Configuring Transmit Power on Wireless Routers

Radio cell size is controlled by the transmitted power level of the wireless device and controls interference between cells. The maximum transmit power is limited according to regulatory region.

An improper combination of transmit power level and antenna gain can result in equivalent isotropic radiated power (EIRP) that exceeds the amount allowed per regulatory domain.

In some situations, the channel selection or country code affects the transmit power level. See the "Radio Channels and Transmit Frequencies" document for additional information.

For general information on power values, see RF Power Values (Document ID 23231) at:

http://www.cisco.com/en/US/tech/tk722/tk809/technologies_tech_note09186a00800e90fe.shtml

For general information on channel selection and transmit power, see the FCC Regulations Update For 2004 white paper at:

http://www.cisco.com/en/US/products/hw/wireless/ps4555/products_white_paper0900aecd801c4a88.shtml

Configuring Radio Transmit Power

To set the transmit power on the wireless device radio to one of the power levels allowed in your regulatory domain, use the **power local** interface command.

For all 802.11b 2.4 GHz radios, the settings are in mW:
power local [1 | 5 | 20 | 30 | 50 | 100 | maximum]

For 802.11g, 2.4 GHz radios where the settings are in mW:
power local {cck | ofdm} [1 | 5 | 20 | 30 | 50 | 100 | maximum]

For the 802.11g, 2.4 GHz radio where the settings are in dBm:
power local {cck | ofdm} [1 | 2 | 5 | 8 | 11 | 14 | 16 | 17 | 20 | maximum]

For 802.11a, 5 GHz radios or 4.9 GHz radios where the settings are in mW:
power local {cck | ofdm} [5 | 10 | 20 | 40 | maximum]

The maximum power level for a 4.9 GHz (US Only, Public Safety) radio is 40 mW.

For 802.11a, 5 GHz radio where the settings are in dBm:
power local {cck | ofdm} [1 | 2 | 5 | 8 | 11 | 14 | 16 | 17 | maximum]

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Complementary Code Keying (CCK) is supported by 802.11b and 802.11g devices. Orthogonal Frequency Division Multiplexing (OFDM) is supported by 802.11g and 802.11a devices.

Note The structure of this command is determined by the radio in the wireless device and the settings allowed in your regulatory domain. To display the options for your wireless infrastructure device running your image, use the **power local ?** command in privileged EXEC mode.

Use the **no** form of the power command to return the power setting to **maximum**, the default setting.

Determine the Radio Type

Determine the radio type to establish the frequency range and power setting of the radio. Use the **show controllers dot11Radio** command to show the radio type, frequency, and current channel for the wireless device. For example:

```
WD>enable
WD>password                                ! If prompted
WD#show controllers dot11Radio 0
interface Dot11Radio0
!
Radio AIR-AP1242GA, Base Address 0014.1b58.08f  ! AIR-AP1242GA radio type shown
Version 5.80.12
Serial number: GAM09200992
Number of supported simultaneous BSSID on Dot1
Carrier Set: Americas (US)                 ! Domain
DFS Required: No                           ! DFS requirement
!
Current Frequency: 2412 MHz Channel 1      ! Frequency
```

Configuring Client Radio Transmit Power

The transmit power level of Cisco clients can be controlled by a Cisco wireless infrastructure device. The client software chooses the actual transmit power level, choosing between the lower of the access point value and the locally configured value.

To set the transmit power on your wireless device radio, use the **power client** command.

For all 802.11b 2.4 GHz radios, the settings are in mW:
power client [1 | 5 | 20 | 30 | 50 | 100 | maximum]

For 802.11g, 2.4 GHz radios where the settings are in mW:
power client [1 | 5 | 20 | 30 | 50 | 100 | maximum]

For the 802.11g, 2.4 GHz radio where the settings are in dBm:
power client [1 | 2 | 5 | 8 | 11 | 14 | 16 | 17 | 20 | maximum]

For 802.11a, 5 GHz radios where the settings are in mW:
power client [5 | 10 | 20 | 40 | maximum]

For 802.11a, 5 GHz radio where the settings are in dBm:
power client [1 | 2 | 5 | 8 | 11 | 14 | 16 | 17 | maximum]

Sets the maximum power level allowed on client devices that associate to the wireless device.

