

## Nomadic Communications Labs

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### IEEE 802.11b in brief

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### IEEE 802.11b in brief

- The 802.11b standard belong to the family of IEEE 802 standard regarding the Local Area Network (LAN) specifications
- For instance:
  - 802.3 specify Ethernet and CSMA/CD
  - 802.1q specify VLAN
- The published standards are availables at the address:  
<http://standards.ieee.org/getieee802/portfolio.html>

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### IEEE 802.11b in brief : Frequencies

- 802.11b works in ISM (*Industrial, Scientific and Medical*) band at 2.4 GHz
- These frequencies are unlicensed!

Regions	Frequencies
USA	2.4000 – 2.4835 GHz
Europe	2.4000 – 2.4835 GHz
France	2.4465 – 2.4835 GHz
Spain	2.4450 – 2.4750 GHz
Japan	2.4000 – 2.4835 GHz 2.4710 – 2.4970 GHz

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### IEEE 802.11b in brief : Frequencies

- In Europe: 13 Channels
- The following table summarize the usable channels:

Regions	Channels (5MHz)
USA	1 - 11
Europe	1 - 13
Japan	1 - 13 + 14
France	10 - 13
Spain	10 - 11

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### IEEE 802.11b in brief : Frequencies

- The central frequency of each channel is shown in the table
- Central channel frequencies are separated by 5MHz
- A channel bandwidth is 22 MHz
- To avoid interferences, channels in the same area must be 25 MHz apart

3 non-overlapping channels:  
 (USA) 1,6,11  
 (EU) 1,7,13 or 1,6,11 or  
 2,8,13, or ...

Channel	Frequencies
1	2412 MHz
2	2417 MHz
3	2422 MHz
4	2427 MHz
5	2432 MHz
6	2437 MHz
7	2442 MHz
8	2447 MHz
9	2452 MHz
10	2457 MHz
11	2462 MHz
12	2467 MHz
13	2472 MHz

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## IEEE 802.11b in breve: Frequenze



Figure 143—European channel selection—non-overlapping

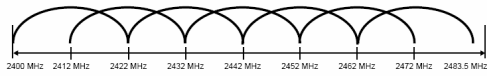


Figure 144—European channel selection—overlapping

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## IEEE 802.11b in brief : Power

- The power which can be irradiated depends by the geographic areas

Maximum Power Permitted	Region
1000 mW	USA
100 mW	Europe
10 mW	Japan

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## IEEE 802.11b in brief : Speed

- The transmission speeds supported by the standard are:
  - 1, 2, 5.5, 11 Mbps
- The speed depends by the distance (channel conditions)
- The following table shows what is declared by Avaya for the its NICs in ideal propagation conditions:

Type of area	11 Mbs	5,5 Mbs	2 Mbs	1 Mbs
Open	160 m	270 m	400 m	550 m
Semi-Open	50 m	70 m	90 m	115 m
Close	25 m	35 m	40 m	50 m

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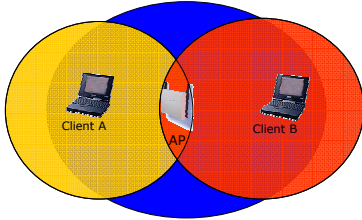
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### IEEE 802.11b in brief: RTS/CTS

- Hidden Node Problem:



- A talk with AP (but not with B)
- B talk with AP (but not with A)

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### IEEE 802.11b in brief: RTS/CTS

- B starts to transmit
- A does not hear B so starts to transmit → **COLLISION**
- To prevent this situation the standard define the mechanism of RTS/CTS:
  - the packets longer than an assigned threshold are transmitted only after a RTS/CTS exchange

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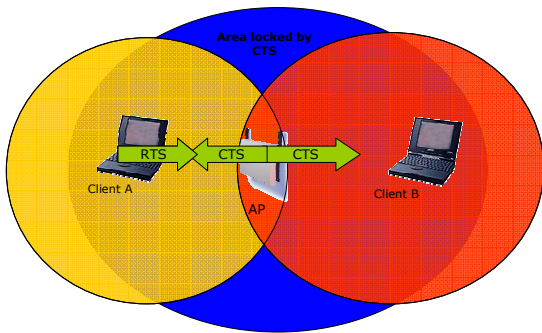
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### IEEE 802.11b in brief: RTS/CTS



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### IEEE 802.11b in brief: WEP

- ❑ 802.11 defines a mechanism to protect the data privacy and authenticate AP/Mobile Stations :  
WEP (Wired Equivalent Privacy)
- ❑ The encryption algorithm is a RC4 (a system of encryption based on a shared key)
- ❑ The shared key is long 40 bits and is concatenated to a long vector of initialization (IV) with a length of 24 bits  
→ key to 64 bits

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### IEEE 802.11b in brief: WEP

- ❑ Evolution from the standard: key of 128 bits, with shared key of 104 bit and IV of 24 bits
- ❑ Have been highlighted weaknesses of WEP and of his implementations (too short key, foreseeable IV).

