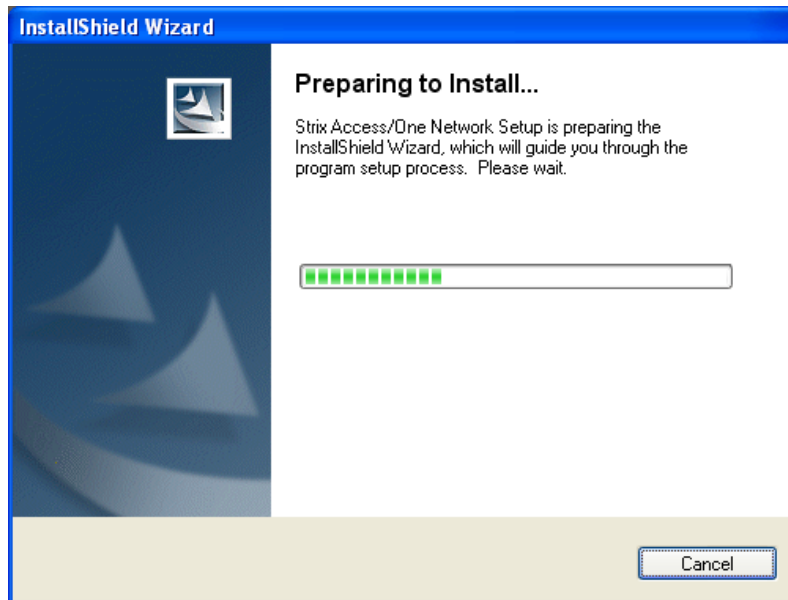
Note: You can reset a Network Node to the factory default setting by a) disconnecting the Ethernet and power cables and b) pressing and holding the reset button (next to the power jack in the back of the base module) with a paper clip while connecting the power cable again. Hold the reset button for about 10 seconds – you can release it when the green LEDs on the front of all modules start flashing fast. Let the Node finish its reset sequence (wait for LEDs to go solid green); plug back the Ethernet cable if necessary, and reboot the Node by removing and reinserting the power cord.

MANAGER/ONE

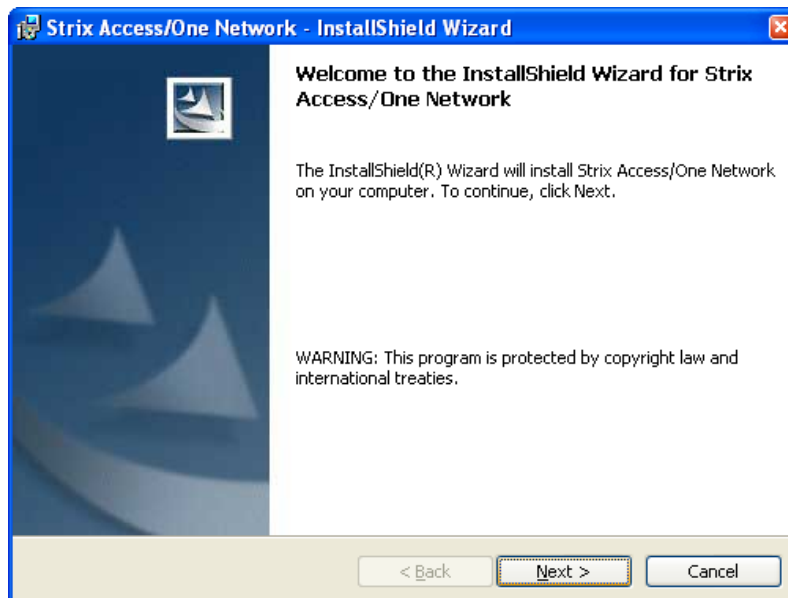
The Manager/One plug-in must be installed on your PC to facilitate discovery and management of all the Access/One Network elements. When installed, Manager/One lists all the available Network Servers – points of attachment to Access/One Network for the administrator to manage it. It also allows the user to page, ping or Telnet into any listed module.

To install Manager/One, follow these simple steps:

- 1- Download the Manager/One plug-in file (.zip) from <http://www.strixsystems.com>
- 2- Open the zip file and run the *setup.exe* file. The following window will appear:



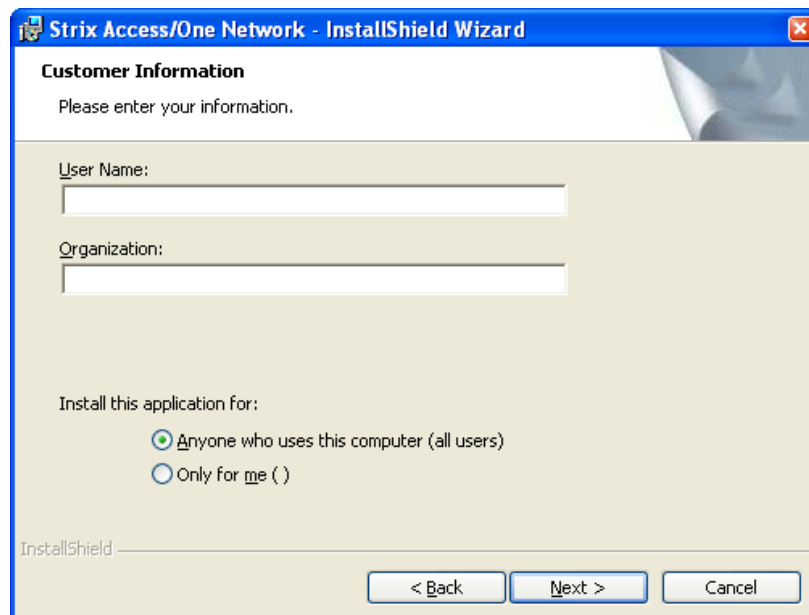
- 3- After a few seconds the following window will appear. When it does, click on the 'Next' button.



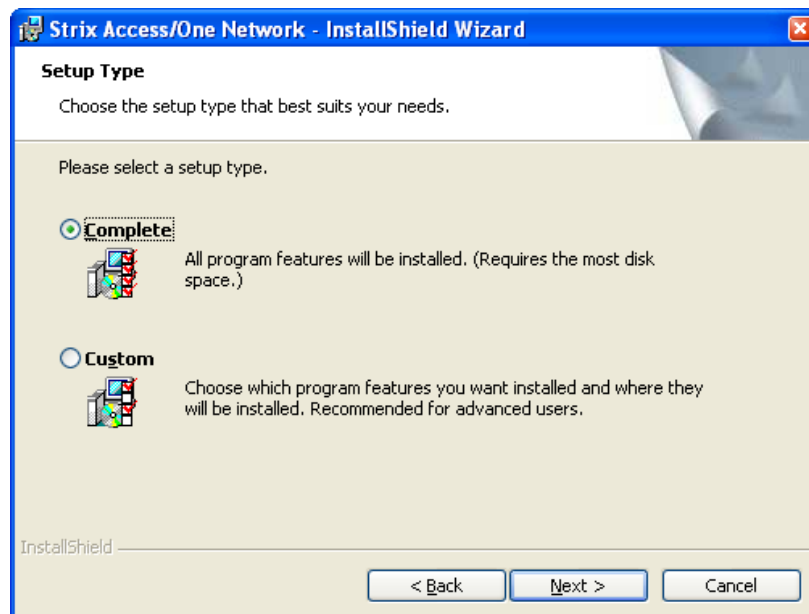
- 4- When the following window appears, read the Software License, select “I accept the terms in the license agreement” and click the ‘Next’ button. If you select “I do not accept the terms in the license agreement” the installation will terminate.



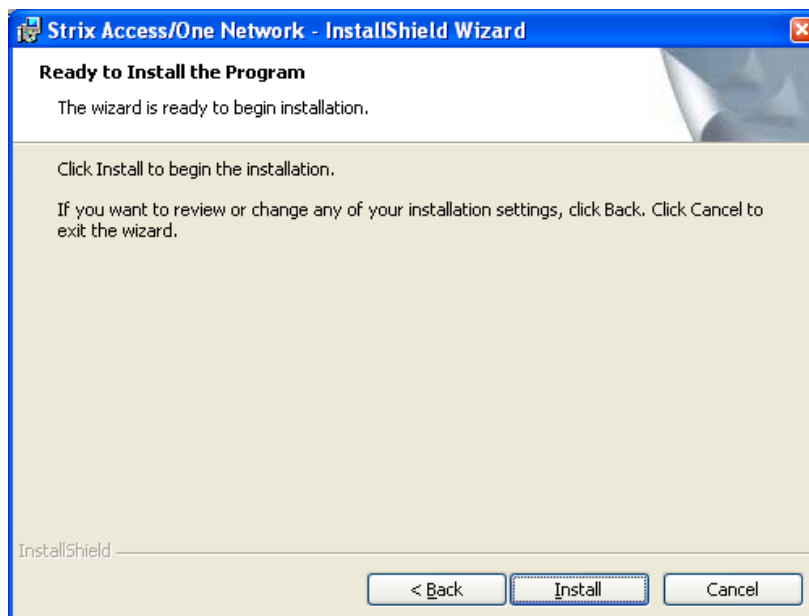
- 5- When the following window appears, enter your User Name and your Organization, and select who the application will be installed for (“all users” or “me”). Click the ‘Next’ button when ready.



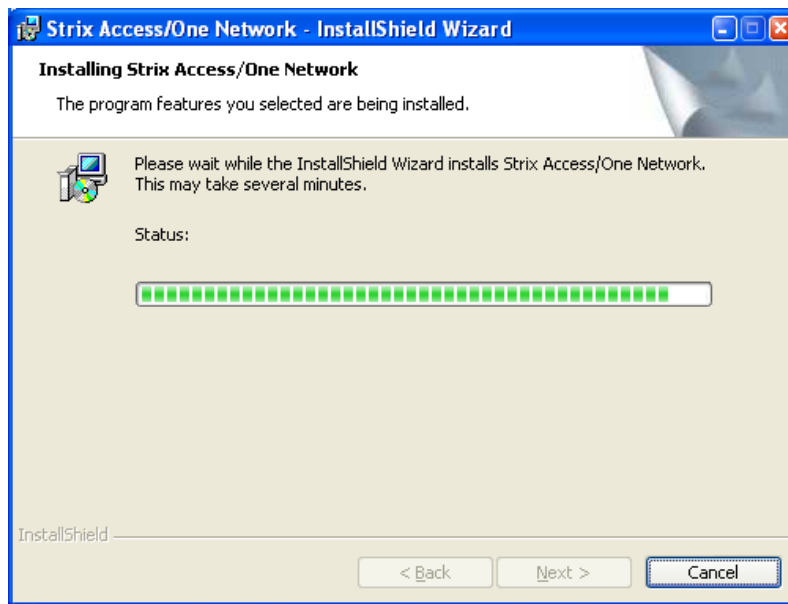
- 6- When the following window appears, select “Complete” as the setup type and click the ‘Next’ button.



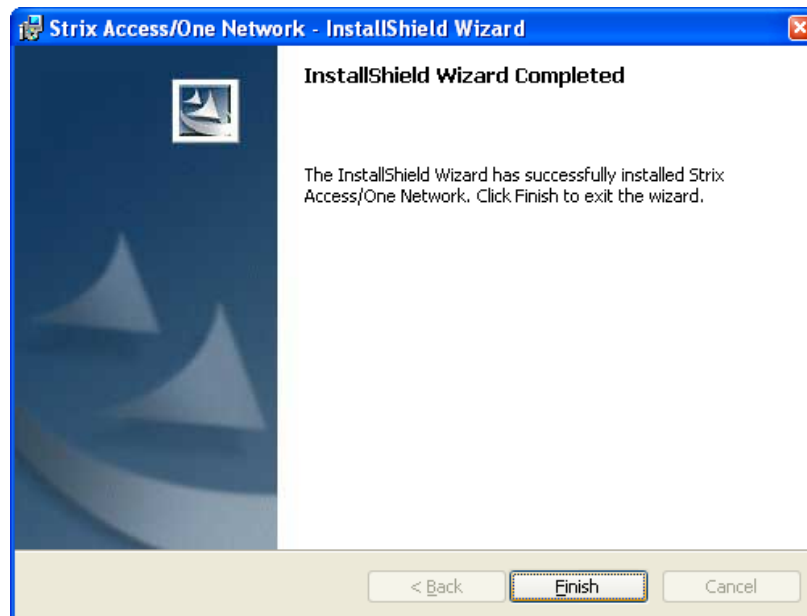
- 7- When the following window appears, click the ‘Install’ button.



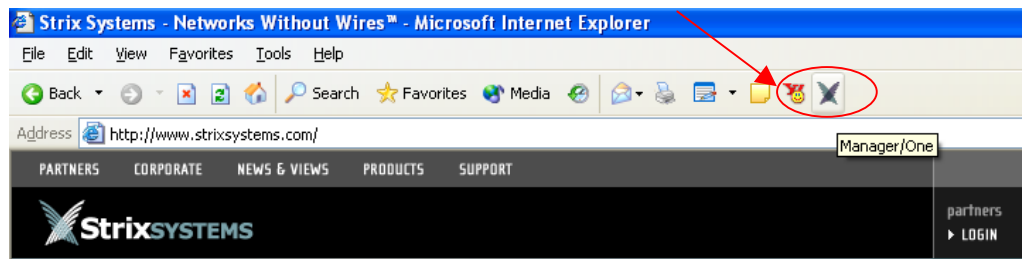
- 8- The following window will then appear. The installation process can be cancelled at any moment by clicking the 'Cancel' button.



- 9- When the following window appears, click the 'Finish' button to complete the installation process.

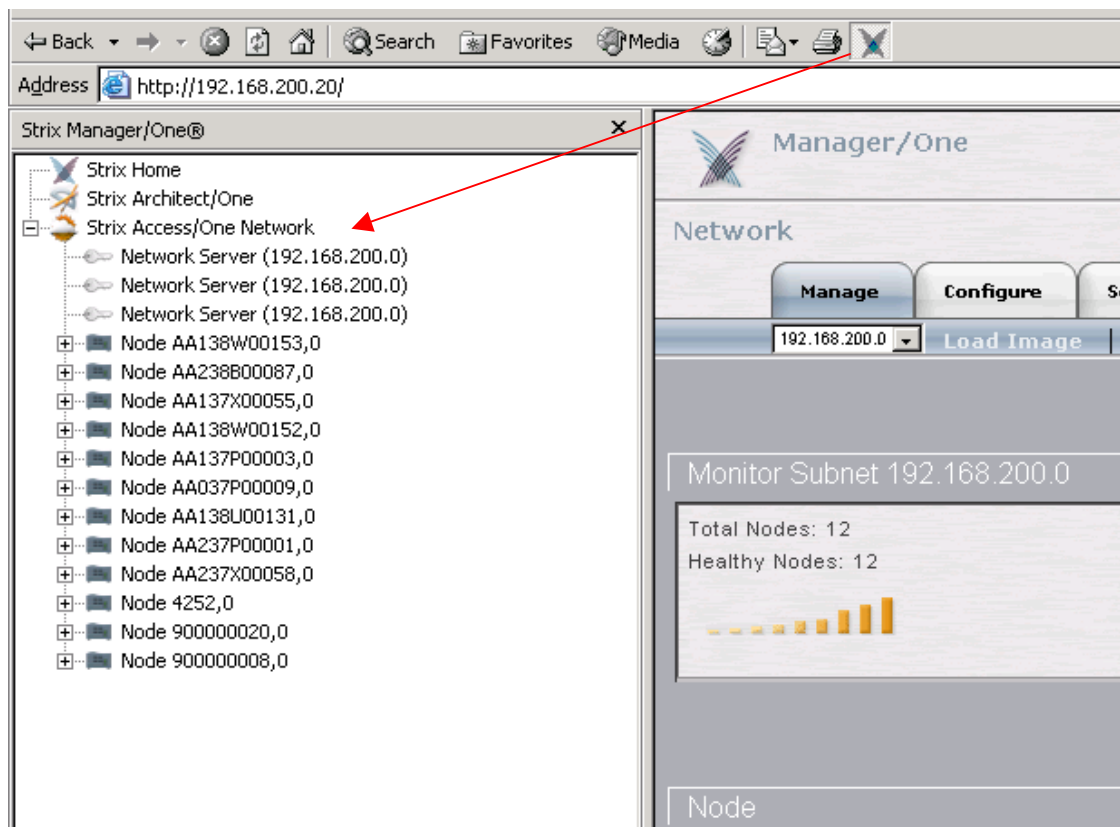


- 10- The next time you launch your Web browser, a Manager/One icon will be placed in the top menu, similar to the figure below.



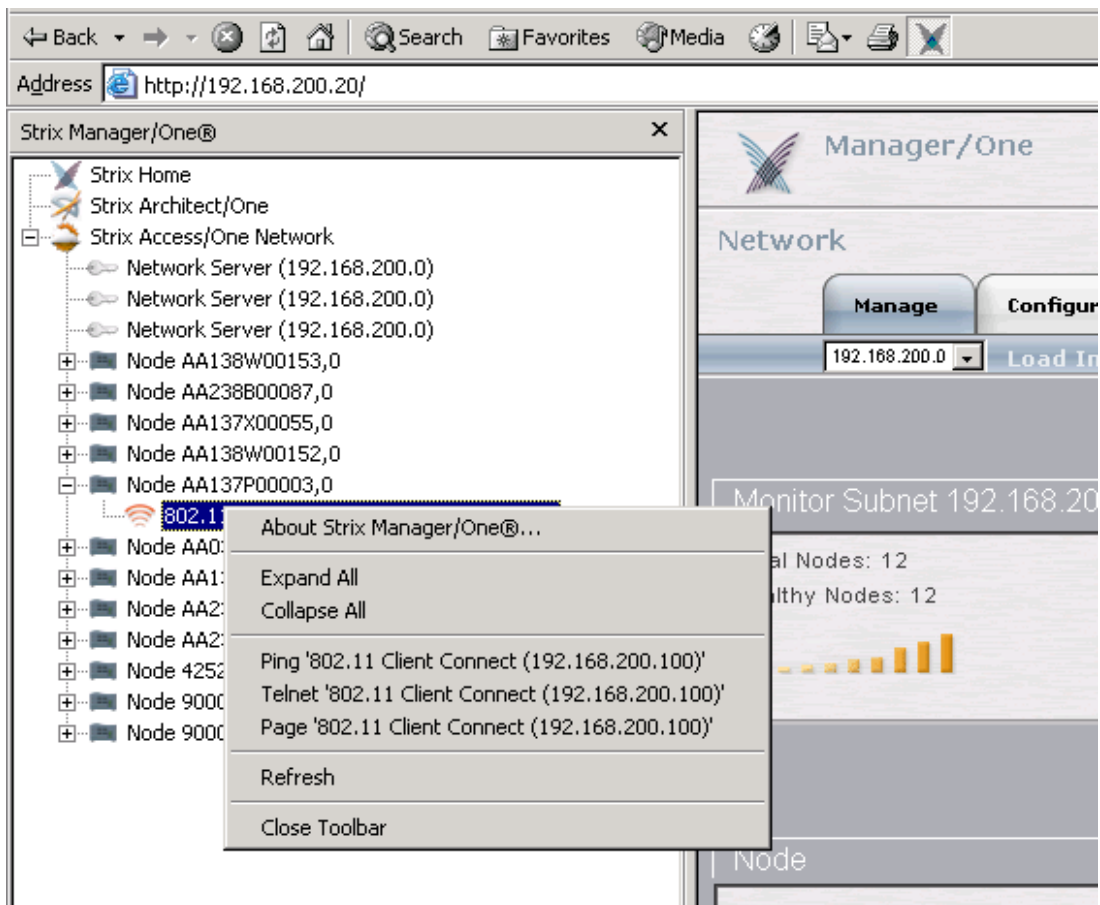
- 11- The Manager/One installation is now complete!