Use the **no** form of the command to return the power setting to **maximum**, the default setting.

Table 1   mW DBm Power Conversion Table

mW	1	2	3	4	5	6	8	10	12	15	20	25	30	40	50	60	80	100
DBm	-1	2	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Note   Aironet extensions must be enabled to limit the power level on associated client devices. Aironet extensions are enabled by default.

Maximum Power Levels and Antenna Gains

IEEE 802.11g (2.4 GHz Band)

Table 2 indicates the maximum power levels and antenna gains allowed for the 2.4 GHz radios in most regulatory domains. We recommend that you check your local regulations with the appropriate agencies.

Table 2   Maximum Power Levels Per Antenna Gain for IEEE 802.11g

Regulatory Domain	Antenna Gain (dBi)	Maximum Power Level (mW)	
		CCK	OFDM
Americas (–A) (4 W EIRP maximum)	2.2	100	30
	6	100	30
	6.5	100	30
	10	100	30
	13.5	100	30
	15	50	20
	21	20	10
EMEA (–E) and Israel(-I) (100 mW EIRP maximum)	2.2	50	30
	6	30	10
	6.5	20	10
	10	10	5
	13.5	5	5
	15	5	1
	21	1	—

Table 2   *Maximum Power Levels Per Antenna Gain for IEEE 802.11g (continued)*

Regulatory Domain	Antenna Gain (dBi)	Maximum Power Level (mW)	
		CCK	OFDM
Japan (-J) (10 mW/MHz EIRP maximum)	2.2	5	5
	6	5	5
	6.5	5	5
	10	5	5
	13.5	5	5
	15	5	5
	21	5	5

Configuring Radio Data Rates

Client devices are *required* to support at least one **basic** data rate or they are not be allowed to associate with the wireless device. For example, if the speed of the wireless device is set to basic-1.0, the client must support a 1.0 Mbps transmission rate or it will not be allowed to associate with the wireless device. If the speed of the wireless device is set to basic-1.0 and basic-6.0, the client must support a 1.0 Mbps or a 6.0 Mbps transmission rate or it will not be allowed to associate with the wireless device.

The wireless device always attempts to begin data transmission at the highest basic data rate. For example, if the client device supports both t a 1.0 Mbps and a 6.0 Mbps transmission rate, both of the devices use the higher 6.0 Mbps transmission rate.

Client devices are *allowed* to transmit at other data rates, depending on the configuration. If the client device supports the basic data rate and due to environmental conditions, the wireless and client devices can transmit at a higher data rate, the devices will transmit unicast packets at the highest allowed data rate; multicast packets are always sent at the highest basic data rate.

If, due to environmental factors such as obstacles or interference, the wireless device cannot transmit data at the highest basic data rate, the wireless device steps the speed down to the highest rate that allows it to transmit data.

The wireless device can be configured to automatically transmit at the data rate that optimizes either the range of the transmission or the throughput of the data. Use the **range** keyword to optimize the wireless device for the best range. The wireless device sets the basic rate to **basic-1.0** and all other rates are allowed. Use the **throughput** keyword to optimize the wireless device for maximum data throughput. The wireless device sets all data rates to **basic**.

speed Command

To manage the data rates on wireless devices, use the **speed** *datarate* interface command.

Table 3 shows the data rate settings for the **speed** command.