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### IEEE 802.11b in brief: BSS/ESS

- ❑ One AP and the mobile stations associated to it define a *Basic Service Set* (BSS).
- ❑ Two or more attached BSS form together an *Extended Set Service* (ESS) if they supply the additional services (support for roaming)
- ❑ The *Independent Basic Service Set* (IBSS), is the simplest form → Ad Hoc Network

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### IEEE 802.11b in brief: SSID

- ❑ The SSID (*Service Set IDentity*) is a string identifying the WLAN (32 bytes max)
- ❑ The SSID of length 0 corresponds to a broadcast identity and is used in probing the available nets
- ❑ On many AP you can inhibit the transmission of SSID, so that only who knows the SSID of the WLAN can join it (poor protection indeed! you can configure the card to scan other cards associations)

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### IEEE 802.11b in brief: DTIM

- ❑ **DTIM Period.** The *Delivery Traffic Indicator Map* (DTIM) is used by the client when in power saving mode
- ❑ It is used to specify to the AP how many periods of beacon the client will be in power saving mode and when it will be "awake" and able to find out if there are data directed to the client itself

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Set up of an Access Point  
Avaya Ap3

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## Access Point: Avaya AP3

- ❑ Access Point Avaya AP3
- ❑ Configurable via serial port:
  - Null-Modem cable
  - Baud Rate: 9600
  - Parity: none
  - Data bit: 8
  - Stop bit: 1
  - Flow Control: none
  - Default passwd: public
  - Line feed con Carriage Returns

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## Avaya AP : Boot

```
*****
PowerOn Selftests
*****
Running SDRAM test.....OK
SDRAM Size: 16 Mbyte
CPU id: 4401a104
CPU Frequency: 228.1 MHz
Checking timers....OK
FLASH Manufacturer: Intel (89)
FLASH Device: E28F320J3A(16)
FLASH Size: 8 Mbyte (32 blocks of 256
kbyte each)
Scanning PCI-Bus...

SYSTEM SLOT
*****
Vendor ID: Intel Corporation (1011)
Device ID: 21285 (1065)

SLOT: 1
*****
Vendor ID: National Semiconductor
(100b)
Device ID: DP83815 (0020)

SLOT: 2
*****
Vendor ID: Texas Instruments (104c)
Device ID: PCI1225 (ac1c)

SLOT: 3
*****
EMPTY

***** Selftests OK *****
Executing Original BSP/BootLoader.
Version 2.0.10
Loading image...2641768 + 276792 +
2441816
[Avaya Wireless AP-3]> Please enter
password:
```

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## Avaya AP : Configure via CLI

- ❑ Available commands list : ?
- ❑ For a short command description do not specify any parameter :

```
[Avaya-Wireless-AP-3]> reboot
Command Description:
The reboot command reboots the device in the specified number of
seconds.
```

```
Command Usage:
reboot <number of seconds> <CR>
```

```
Examples:
reboot 0 <CR>
reboot 100 <CR>
```

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## Avaya AP : Configure via CLI

- ❑ List of the parameters available:  
show ?
- ❑ List of the parameters beginning for ip:  
show ip?
- ❑ For the list of the settable parameters (beginning for ip):  
set ip?

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## Avaya AP : Configuration

- ❑ The default IP address of the Avaya AP is 10.0.0.1
- ❑ So it is possible to reach them also via network using a cross cable or a switch/hub and using an IP in the same subnet
- ❑ Together with the software enclosed there it is a tool to find all the AP connected to the network

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## Avaya AP: Assigning the IP Address

- ❑ To assign an IP address to the AP:

```
[Avaya Wireless AP-3]> set ipaddrtype static
[Avaya Wireless AP-3]> set ipaddr 192.168.91.123
[Avaya Wireless AP-3]> set ipgw 192.168.91.1

[Avaya Wireless AP-3]> show network
IP/Network Group Parameters
=====
IP Address      :          192.168.91.123
Subnet Mask     :          255.0.0.0
Default Router  :          192.168.91.1
Default TTL     :              64
Address Type    :          static
```