When you click the Manager/One button (Strix logo) in your browser, you will launch the Manager/One utility, and the following window panel will appear on the left side of the screen:



The Manager/One utility window contains a link to the Strix Systems Home Page, a link to the password-protected Strix Architect/One software, and your Strix Access/One Network. A list of Access/One Network Nodes, listed by label (Base Module serial number by default), will be displayed below the Access/One Network heading as the Nodes are automatically discovered.

You can now select (double-click) any Node in the list to expand it, and right-click on the selected module to page, ping, or Telnet into it as shown in the figure below:



To manage Access/One Network click on any listed Network Server, which you will see when you expand a Node that contains one. A login window (shown below) will appear and the Manager/One utility window will close.



Enter the administrator User Name – “Admin” and a Password. The default password is “Admin” but we strongly recommend that you to change it immediately after logging into the Manager/One application. Click the ‘OK’ button to login to Manager/One.

An initial network view page will appear. Refer to the Management and Configuration section for more information about how to use Manager/One to configure and manage your network.

HOST NETWORK REQUIREMENTS

Access/One Network requires the presence of several network servers/services in the host wired network. These are:

DHCP server – is necessary to distribute IP addresses and ancillary information to the Access/One Network. Many routers contain DHCP servers and allow the specification of DHCP options necessary to provide network information otherwise configured by hand. Strix recommends each module be given a DHCP reservation allowing it to obtain the same IP address whenever required. The reservation is based on MAC address and may allow administrator to specify options unique to a module as well as a network. The Access/One Network modules require the following option numbers (RFC 2132) to be specified:

Option Number	Title	Description
1	Subnet mask	Network subnet mask as applied to the given IP address
2	Time Offset	Number of hours the DHCP client will add or subtract from SNTP time
3	Default Router	Specifies the default gateway for this network segment
6	DNS Server	Specifies one or two DNS servers in order of precedence
12	Host Name	Specifies the unique system name of the module
15	Domain Name	Specifies the domain name for this network. This is used to fully qualify any hostname operations the module may generate (i.e. ping node1 = ping node1.strixsystems.com). Applies to module operations only, doesn't affect users.
42	NTP server	Specifies the NTP server IP address (local or internet)

The DHCP lease time should be infinite whenever possible to prevent interruption in service, although Strix recommends configuring a reservation for each Access/One Network module to prevent issues regardless of the lease time and in order to maintain management consistency.

DHCP server examples are: Windows 200X Server, Cisco IOS, Linux, Sun OS, etc.

FTP server – is required to transfer firmware and configuration from distribution media to Access/One Network modules. Software distribution via an FTP server relies on user accounts to maintain security. Access/One Network modules are capable of specifying a user name and password (including anonymous) to log into an FTP server. Directory access may be configurable based on the FTP server software, so Access/One Network related files may be available only to Access/One Network modules. TFTP is not currently supported.

Examples of FTP servers are: Windows 200X Server, Linux, Sun OS, and many shareware / freeware implementations.

Internet browser – Access/One Network and Manager/One are supported in Windows Internet Explorer v6.0 and above.

Single/Multiple Subnet – Access/One Network uses broadcast and multicast packets to maintain management connectivity. If subnet space is an issue, using NAT (Network Address Translation) at the Access/One Network boundary and specifying a class B subnet should be sufficient. A global network may present an unavoidable multi-network configuration which may be managed by specifying an IP address of an Access/One Network Server in each subnet as described later in this guide.

Power-over-Ethernet (PoE) – may be used to provide primary or backup power to the Access/One Network Nodes. If you want to use the PoE feature, PoE injectors or PoE enabled switches must be present on the host network. One caveat is that the PoE must come straight from the supplying device; it won't pass through intermediate switches. Currently, Access/One Network supports the following versions of PoE: 802.3af and Cisco proprietary.

USER SECURITY CONSIDERATIONS

The topic of security may be split into two categories: network-level security (inter-Network Node) and user security (station/user device to Network Node). Network-level security is an integral part of the Access/One Network and requires no external resources. User security may require an external resource (such as a RADIUS server), specific hardware (an AES capable NIC), or even a redundant security system (like a VPN client/server) depending on the level of user security desired. Adherence to newer security standards (WiFi WPA and IEEE 802.11i) will require a RADIUS server supporting EAP at a minimum. The following table summarizes the levels of wireless security typically available in an 802.11 network:

	Minimum	Better (WPA)	Best (Strix)
Authentication	Local MAC address control list	Remote 802.1x EAP	Remote 802.1x EAP (TLS or TTLS)
Encryption	Static WEP	128-bit WEP with TKIP (or Dynamic WEP)	Dynamic AES
Supplemental Requirements	None	RADIUS server	RADIUS server AES NICs

Achieving a secure network requires that the user *authenticate* to the Network Node to validate that the user is allowed access to the network and the data must then be *encrypted* to prevent other users from eavesdropping. Some definitions may help to clarify your security choices:

Cipher Types – The Access/One Network supports both the WEP and AES cipher suites. A more detailed discussion regarding these can be found later in this user guide. In summary, the older WEP cipher has been shown to have significant weaknesses. Since WEP is widely deployed, the WiFi WPA specification is designed to address these weaknesses and should only require a driver update to realize these benefits. The 802.11i specification (a superset of WPA) also requires a newer cipher, AES, which has additional benefits but also an additional cost (AES typically requires hardware acceleration which only newer NICs support).

Key Types – The previous table indicates that there are both static and dynamic cipher keys. The distinction is how individualized the key is per user device/station. A static default key is configured within the Access/One Network Node and the same key is used for each station (unicast and multicast traffic). A unique static key provides additional protection by assigning a specific, unique key to each station for unicast traffic based on MAC address. This is more secure but not very scalable. A dynamic key is generated for each user by the network-based RADIUS server when the user remotely authenticates. The key is dynamic because it is created when the user authenticates and will change every time the session begins. This is more secure because the key isn't manually administered and changes frequently.

Local Authentication – The Access/One Network is responsible for determining whether the user device/station has network privileges. Since most access points don't have a user database, there is typically very little information for a system like Access/One Network. One mechanism to determine user privileges is an Access Control List, which disallows (or allows) any user based on their MAC address. However, MAC addresses can be spoofed so this method is not secure.

Remote Authentication – Access/One Network becomes a gatekeeper and requires the use of an external RADIUS server on the LAN to determine which users/stations are granted access. The RADIUS server has a list of users and passwords to validate the user or device (one is more secure than the other) and dynamically generate a key to Access/One Network for this user or device. The RADIUS server must support EAP encapsulated RADIUS exchanges, as Access/One Network only supports this format. When remote authentication is enabled, only EAP traffic is bridged to the LAN until the RADIUS server authorizes Access/One Network to allow the user or device access to the network.

Some examples of devices that support RADIUS with EAP are:

- Windows 2000 IAS/Active Directory/Certificate Server (MD5/TLS)
- Windows 2003 IAS/Active Directory/Certificate Server (MD5/TLS/PEAP)
- Funk Odyssey with Active Directory interface or its own user list (MD5/LEAP/TLS/TTLS/PEAP) – Note: Microsoft and Funk are the two servers used for WiFi WPA testing.
- Cisco ACS with Active Directory interface or its own user list (MD5/LEAP/TLS/PEAP)
- Linux Cistron Radius server (MD5/TLS)
- Meetinghouse AEGIS server (MD5/LEAP/TLS/TTLS/PEAP)
- Interlink Secure.XS server (MD5/LEAP/TLS/TTLS/PEAP/SPEKE)

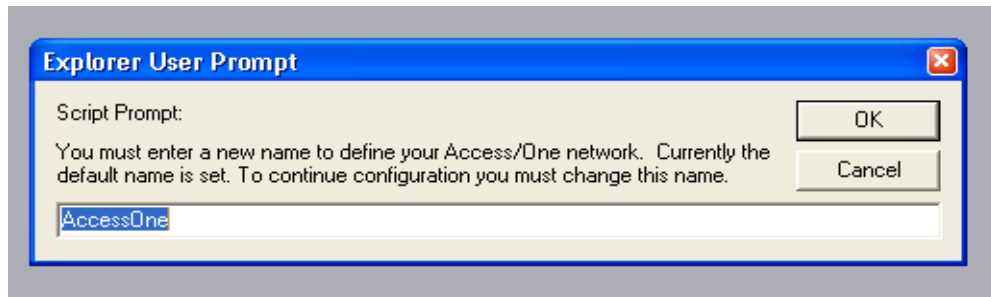
Good security may be achieved by using Windows 200X IAS/Active Directory or Linux RADIUS with TLS certificates. The best security will be provided by using Windows 2003 IAS/Active Directory, Funk Odyssey or Cisco ACS etc. running TTLS or PEAP.

Access/One Network provides encrypted protection from the user device/station to the host LAN. If security on the LAN is also an issue, a Virtual Private Network (VPN) may be used to doubly secure the wireless traffic while providing protection on the LAN. Due to the significant overhead associated with this method, additional performance penalties will occur.

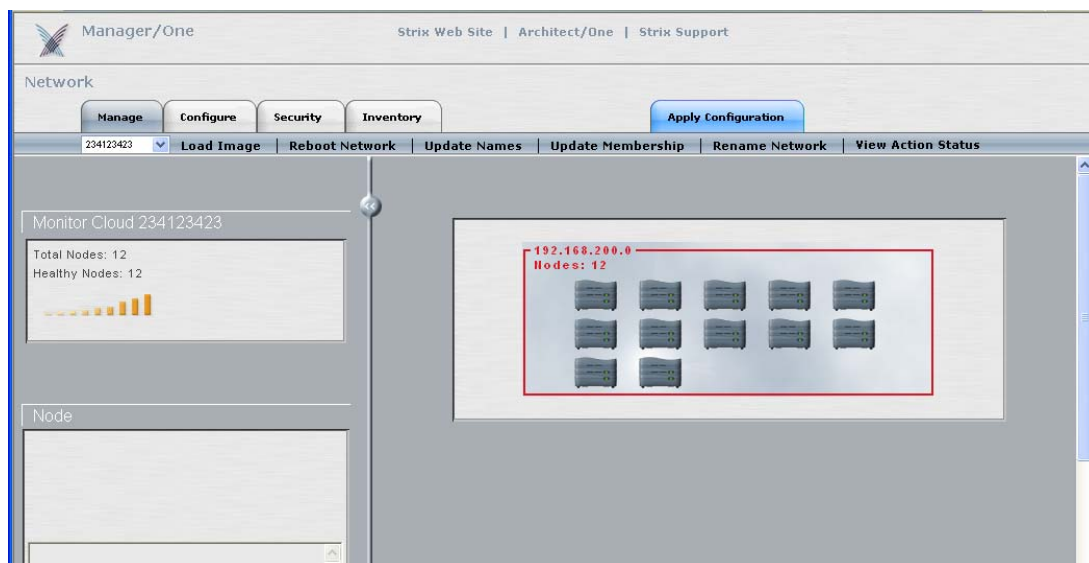
Management

Management of the Access/One Network has been designed to be as simple as possible. This chapter describes the network views, naming conventions and rules to include and associate a newly installed Network Node as part of your Access/One Network. Visual cues are provided that indicate network ‘health’, along with the presence of unattached or rogue Node/devices. Explanations of other management windows are also provided, such as the Node detail and status windows.

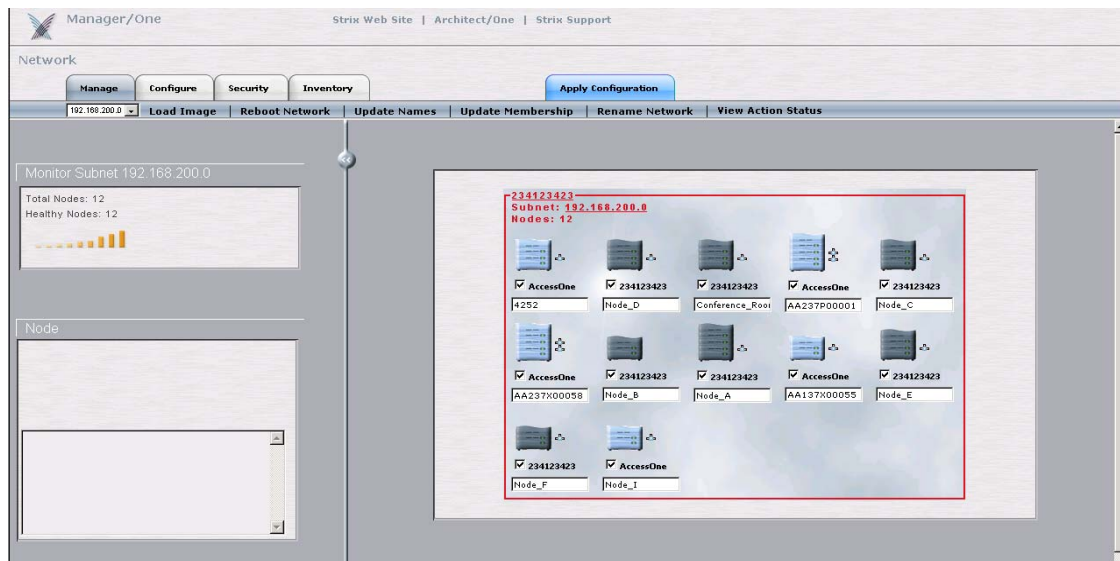
Manager/One resides on all Access/One Network modules, but is centrally managed from each of the Network Server Modules. In addition to using the Manager/One utility, using the IP address of any Network Server as a URL within Internet Explorer will automatically display the Manager/One screen. The first time Manager/One is accessed on the Access/One Network it will prompt for a network name change (from “AccessOne”), which is a security feature that ensures that the default network name is maintained.



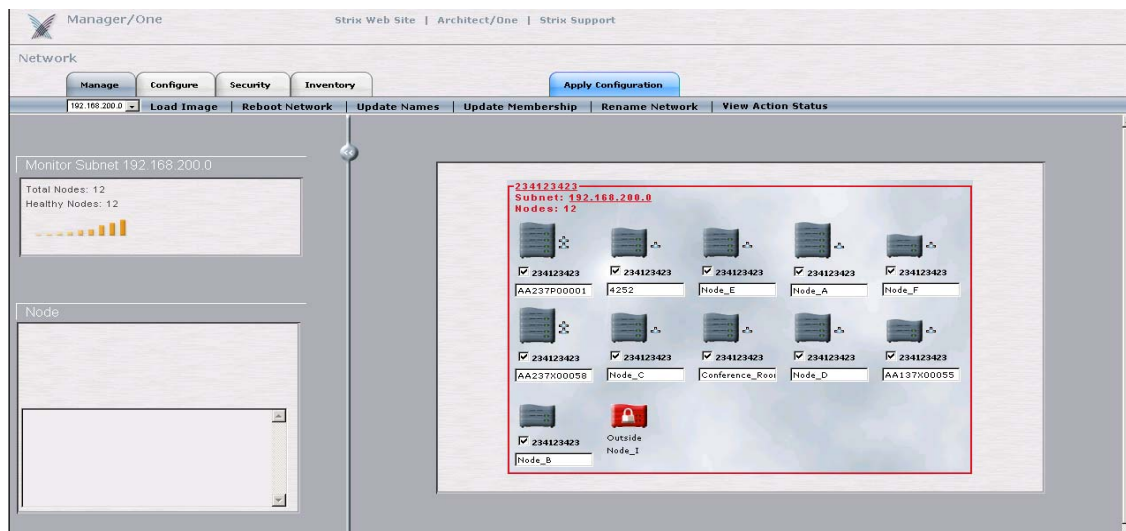
After a new network name is created, Manager/One will display a network view with all discovered Access/One Network subnets and the number of Nodes in each. In the example below, there is just one IP subnet (cloud). Notice the red color of the frame, which means that either one or more Nodes within the cloud have not yet been included or configured in the network, or that there is a fault condition with one or more of the Nodes in the network.



Click anywhere within the frame in order to enter the cloud (IP subnet) and view the details. In the below example, notice that some of the Network Nodes are sky blue in color and some are dark grey in color. The Nodes that are sky blue have yet to be included as part of the new Access/One Network that was named in the previous step and are still associated to the default network name (AccessOne), as listed below each Node.

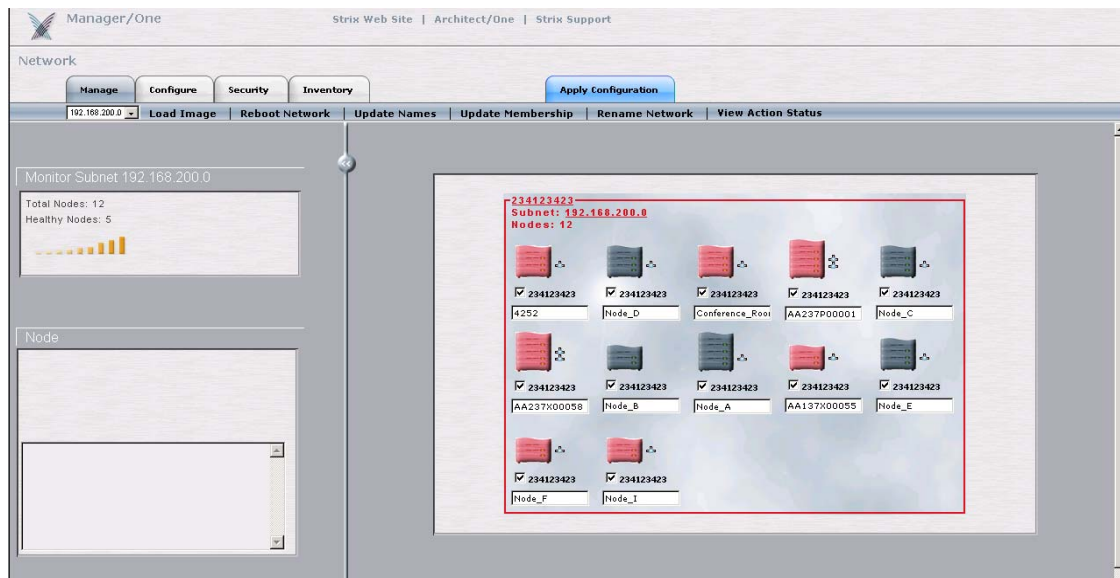


To assign any of the sky blue colored Network Nodes to the newly created network, click the checkbox below each Node to select it and then click the 'Update Membership' command in the toolbar to include the Node into your network.



If the 'Update Membership' operation was successful the network name below each of the selected Nodes will have updated to the newly created name, and the Nodes will have changed from sky blue to dark grey in color, as shown above. The 'Update Membership' process can take up to 30 seconds to take effect. Notice that in this instance one of the Nodes is red with a lock symbol – Nodes of this type belong to different clouds and cannot be accessed from this screen.

As shown below, if the screen displays Nodes that are red in color but that do not have a lock symbol on them, these are nodes that are in alert status which should be investigated further.



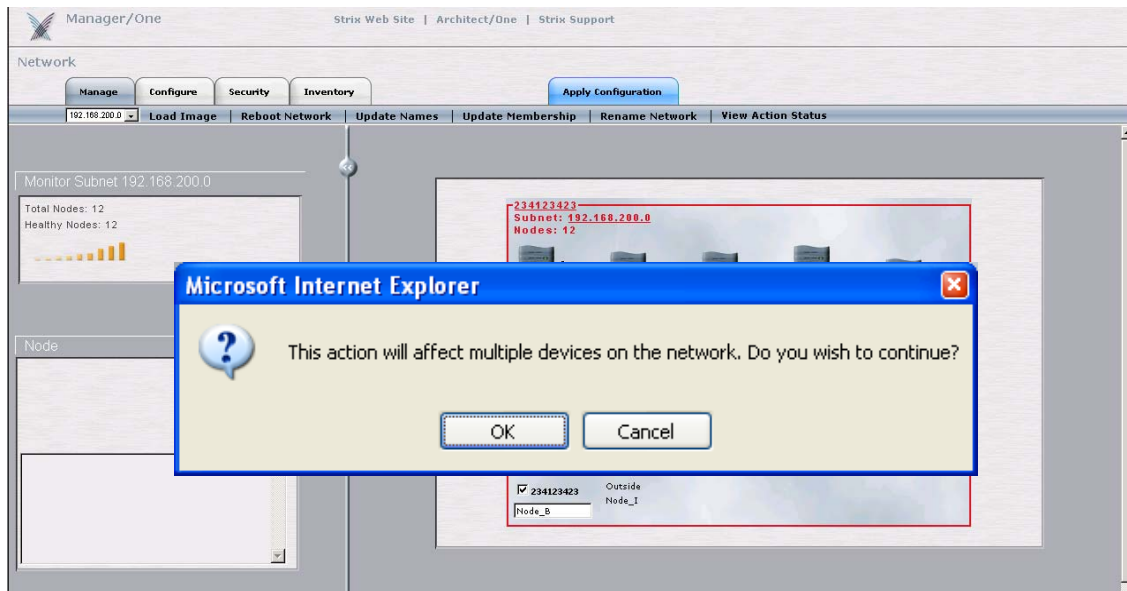
The white box below each Node is a label provided for Node identification purposes, and is set as the Base Module's serial number in the default configuration. This label can be changed to be more meaningful, e.g. Room123. Modify the label field and click the 'Update Names' command for the Node name changes to take effect. Note: this label name is stored in the Node's Base Module, so if the module configuration of the Node is changed the label will remain intact.