Table 3   Data Rates for speed Command Keywords

Keyword	2.4 GHz 802.11b Radio	2.4 GHz 802.11g Radio	4.9 GHz at 5 MHz	4.9 GHz at 10 MHz	4.9 GHz at 20 MHz
rate	basic-1.0, basic-2.0, basic-5.0, basic-11.0, 1.0, 2.0, 5.0, 11.0	basic-1.0, basic-2.0, basic-5.0, basic-11.0, basic-12.0, basic-18.0, basic-24.0, basic-36.0, basic-48.0, basic-54.0, 1.0, 2.0, 5.0, 11.0, 12.0, 18.0, 24.0, 36.0, 48.0, 54.0	basic-1.5, basic-2.25, basic-3.0, basic-4.5, basic-9.0, basic-12.0, basic-13.5, 1.5, 2.25, 3.0, 4.5, 9.0, 12.0, 13.5	basic-3.0, basic-4.5, basic-6.0, basic-9.0, basic-12.0, basic-18.0, basic-24.0, basic-27.0, 3.0, 4.5, 6.0, 9.0, 12.0, 18.0, 24.0, 27.0	basic-6.0, basic-9.0, basic-12.0, basic-18.0, basic-24.0, basic-36.0, basic-48.0, basic-54.0, 6.0, 9.0, 12.0, 18.0, 24.0, 36.0, 48.0, 54.0
default	The default keyword is not supported on 802.11b radios.	basic-1.0, basic-2.0, basic-5.5, basic-11.0, 6.0, 9.0, 12.0, 18.0, 24.0, 36.0, 48.0, 54.0	basic-1.5, 2.25, basic-3.0, 4.5, basic-6.0, 9.0, 12.0, 13.5	basic-3.0, 4.5, basic-6.0, 9.0, basic-12.0, 18.0, 24.0, 27.0	basic-6.0, 9.0, basic-12.0, 18.0, basic-24.0, 36.0, 48.0, 54.0
range	basic-1.0, 2.0, 5.0, 11.0	basic-1.0, 2.0, 5.0, 11.0, 12.0, 18.0, 24.0, 36.0, 48.0, 54.0	basic-1.5, 2.25, 3.0, 4.5, 6.0, 9.0, 12.0, 13.5	basic-3.0, 4.5, 6.0, 9.0, 12.0, 18.0, 24.0, 27.0	basic-6.0, 9.0, 12.0, 18.0, 24.0, 36.0, 48.0, 54.0
no speed	basic-1.0, 2.0, 5.0, 11.0	basic-1.0, 2.0, 5.0, 11.0, 12.0, 18.0, 24.0, 36.0, 48.0, 54.0	1.5, 2.25, 3.0, 4.5, 6.0, 9.0, 12.0, 13.5	3.0, 4.5, 6.0, 9.0, 12.0, 18.0, 24.0, 27.0	6.0, 9.0, 12.0, 18.0, 24.0, 36.0, 48.0, 54.0

Table 3   Data Rates for speed Command Keywords

Keyword	2.4 GHz 802.11b Radio	2.4 GHz 802.11g Radio	4.9 GHz at 5 MHz	4.9 GHz at 10 MHz	4.9 GHz at 20 MHz
throughput	basic-1.0, basic-2.0, basic-5.0, basic-11.0	basic-1.0, basic-2.0, basic-5.0, basic-11.0, basic-12.0, basic-18.0, basic-24.0, basic-36.0, basic-48.0, basic-54.0	basic-1.5, basic-2.25, basic-3.0, basic-4.5, basic-6.0, basic-9.0, basic-12.0, basic-13.5	basic-3.0, basic-4.5, basic-6.0, basic-9.0, basic-12.0, basic-18.0, basic-24.0, basic-27.0	basic-6.0, basic-9.0, basic-12.0, basic-18.0, basic-24.0, basic-36.0, basic-48.0, basic-54.0
throughput ofdm		[1]Sets OFDM rates to basic-6.0, basic-9.0, basic-12.0, basic-18.0, basic-24.0, basic-36.0 and disables CCK data rates 1.0, 2.0, 5.5, 11.0.			

1. Disables 802.11b protection mechanisms, prevents 802.11b clients from associating to the wireless device, and maximizes throughput for 802.11g clients.

speed Command Examples

This example sets a 5 GHz radio for **basic-6.0** and **basic-9.0** service only. Client devices must support **basic-6.0** and **basic-9.0** service or they will not be able to associate.

```
WD# configure terminal
WD(config)# interface dot11radio 1
WD(config-if)# speed basic-6.0 basic-9.0
WD(config-if)# end
```

This example sets a 2.4 GHz radio for **basic-1.0** service and allows all other data rates by using the **no** form of the command. Multicast packets are transmitted at 1 Mbps. Unicast packets are transmitted at the highest allowed data rate. Client devices must support **basic-1.0** service or they will not be able to associate.

```
WD# configure terminal
WD(config)# interface dot11radio 1
WD(config-if)# no speed
WD(config-if)# end
```

This example sets a 2.4 GHz radio to serve only 802.11g client devices by using the Orthogonal frequency division multiplexing (OFDM) keyword **throughput ofdm**.

```
WD# configure terminal
WD(config)# interface dot11radio 0
WD(config-if)# speed throughput ofdm
WD(config-if)# end
```

Verify Settings

Use the **show controller dot11radio** command to display the data rates for the **speed** command and the **default** keyword.