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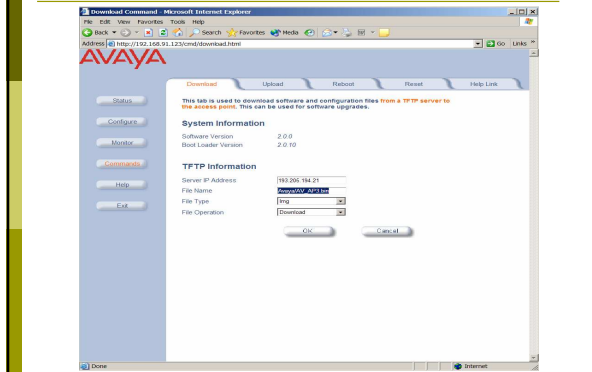
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## Avaya AP: Updating the Firmware



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## Avaya AP: Wireless Interfaces

- In these AP different types of cards can be inserted with different properties:
  - Two maximum lengths for the WEP key are supported (Silver: 64, Gold: 128)
  - Different cards for the various channel sets (ETSI: Canali 1-13, World: Canali 1-11) are available
  - Besides the 802.11b cards there are 802.11a and 802.11b/g cards

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## Avaya AP: Wireless Interfaces

- Besides the net parameters we will have to set up for the wireless interface
  - The channel to use:
    - We can chose the automatic channel option
  - The SSID of the WLAN:
    - We can enable the Closed System option: the AP are not authorized to connect the terminals with the SSID *any*
  - The threshold for the activation of RTS/CTS:
    - Disabled by default

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## Avaya AP: Wireless Interfaces

- Based on the module/model it is possible to define:
  - More than one SSID on the same wireless interfaces
  - The standard adopted
  - The supported speeds
  - The power used
- Other important configurations:
  - Modify the administrator password
  - Set up the WEP key
  - Configure the IP of a syslog or SNMP server
  - Enable a radius server for the MAC address check
  - Enable an 802.1x server

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## Avaya AP: Wireless Interfaces

- For instance using the 802.11b/g radio module, several SSID can be managed on the same AP :
  - Each SSID is associated to a distinct VLAN
  - For each SSID a different security profile can be associated with different parameters for the authentication method, for the accounting radius servers , ...

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## Avaya AP: Wireless Interfaces

The screenshot shows a web-based configuration interface for an Avaya AP. The main area is titled 'Enable Security Per SSID' and contains several configuration options:

- Enable Security Per SSID:
- Accounting Status:  Create
- RADIUS MAC Authentication Status:  Create
- MAC ACL Status:  Create
- Relaying Internal (seconds): 300
- Security Profile:
- RADIUS MAC Authentication Profile: MAC Authentication
- RADIUS EAP Authentication Profile: EAP Authentication
- RADIUS Accounting Profile: Accounting

Buttons for 'OK' and 'CANCEL' are visible below these settings.

Below the main settings is a section titled 'SSID and VLAN Data Table' with 'ADD' and 'EDIT' buttons. It contains a table with the following data:

Index	Network Name (SSID)	VLAN ID	Status
1	VLAN1	1	Enable
2	VLAN2	21	Enable

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Configuration of CISCO AP  
1200 Series

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- ### AP 1200: Features
- With the last firmware (version 12.3(8)JA) the AP supports:
    - Multiple SSID (up to 16), for each one it is possible to choose:
      - If transmitting in broadcast the SSID (guests mode)
      - The method of authentication
      - The maximum number of customers
      - VLAN: a VLAN for each SSID
    - Authentication Methods:
      - MAC Address
      - 802.1x
      - WPA

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- ### AP 1200: Initial Configuration
- Configuration using serial port
    - 9600 baud
    - 8 data bits
    - Parity none
    - stop bit 1
    - flow control no

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## AP 1200: Initial Configuration

### □ "Standard" CISCO commands:

- enable
- Password → Cisco
- configure [terminal]
- ip default-gateway 192.168.10.1
- interface FastEthernet 0
- ip address 192.168.10.40 255.255.255.0
- exit
- Ctrl-z
- copy running-config startup-config
- reload

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## AP 1200: Initial Configuration

### □ To display the initial configuration:

- Enable
- Password: Cisco
- show running-config

### □ The network interface to configure in the current release of the firmware is BVI 1 (not FastEthernet 0 as in the previous versions)