The next few paragraphs describe the 'Manage' tab in great detail. The actions within this tab enable the Access/One Network administrator to view & manage the network in its entirety or to drill down to the subnet, Node, or even device level. To reduce the number of network resets, it is recommended that the initial cloud configuration be created on the Network Server before admitting any other Network Nodes to the cloud. When any other Node is admitted, it will automatically retrieve the cloud configuration and reboot.

Creating a configuration using the 'Configure' or 'Security' tabs and clicking on the 'Update' button will create a local configuration on the Network Server, and when the 'Apply Configuration' tab is selected, that information is pushed to every Node in the network. Once the configuration has been pushed successfully to the other Nodes (monitor by pressing 'View Active Status'), use the 'Reboot Network' command to make the changes effective. Note: the Network Server will not allow additional management changes (the various tabs will be shaded) until the previous command has completed.

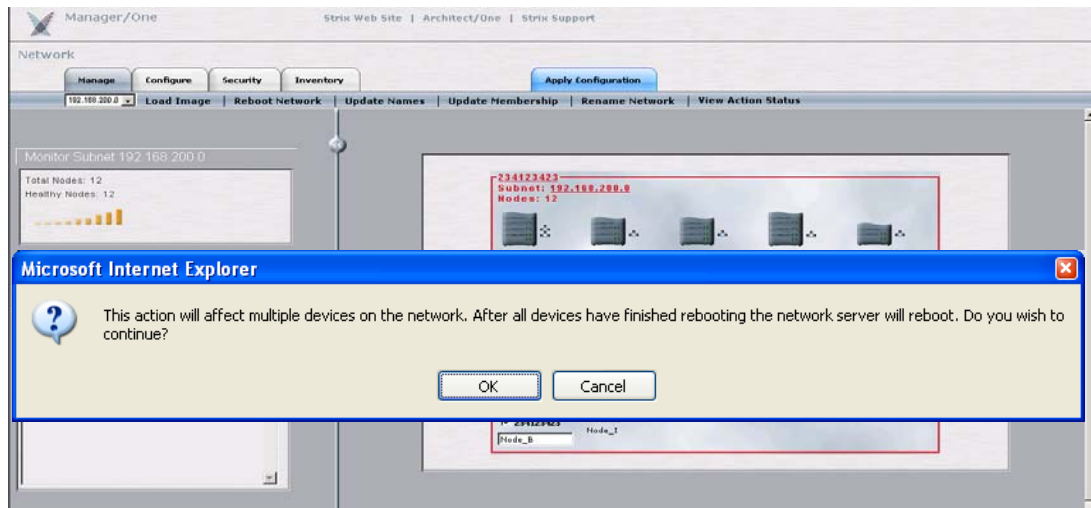
LOAD IMAGE

Click on the 'Load Image' command in the 'Manage' sub menu to send the command to load a new image to each of the modules in all of the Nodes within the network. The parameters of the FTP location where the new software image resides should be set via the 'Configure' tab (use the 'Firmware FTP' command in the submenu) before attempting to load a new image to the network. Loading a new image will require all Nodes within the network to reboot by using the 'Reboot Network' command.



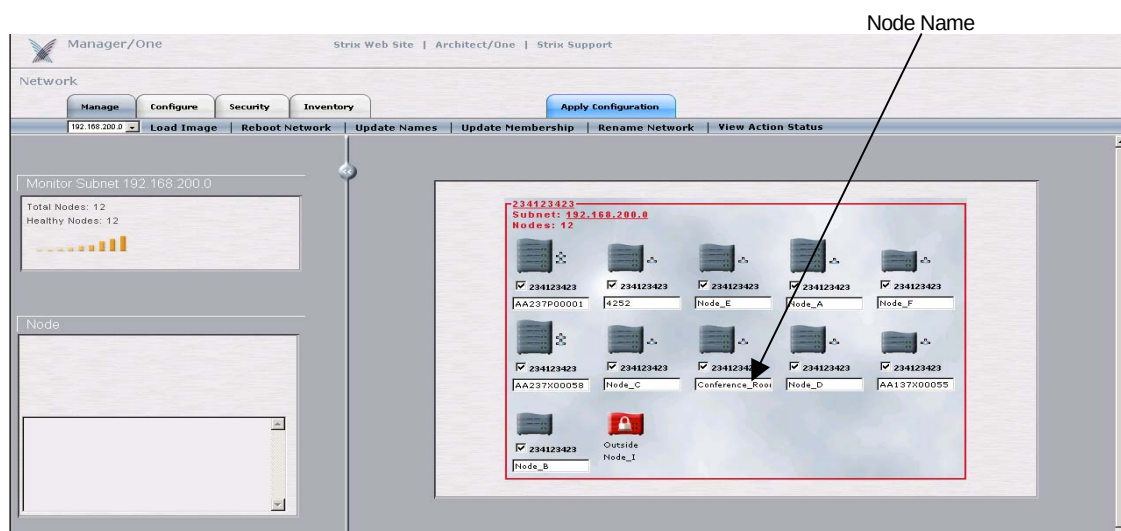
REBOOT NETWORK

The 'Reboot Network' command will reboot each of the modules in all of the Nodes within the Access/One Network. This is required when network-level configuration changes are made or a new image is loaded. The Network Server will generate the request in stages in order to monitor the progress of the network reboot. Once each module reports receiving the reboot command and successfully reboots (monitor by pressing 'View Active Status'), the Network Server will perform a final self-reboot.



UPDATE NAMES

Each Network Node has an editable text field beneath the Node image showing the Node's current name (default is the Base Module serial number). A Node name can be up to 15 characters in length & any alphanumeric character may be used. The Node name must be unique within the wireless network. A duplicate name will cause Manager/One to prompt for a new name. Changes to Node names are applied using the 'Update Names' command. A name update does not require a reboot, but may take 10-15 seconds before the change is reported. Refresh the browser window frequently to display the latest network information.

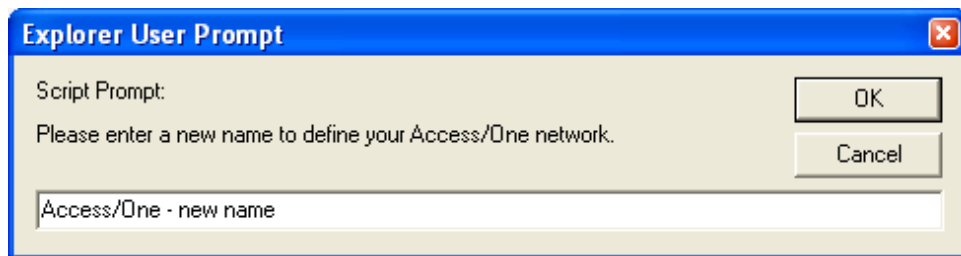


UPDATE MEMBERSHIP

The cloud display indicates all of the Network Nodes in the network (including rogue Strix Nodes). Nodes which belong to the Network Server cloud name are dark grey in color and have a checkbox that is checked. Nodes which are sky blue in color and have an unchecked checkbox are not part of the cloud but may be admitted. Nodes which have no checkbox or are red with a lock symbol may not be admitted to the cloud. Adding or removing Nodes from the cloud is accomplished by checking or unchecking the checkbox and selecting the 'Update Membership' command. This will result in a reboot of Nodes which have changed status. Access/One Network Nodes not admitted to a cloud name other than default will not bridge user traffic.

RENAME NETWORK

The administrator can use this command to rename the Access/One Network. Any device that belongs to this network will then be admitted to the new network name without requiring a network reboot.



VIEW ACTION STATUS

This command launches a separate window displaying a list of all the modules within the wireless network. This list consists of a Network Node name, the device stack order (Row ID), the IP address of the module and its current status. This window gives the most current status because the information is refreshed every 5 seconds. The list below provides details on what type of information the action status window provides. Note that some status values can occur too quickly for observation. The display shows the last command sent to the module and the pending status of that command.

Commands issued to an Access/One Network module:

Page: Toggle paging on or off

Apply Configuration: apply the configuration in the Network Server to the entire network

Image Load: download the software image as specified in the Firmware FTP settings

Prepare to Reboot: The module has received a command to anticipate a reboot

Stop Reboot: Halt the current reboot process, may be issued following the Prepare to reboot command

Reboot: Execute the reboot

Include: Add this Node to the cloud

Exclude: Remove this Node from the cloud

Change Stack Name: change the Node name

Status results of commands issued to an Access/One Network module:

Running: there are no pending commands against this module and it is communicating with the Network Server

Link Lost: Manager/One has lost contact with this module for more than a minute

Command Started: Manager/One is attempting the command

Command Sent Successfully: the command was received by the module

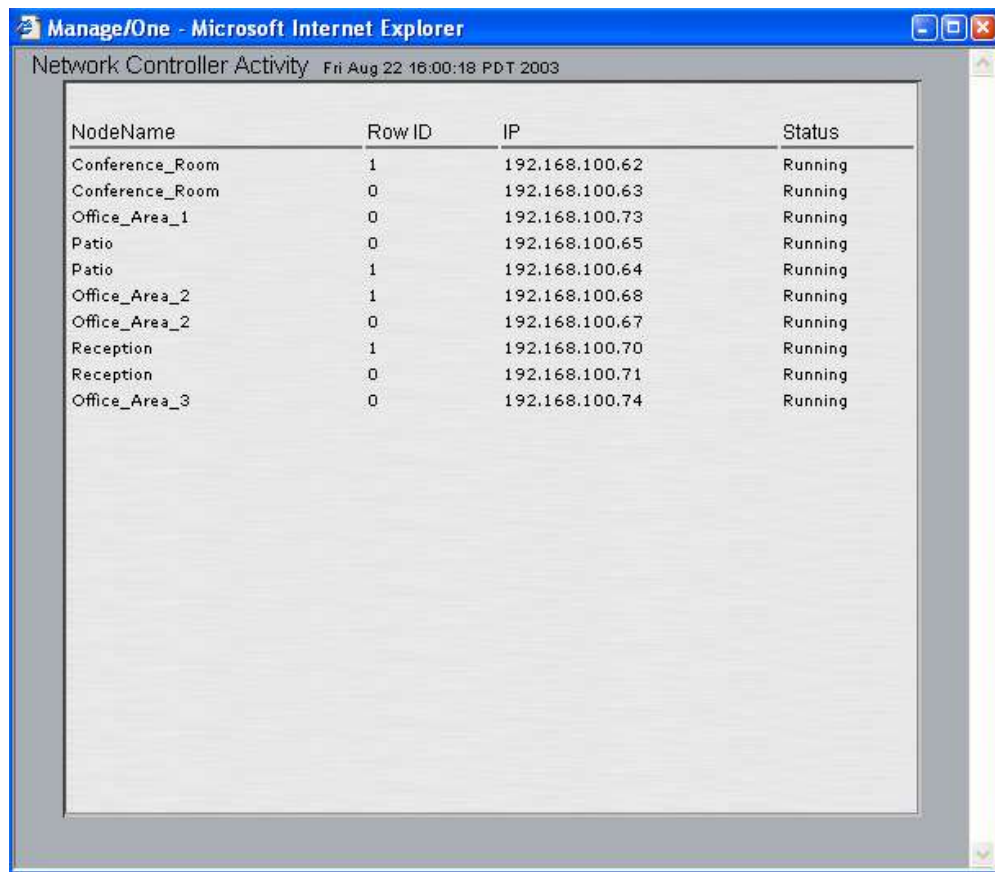
Command Sent: the module replied that it was received

Command Executed Successfully: the command was executed on the module

Command Not Sent: Manager/One failed to send the command to the module

Command Sent. No response from device: Manager/One sent the command but the module didn't reply

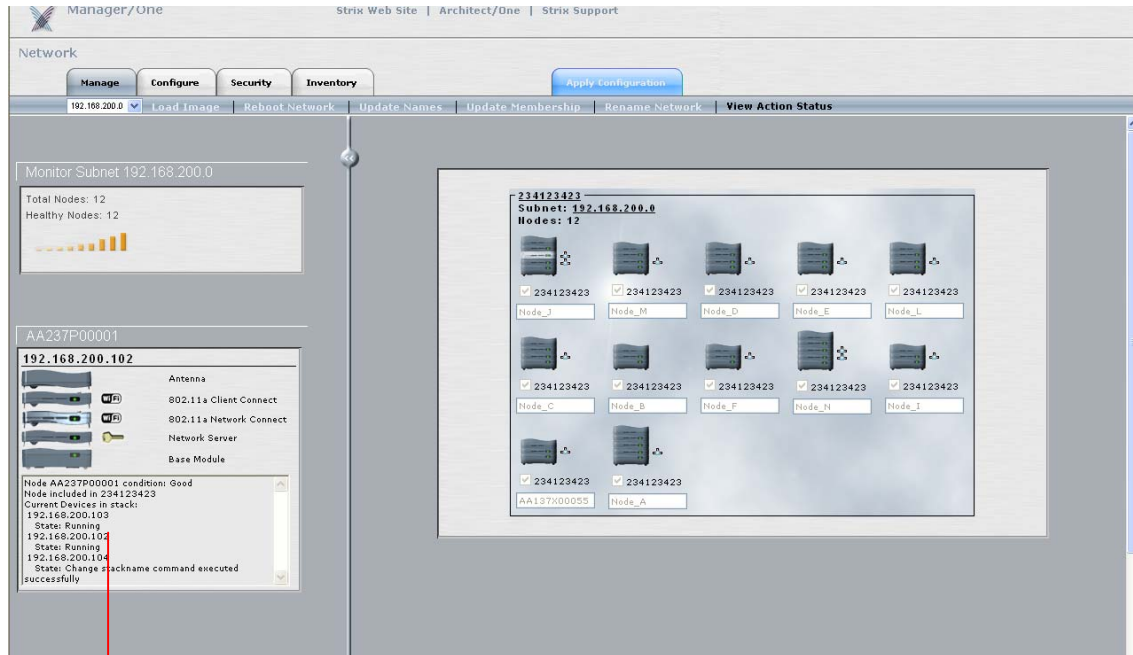
Command Failed: The module received the command but failed to execute the command



NodeName	Row ID	IP	Status
Conference_Room	1	192.168.100.62	Running
Conference_Room	0	192.168.100.63	Running
Office_Area_1	0	192.168.100.73	Running
Patio	0	192.168.100.65	Running
Patio	1	192.168.100.64	Running
Office_Area_2	1	192.168.100.68	Running
Office_Area_2	0	192.168.100.67	Running
Reception	1	192.168.100.70	Running
Reception	0	192.168.100.71	Running
Office_Area_3	0	192.168.100.74	Running

NODE STATUS

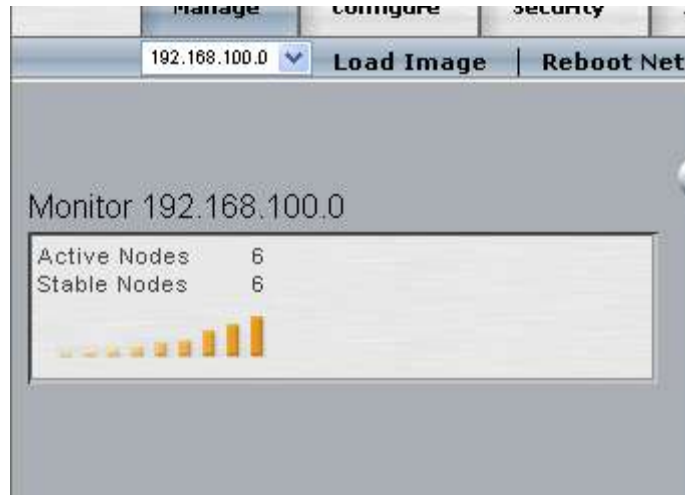
Selecting any Node listed on the network view will update a frame on the left side of the window showing the Node's status and its components. You may close this frame at any time by selecting the "<<" button on the line separating the frames.



This frame shows all the Node components, their roles, IP addresses and status. Double-clicking on one of the modules takes you directly to the management screen for that module and opens a new Manager/One window with module-level commands and screens similar to the ones available for the network configuration. Use this utility to monitor and manage the module itself, and to perform module-specific configurations such as setting a unique SSID, etc.

Note: For module-specific Manager/One capabilities please refer to Appendix 1. It is generally sufficient to configure the network as a whole without configuring specific modules or Nodes. When a specific device is configured (as outlined in Appendix 1), the manually configured parameters override the global network parameters configured or defaulted at the network (cloud) level. It is presumed that if a module is manually configured, the configured parameter values take precedence over global values.

The Monitor frame in the main network window presents a summary of the network health. Nodes under heavy load or losing management connectivity are considered less stable and will not be counted as a stable Node in the Access/One Network.



Configuration

Use information in this chapter to configure all or any subset of Access/One Network Nodes simultaneously. Individual modules within the Nodes will present similar configuration screens if and when you drill down to the module-level configuration screens. Module-level configuration is described in Appendix 1.

SYSTEM CONFIGURATION

The system configuration allows the following changes to be made: DNS settings, administrator password, or outdoor environment selection.

- **Domain Name Server (DNS) IP Address:** Enter the DNS IP address of the primary and secondary DNS. The DNS is used by the Access/One modules to lookup the names of various servers (e.g., RADIUS server, FTP server, etc.). The Domain Name may be specified when static IP addresses are used. This will have the effect of appending the domain name to non-fully qualified address requests (e.g. FTP server host name configured as FTP123 will become FTP123.strixsystems.com.)

Note: When using wireless uplinks between Network Nodes, the Access/One Network self tuning process requires that a default gateway and/or DNS be specified to determine delays to the host Ethernet. If DHCP is used throughout the network (default setting), specifying both of these as part of the options will satisfy this requirement. Otherwise, if static IP addresses are configured, the default gateway must also be configured to allow correct operation of the self tuning feature.

- **User Name:** Enter the user name that is required to access the web server interface within the Network Server Module. The default value for the User Name is 'Admin'. The user name is case sensitive.
- **Password:** Enter the password that is required to access the web server interface within the Network Server Module. The default value for the Password is 'Admin'. The password is case sensitive. Note: We strongly recommend changing the Admin password immediately after the initial login to the Access/One Network.
- **Confirm:** If you typed a new password in the 'Password' field, retype the same password in this field in order to confirm the password change. Note: Performing this action will permanently change the login password.
- **Outdoor Environment:** Check this item if the Access/One Network Node is going to be installed in an environment with uncontrolled temperature. The affected Nodes will set the appropriate temperature regime and corresponding fan speed to better survive in these types of environments.

Click the 'Update' button at the bottom of the page to save any changes made to the settings in this page. Click the 'Apply Configuration' tab to make the configuration information active in the Access/One Network cloud.

STATIC NETWORK SERVERS

When your Access/One Network spans multiple IP subnets, it is necessary to enter an IP address of at least one Network Server Module that resides on each of the other subnets so that all of the subnets can be managed from within a single Manager/One browser window.

