Influence of channel (frequency) in wireless quality

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Introduction

This document describes simple tests made with a wireless access point and a client host to check the influence of channel on signal quality.

Without changing place, I will try different channels used by the AP (access point) for emetting, and compare the resulting link quality, in terms of dBm decrease.

The assumption is that the lower the channel is, better the communication is between the client and AP.

Technical specifications

The client device is an Asus EEEPC 1005HA with Ubuntu Linux Netbook edition 10.04 Lucid Lynx. Its name is 'handel'.

- lspci

00:00.0 Host bridge: Intel Corporation Mobile 945GME Express Memory Controller Hub (rev 03)
00:02.0 VGA compatible controller: Intel Corporation Mobile 945GME Express Integrated Graphics Controller (rev 03)
00:02.1 Display controller: Intel Corporation Mobile 945GM/GMS/GME, 943/940GML Express Integrated Graphics Controller (rev 03)
00:1b.0 Audio device: Intel Corporation N10/ICH 7 Family High Definition Audio Controller (rev 02)
00:1c.0 PCI bridge: Intel Corporation N10/ICH 7 Family PCI Express Port 1 (rev 02)
00:1c.1 PCI bridge: Intel Corporation N10/ICH 7 Family PCI Express Port 2 (rev 02)
00:1c.3 PCI bridge: Intel Corporation N10/ICH 7 Family PCI Express Port 4 (rev 02)
00:1d.0 USB Controller: Intel Corporation N10/ICH7 Family USB UHCI Controller #1 (rev 02)
00:1d.1 USB Controller: Intel Corporation N10/ICH 7 Family USB UHCI Controller #2 (rev 02)
00:1d.2 USB Controller: Intel Corporation N10/ICH 7 Family USB UHCI Controller #3 (rev 02)
00:1d.3 USB Controller: Intel Corporation N10/ICH 7 Family USB UHCI Controller #4 (rev 02)
00:1d.7 USB Controller: Intel Corporation N10/ICH 7 Family USB2 EHCI Controller (rev 02)
00:1e.0 PCI bridge: Intel Corporation 82801 Mobile PCI Bridge (rev e2)
00:1f.0 ISA bridge: Intel Corporation 82801GBM (ICH7-M) LPC Interface Bridge (rev 02)
00:1f.2 SATA controller: Intel Corporation 82801GBM/GHM (ICH7 Family) SATA AHCI Controller (rev 02)
01:00.0 Ethernet controller: Atheros Communications Atheros AR8132 / L1c Gigabit Ethernet Adapter (rev c0)
02:00.0 Network controller: Atheros Communications Inc. AR9285 Wireless Network Adapter (PCI-Express) (rev 01)

- uname -a

Linux handel 2.6.32-22-386 #33-Ubuntu SMP Wed Apr 28 16:27:37 UTC 2010 i686 GNU/Linux

The Atheros client wireless card is drived by the 'ath9k' Linux module, and is saw by the OS as

WLAN0 device.

- modinfo ath9k

```
filename:       /lib/modules/2.6.32-22-386/kernel/drivers/net/wireless/ath/ath9k/ath9k.ko
license:        Dual BSD/GPL
description:    Support for Atheros 802.11n wireless LAN cards.
author:         Atheros Communications
srcversion:     6113BBF78E3F6164BF04C92
alias:          pci:v0000168Cd0000002Esv*sd*bc*sc*i*
alias:          pci:v0000168Cd0000002Dsv*sd*bc*sc*i*
alias:          pci:v0000168Cd0000002Bsv*sd*bc*sc*i*
alias:          pci:v0000168Cd0000002Asv*sd*bc*sc*i*
alias:          pci:v0000168Cd00000029sv*sd*bc*sc*i*
alias:          pci:v0000168Cd00000027sv*sd*bc*sc*i*
alias:          pci:v0000168Cd00000024sv*sd*bc*sc*i*
alias:          pci:v0000168Cd00000023sv*sd*bc*sc*i*
depends:        mac80211,led-class,ath,cfg80211
vermagic:       2.6.32-22-386 SMP mod_unload modversions 486
parm:           debug:uint
parm:           nohwcrypt:Disable hardware encryption (int)
```

Wireless configuration

The AP is configured to broadcast on a specific SSID – djtonio.fr, protected with WPA2 – TKIP/AES encryption. The client is configured with the correct pre-shared key. Technically, it is a Netgear wireless access point (CVG834G), rented by www.numericable.lu.