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## AP 1200: WEB Interface

### □ After the first configuration via CLI:

Express Set-Up

Host Name: CISCO1200-NetworkLab  
MAC Address: 0004.2967.cef5

Configuration Server Protocol:  DHCP  Static IP  
IP Address: 192.168.10.40  
IP Subnet Mask: 255.255.255.0  
Default Gateway: 192.168.10.1

SNMP Community: defaultCommunity  
 Read-Only  Read-Write

Radio0-802.11B

Role in Radio Network:  Access Point Root  Repeater Non-Root

Optimize Radio Network for:  Throughput  Range  Custom

Aironet Extensions:  Enable  Disable

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## AP 1200: Firmware Update

- ❑ The Firmware is downloadable from the CISCO WEB Site:
  - <http://tools.cisco.com/support/downloads/go/MDFTree.x?butype=wireless>
  - You have to register at least as guest user
  - The current version is: c1200-k9w7-tar.123-8.JEA1.tar
  - The AP firmware can be updated via tftp or via http

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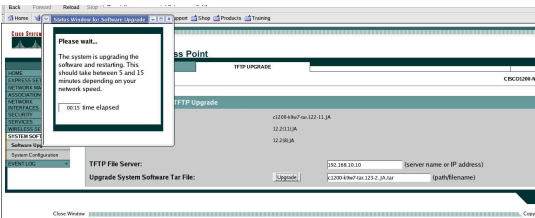
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## AP 1200: Firmware Update

- ❑ Firmware Update via HTTP



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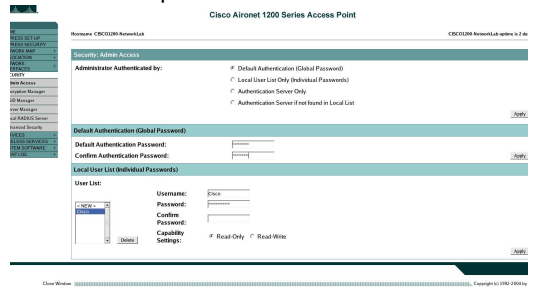
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## AP 1200: Password Administrator

- ❑ We can define more than a user with different capabilities



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## AP 1200: Wireless Configuration

- Role in a Wireless Network:
  - Root or repeater
- Speed:
  - Basic: unicast and multicast traffic, used from the highest to the lowest. At least one must be set up.
  - Enabled: Unicast traffic only
  - Disabled: This speed is not usable
- Power:
  - It is possible to limit the power (in transmission) of the client stations (CISCO extensions)

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## AP 1200: Wireless Configuration

### □ Configuration of the basic parameters

The screenshot shows the 'Radio' configuration page for a Cisco AP 1200. The 'Network Interfaces: Radio802.11B Settings' section is active. Key settings include:
 

- Enable Radio:**  Enable,  Disable
- Current Status (Software/Hardware):** Enabled  Up
- Role in Radio Network:**
  - Access Point Root (Fallback to Radio Island)
  - Access Point Root (Fallback to Radio Standalone)
  - Access Point Root (Fallback to Repeater)
  - Repeater Non-Root
- Data Rates:**
  - 1.0Mbit/sec:  Require,  Enable,  Disable
  - 2.0Mbit/sec:  Require,  Enable,  Disable
  - 5.5Mbit/sec:  Require,  Enable,  Disable
  - 11.0Mbit/sec:  Require,  Enable,  Disable
- Transmitter Power (mW):**  1  5  20  30  50  Max
- Limit Client Power (mW):**  1  5  20  30  50  Max
- Default Radio Channel:**  Last Configured Frequency: Channel 10 (2457 MHz)
- Least Congested Channel Search:**
  - Channel 1 (2412 MHz)
  - Channel 2 (2424 MHz)
  - Channel 3 (2436 MHz)
  - Channel 4 (2448 MHz)
  - Channel 5 (2460 MHz)
  - Channel 6 (2472 MHz)
  - Channel 7 (2484 MHz)
  - Channel 8 (2496 MHz)
  - Channel 9 (2508 MHz)

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## AP 1200: Wireless Configuration

- World Mode:
  - Clients can receive "national" information about setting. Legacy for CISCO compatibility, 802.11d new standards
- Antenna:
  - Diversity: both antennas are used and the one that receives the best signal is chosen
- Encapsulation:
  - To manage the non 802.3 packages, these have to be encapsulated. Interoperability with others: RFC1042; 802.1H optimized for CISCO