The screenshot shows a web interface for configuring static network servers. At the top, there is a navigation bar with tabs: 'Inventory', 'Servers', 'WiFi', 'Advanced WiFi', and 'Firmware Ftp'. The 'Apply Configuration' button is highlighted in blue. Below the navigation bar, the 'Static Network Servers' section is active. It contains two rows of input fields: 'IP Address' and 'IP Mask'. The 'IP Address' row has four empty text boxes separated by dots, followed by an 'Update' button. The 'IP Mask' row has four text boxes containing '255' separated by dots. Below the input fields, there is a note: '(IP format: xxx.xxx.xxx.xxx)'.

- **IP Address:** Enter the IP address of a Network Server Module on another subnet.
- **Subnet Mask:** Enter the subnet mask of the Network Server Module on another subnet.

Click the 'Update' button to save any changes made to the settings in this page. The listed Network Server will be added to the internal list as a Network Server that is available on another subnet, and the IP Address field will clear. Multiple Network Server IP addresses can be added. When you have finished adding Network Servers click the 'Apply Configuration' tab to make the configuration information active in the Access/One Network cloud.

WiFi

The Wi-Fi network settings can be configured from this window, including SSID, SSID parameters, and 802.11a and 802.11g Wireless options.

The screenshot shows the 'WiFi' configuration window. At the top, there are tabs for 'Inventory', 'WiFi', 'Advanced WiFi', and 'Firmware Ftp'. The 'WiFi' tab is active. Below the tabs is a title bar 'WIFI CONFIGURATION'. To the right of the title bar is an 'Apply Configuration' button. The main content area is divided into sections. The 'RADIO MODE' section contains an 'SSID' text input field, a 'Suppress SSID' dropdown menu currently set to 'No', and a 'Wireless Options' section with two checkboxes: 'When running in 802.11a mode, enable 802.11a Turbo mode' and 'When running in 802.11g mode, enable 802.11g Only mode'. At the bottom of the window is an 'Update' button.

- **SSID:** This field defines the identifier of the Service Set to which all the Access/One Network Wireless Modules belong. User devices must provide this SSID to connect to Access/One Network. You may enter an alphanumeric string that is between 1 and 32 characters in length that user devices will associate with in Infrastructure mode. If you want to assign a unique SSID to a specific Wireless Module, drill down to the module itself and update the System Name field to set a unique SSID for the device.
- **Suppress SSID:** Select 'Yes' if you want to prevent the broadcast of the SSID in beacons from all Wireless Modules in the Access/One Network (recommended).
- **Enabling 802.11a Turbo Mode:** Clicking on the 'enable 802.11a Turbo mode' checkbox will configure all 802.11a Wireless Modules in the Access/One Network to operate in Turbo Mode. In this mode the 802.11a Wireless Modules will operate with data rates at speeds up to 108 Mbps. This translates to nearly double the throughput, but there are some limitations. These limitations are as follows:
 - Only three operating channels are supported, as opposed to eight channels in non-turbo mode.
 - All user devices must also be capable of and configured for 802.11a Turbo Mode. Note: Turbo Mode is not an industry standard and so not all 802.11a user devices support this feature.

- **Enabling 802.11g Only Mode:** Clicking on the 'enable 802.11g Only mode' checkbox will configure all 802.11g Wireless Modules in the Access/One Network to support 802.11g only. In this mode each 802.11g Wireless Module will only support 802.11g user devices, which will improve the performance of the 802.11g network. If this mode is not enabled (default configuration) the 802.11g Wireless Modules will support both 802.11b and 802.11g user devices simultaneously. Note: When this mode is enabled, all 802.11b user devices will lose connectivity to the 802.11g Wireless Module.

Click the 'Update' button at the bottom of the page to save any changes made to the settings in this page. Click the 'Apply Configuration' tab to make the configuration information active in the Access/One Network cloud.

ADVANCED WiFi

Advanced Wi-Fi network settings are configurable from this window.

Inventory Apply Configuration

ervers | WiFi | **Advanced WiFi** | Firmware Ftp

ADVANCED WIFI CONFIGURATION

Country Code: UNITED_STATES-US ▼

Data Rate: best ▼

Transmit Power: Full ▼

Beacon Interval (20 - 1000ms): 100

Data Beacon Rate (DTIM) (1 - 16384): 1

Fragment Length (256 - 2346 bytes): 2346

RTS/CTS Threshold (256 - 2346 bytes): 2346

Enable 802.11a Outdoor Auto Channel Scan: ☐

Short Preamble: ☐ Disable ☒ Enable

802.11G PARAMETERS

Protection Mode: Auto ▼

Protection Rate: 11 Mbps ▼

Protection Type: ☒ CTS-only ☐ RTS-CTS

Short Slot Time: ☐ Disable ☒ Enable

Update

- **Country Code:** The Regulatory Domain for all Access/One Network Node is pre-configured in manufacturing and can not be changed by the user.
- **Data Rate:** Select a data transmission rate from the drop-down menu. The 'best' selection will adapt the rate to the best available. Alternately, the user has the option of selecting a fixed data rate, but if that data rate is unachievable no connection will be made. The default value is 'best'. The Wireless Modules will adjust the data rate automatically based on the noise conditions, distance to the connected user device, etc. so Strix does not recommend changing this parameter.

- **Transmit Power:** Select the Wireless Modules' level of transmit power from the drop-down list box. The choices are Full, Half (-3dB), Quarter (-6dB), Eighth (-9dB) and Minimum. Decrease the transmit power if you wish to decrease the range of the Wireless Modules in the Access/One Network. The default value is 'Full'. Note: the Wireless Modules themselves will adapt to the conditions in the RF 'neighborhood' automatically, so Strix does not recommend changing this parameter.
- **Beacon Interval (20 - 1000ms):** Enter a value between 20 and 1000 in milliseconds that specifies the Beacon Interval. The default value is 100.
- **Data Beacon Rate (1 - 16384):** Specifies the Data Beacon Rate. Enter a value between 1 and 16384 that specifies the Delivery Traffic Indication Message (DTIM). Increasing this interval allows the station to sleep for longer periods of time resulting in power savings in exchange for some degradation in performance. The default value is 1.
- **Fragment Length (256 - 2346 bytes):** Enter a value between 256 and 2346. This fragment length setting will determine the frame size of the wireless frame. Wireless frames will be reassembled by the Access/One Network Wireless Modules before being forwarded to the Ethernet port, provided the frame is smaller than the Ethernet MTU (1536 bytes). The default value is 2346.
- **RTS/CTS Threshold (256 - 2346 bytes):** Enter a value between 256 and 2346 that specifies the RTS/CTS threshold. The default value is 2346.
- **Enable 802.11a Outdoor Auto Channel Scan:** Certain countries provide for different indoor and outdoor frequencies/channels. Depending on the Country Code selected in the Country Code field, use this checkbox to enable/disable the use of outdoor channel frequencies. Selecting this checkbox will enable the Auto Channel Scan to search through the outdoor frequency list. The default value is deselected/disabled.
- **Short Preamble:** The short preamble improves network efficiency by reducing the preamble from 128 bits to 56 bits. This is an *optional* feature within the 802.11b standard and most 802.11b NICs support short preambles. 802.11g is required to support both short and long preambles. This does not apply to 802.11a.
- **Protection Mode:** 802.11b and 802.11g networks may occupy the same frequency range, but they don't speak the same language (802.11b uses CCK while 802.11g uses OFDM). To co-exist within the same space, 802.11g must make allowances for 802.11b by using CCK for a short period of time (RTS or Request To Send). Selecting 'Auto' detects the presence of 802.11b and automatically begins protection. Selecting 'None' will not provide protection under any circumstances. Selecting Always will always provide protection even if 802.11b is not present.
 - Enabling this feature will reduce 802.11g performance. However, if protection is disabled and 802.11b clients are present on the same channel, 802.11g performance *will* be affected because there will be collisions.

- **Protection Rate:** Determines the rate to generate the RTS/CTS frames when protection mode is enabled.
- **Protection Type:** The protection will apply to CTS (Clear To Send) or both RTS and CTS. The RTS-CTS setting provides more robust protection but performance will be reduced for 802.11g.
- **Short Slot Time:** If the network contains a combination of 802.11b and 802.11g user devices, enabling this will give precedence to 802.11g traffic.

Click the 'Update' button at the bottom of the page to save any changes made to the settings in this page. Click the 'Apply Configuration' tab to make the configuration information active in the Access/One Network cloud.

FIRMWARE FTP

This window is where FTP parameters are set at the network level in order for software updates to be made to the Access/One Network.

ntory

Apply Configuration

s | WiFi | Advanced WiFi | Firmware Ftp

FIRMWARE FTP CONFIGURATION

FTP SETTINGS

Host Name: test2

User Name: test2

Password: •••••

HOST FILE PATH

Path: Test

Update

- **Host Name:** FTP server host name.
- **User Name:** FTP server user name.
- **Password:** FTP server password.
- **Path:** Identify any accessible directory for downloading an image.

Note: The downloaded file will always be 'accessone.bin' when configured via Manager/One. If a different file name is required, using the module-level management will allow another filename to be used.

Click the 'Update' button at the bottom of the page to save any changes made to the settings in this page. Click the 'Apply Configuration' tab to make the configuration information active in the Access/One Network cloud.

Security

WiFi SECURITY

This window is where Wi-Fi network Security parameters are set for Access/One Network.

The screenshot shows the 'WiFi Security Configuration' window. At the top, there are three tabs: 'Configure', 'Security' (selected), and 'Inventory'. Below these are three sub-tabs: 'WiFi Security' (selected), 'Security Server', and 'WiFi ACL'. A blue 'Apply Configuration' button is in the top right. The main title is 'WIFI SECURITY CONFIGURATION'. The 'Authentication Mode' section has three radio buttons: 'Open' (selected), 'Shared Key', and 'Dynamic (802.1X)'. The 'Encryption Mode' section has four radio buttons: 'Clear' (selected), 'WEP', 'AES', and 'Auto Negotiate'. The 'Key Entry Method' section has two radio buttons: 'Hexadecimal' (selected) and 'Ascii Text'. The 'Client Connect Security Key' section has a 'Default Shared Key' column with four radio buttons (1, 2, 3, 4), an 'Encryption Key' column with four text input fields, and a 'Key Length' column with four dropdown menus (all set to 'None'). The 'Network Connect Security Key' section has a single text input field and a dropdown menu set to '152 bit (32 hex digits/16 ascii keys)'. An 'Update' button is at the bottom center.

- **Authentication Mode:** This option selects the authentication type that will be used.
 - **Open:** Local authentication.
 - **Shared Key:** A static shared WEP key will be used for authentication. This option is not recommended since all users will be using the same key.
 - **Dynamic Key:** The authentication server (RADIUS) will give a key to each user for unicast traffic. Multicast traffic will use the default key. This is the safest and recommended option. A default shared key must be configured in slots 2, 3 or 4 if dynamic key is selected. See below for more information.

- **Encryption Mode:** This option selects the type of encryption used.
 - **Clear:** Available for Open or Dynamic authentication. Messages will be sent unencrypted between user devices and the Access/One Network Nodes.
 - **WEP:** Wired Equivalency Privacy (WEP) is a security protocol for WLAN. It encrypts data using an RC4 stream cipher with a seed of 64, 128 or 152 bits.
 - **AES:** Advance Encryption Standard (AES) encrypts data using a symmetric 128 bit data block, and is generally considered the most secure option available.
 - **Auto Negotiate:** The encryption mode will be negotiated in real time between the participating devices. This allows the simultaneous use of AES and WEP.

Authentication Type	Supported Encryption Types
Open	Clear: All users have access WEP, AES, Auto: Requires static encryption key
Shared	WEP: Requires static encryption key (not recommended)
Dynamic	Clear: User must authenticate, but no encryption WEP, AES, Auto: Key is delivered via authentication server after authentication.

- **Key Entry Mode:** Select between hexadecimal and ASCII text.
- **Network Connect Security Key:** Select which key will serve as the default key to encrypt packets to be transmitted on a wireless uplink between Nodes. The key length is fixed at 152 bits. Refer to the next section for more details on this.

If 'Dynamic' key is selected for Authentication Mode, a Security Server Configuration appears:

The screenshot shows a web-based configuration interface. At the top, there are two radio buttons labeled '3.' and '4.' with corresponding text input fields and dropdown menus set to 'None'. Below these is a section titled 'Network Connect Security Key' with a text input field and a dropdown menu set to '152 bit (32 hex digits/16 ascii keys)'. The main section is titled 'SECURITY SERVER CONFIGURATION' and contains the following fields: 'RADIUS Server:' (text input), 'RADIUS Port:' (text input with '1812' entered), 'RADIUS Secret:' (text input), and 'Key Source:' with 'Local' (checked) and 'Remote' (unchecked) checkboxes. An 'Update' button is located at the bottom right of the form.

The user can enter RADIUS (Remote Authentication Dial In User Service) Server parameters here or on the next tab (Security Server). For dynamic encryption, the Access/One Network Nodes communicate with an authentication server to obtain encryption keys to use.

- **RADIUS Server:** Specify the Host name or IP address of the RADIUS Server.
- **RADIUS Port:** Specify the RADIUS port number.
- **RADIUS Secret:** Specify the RADIUS Server's shared secret. The Network Node will use this server secret when it forwards authentication credentials to the RADIUS Server.
- **Key Source:** Specify where the RADIUS keys are located. Selecting 'Local' will cause the Network Node to use the static keys configured in the previous section. If both checkboxes are selected the Network Node will use the local key unless it receives a key from the RADIUS Server. If 'Remote' is selected, the Network Node will use only keys from the RADIUS Server.

Click the 'Update' button at the bottom of the page to save any changes made to the settings in this page. Click the 'Apply Configuration' tab to make the configuration information active in the Access/One Network cloud.

WIRELESS UPLINK (NETWORK CONNECT) SECURITY

The Access/One Network provides WEP and AES ciphers for encryption and 802.1x remote authentication to protect wireless stations associated with each Network Node. The inter-Node Network Connect wireless uplink is protected with an AES static key to prevent eavesdropping.

The factory configured default key is hidden from view to retain secrecy for a basic network. However, this key may be changed by using the 'Network Connect Security Key' field to allow each network to have a unique key. If additional security is required, a different Network Connect Security Key may be provisioned for each Network Connect module. This is done by creating an Access Control List (ACL) entry in the receiving Node that contains the MAC address of the Network Connect Node and a specific unique key.

The Network Connect solution for Access/One Network prevents unauthorized wireless connections from being established to the network by blocking user traffic in two scenarios:

1. If the Network Connect is configured for the default cloud name (AccessOne), Manager/One forces the Administrator to approve/admit the Network Node to the cloud before user traffic is bridged to the network.
2. If the two Network Nodes that are wirelessly connected (via the uplink) have different Network Connect Security Keys configured.

In either instance, the Network Connect is remotely manageable within Manager/One to allow configuration changes necessary to update the Network Connect parameters. However, if Network Connect is configured for a new security key, but the receiving Network Node still has the default security key, remote management will not be possible.

WiFi ACL

This window configures an Access Control List (ACL) determining which user devices (stations) are allowed to connect to Access/One Network.

ntory Apply Configuration

WiFi ACL

WIFI ACL CONFIGURATION

Access Control List: Enable Add New Station

Page prev next

MAC Address	Permission
AA:BB:CC:DD:EE:FF	allowed

Delete

Update

- **Access Control List:** Enables you to enable or deny network access based on the MAC address of a user device (station).
 - **Disable:** All stations can request association with a Network Node in the Access/One Network. This means that the ACL will not be checked when a station attempts to authenticate.
 - **Enable:** Stations are assigned a DENY or ALLOW permission status. If the MAC address of station trying to gain access is set to DENY, it will not be allowed to associate with the network. If the MAC address is set to ALLOW, or not configured in the ACL, the station will be allowed network access.

- **Strict:** Only stations assigned ALLOW permissions in the ACL will be granted access to the network, regardless of encryption settings. In addition, if the entry is configured for an encryption key, the station is also required to match that key before gaining access. If no ACL entry exists for a MAC address it will not be allowed to associate with the network. The ACL will accept multiple levels of authentication (ALLOW, KEY, DENY) concurrently so that stations with or without encryption (or shared key authentication) can be admitted.
- Click the 'Add New Station' button to configure the following:

The screenshot shows a web interface for configuring a WiFi ACL. At the top, there's a tab labeled 'WIFI ACL' and a button 'Apply Configuration'. Below this is a section titled 'CREATE RADIO ACCESS CONTROL'. It contains three main input fields: 'MAC Address' with a text box and a hint '(MAC Address format: aa:bb:cc:dd:ee:ff)', 'ACL Type' with a dropdown menu currently showing 'Allow', and 'Unique Key' with a text box and a hint '(If unique key is used in ACL type)'. At the bottom of the form are two buttons: 'Add to list' and 'Back'.

- **MAC Address:** Enter the MAC address of a user device/station.
- **ACL Type:** Select the permission level for this user device/station.
- **Unique Key:** Optionally, enter a unique key which will be used for unicast messages.

Click the 'Add to list' button to add the new user device to the ACL. To remove a user device from the ACL, click the corresponding 'Delete' button (shown in the previous window).

Click the 'Back' button when finished adding new user devices/stations.

In the previous window, click the 'Update' button at the bottom of the page to save any changes made to the settings in this page. Click the 'Apply Configuration' tab to make the configuration information active in the Access/One Network cloud.

Inventory

This tab provides administrator with an inventory view of the Access/One Network. The inventory list consists of Module serial numbers, Module types, Module status and IP addresses assigned.

Strix Web Site | Architect/One | Strix Support

Security **Inventory** Apply Configuration

Serial Number	Device Type	Device Status	Device IP Address
3BtUsb205	802.11a Network Connect	Running	10.10.10.38
JINC	Network Server	Running	10.10.10.111
Sh3:615	802.11a Network Connect	Running	10.10.10.196
anaNC	Network Server	Running	10.10.10.109
3BtUsb202	802.11a Network Connect	Running	10.10.10.141
AC037T00056	802.11a AP	Running	10.10.10.34
AC137S00045	802.11a AP	Running	10.10.10.36
AB037W00014	Network Server	Running	10.10.10.33
123	802.11a AP	Running	10.10.10.124
700000003	802.11a AP	Running	10.10.10.145
700000004	802.11b AP	Running	10.10.10.129
700000008	802.11a Network Connect	Running	10.10.10.25
800000008	Network Server	Running	10.10.10.27
700000002	802.11a Network Connect	Running	10.10.10.123
6602	802.11a AP	Running	10.10.10.194
39	802.11a AP	Running	10.10.10.178
8000	Network Server	Link Lost	10.10.10.22
davidAP	802.11a AP	Running	10.10.10.121
davidNC	Network Server	Running	10.10.10.177
Sh2:FF000B	Network Server	Running	10.10.10.193
Sh5:607	802.11a Network Connect	Running	10.10.10.195
Sh1:614	802.11a Network Connect	Running	10.10.10.191
3BtUsb212	802.11a Network Connect	Running	10.10.10.149
alexAP2	Network Server	Running	10.10.10.151
3BtUsb209	Network Server	Running	10.10.10.181
601	802.11a Network Connect	Running	10.10.10.140
ahmad86	802.11a AP	Running	10.10.10.86
ap1	802.11a AP	Running	10.10.10.84
7000	Network Server	Running	10.10.10.85

Apply Configuration

This tab is used to apply any changes that have been made at either the network (cloud) or subnet (sub-cloud) level. Once this tab has been clicked, the changes are propagated and applied to all Network Nodes and modules within the Access/One Network.

Appendix 1: Module / Device Management

DEVICE

The ‘Device’ tab has two submenu items. The ‘About’ submenu provides information about the selected module, such as code version, serial number, MAC address, etc. The ‘Reboot’ submenu is used when a reboot needs to be performed on just this module, and is immediate.



CONFIGURE

The 'Configure' tab enables the module-level configuration to be performed. Click the 'Update' button at the bottom of the page for any changes to be saved. A 'Reboot' button will appear after clicking 'Update' as it is necessary to reboot the module after changes are made.