With the speed command set to the default value for a 2.4 GHz, 802.11g radio, the **show controller dot11radio** command displays the following:

```
WD# show controller dot11Radio0
interface Dot11Radio0
Radio ATHEROS AR5212, Address 000e.9bb0.7360, BBlock version
0.01, Software version 3.00.0 Serial number: FOC05120075
Carrier Set: Americas (US) Current Frequency: 2432 Mhz
Channel 5 Allowed Frequencies: 2412(1) 2417(2) 2422(3) 2427(4) 2432(5) 2437(6) 2442(7)
2447(8) 2452(9) 2457(10)
2462(11) Current CCK Power: 20 dBm Allowed CCK Power Levels: 7 10 13 15 17 20 Current OFDM
Power: 17 dBm Allowed OFDM
Power Levels: 7 10 13 15 17 ERP settings: protection mechanisms, non-ERP present.
Neighbors in non-erp mode:
0040.96a2.7d70 0013.5f0c.2961 000c.8548.d9b9 0007.50ca.6885
000e.9b91.cb82 0013.5f0c.2960 0013.5f0c.2962 000d.9701.212b
000e.9ba1.cba4 0014.a40b.b4f0
Current Rates:  basic-1.0 basic-2.0 basic-5.5 6.0 9.0 basic-11.0 12.0 18.0 24.0 36.0 48.0
54.0
Allowed Rates:  1.0 2.0 5.5 6.0 9.0 11.0 12.0 18.0 24.0 36.0 48.0 54.0
Best Range Rates:  basic-1.0 2.0 5.5 6.0 9.0 11.0 12.0 18.0 24.0 36.0 48.0 54.0
Best Throughput Rates: basic-1.0 basic-2.0 basic-5.5 basic-6.0 basic-9.0 basic-11.0
basic-12.0 basic-18.0 basic-24.0 basic-36.0 basic-48.0 basic-54.0
```

With the **no speed** command set on a 2.4 GHz, 802.11g radio,

```
WD# configure terminal
WD(config)# interface dot11 0
WD(config-if)# no speed
WD(config-if)# end
```

the **show controller dot11radio** command displays the following:

```
WD# show controller dot11Radio 0
interface Dot11Radio0
Radio ATHEROS AR5212, Address 000e.9bb0.7360, BBlock version
0.01, Software version 3.00.0 Serial number: FOC05120075
Carrier Set: Americas (US) Current Frequency: 2432 Mhz
Channel 5 Allowed Frequencies: 2412(1) 2417(2) 2422(3)
2427(4) 2432(5) 2437(6) 2442(7) 2447(8) 2452(9) 2457(10)
2462(11) Current CCK Power: 20 dBm Allowed CCK Power Levels:
7 10 13 15 17 20 Current OFDM Power: 17 dBm Allowed OFDM
Power Levels: 7 10 13 15 17 ERP settings: protection
mechanisms, non-ERP present.
Neighbors in non-erp mode:
000e.9b91.cb82 000e.9ba1.cba4 0040.96a2.7d70 000d.9701.212b
0014.a40b.b4f0
Current Rates:  basic-1.0 2.0 5.5 6.0 9.0 11.0 12.0 18.0 24.0 36.0 48.0 54.0
Allowed Rates:  1.0 2.0 5.5 6.0 9.0 11.0 12.0 18.0 24.0 36.0 48.0 54.0
Best Range Rates: basic-1.0 2.0 5.5 6.0 9.0 11.0 12.0 18.0 24.0 36.0 48.0 54.0
Best Throughput Rates:  basic-1.0 basic-2.0 basic-5.5 basic-6.0 basic-9.0 basic-11.0
basic-12.0 basic-18.0 basic-24.0 basic-36.0 basic-48.0 basic-54.0
Default Rates: basic-1.0 basic-2.0 basic-5.5 6.0 9.0 basic-11.0 12.0 18.0 24.0 36.0 48.0
54.0
```