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## AP 1200: Wireless Configuration

- RTS:
  - Choose low values if not all of the stations are within sensing range of each other
- Fragmentation:
  - Choose low values if the area is disturbed or with low transmission quality
- CISCO Extension:
  - Used to support special features

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## AP 1200: Wireless Configuration

- Configuration of the basic parameters

The screenshot shows the configuration page for a Cisco AP 1200. Key sections include:

- World Mode:** Multi-Domain Operation (Disable, Legacy, Dual), Country Code (FR).
- Radio Profiles:** Short, Long, Left (Primary), Right (Primary), Left (Secondary), Right (Secondary).
- External Antenna Configuration:** Enable/Disable, Antenna Gain(dB).
- Antennal Extensions:** Enable/Disable.
- Ethernet Encapsulation Transform:** RFC2042, 802.1Q.
- Reliable Multicast to WGB:** Enable/Disable.
- Public Secure Packet Forwarding:** Enable/Disable.
- Beacon Period:** 300 (0-4000 KHz), Data Beacon Rate (DTM): 0 (0-100).
- Min. Data Retries:** 3 (0-320), RTS Max. Retries: 3 (0-128).
- Fragmentation Threshold:** 2345 (0-2345), RTS Threshold: 2345 (0-2345).
- Repeater Parent AP MAC:** 00:55:55:xxxx.
- Repeater Parent AP MAC 1 (optional):** 00:00:00:00:00:00:00:00.
- Repeater Parent AP MAC 2 (optional):** 00:00:00:00:00:00:00:00.
- Repeater Parent AP MAC 3 (optional):** 00:00:00:00:00:00:00:00.
- Repeater Parent AP MAC 4 (optional):** 00:00:00:00:00:00:00:00.

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## AP 1200: Wireless Configuration

- Channel Selection:
  - It is possible to make the AP choose the channel automatically
  - It is possible to set it manually
  - It is possible to do a survey to determine the state of the channels in the area

The screenshot shows the Channel Busy Test (CBT) results for a Cisco AP 1200. The test was performed on channel 36. The results table is as follows:

Channel Busy Test Cycle	Frequency	Channel Busy %
1	2412	0
2	2412	0
3	2412	0
4	2412	0
5	2412	0
6	2412	0
7	2412	0
8	2412	0
9	2412	0
10	2412	0
11	2412	0
12	2412	0
13	2412	0
14	2412	0
15	2412	0
16	2412	0
17	2412	0
18	2412	0
19	2412	0
20	2412	0
21	2412	0
22	2412	0
23	2412	0
24	2412	0
25	2412	0
26	2412	0
27	2412	0
28	2412	0
29	2412	0
30	2412	0
31	2412	0
32	2412	0
33	2412	0
34	2412	0
35	2412	0
36	2412	0
37	2412	0
38	2412	0
39	2412	0
40	2412	0
41	2412	0
42	2412	0
43	2412	0
44	2412	0
45	2412	0
46	2412	0
47	2412	0
48	2412	0
49	2412	0
50	2412	0
51	2412	0
52	2412	0
53	2412	0
54	2412	0
55	2412	0
56	2412	0
57	2412	0
58	2412	0
59	2412	0
60	2412	0
61	2412	0
62	2412	0
63	2412	0
64	2412	0
65	2412	0
66	2412	0
67	2412	0
68	2412	0
69	2412	0
70	2412	0
71	2412	0
72	2412	0
73	2412	0
74	2412	0
75	2412	0
76	2412	0
77	2412	0
78	2412	0
79	2412	0
80	2412	0
81	2412	0
82	2412	0
83	2412	0
84	2412	0
85	2412	0
86	2412	0
87	2412	0
88	2412	0
89	2412	0
90	2412	0
91	2412	0
92	2412	0
93	2412	0
94	2412	0
95	2412	0
96	2412	0
97	2412	0
98	2412	0
99	2412	0
100	2412	0

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## AP 1200: Radius Server

- Basic Configuration:
  - Authentication with client stations MAC address
  - Server IP, ports for authentication and accounting
  - Shared password between radius server and AP

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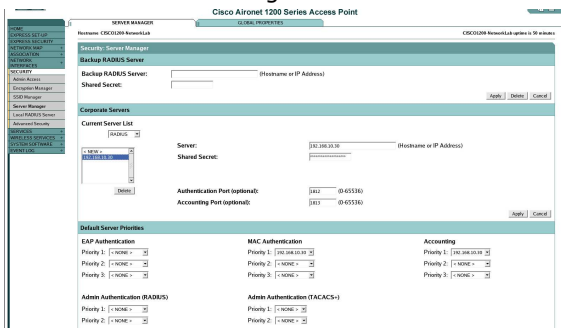
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## AP 1200: Server Radius