The 'Module' submenu (shown below) is used to configure basic module-level details, such as name, network assignment, static IP address, static DNS and management password.

The screenshot displays the 'WiFi Module' configuration interface. At the top, there's a navigation bar with tabs: 'Device', 'Configure' (selected), 'Security', 'Monitor', and 'Help'. Below this is a submenu bar with options: 'Module' (selected), 'WiFi Radio', 'Advanced WiFi', 'Script', 'Firmware Ftp', and 'Factory Default'. The main content area is titled 'CONFIGURATION' and contains several sections:

- MODULE IDENTITY**: Fields for 'Module Name' (set to 'Strox_2003') and 'Network Name' (set to 'strox_cloud').
- IP SETTINGS**: Radio buttons for 'Obtain IP address automatically using DHCP' (unselected) and 'Use pre-configured IP address' (selected). Below are fields for 'IP Address' (10.10.10.169), 'Subnet Mask' (255.255.255.0), 'Default Gateway Address' (10.10.10.254), 'DHCP Timeout' (empty), and a checked 'Enable Telnet' checkbox.
- DNS SETTINGS**: Fields for 'Primary DNS IP Address' (192.168.123.1), 'Secondary DNS IP Address' (empty), and 'Domain Name' (empty).
- SNTP SETTINGS**: Fields for 'SNTP/NTP Server IP Address' (empty) and 'Time zone' (0).
- USER MANAGEMENT**: Fields for 'User Name' (Admin), 'Password' (masked with dots), and 'Confirm' (masked with dots). There's also an 'Outdoor Environment' checkbox (unchecked).

An 'Update' button is located at the bottom center of the configuration area.

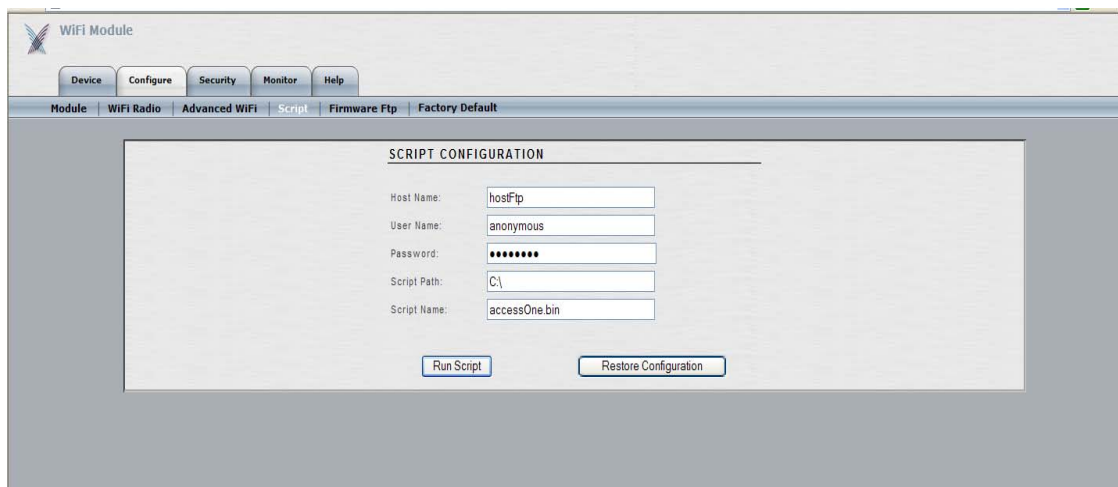
The 'WiFi Radio' submenu (shown below) is used to configure module-level Wi-Fi settings, such as module role (Client Connect, Network Connect), SSID, RF type, etc.

The screenshot shows the 'WiFi Radio' configuration page. At the top, there's a 'WiFi Module' header with a logo and navigation tabs: Device, Configure, Security, Monitor, and Help. Below these are sub-tabs: Module, WiFi Radio, Advanced WiFi, Script, Firmware Ftp, and Factory Default. The main content area is titled 'WIFI RADIO CONFIGURATION' and contains two sections: 'WIFI MODE' and 'WIFI NETWORK CONNECT'. In the 'WIFI MODE' section, 'Operating Mode' has three radio buttons: 'Client Connect' (selected), 'Network Connect', and 'Auto'. Below this is an 'SSID' text field containing 'strio-bh' and a 'Suppress SSID' dropdown menu set to 'No'. The 'Wireless Mode' section has three radio buttons: '802.11a', '802.11b' (selected), and '802.11g'. There are also two checkboxes: 'When running in 802.11a mode, enable 802.11a Turbo mode' and 'When running in 802.11g mode, enable 802.11g Only mode'. The 'WIFI NETWORK CONNECT' section has three radio buttons: 'Automatic Peer Selection', 'Target MAC Address' (with five empty fields), and 'Target SSID' (with a text field containing 'surajit-bh'). An 'Update' button is at the bottom right.

The 'Advanced WiFi' submenu (shown below) is used to configure advanced module-level Wi-Fi settings, such as country code, data rate, transmit power, etc.

The screenshot shows the 'Advanced WiFi' configuration page. It has the same header and sub-tabs as the previous page. The main content area is titled 'ADVANCED WIFI CONFIGURATION' and contains several settings. 'Country Code' is a dropdown menu set to 'UNITED_STATES-US'. 'Radio Frequency' is a dropdown menu set to 'SmartSelect'. 'Data Rate' is a dropdown menu set to 'best'. 'Transmit Power' is a dropdown menu set to 'Full'. Below these are several text input fields: 'Beacon Interval (20 - 1000ms)' set to '100', 'Data Beacon Rate (DTIM) (1 - 16384)' set to '1', 'Fragment Length (256 - 2346 bytes)' set to '2346', and 'RTS/CTS Threshold (256 - 2346 bytes)' set to '2346'. There is a checkbox for 'Enable 802.11a Outdoor Auto Channel Scan' which is unchecked. 'Short Preamble' has two radio buttons: 'Disable' and 'Enable' (selected). The '802.11G PARAMETERS' section has 'Protection Mode' set to 'Auto', 'Protection Rate' set to '11 Mbps', 'Protection Type' with radio buttons for 'CTS-only' (selected) and 'RTS-CTS', and 'Short Slot Time' with radio buttons for 'Disable' and 'Enable'. An 'Update' button is at the bottom right.

The ‘Script’ submenu (shown below) is used to configure an individual module with a text script.

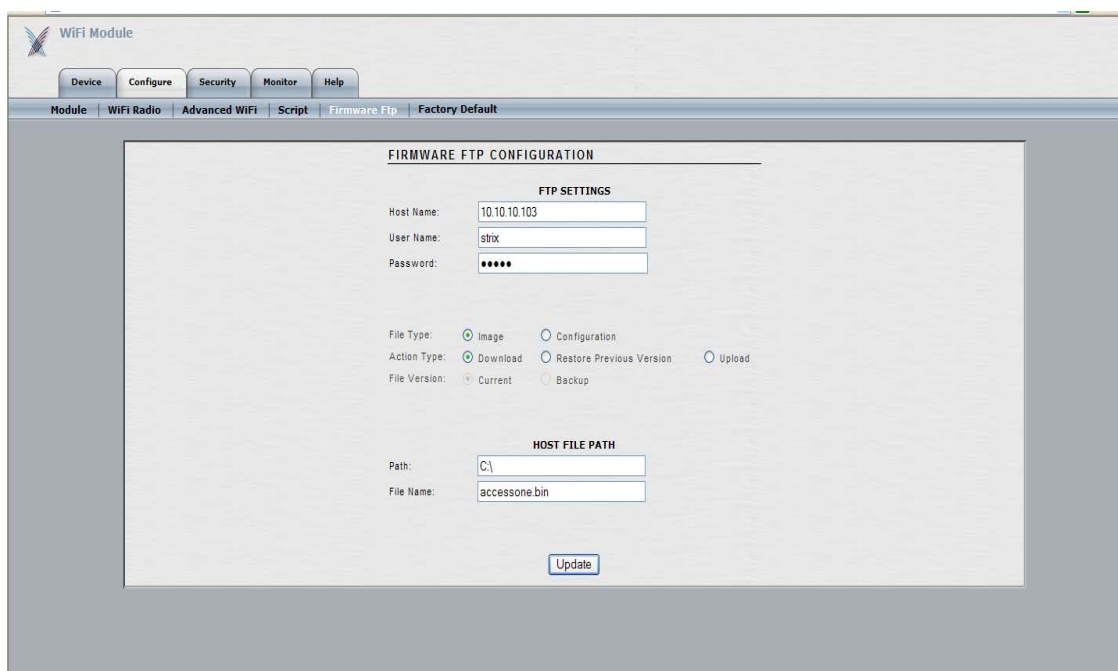


The screenshot shows the 'WiFi Module' configuration window with the 'Script' submenu selected. The 'SCRIPT CONFIGURATION' section contains the following fields:

- Host Name:
- User Name:
- Password:
- Script Path:
- Script Name:

At the bottom of the configuration area are two buttons: 'Run Script' and 'Restore Configuration'.

The ‘Firmware FTP’ submenu (shown below) is used to configure module-level FTP settings, such as host name, user name, password, file path, file name, etc.



The screenshot shows the 'WiFi Module' configuration window with the 'Firmware FTP' submenu selected. The 'FIRMWARE FTP CONFIGURATION' section is divided into two parts:

FTP SETTINGS

- Host Name:
- User Name:
- Password:

Below these are three groups of radio buttons:

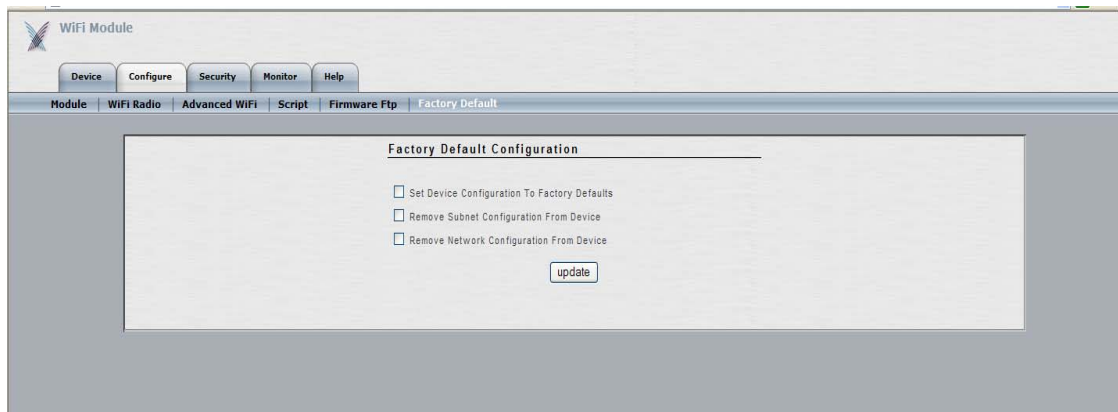
- File Type: ☒ Image ☐ Configuration
- Action Type: ☒ Download ☐ Restore Previous Version ☐ Upload
- File Version: ☒ Current ☐ Backup

HOST FILE PATH

- Path:
- File Name:

At the bottom of the configuration area is an 'Update' button.

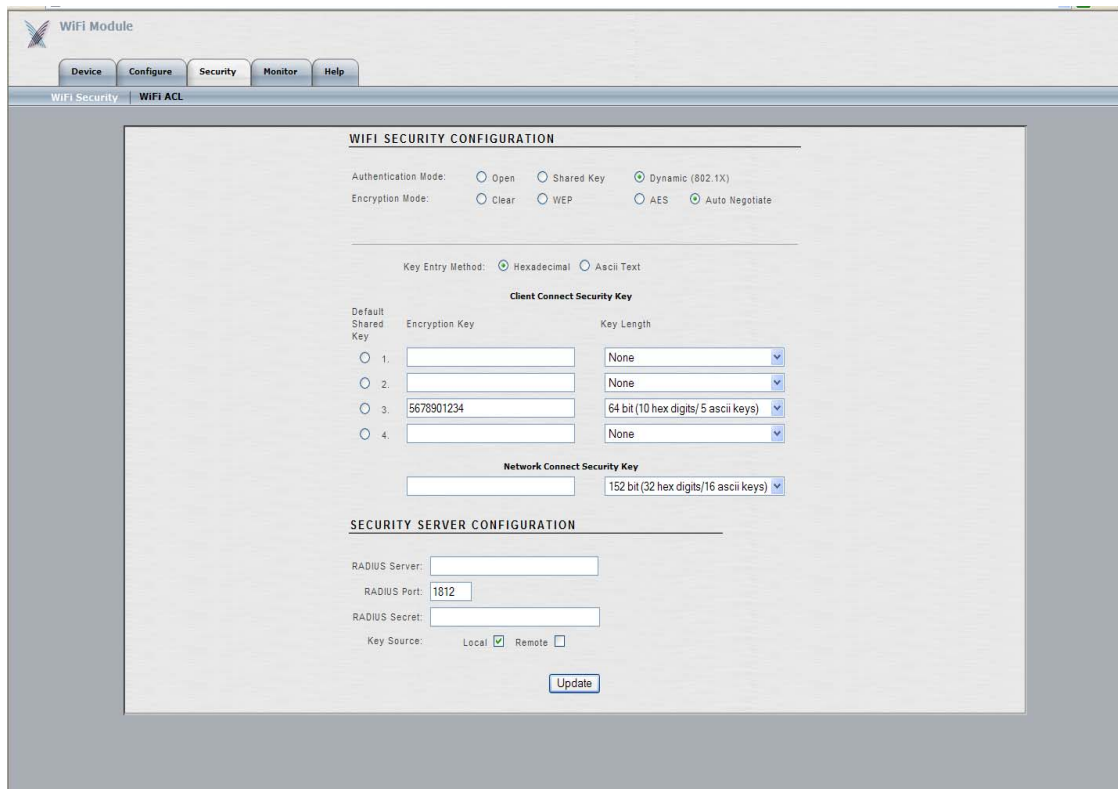
The 'Factory Default' submenu (shown below) is used to reset the module back to its factory default configuration.



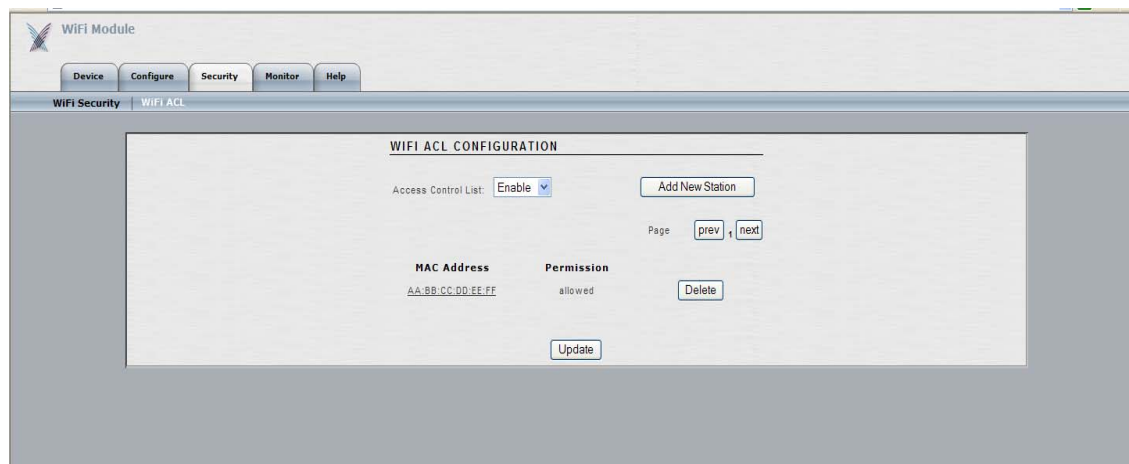
SECURITY

The 'Security' tab enables the module-level security configuration to be performed. Click the 'Update' button at the bottom of the page for any changes to be saved. A 'Reboot' button will appear after clicking 'Update' as it is necessary to reboot the module after changes are made.

The 'WiFi Security' submenu (shown below) is used to configure module-level Wi-Fi security settings, such as authentication type, encryption type, static security keys, RADIUS Server parameters, etc.



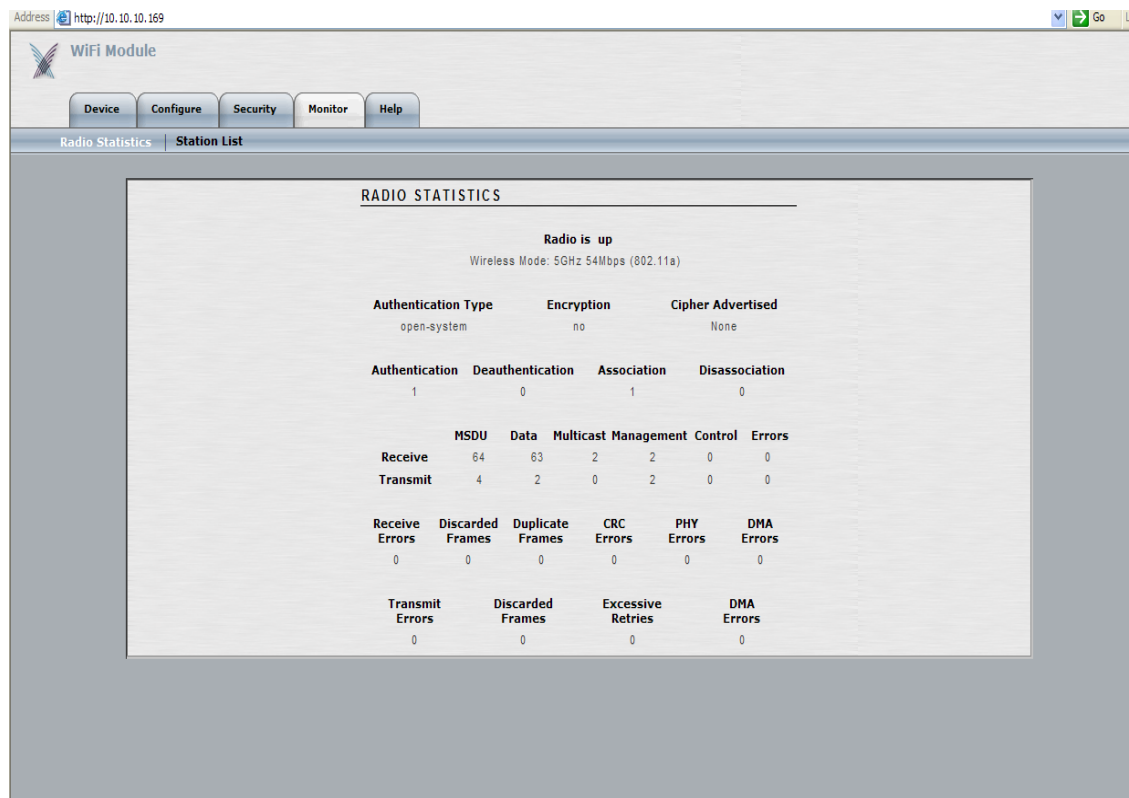
The ‘WiFi ACL’ submenu (shown below) is used to configure module-level Wi-Fi Access Control List (ACL) settings, such as ACL mode, add/remove stations, etc.