- Radius Server Configuration:



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## AP 1200: SSID and Authentication

- SSID:
  - You have to define an SSID. Default "tsunami"
  - Guest SSID: is the SSID advertised
- Authentications:
  - Open: all the devices are allowed to authenticate with the AP
  - Shared: there is an exchange of a message plain or encrypted. Unsafe
  - EAP: the safest mode
- Authentication based on MAC:
  - Open authentication → "With MAC Authentication"

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## AP 1200: Multi SSID and VLAN

- To use more than one SSID:
  - More than one SSID can be declared
  - At most one is announced
  - It is possible to associate each SSID to a different VLAN
  - For each SSID we can define different policy of authentication, accounting, and encryption
  - We can configure a radius server so that it will be the radius to assign the VLAN to the mobile client

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## AP 1200: SSID and Authentication

### □ SSID definition

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## AP 1200: SSID and Authentication

### □ Definition of Cryptography

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## AP 1200: SSID and Authentication

- Example of an SSID/VLAN configuration:

Configuration for Cisco Aironet 1200 Series Access Point:

SSID	VLAN	Open	Shared	Network CAP
CREATE-TEST	4	with MAC		
WLAN-LAB	3	with MAC		
WLAN-LAB-TEST	5	with MAC		

VLAN	Encryption Mode	WEP			Cipher				Key Rotation
		MC	PK	TKIP	WEP128	WEP128H	CKIP	CMC	
3	WEP-Mandatory								
4	None								
5	None								

Server Name/IP Address	Type	EAP	MAC	Proxy Mobile IP	Admin	Accounting
192.168.10.30	RADIUS		<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>

## AP 1200: SSID and Authentication

- Examples of client stations assigned to different VLAN based on SSID

Configuration for Cisco Aironet 1200 Series Access Point:

SSID	Client IP	Repeaters
CREATE-TEST	192.168.10.30	1
WLAN-LAB	192.168.10.30	1
WLAN-LAB-TEST	192.168.10.30	1

## AP 1200: SSID and Authentication

- Client statistics

Client Statistics for Cisco Aironet 1200 Series Access Point:

MAC Address	00:0c:8c:00:00:00	Name	NONE
IP Address	172.16.194.251	Class	unknown
Device	unknown	Software Version	NONE
CCA Version	NONE		
Site	MAC-Associated	Priority	unknown
SSID	WLAN-LAB	VLAN	3
Time To Authentication	1	Completion Queue Instance	Radius-0021100
Client Associated	0	Repeaters Associated	0
Key Mgmt Type	NONE	Encryption	WEP
Capabilities-Mgmt	110	Capability	
Supported Rates (kbps)	1.5, 2.0, 5.5, 11.0	Association M	0
Signal Strength (dBm)	-40	Control Fw (last)	180
Signal Quality (%)	77	Joining Time (s) (last)	44
PowerSave	Off	Last Activity (sec)	11
Total Packets Input	70	Total Packets Output	29
Total Bytes Input	11004	Total Bytes Output	2384
Duplicates Received	0	Maximum Data Retries	0
Beacon Errors	0	Maximum RTS Retries	0
MAC Failure	0		
MAC Missing	0		

## AP 1200: Configuration via CLI

- All the configurations via HTTP are possible via CLI

- show running-config

```
interface Dot11Radio0
no ip address
no ip route-cache
!
encryption vlan 3 key 1 size 128bit 7 501B2057424875554B78965D207B
transmit-key
encryption vlan 3 mode wep mandatory
!
ssid CREATE-NET-TEST
  vlan 4
  authentication open mac-address mac_methods
  accounting acct_methods
  mobility Network-id 4
  information-element ssid advertisement
!
ssid WIMA-LAB
  vlan 3
  authentication open mac-address mac_methods
  accounting acct_methods
  mobility Network-id 3
  information-element ssid advertisement
!
ssid WIMA-LAB-TEST
  vlan 5
  authentication open mac-address mac_methods
  accounting acct_methods
  guest-mode
  mobility Network-id 5
```

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## AP 1200: Multi SSID and VLAN

- Other relevant configuration:

- Syslog
- SNMP
- QoS

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