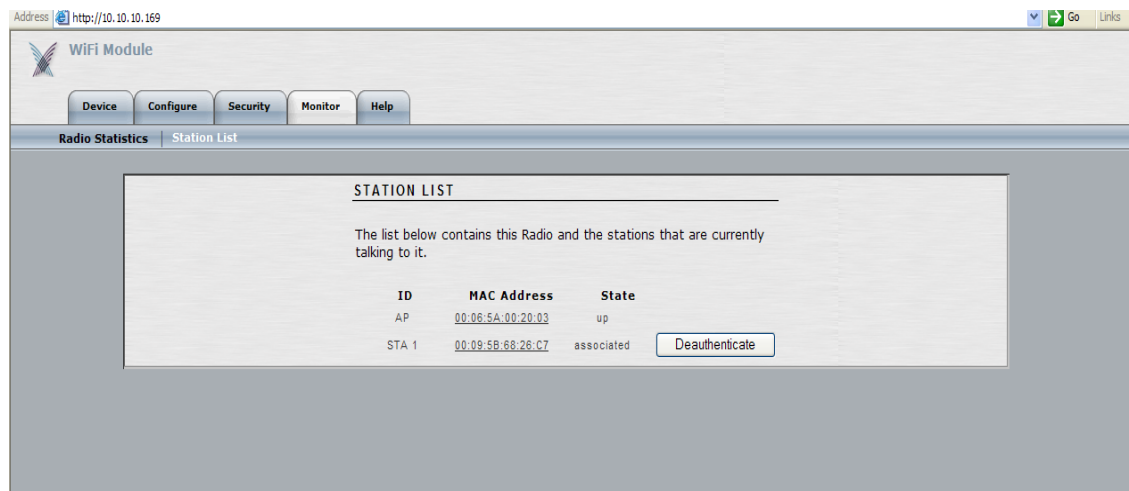
MONITOR

The ‘Monitor’ tab provides module-level monitoring functions.

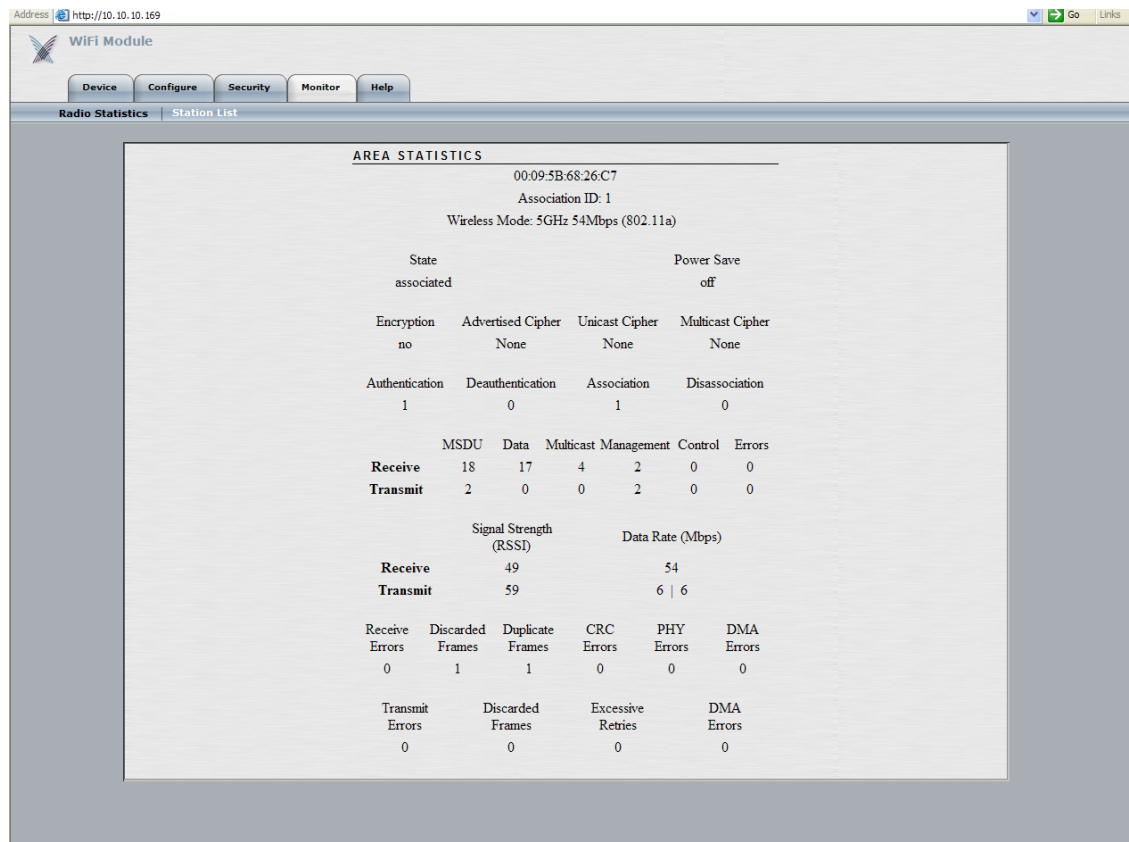
The ‘Radio Statistics’ submenu (shown below) is used to view module-level details and statistics, such as status, authentication / deauthentication / association / disassociation attempts, receive/transmit packet statistics, error statistics, etc.



The ‘Station List’ submenu (shown below) is used to view a list of devices/stations that are attached to the specific module being managed. Each station’s ID, MAC address and state are provided. Any station’s MAC address can be clicked on for more detailed statistics summary for that station.



Once a MAC address is clicked, a window like the one the below is shown which displays station-level details and statistics, such as status, authentication / deauthentication / association / disassociation attempts, receive/transmit packet statistics, error statistics, etc.



Appendix 2: Specifications

This chapter lists the basic protocols and features supported by the Access/One Network and its Network Nodes. It also includes the environmental and regulatory characteristics of the hardware. For more up-to-date information, please refer to the Strix Access/One Network data sheets.

PHYSICAL ATTRIBUTES

Module	Description	User Interfaces	Size
BME0	Base Module with no RJ-45	18V DC input	5.0" x 3.65" x 1.30"
BME1	Base Module with one RJ-45	18V DC input Qty 1 RJ-45 w/ PoE	5.0" x 3.65" x 1.30"
BME4	Base Module with four RJ-45	18V DC input Qty 4 RJ-45, incl. PoE	5.0" x 3.65" x 1.30"
WM11Ac	802.11a Wireless Module	Qty 2 Reverse SMA	5.0" x 3.65" x 0.60"
WM11Ge	802.11g Wireless Module	Qty 2 Reverse SMA	5.0" x 3.65" x 0.60"
AM11AABG	802.11a & a/b/g Antenna Module	N/A	5.0" x 3.65" x 1.25"
NWSV	Network Server Module	N/A	5.0" x 3.65" x 0.60"

EMISSIONS AND SAFETY STANDARDS

The Access/One Network complies with standard qualifications for North America, Canada, the European Union, and many Asia Pacific countries. These qualifications include:

EN 55022:1998 + A1:2000, EN 55024:1998 + A1:2001, IEC 60950 3rd Ed.:1999 / EN 60950:2000, EN 300328-1:2001, ETS 300328-2:2001, EN 301489-1:2000, EN 301489-17:2002, and EN 301893:2002.

USER COVERAGE RANGES FOR 802.11A, 802.11B, & 802.11G

Exact range calculations for each of the technologies cannot be provided as many factors impact the range and coverage area. These factors include; physical environment configuration, interfering factors (such as walls, cubicles, desks, elevators, etc), and use of external versus antenna module, to name just a few. The Strix Architect/One application will enable users to understand what ranges to expect based on their exact deployment environment. In performance benchmarking against competitive products the Strix solution met or exceeded our primary competitor's range. Following is a table that provides general information regarding what types of ranges should be expected for the various wireless technologies supported by the Access/One Network.

802.11a	802.11b	802.11g
Indoor: 60 ft (18m) @ 54Mbps 170 ft (50m) @ 6Mbps Outdoor: 100 ft (30m) @ 54Mbps 1000 ft (300m) @ 6Mbps	Indoor: 150 ft (45m) @ 11Mbps 400 ft (120m) @ 1Mbps Outdoor: 800 ft (240m) @ 11Mbps 2000 ft (600m) @ 1Mbps	Indoor: 60 ft (18m) @ 54Mbps 170 ft (50m) @ 6Mbps Outdoor: 100 ft (30m) @ 54Mbps 1000 ft (300m) @ 6Mbps

Appendix 3: CLI Commands

This chapter lists the Command Line Interface (CLI) commands available through every Access/One Network module. A Telnet session can be started by ‘right-clicking’ on the module displayed in the Manager/One window of your browser. The term ‘cloud’ used in the commands refers to the Access/One Network as a whole, while ‘sub-cloud’ denotes an IP subnet or other arbitrary grouping of the Access/One Network Nodes.

bc shownodes	- Show nodes in cloud
bc showdevices	- Show devices in cloud
bc sendcfg cloud	- Send cloud configuration
bc sendcfg subcloud <id>	- Send sub-cloud
bc imageload cloud	- Load image on cloud
bc imageload subcloud <id>	- Load image on sub-cloud
bc pagerenable cloud	- Set pager on for cloud
bc pagerenable subcloud <id>	- Set pager on for sub-cloud
bc pagerdisable cloud	- Set pager off for cloud
bc pagerdisable subcloud <id>	- Set pager off for sub-cloud
bc reboot cloud	- Reboot cloud
bc reboot subcloud <id>	- Reboot sub-cloud
bc setview cloud	- Cloud view
bc setview subcloud <id>	- Sub-cloud view
bc setview device <ipaddr>	- Device view
bc include all	- Include all devices
bc include devices <ipaddr>	- Include specified devices
bc exclude all	- Exclude all devices
bc exclude devices <ipaddr>	- Exclude specified devices
bc changestname <ipaddr> <name>	- Change station name
bc help	- Batch configuration help

ftransfer params set ...	- Set ftp parameters
hostname <hostname>	
username <username>	
password <password>	
path <path>	
filename <remotefile>	
ftransfer params get	- Get ftp parameters
ftransfer download image <remotefile>	- Download image file
ftransfer download configuration <remotefile>	- Download configuration file
ftransfer restore image	- Restore previous image
ftransfer restore configuration	- Restore previous configuration
ftransfer upload image current <remotefile>	- Upload current image
ftransfer upload image backup <remotefile>	- Upload backup image
ftransfer upload configuration current <remotefile>	- Upload current configuration
ftransfer upload configuration backup <remotefile>	- Upload backup configuration
ftransfer help	- File transfer help
get cims	- Display Cloud structure
get config	- Display System Configuration
get dhcp mode	- Display DHCP mode
get domainsuffix	- Display Domain Name Server suffix
get fan	- Display the fan status
get gateway	- Display Gateway IP Address
get hardware	- Display Hardware Revisions
get hostipaddr	- Display Host IP Address
get ipaddr	- Display IP Address

get ipmask	- Display IP Subnet Mask
get login	- Display Login User Name
get nameaddr	- Display IP address of name server
get cloudname	- Display Cloud Name
get subcloudname	- Display Subcloud Name
get stackid	- Display Stack Id
get outdoorenviron	- Display outdoor environment
get radiusname	- Display RADIUS server name or IP address
get radiusport	- Display RADIUS port number
get snmp	- Display SNMP Community Name
get sntpserver	- Display SNTP/NTP Server IP address
get syslog settings	- Get syslog configuration settings
get syslog consoledump	- Dump syslog console buffer contents
get syslog filedump	- Dump syslog file contents
get syslog help	- Syslog get help
get system	- Display System Name
get telnet	- Display Telnet Mode
get temperature	- Display ambient temperature
get timeout	- Display Telnet Timeout
get tzone	- Display Time Zone Settin
get uptime	- Display UpTime
get voltage	- Display the voltage sources
help	- Display CLI Command List
ping	- Ping

quit	- Logoff
rawftp	- Software update via FTP
reboot	- Reboot Access/One
remotenc add	- Add remote network server IP address
remotenc remove	- Remove remote network server IP address
remotenc show	- Show remote network server IP address
run	- Run command file
set cloudname	- Set cloud name
set dhcp disable	- Disable DHCP
set dhcp enable	- Enable DHCP
set domainsuffix	- Set Domain Name Server suffix
set factorydefault	- Restore to default factory settings
set snmp getcmnty	- Set SNMP community
set snmp setcmnty	- Get SNMP community
set gateway	- Set Gateway IP address
set hostipaddr	- Set Host IP address
set ipaddr	- Set IP address
set ipmask	- Set IP subnet mask
set login	- Modify Login user name
set nameaddress primary	- Set primary name server IP address
set nameaddress secondary	- Set secondary name server IP address
set outdoorenviron disable	- Disable outdoor environment
set outdoorenviron enable	- Enable outdoor environment

set pager off	- Module LED returns to current state
set pager on	- Module LED repeats Red, Green, Orange sequence
set password	- Modify Password
set radiusname	- Set RADIUS name or IP address
set radiusport	- Set RADIUS port number
set radiussecret	- Set RADIUS shared secret
set sntpserver	- Set SNTP/NTP Server IP Address
set syslog server	- Syslog server configuration
set syslog console	- Syslog console configuration
set syslog file	- Syslog file configuration
set syslog help	- Syslog set help
set system name	- Set System Name
set system contact	- Set System Contact
set system location	- Set System Location
set telnet disable	- Disable Telnet access
set telnet enable	- Enable Telnet access
set timeout	- Set Telnet timeout
set tzone	- Set time zone setting
timeofday	- Display current time of day
version	- Software version

bc shownodes bc showdevices bc sendcfg cloud bc sendcfg subcloud <id> bc imageload cloud bc imageload subcloud <id> bc pagerenable cloud bc pagerenable subcloud <id> bc pagerdisable cloud bc pagerdisable subcloud <id> bc reboot cloud bc reboot subcloud <id> bc setview cloud bc setview subcloud <id> bc setview device <ipaddr> bc include all bc include devices <ipaddr> bc exclude all bc exclude devices <ipaddr> bc changestname <ipaddr> <name> bc help fttransfer params set ... hostname <hostname> username <username> password <password> path <path> filename <remotefile> fttransfer params get fttransfer download image <remotefile> fttransfer download configuration <remotefile> fttransfer restore image fttransfer restore configuration fttransfer upload image current <remotefile> fttransfer upload image backup <remotefile> fttransfer upload configuration current <remotefile> fttransfer upload configuration backup <remotefile> fttransfer help get cims	-Show nodes in cloud -Show devices in cloud -Send cloud configuration -Send sub-cloud -Load image on cloud -Load image on sub-cloud -Set pager on for cloud -Set pager on for sub-cloud -Set pager off for cloud -Set pager off for sub-cloud -Reboot cloud -Reboot sub-cloud -Cloud view -Sub-cloud view -Device view -Include all devices -Include specified devices -Exclude all devices -Exclude specified devices -Change station name -Batch configuration help -Set ftp parameters -Get ftp parameters -Download image file -Download configuration file -Restore previous image -Restore previous configuration -Upload current image -Upload backup image -Upload current configuration -Upload backup configuration -File transfer help -Display Cloud structure	get config get dhcp mode get domainsuffix get fan get gateway get hardware get hostipaddr get ipaddr get ipmask get login get nameaddr get cloudname get subcloudname get stackid get outdoorenviron get radiusname get radiusport get snmp get snmpserver get syslog settings get syslog consoledump get syslog filedump get syslog help get system get telnet get temperature get timeout get tzone get uptime get voltage help ping quit rawftp reboot remotenc add remotenc remove remotenc show run set cloudname set dhcp disable set dhcp enable	- Display Current System Configuration - Display DHCP mode - Display Domain Name Server suffix - Display the fan status - Display Gateway IP Address - Display Hardware Revisions - Display Host IP Address - Display IP Address - Display IP Subnet Mask - Display Login User Name - Display IP address of name server - Display Cloud Name - Display Subcloud Name - Display Stack Id - Display outdoor environment - Display RADIUS server name or IP address - Display RADIUS port number - Display SNMP Community Name - Display SNTP/NTP Server IP address - Get syslog configuration settings - Dump syslog console buffer contents - Dump syslog file contents - Syslog get help - Display System Name - Display Telnet Mode - Display the unit's ambient temperature - Display Telnet Timeout - Display Time Zone Settin - Display UpTime - Display the voltage sources - Display CLI Command List - Ping - Logoff - Software update via FTP - Reboot Access/One - Add remote network server IP address - Remove remote network server IP address - Show remote network server IP address - Run command file -Set cloud name -Disable DHCP -Enable DHCP	set domainsuffix set factorydefault set snmp getcmnty set snmp setcmnty set gateway set hostipaddr set ipaddr set ipmask set login set nameaddress primary set nameaddress secondary set outdoorenviron disable set outdoorenviron enable set pager off set pager on set password set radiusname set radiusport set radiussecret set snmpserver set syslog server set syslog console set syslog file set syslog help set system name set system contact set system location set telnet disable set telnet enable set timeout set tzone timeofday version	-Set Domain Name Server suffix -Restore to default factory settings -Set SNMP community -Get SNMP community -Set Gateway IP address -Set Host IP address -Set IP address -Set IP subnet mask -Modify Login user name -Set primary name server IP address -Set secondary name server IP address -Disable outdoor environment -Enable outdoor environment -Module LED returns to current state - Module LED repeats Red, Green, Orange sequence - Modify Password - Set RADIUS name or IP address - Set RADIUS port number - Set RADIUS shared secret - Set SNTP/NTP Server IP Address - Syslog server configuration - Syslog console configuration - Syslog file configuration - Syslog set help - Set System Name - Set System Contact - Set System Location - Disable Telnet access - Enable Telnet access - Set Telnet timeout - Set time zone setting - Display current time of day - Software version
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Appendix 4: Frequently Asked Questions

NETWORK ELEMENTS

Q- What are the elements that make up the Strix Systems product?

A- Access/One Network is a modular system with several categories of building blocks that perform specific roles within the system. These categories are Client Connect, Network Connect, Wireless Workgroup, and Network Server.

Each of these categories contains a choice of modules which are individually selected and assembled to form a single network element called a Network Node. Each Network Node provides localized connectivity and intelligence with multiple Network Nodes connected in a mesh to form the Access/One Network.

Q- What are all the possible combinations of modules?

A- Due to the modular architecture of Access/One Network, there are a large number of possible combinations of modules. Each Network Node within the Access/One Network is assembled based on the categories defined above.

Each Network Node can be assembled to provide a single or dual RF technology for Client Connection (802.11a or b/g), with wired or wireless Network Connectivity, and with or without a Network Server. Stationary users can also be added to the Access/One Network via the Wireless Workgroup.

There are some basic physical configuration rules for each Network Node as they are being assembled, which are outlined below.

- The Base Module must always be the lowest module within the Node
- When using 802.11a Network Connect, the 802.11a Wireless Module must be placed as the lowest Wireless Module within the Node.
- The 802.11 Antenna Module must be placed above all other modules within the Node (must be the topmost module in the Node).

Q- What are the prohibited combinations?

A- Besides the physical assembly rules defined above, it is prohibited to use more than one radio module of the same type. For example, a WM11Ae may not be used with another WM11Ae module. Also, it is prohibited to use more than three 'active' modules within any single Network Node. An 'active' module is defined as being either a Wireless Module or a Network Server Module. Base Modules and Antenna Modules are not considered 'active.'

PRODUCT ASSEMBLY AND SETUP**Q- Which modules can be used for wireless Network Connect.**

A- Both the WM11A and WM11G Wireless Modules can function as either Network Connect (wireless uplink) or a Client Connect (for user connectivity). The exact function of a WM11A or WM11G Module is determined automatically by the Access/One Network based on needs of the Node. If a 10/100 Ethernet cable is not plugged-in to the Base Module of the Node, one of the Wireless Modules in the Node must function as a Network Connect. If there is more than one Wireless Module in the Node, the bottom (lowest) Module will act as the Network Connect. In a correctly configured Node (as described in the 8-step process above) this Module will be either a WM11A or a WM11G Wireless Module.

Q- How do I setup a wireless Network Connect on a Network Node that does not have an Ethernet cable connection?

A- Nothing. In the absence of an Ethernet cable connection, the Node will automatically configure the lowest Wireless Module to act as a Network Connect during the intra-Node discovery process.

Q- Do I need to power-up the Network Nodes in any particular order to enable the wireless Network Connect function correctly?

A- No. The order in which you power up the Network Nodes is irrelevant to setting up the network. After the Intra-Node discovery process has been completed, the Nodes will start the inter-Node discovery. This process will take several minutes after all the Nodes are powered-up and their LEDs are solid green.

Q- What do I need to do to manage the newly setup Access/One Network?

A- Follow the instructions in this User Guide that start on Page 2, by downloading and installing the Manager/One plug-in. The same section describes in detail how to reconfigure each Node. You will need to use a PC residing on the same subnet as the Access/One Network, and you will have to use Internet Explorer 6.0 with the Manager/One plug-in to do this.

PRODUCT PERFORMANCE**Q- What bandwidth can I expect?**

A- Actual data throughput is approximately one-half the link rate at these ranges for 802.11 technology, which is standard for these types of products.

Q- How many Network Server Modules do I need?

A- A single Network Server is needed for every eight (8) Network Nodes in the Access/One Network, regardless of the RF technology is being used. This rule applies whether the Network Nodes communicate with the Network Server via wired Ethernet or wireless 802.11a. For traffic the Ethernet rule-of-thumb applies: while Each Node can support up to 256 users per RF technology, for optimal throughput target 20 users per RF per Node.

SYSTEM SOFTWARE AND OPERATION**Q- Describe the features in a Network Server.**

A- The main features within the Network Server fall into three categories, discovery, management and security.

The discovery category of features enables the Access/One Network elements to automatically link themselves together enabling secure, reliable performance and allowing IT administrators to install Network Nodes with minimal effort. The discovery category also provides for complete user mobility within the Access/One Network.

There are two types of discovery mechanism within the Access/One Network: infrastructure and user. Infrastructure discovery involves Access/One Network automatic network construction, as well as self-healing. User discovery involves new user authorization and mobility.

The management category of features provides the tools and facilities to monitor, diagnose, configure, meter usage, and extend Access/One Network services so that administration of the wireless network is minimal (occurs automatically), intuitive, flexible and secure. These tools include configuration management, usage metering and SNMP monitoring.

The security category of features protects the customer's internal network resources from unauthorized access through the Access/One Network, providing privacy for wireless communications and mitigating the risk of denial-of-service and other similar attacks.

Q- Describe the “Active Discovery” process and how it works.

A- When a Network Node is turned on in an Access/One Network the individual modules within the Node automatically discover each other and determine their physical position and role within the Node, including whether the interface to the network is wired or wireless.

The Network Node then automatically discovers the rest of the Nodes in the Access/One Network via the wired or wireless Network Connect. The Node automatically associates with one Network Server using an algorithm based on several decision factors. The selected Network Server then provides a list of known network elements across all subnets to the Node, as well as information such as connected devices, wireless channels in use, etc.

In addition to this process, as Network Servers become aware of each other they communicate and synchronize known element tables to provide failure redundancy, while tracking users in order to provide mobility as they move around the network.

Q- How does the Access/One Network prevent bridge loops?

A- The Network Connect function of the Access/One Network contains a proprietary algorithm which prevents the association to Network Nodes which are also known on the Ethernet network. For instance, if a Network Connect was accidentally plugged directly into the host LAN, it would detect that the Network Nodes were also reachable via the same Ethernet LAN and automatically shutdown the wireless uplink connection. This will not prevent traffic from a co-located Network Node from being bridged; rather it would go directly to the Ethernet LAN. Removing the loop will allow the Network Connect to re-establish a wireless connection to the Network Nodes.

SECURITY**Q- What are the security features and the default security settings?**

A- The Access/One Network supports standards-based security features for each radio technology, as defined in the below table:

802.11a	802.11b	802.11g
Encryption • WEP (40/128-bit) • Dynamic WEP • WPA & TKIP* • AES • 802.11i* Authentication • 802.1x	Encryption • WEP (40/128-bit) • Dynamic WEP • WPA & TKIP* • AES • 802.11i* Authentication • 802.1x	Encryption • WEP (40/128-bit) • Dynamic WEP • WPA & TKIP* • AES • 802.11i* Authentication • 802.1x

* Available as a software upgrade in 2H03

These security features provide various options to prevent access to the wireless network by unauthorized devices. In addition, the Access/One Network contains a RADIUS client that can interface with a RADIUS network server for user-level authentication (i.e. by providing a unique username and password). This is an important extra level of security for customers that are concerned that device-level security is not enough.

In addition, Access/One Network provides an additional level of system security that is not present in other wireless networking solutions. When using an 802.11a wireless Network Connect, the wireless link has AES encryption enabled by default. This security does not normally exist, as standard wireless networking equipment does nothing to secure the 10/100 Ethernet connection back to the network.

Q- Where does the RADIUS client reside?

A- There is a RADIUS client within each Access/One Network Wireless Module and the Network Server.

Q- What authorization databases do you support?

A- The Access/One Network system supports the RADIUS authorization database.

SYSTEM MANAGEMENT

Q- Is your system SNMP-manageable? From what platforms?

A- Each Access/One Network Wireless Module and Network Server contains an SNMP Agent that allows them to be managed by any Network Management Platform via standard MIB variables and Strix' private MIB extensions. An example of typical Management Platform is HP OpenView.

Q- Describe the management GUI. What are the statistics that one may gather from the system?

A- The Access/One Network can be configured and monitored via Manager/One™, the system's built-in web server interface, via a standard web browser. Access/One Network can also be managed from a terminal or PC connected via Telnet using the system's Command Line Interface (CLI).

The main Manager/One screen provides a map (via auto-discovery) of all Network Nodes within the Access/One Network. From this screen the IT Manager can define settings such as security on a network-wide, group-level or individual Node basis. This screen will also provide quick glance details of the Nodes such as health status. The IT Manager can also click on any Node and drill-down for element manager-type functionality, such as Node-level configuration and statistics.

The configuration function consists of items such as general and advanced parameters, security and privacy settings, firmware updates, and SNMP configuration. As you would expect, from these screens all of the standard networking and wireless parameters can be defined and set. Examples include SSID, Turbo on/off, DHCP/static IP, Encryption on/off, WEP/TKIP/AES, Encryption key and length, 802.1x enable, and RADIUS setup.

The reported statistics are separated by Network Node versus attached stations. The Network Node statistics reported include total authentication and association attempts, number of packets sent and received, various transmit / receive errors, and CRC errors. The per-station statistics monitored and reported include association state, signal strength, data rate (Mbps), various types of packet errors, authentication type, encryption, number of associations / disassociations / reassociations, and number of packets sent and received.

INSTALLATION CONSIDERATIONS

Q- How do I mount Strix Network Nodes and Network Servers?

A- There are several mounting options for the Access/One Network. The system is designed to be placed on a desktop, an office cubicle or the wall/ceiling. As a desktop or cubicle product, the Access/One Network Node has no specific mounting requirements and it simply rests on the unit's rubber feet. Mounting brackets are available from Strix for the Network Node to be attached to a wall or the ceiling. Note: When used with the wall/ceiling mounting bracket the Node is physically positioned upside down for optimal wireless coverage. Also, the Network Node can be placed above the ceiling tiles, but does require that the unit either be mounted upside down or used with an appropriately positioned external antenna (i.e. ceiling mounted to provide adequate wireless coverage for users below).

Q- Describe your antennas and antenna options, and recommendations for each.

A- There are several different antenna options for the Access/One Network depending on the technology being used. There is one Antenna Module available. This module is designed to support either a single 802.11a or 802.11b/g radio module or both an 802.11a and an 802.11b/g radio module.

For 802.11b/g, either the 802.11b/g Antenna Module can be used or an external antenna can be attached via the external Reverse SMA connectors. Strix provides several external antenna options for use with the Access/One Network. The recommendation is to use the Antenna Module for most applications unless there are specific installation requirements satisfied by an external antenna.

For 802.11a, either the Antenna Module can be used or one of Strix' external antennas can be attached via the external Reverse SMA connectors. Again, the recommendation is to use the Antenna Module for most applications unless there is a requirement satisfied by an external antenna.

Q- What LEDs exist and what do they mean?

A- Each Access/One Network module, with the exception of the Antenna Module, contains a single multi-state LED on the front panel. This LED maintains the following states:

- Not lit – the module has no power
- Solid Green – the module is functioning normally
- Flashing Green – the module is initializing
- Solid Orange – the module is not functioning
- Flashing Orange – the module is functioning but it is overloaded
- Flashing Red/Green/Orange sequence – the module is being 'paged' (located) by the administrator

Q- Can I add new Wireless Modules myself, once the initial Network Node has been installed?

A- Yes. Note the configuration rules defined previously.

Q- Can I readily add another Network Node after the initial system has already been installed?

A- Yes. Should you need to add a Network Node – or Network Server – at any time, you just plug it in, and the Node will configure itself.

Q- Can I add a Network Server to any Network Node?

A- Yes. This is as simple as unplugging the Network Node from the power source, placing the physical Network Server Module within the Node, and reapplying power to the Node.

Q- Can I install a single Network Node or several Network Nodes without a Network Server? If so, what features do I sacrifice?

A- The Access/One Network cannot operate without a Network Server being present somewhere in the network. There must be at least one Network Server in the Access/One Network for it to function.

A single Network Server is needed for every eight (8) Network Nodes in the Access/One Network, regardless of the RF technology is being used. This rule applies whether the Network Nodes communicate with the Network Server via wired Ethernet or wireless 802.11a.

Appendix 5: Security Overview

Wireless network security is challenging for several reasons. First, the problem is very different from the wired network security because the boundaries have changed. In addition, initial attempts at wireless security (e.g., 802.11b) were seriously flawed, but commercially successful. Solutions that hope to capitalize on these markets must compensate for their flaws while remaining compatible. Finally, securing network access and communication poses tradeoffs with network performance and convenience. Security measures must be provided in a way that is flexible so that it works correctly in environments that have varying requirements.

The ability to establish boundaries is essential to realizing reliable network security. With wireless networks the physical boundaries have moved. With a wired LAN, you must be physically connected to the network to send or receive messages on the network. A building's physical security, its walls, ceilings, doors, and alarms play a role in the security of the network by preventing unintended recipients from gaining access to the network.

In a wireless network, any client within the coverage area of an Access Point can receive data transmitted to or from it. Radio waves travel through walls and ceilings, so intruders and eavesdroppers don't have to be in the same room, on the same floor, or even inside the building. So, a secure connection must be forged only with legitimate users over this open communication channel.

Security for a generic Access Point is comprised of two distinct parts: authentication and encryption. Authentication is the process used to verify that the device attempting to attach to an access point has the correct credentials to access the wired network. Encryption protects subsequent data exchanges so that transmissions between the device and the access point cannot be intercepted and deciphered. Data encryption generally does not extend to the wired network unless a Virtual Private Network (VPN) is utilized.

Security Process

Authentication → Association → Remote Authentication → Key Exchange → Network Access
→ Periodic Validation/Key Exchange

AUTHENTICATION

The authentication process begins with one of two local authentication procedures and may optionally include a remote authentication for additional security. A pre-authentication MAC address filter (Access Control List) can be used to prevent devices from authentication attempts, but is difficult to manage scale and MAC address substitution is supported on almost all wireless network interface cards (NICs).

Local authentication choices are **open** or **shared key**. Open system implies that any device may successfully authenticate after exchanging some basic information. Shared key requires that the device know the same static encryption keys as the Access Point. When the AP receives an authentication request from the device, it sends an unencrypted data message as a challenge. The device is required to encrypt the message with the known (shared) key and send it to the Access Point. If the AP is able to correctly decipher the encrypted message, the device is considered to have passed the local authentication process. Since an eavesdropper could intercept both the unencrypted and encrypted message and derive the pseudorandom key stream, this authentication method is considered less secure than open system because an open system with encryption enabled will not perform the key exchange and will deny communication to the devices that don't know the correct key (can't decipher the data).

Remote authentication provides additional network security by allowing credentials-based checks (username/password, certificate, smart card, etc.) to validate a device or user beyond a shared key.

Remote Authentication Protocol

Device $\leftarrow$ EAP $\rightarrow$ Access Point $\leftarrow$ RADIUS (EAP encapsulation) $\rightarrow$ RADIUS or AAA server

The remote authentication process begins after the device has locally authenticated and associated to the AP. The 5 typical EAP types are (in order of growing strength) MD5, LEAP, TLS, TTLS and PEAP. EAP exchange occurs unencrypted but not unprotected and the Access Point should only allow EAP traffic between the device and the network during this process. If remote authentication fails five times, the Access Point disassociates the device to prevent prolonged attacks (the device can associate again later). *Authentications where a username/password is exchanged are more secure because the user and not the device is authenticated (device could be stolen).*

The Access Point translates some information contained in the EAP packet and generates a RADIUS packet (with EAP encapsulation type) to the RADIUS server. Credential information over the wire between the RADIUS server and the AP is protected by the RADIUS secret, which hashes the info in the RADIUS exchange. The RADIUS server must have an entry for client (access point) and device (user) or it will fail the request.

Variations on the EAP theme

MD5: The MD5 protocol is essentially CHAP (RFC 1994) over EAP. When the identification request is made to the user device (supplicant), the user name is sent to the RADIUS server. The RADIUS server sends a challenge to the supplicant, which the supplicant responds to with a one-way hash based on its known password. The server compares the challenge response with its version of a one-way hash based on what it knows as the password. If they are identical, the supplicant has “proved” its identity and is authenticated. The challenge is never the same twice and can occur at any time. Advantages: easy to manage (no certificates), all 802.1x clients support this EAP type, IETF standard. Disadvantages: authentication is only one way (no server authentication - rogue Access Point risk), no dynamic key support, passwords need to be stored reversibly encrypted on the server (hacker could get all of the passwords off the server), vulnerable to dictionary attacks, man-in-middle attacks and session hijacking. Deployment recommendation: use static key encryption to maintain some data security.

LEAP: Lightweight EAP is a Cisco proprietary security method using EAP with a vendor specific tag to authenticate a supplicant as well as an Access Point. The initial authentication process is similar to MD5. Once the supplicant is authenticated, the AP is also authenticated using a similar process, thereby preventing rogue Access Points on the network. Advantages: easy to manage (no certificates), supports dynamic key exchange with session expiration, mutual authentication. Disadvantages: not universally supported by all clients (e.g. Microsoft), reversibly encrypted passwords, vulnerable to dictionary attacks.

TLS: Transport Layer Security (TLS) is based on the same SSL mechanism used to secure web pages and is requires digital client and server certificates. A certificate is issued by a Certificate Authority and typically contains the certificate version, serial number, issuer, public key for the user, expiration date and digital signature. The digital signature is a hash of the above items with the private key known only to the certificate authority. The digital signature is used to authenticate the information in a certificate. The TLS exchange starts with the AP requesting an identity from the device. The device replies with its Network Access Identifier (NAI). The server then sends its certificate to the device for authentication and the device replies with its certificate for authentication. Both server and device derive encryption keys and the server sends a RADIUS ACCEPT to the Access Point, which includes the key necessary to talk to the device (the AP never derives keys). When the AP receives this message, it sends an EAP SUCCESS and opens the port for communication. After the connection is secure, the AP forwards the multicast key to the station. Advantages: supports dynamic key exchange with session expiration, all 802.1x clients support this EAP type, very strong security because of mutual authentication via certificates, IETF standard. Disadvantages: difficult to manage (each device must have a certificate), authenticates a device not a user.

TTLS: Tunneled TLS uses a TLS tunnel to create a secure connection between the device and the AP before user credentials are exchanged. The TLS tunnel is created using a server based certificate only. Once the TLS tunnel exists, the supplicant authenticates with the server with CHAP or MSCHAP. The credentials can even use clear text because the traffic is protected. Advantages: easy to manage (one server certificate, no client certificate), very strong security because of mutual authentication, uses legacy CHAP or most other protocol for client authentication, user is authenticated, not the device. Disadvantages: not industry standard, not universally supported by all clients.

PEAP: Protected EAP is nearly identical in authentication mechanism to TTLS. Advantages: see TTLS, IETF standard (soon). Disadvantages: doesn't support legacy CHAP procedures.

ENCRYPTION

Encryption requires a cipher and a key. The cipher is the algorithm used to modify clear text based on the key. Two ciphers used in the wireless world are Wired Equivalent Privacy (WEP) and Advanced Encryption Standard (AES). The security of the cipher is greatly affected by the size of the key and how often it's changed. A cipher is either stream based or block based, and both fall under the category of Electronic Code Book (ECB) encryption. In general, the clear text is XORed with the key stream to produce the encrypted text. Since it would be extremely easy to crack an encryption key if it were NEVER changed, the concept of a rolling initialization vector (IV) was introduced which combines with the key so the same clear text isn't sent out with the same encryption every time. The size of the IV is relatively small (24 bits) which introduces the issue of reuse and only slightly prolongs the network security. An even more robust method of encryption uses concept of feedback to remember the current encrypted packet as the next key, thus creating a chain of dependent frames referred to as Cipher Block Chaining (CBC).

WEP: WEP is based on the RC4 cipher which has been around for quite some time. It uses a stream cipher with a key length of 64, 128 or 152 bits and a 24 bit IV. Since it doesn't have a feedback mechanism like Counter Block Chaining (CBC), it is not computationally intense.

AES: AES is a standard designed to replace the current DES scheme and is minimally 128 bits. There are two prevailing schemes (of about 20 total) using the AES cipher: Offset Code Book (OCB) and Cipher Block Chaining with Counter Mode (CCM). Both are extremely secure, CCM was chosen as the mandatory scheme for 802.11i.

Static Default Key Operation: The Access Point and the device both maintain a table of four available key slots while using static keys. Each key slot is assigned a number (0-3) and one slot is selected as the default transmit key slot. Every encrypted packet includes the key slot number used to encrypt the data so the receiver can decrypt it. This requires each station and the Access Point to have identical keys configured in identical slots. The default transmit key slot can be different on the device and the AP allowing the use of a different key in each direction of transmission. The static session key has a security risk in that the same key is used for all transmissions, making it more vulnerable to long term attacks. Additional static key security is available with a unique key.

Unique Key: The unique key slot is supported by some NICs and allows a more robust static key operation by assigning a specific key to each device based on the MAC address. The unique key is used to encrypt unicast packets, as the default session key is still necessary for broadcast packets.

SOME ATTACK TYPES

Wireless attacks can be categorized into two types: passive and active. Passive attacks involve sniffing the wireless network to acquire as much information as possible about the network. Active attacks can range from hijacking a session to massive denial of service.

Passive Attack: The passive attacker is looking to crack the encryption key by listening to enough packets and finding repetition in the IV. Since the IV is sent in the clear, and comprises as much as 33% of the cipher, intelligent guesses about the cipher can begin with as little as two or three frames with the same IV. Typically it will take more frames than that, but it is estimated that a 128 bit static WEP key can be cracked in as little as 4 hours on a high traffic network (1-2 million frames per hour). Both AES and WPA have guards to protect for this type of attack.

Active Attack: The active attack is typically concentrated on a particular session created by either a valid user or the attacker. Most often, the attacker will attempt to send a known (unencrypted) packet or message over the Internet to an observable wireless user and can decrypt a single packet. If repeated enough times, the attacker can use the known packet to build the key base and finally crack the key. The attack can also come from the other direction, by intercepting a frame and flipping bits in such a manner so as to fool the standard WEP Integrity Check Value, a known error message will be generated by some upper layer in the network and encrypted by the access point back to the attacker. Denial of service can occur if a rogue device sends disassociation packets to valid devices, or flooding the wireless area with association requests to the AP.

SECURITY DEVICES

The 802.1x security model requires a supplicant (802.1x client on device), RADIUS client (AP), an authenticator (RADIUS server like MS Internet Authentication Service), and a certificate generator (MS Certificate Authority or similar). The authenticator verifies the identity of the supplicant against the user list (MS Active Directory, for instance) located on the same or a remote host. Before the authentication process takes place, the user list must contain the identity and credentials of the device (or user) and can be a simple username and password or a certificate generated by a certificate server. The certificate is typically pre-installed on the supplicant over a wired connection (you can't get a certificate over wireless because you don't have a certificate) and doesn't require maintenance unless there is a security breach or the root certificate is no longer valid.

IEEE 802.11i

The 802.11i standard addresses all of the known weaknesses associated with the WEP cipher and wireless security in general. It mandates the use of 802.1x for remote authentication, and the AES cipher using the CCMP scheme to provide a Robust Security Network (RSN). TKIP is supported as an option under 802.11i.

Wi-Fi AND WPA REQUIREMENTS

WPA is a subset of the 802.11i standard and boosts the original static WEP security by mandating 802.1x remote authentication procedures and the advent of Temporal Key Integrity Protocol (TKIP) which is comprised of the following improvements:

Longer IV: The initialization vector for WEP is 24 bits long and is subject to reuse after a short period. The new IV is 48 bits long, making it less susceptible to reuse.

Per Packet Keying: Each packet is assigned a new key based on a stepping algorithm and encrypted. This prevents passive attacks.

MIC: The message integrity check (MIC) provides two forms of protection for each packet by affixing a sequence number SEQ (OOS will be dropped) and an additional integrity check value (MIC) to prevent bit flipping attacks.

Software Upgradeable: The WPA requirements are such that wireless NICs with WEP should be field upgradeable to realize these benefits.

Glossary

802.11: An IEEE specification that defines wireless LAN (WLAN) data link and physical layers. The specification includes data link layer media access control (MAC) sub-layer, and two sub-layers of the physical (PHY) layer—a frequency-hopping spread-spectrum (FHSS) and a direct-sequence spread-spectrum (DSSS).

802.11a: A supplement to the IEEE 802.11 wireless LAN (WLAN) specification that describes transmission through the physical layer (PHY) based on orthogonal frequency division multiplexing (OFDM), at a frequency of 5 GHz and data rates of up to 54 Mbps.

802.11b: A supplement to the IEEE 802.11 wireless LAN (WLAN) specification that describes transmission through the physical layer (PHY) based on direct-sequence spread-spectrum (DSSS), at a frequency of 2.412 GHz and data rates of up to 11 Mbps.

802.11g: A supplement to the IEEE 802.11 wireless LAN (WLAN) specification that describes transmission through the physical layer (PHY) based on orthogonal frequency division multiplexing (OFDM), at a frequency of 2.412 GHz and data rates of up to 54 Mbps.

802.11i: A supplement to the IEEE 802.11 wireless LAN (WLAN) specification for enhanced security. It describes encryption protocols such as the Temporal Key Integrity Protocol (TKIP) and AES Counter-Mode Cipher Block Chaining Message Authentication Code Protocol (AES-CCMP). These protocols provide replay protection, cryptographically keyed integrity checks, and key derivation based on the IEEE 802.1X port authentication standard.

802.1D: The IEEE LAN specification for remote media access control (MAC) bridging.

802.1Q: The IEEE LAN specification for bridged virtual LANs (VLANs).

802.1X: The IEEE specification for port-based network access control. The 802.1X standard based on the Extensible Authentication Protocol (EAP) provides an authentication framework that supports a variety of methods for authenticating and authorizing network access for wired or wireless users.

802.2: IEEE specification that describes the logical link control (LLC) encapsulation common to all 802 series LANs.

802.3: An IEEE LAN specification for a Carrier Sense Multiple Access with Collision Detection (CSMA-CD) Ethernet network. The standard describes physical media. An 802.3 frame uses source and destination media access control (MAC) addresses to identify its originator and receiver(s).

adaptive routing: A network routing mechanism where the data path from a source to a destination Node depends on the current state of the network. Normally with adaptive routing, routing information stored at each Node changes according to some algorithm that calculates the best paths through the network.

AP: access point. A physical edge device that allows wireless user devices to access network resources. Sometimes it is referred to as a base station or a Node.

ARP: address resolution protocol. A TCP/IP protocol that binds logical (IP) addresses to physical (MAC) addresses.

authentication: The process that a station, device, or user employs to announce its identity to the network which validates it. IEEE 802.11 specifies two forms of authentication: open system and shared key.

authorization: The process of deciding if device 'X' may use network service 'Y'. Trusted devices (the devices that are both authenticated and authorized) are allowed access to network services. Unknown (not trusted) devices may require further user authorization to access network services. This does not principally exclude that the authorization might be given by an application automatically. Authorization always includes authentication.

bandwidth: Specifies the amount of the frequency spectrum that is usable for data transfer. In other words, it identifies the maximum data rate a signal can attain on the medium without encountering significant attenuation (loss of power).

baud rate: The number of pulses of a signal that occur in one second. Thus, baud rate is the speed at which digital signal pulses travel.

bit rate: The transmission rate of binary symbols ('0' and '1'). Bit rate is equal to the total number of bits transmitted in one second.

bridge: A network component that provides internetworking functionality at the data link or medium access layer (Layer 2). Bridges provide segmentation and re-assembly of data frames.

Category 5 (Cat 5): A category of performance for inside Ethernet wiring that defines a cable with eight insulated copper wires. Each pair is twisted around each other to reduce cross talk and electromagnetic induction. Each connection on a twisted pair requires both wires. Cat5 cables are suitable for 10/100BaseT communication.

CHAP: challenge handshake authentication protocol. One of two authentication methods that is part of the point to point protocol – PPP (PAP is the other). CHAP is a method for a device to authenticate itself with a three-way handshake. Authentication information is not sent in the clear. CHAP is defined in RFC 1334.

connectivity: A path for communications signals to flow through. Connectivity exists between a pair of Nodes if the destination Node can correctly receive data from the source Node at a specified minimum data rate.

DES: data encryption standard. A cryptographic algorithm that protects computer data. DES is a National Institute of Standards and Technology (NIST) standard.

DHCP: dynamic host configuration protocol. A method for dynamically assigning IP addresses to devices on a network. Issues IP addresses automatically within a specified range to devices such as PCs when they are first powered up. The device retains the use of the IP address for a specific license period defined by the system administrator.

DSSS: direct sequence spread spectrum. Combines a data signal at the sending station with a higher data rate bit sequence, which many refer to as a chip sequence (also known as processing gain). A high processing gain increases the signal's resistance to interference. The minimum processing gain that the FCC allows is 10, and most products operate under 20.

EAP: extensible authentication protocol. A general point-to-point protocol that supports multiple authentication mechanisms. Defined in RFC 2284, EAP has been adopted by IEEE 802.1X as an encapsulation protocol for carrying authentication messages in a standard message exchange between a user (client or supplicant) and an authenticator.

EAPoL: EAP over LAN. An encapsulated form of the Extensible Authentication Protocol (EAP), defined in the IEEE 802.1X standard, that allows EAP messages to be carried directly by a LAN media access control (MAC) service between a user (client or supplicant) and an authenticator.

EAP-TLS: extensible authentication protocol with transport layer security. Used for 802.1X authentication. EAP-TLS supports mutual authentication and uses digital certificates to address the mutual challenge. The authentication server responds to a user authentication request with a server certificate. The user then replies with its own certificate and validates the server certificate. EAP-TLS algorithm derives session encryption keys from the certificate values. The authentication server in turn sends the session encryption keys for a particular session to the user after validating the user certificate.

encryption: Any procedure used in cryptography to translate data into a form that can be decrypted and read only by its intended receiver.

Ethernet: A LAN architecture that uses CSMA to allow the sharing of a bus-type network. IEEE 802.3 is a standard that defines Ethernet.

Ethernet repeater: Refers to a network element that provides Ethernet connections among multiple other elements sharing a common collision domain. Also referred to as a shared Ethernet hub.

FHSS: frequency-hopping spread-spectrum. One of two types of spread-spectrum radio technology used in wireless LAN (WLAN) transmissions. The FHSS technique modulates the data signal with a narrowband carrier signal that “hops” in a predictable sequence from frequency to frequency as a function of time over a wide band of frequencies. Interference is reduced, because a narrowband interferer affects the spread-spectrum signal only if both are transmitting at the same frequency at the same time. The transmission frequencies are determined by a spreading (hopping) code. The receiver must be set to the same hopping code and must listen to the incoming signal at the proper time and frequency to receive the signal.

FTP: file transfer protocol. A TCP/IP based protocol for file transfer. FTP is defined by RFC 959.

GMK: group master key. A cryptographic key used to derive a group transient key (GTK) for the Temporal Key Integrity Protocol (TKIP) and Advanced Encryption Standard (AES).

GTK: group transient key. A cryptographic key used to encrypt broadcast and multicast packets for transmissions using the Temporal Key Integrity Protocol (TKIP) and Advanced Encryption Standard (AES).

HiperLAN: high-performance radio local area network. A set of wireless LAN (WLAN) communication standards used primarily in European countries and adopted by the European Telecommunications Standards Institute (ETSI).

homologation: the process of certifying a product or specification to verify that it meets regulatory standards.

IAPP: InterAP Protocol. A protocol being developed as the 802.11f version of the IEEE 802.11 wireless LAN (WLAN) specification to support interoperability, mobility, handover, and coordination among Access Points (APs). Implemented on top of IP, IAPP uses UDP/IP and Sub-network Access Protocol (SNAP) as transfer protocols.

IAS: internet authentication service. Microsoft's RADIUS server.

IGMP: internet group management protocol. An Internet protocol defined in RFC 2236 used to report its multicast group membership to neighboring multicast routers.

IV: initialization vector. Random data bytes prepended to a message to make it unique.

IPsec: A Layer 3 authentication and encryption protocol. Used to secure VPNs.

MAC address: media access control address. A 6-byte hexadecimal address assigned by a manufacturer to a device.

master secret: A code derived from the pre-master secret. A master secret is used to encrypt Transport Layer Security (TLS) authentication exchanges and to derive a pair-wise master key (PMK).

MD5: message-digest algorithm 5. A one-way hashing algorithm used in many authentication algorithms to derive cryptographic keys. MD5 takes a message of an arbitrary length and creates a 128-bit message digest.

MS-CHAP: Microsoft challenge handshake authentication protocol. Microsoft's extension to CHAP. MS-CHAP is a mutual authentication protocol that also permits a single login in a Microsoft network environment.

NAT: network address translation. RFC 3022 defines a way to translate global routable IP addresses into local and private non-routable ones.

Odyssey: An 802.1X security and access control application for wireless LANs (WLANs), developed by Funk Software, Inc.

OFDM: orthogonal frequency division multiplexing. A technique that splits a wide frequency band into a number of narrow frequency bands and sends data across the sub-channels. The 802.11a and 802.11g standards are based on OFDM.

open system authentication: The IEEE 802.11 default authentication method. The device sends an authentication management frame containing the sender's identity in the clear to the authenticating device which sends back a clear frame alerting whether it recognizes the identity of the requesting device.

PAN: personal area network. A personal area network is used to interconnect devices used by an individual or in their immediate proximity, including devices they are carrying with them and devices that are simply nearby. According to the IEEE, PANs "shall be capable of supporting segments at least 10 meters in length."

PAP: password authentication protocol. One of two authentication methods that is part of PPP (CHAP is the other). PAP is a method for a device to authenticate itself with a two-way handshake. Note that PAP sends its authentication information in the clear; that is, not encrypted. PAP is defined in RFC 1334.

PCI devices: Devices that adhere to the Peripheral Component Interconnect/Interface.

PEAP: protected extensible authentication protocol. An extension to the Extensible Authentication Protocol with Transport Layer Security (EAP-TLS), developed by Microsoft Corporation. TLS is used in PEAP Part 1 to authenticate the server only, and thus avoids having to distribute user certificates to every client. PEAP Part 2 performs mutual authentication between the EAP client and the server.

PKCS: public-key cryptography standards. A group of specifications produced by RSA and secure systems developers, and first published in 1991. Among many other features and functions, the standards define syntax for digital certificates, certificate signing requests and key exchanges.

PKI: public-key infrastructure. Software that enables users of an insecure public network such as the Internet to exchange information securely and privately. The PKI uses public-key cryptography (also known as asymmetric cryptography) to authenticate the message sender and encrypt the message by means of a pair of cryptographic keys, one public and one private. A trusted certificate authority (CA) creates both keys simultaneously with the same algorithm. A registration authority (RA) must verify the certificate authority before a digital certificate is issued to a requestor. The PKI uses the digital certificate to identify an individual or an organization. The private key is given only to the requesting party and is never shared, and the public key is made publicly available (as part of the digital certificate) in a directory that all parties can access. One uses the private key to decrypt text that has been encrypted with the public key by someone else. The certificates are stored (and, when necessary, revoked) by directory services and managed by a certificate management system.

plenum: A compartment or chamber to which one or more air ducts are connected.

plenum-rated cable: A type of cable approved by an independent test laboratory for installation in ducts, plenums, and other air-handling spaces.

PMK: pair-wise master key. A code derived from a master secret and used as an encryption key for IEEE 802.11 encryption algorithms. A PMK is also used to derive a pair-wise transient key (PTK) for IEEE 802.11i robust security.

PoE: Power over Ethernet. A technology, defined in the IEEE 802.3af standard, to deliver power over the twisted-pair Ethernet data cables rather than power cords.

Point-to-Point Tunneling Protocol (PPTP): A protocol from Microsoft that is used to create a virtual private network (VPN) over the Internet. It uses Microsoft's Point-to-Point Encryption (MPPE), which is based on RSA's RC4. It only uses static keys and should not be used to secure WLANs.

pre-master secret: A key generated during the handshake process in Transport Layer Security (TLS) protocol negotiations and used to derive a master secret.

private key: In cryptography, one of a pair of keys, one public and one private, that are created with the same algorithm for encrypting and decrypting messages and digital signatures. The private key is provided to only the requestor and never shared. The requestor uses the private key to decrypt text that has been encrypted with the public key by someone else. See also public key.

PSK: pre-shared key. The IEEE 802.11 term for a shared secret, also known as a shared key.

PTK: pair-wise transient key. A value derived from a pair-wise master key (PMK) and split into multiple encryption keys and message integrity code (MIC) keys for use by a client and server as temporal session keys for IEEE 802.11i robust security.

public key: In cryptography, one of a pair of keys, one public and one private, that are created with the same algorithm for encrypting and decrypting messages and digital signatures. The public key is made publicly available for encryption and decryption.

RADIUS: remote authentication dial-in user service. A client-server security protocol described in RFC 2865 and RFC 2866. Developed to authenticate, authorize, and account for dial-up users, RADIUS has been widely extended to broadband and enterprise networking. The RADIUS server stores user profiles, which include passwords and authorization attributes.

RC4: Rivest cipher 4. A common encryption algorithm, designed by RSA., used by the Wired-Equivalent Privacy (WEP) protocol and Temporal Key Integrity Protocol (TKIP).

RA: registration authority. Network software that verifies a user (client) request for a digital certificate and instructs the certificate authority (CA) to issue the certificate. Registration authorities are part of a public-key infrastructure (PKI), which enables secure exchanges of information over a network. The digital certificate contains a public key for encrypting and decrypting messages and digital signatures.

roaming: The ability of a user (client) to maintain network access when moving between access points (APs).

rogue AP: An access point (AP) that is not authorized to operate within a wireless network. Rogue APs subvert security of an enterprise network by allowing potentially unchallenged access to the network resources by any wireless user in the physical vicinity.

rogue client: A user who is not recognized within a network, but who gains access to it by intercepting and modifying transmissions to circumvent the normal authorization and authentication processes.

RSN: robust security network. A secure wireless LAN (WLAN) based on the developing IEEE 802.11i standard.

SSH: secure shell. A Telnet-like protocol that establishes an encrypted session.

shared secret: A static key distributed by an out-of-band mechanism to both the sender and receiver. Also known as a shared key or pre-shared key (PSK), a shared secret is used as input to a one-way hash algorithm. When a shared secret is used for authentication and the hash output of both the sender and the receiver match, they share the same secret and are authenticated. A shared secret can also be used to generate encryption key.

spread spectrum: A modulation technique that spreads a signal's power over a wide band of frequencies. The main reason for the technique is that the signal is much less susceptible to electrical noise and interferences than other techniques.

SSID: service set identifier. The unique name shared among all devices in a wireless LAN (WLAN).

station: In IEEE 802.11 networks, any device that contains an IEEE 802.11-compliant media access control and physical layers.

supplicant: A wireless client that is requesting access to a network.

Telnet: A virtual terminal protocol. Enables users to login to a remote host.

TKIP: temporal key integrity protocol. A wireless encryption protocol that fixes the known problems in the Wired-Equivalent Privacy (WEP) protocol for existing 802.11 products. Like WEP, TKIP uses RC4 ciphering, but adds functions such as a 128-bit encryption key, a 48-bit initialization vector, a new message integrity code (MIC), and initialization vector (IV) sequencing rules to provide better protection.

TLS: transport layer security protocol. An authentication and encryption protocol that is the successor to the Secure Sockets Layer (SSL) protocol for private transmission over the Internet. Defined in RFC 2246, TLS provides mutual authentication with non-repudiation, encryption, algorithm negotiation, secure key derivation, and message integrity checking. TLS has been adapted for use in wireless LANs (WLANs) and is used widely in IEEE 802.1X authentication.

TTLS: Tunneled Transport Layer Security (TTLS) sub-protocol. An Extensible Authentication Protocol (EAP) sub-protocol developed by Funk Software, Inc. for 802.1X authentication. TTLS uses a combination of certificate and password challenge and response for authentication. The entire EAP sub-protocol exchange of attribute-value pairs takes place inside an encrypted transport layer security (TLS) tunnel. TTLS supports authentication methods defined by EAP, as well as the older Challenge Handshake Authentication Protocol (CHAP), Password Authentication Protocol (PAP), Microsoft CHAP (MS-CHAP), and MS-CHAPV2. Compare EAP-TLS; PEAP.

twisted-pair wire: Type of medium using metallic type conductors twisted together to provide a path for current flow. The wire in this medium is twisted in pairs to minimize the electromagnetic interference between one pair and another.

UDP: User Data Protocol. A connectionless protocol that works at the OSI transport layer. UDP provides datagram transport but does not acknowledge their receipt.

VLAN: virtual LAN. A group of devices that communicate as a single network, even though they are physically located on different LAN segments. Because VLANs are based on logical rather than physical connections, they are extremely flexible. A device that is moved to another location can remain on the same VLAN without any hardware reconfiguration.

VoIP: voice over IP. The ability of an IP network to carry telephone voice signals as IP packets in compliance with International Telecommunications Union Telecommunication Standardization Sector (ITU-T) specification H.323. VoIP enables a router to transmit telephone calls and faxes over the Internet with no loss in functionality, reliability, or voice quality.

VPN: virtual private network. A virtual private network (VPN) is a way to use a public telecommunication infrastructure, such as the Internet, to provide remote offices or individual users with secure access to their organization's network. A VPN works by using the shared public infrastructure while maintaining privacy through security procedures and tunneling protocols such as the Layer Two Tunneling Protocol (L2TP). In effect, the protocols, by encrypting data at the sending end and decrypting it at the receiving end, send the data through a “tunnel” that cannot be “entered” by data that is not properly encrypted.

WAN: wide area network. A computer network that is geographically dispersed. Commonly, a WAN comprises two or more inter-connected LANs. The Internet is the world's largest WAN. According to the IEEE, WANs “interconnect facilities in different parts of a country or of the world.”

WECA: Wireless Ethernet Compatibility Alliance. See Wi-Fi Alliance.

WEP: wired equivalent privacy. An optional IEEE 802.11 function that offers frame transmission privacy similar to a wired network. The Wired Equivalent Privacy generates secret shared encryption keys that both source and destination stations can use to alter frame bits to avoid disclosure to eavesdroppers.

Wi-Fi Alliance: a nonprofit international association formed in 1999 to certify interoperability of wireless Local Area Network products based on IEEE 802.11 specification. The goal of the Wi-Fi Alliance's members is to enhance the user experience through product interoperability.

wired authentication port: An Ethernet port that has 802.1X authentication enabled for access control.

WPA: Wi-Fi Protected Access. A Wi-Fi Alliance standard that contains a subset of the IEEE 802.11i standard, using TKIP as an encryption method and 802.1X for authentication.

XML: extensible markup language. A simpler and easier-to-use subset of the Standard Generalized Markup Language (SGML), with unlimited, self-defining markup symbols (tags). Developed by the World Wide Web Consortium (W3C), the XML specification provides a flexible way to create common information formats and share both the format and the data on the Internet, intranets, and elsewhere.