On Ubuntu desktops, the 'NetworkManager' daemon handles wireless connections, so will automatically change used channel and reconnect to the AP when changing it.

Test protocol

The tests will be done as following :
- at first, we'll get values from the default AP configuration to get a reference power value,
- we'll then switch to the lower possible value for channel,
- switch to the higher possible value
- go back to the reference value.

Each time, we will go on the AP configuration screen (using a web browser), just change the wireless network channel, and wait for the network manager to get back to connection.

Once the connection is made, we wait 1 minute for it to be stable.

Note : when getting the reference values – with default AP channel 6, there were other networks from other AP on the same channel.
I suppose someone could says packet collisions may occur and decrease the TX power, but is it meaningful ???
Fortunately, when testing lowest and highest channels, nobody else was on the same channel.

The 'iwconfig' command will be used to get the current link quality, with the 'date' command to have the precise timestamp, with a 10 seconds pause :

$ while true; do date; iwconfig wlan0 | grep Freq; iwconfig wlan0 | grep Bit; iwconfig wlan0 | grep Link; sleep 10; done

This ensure :
– a 10 seconds pause between data collect,
– the bandwitdh is 54 Mbits

Area specifications

Theses tests are done while the client (netbook) is set on a stable table, 90 cms high, the AP is directly on the floor. There is about 5 meters between both, and 2 appartment walls are between them.

The local temperature is 20.5°C, and humidity 39%.

There were not other source of radio emission (cell phone, running micro-wave, etc...) during theses tests.

Demonstration

Reference value - channel 6

We set the AP to listen on channel 6 – 2437 MHz.

mardi 4 mai 2010, 22:08:06 (UTC+0200)
  Mode:Managed Frequency:2.437 GHz Access Point: 00:1E:8C:4C:41:E6
  Bit Rate=54 Mb/s   Tx-Power=20 dBm
  Link Quality=36/70 Signal level=-74 dBm
mardi 4 mai 2010, 22:08:16 (UTC+0200)
  Mode:Managed Frequency:2.437 GHz Access Point: 00:1E:8C:4C:41:E6
  Bit Rate=54 Mb/s   Tx-Power=20 dBm
  Link Quality=37/70 Signal level=-73 dBm
mardi 4 mai 2010, 22:08:26 (UTC+0200)
  Mode:Managed Frequency:2.437 GHz Access Point: 00:1E:8C:4C:41:E6
  Bit Rate=54 Mb/s   Tx-Power=20 dBm
  Link Quality=36/70 Signal level=-74 dBm
mardi 4 mai 2010, 22:08:36 (UTC+0200)
  Mode:Managed Frequency:2.437 GHz Access Point: 00:1E:8C:4C:41:E6
  Bit Rate=54 Mb/s   Tx-Power=20 dBm
  Link Quality=35/70 Signal level=-75 dBm
mardi 4 mai 2010, 22:08:46 (UTC+0200)
  Mode:Managed Frequency:2.437 GHz Access Point: 00:1E:8C:4C:41:E6
  Bit Rate=54 Mb/s   Tx-Power=20 dBm
  Link Quality=36/70 Signal level=-74 dBm

Lowest frequency – channel 1

We set the AP to channel 1, and wait 1 minute for the client to reconnect.

mardi 4 mai 2010, 22:10:22 (UTC+0200)
          Mode:Managed Frequency:2.412 GHz Access Point: 00:1E:8C:4C:41:E6
          Bit Rate=54 Mb/s   Tx-Power=20 dBm
          Link Quality=36/70 Signal level=-74 dBm
mardi 4 mai 2010, 22:10:32 (UTC+0200)
          Mode:Managed Frequency:2.412 GHz Access Point: 00:1E:8C:4C:41:E6
          Bit Rate=54 Mb/s   Tx-Power=20 dBm
          Link Quality=36/70 Signal level=-74 dBm
mardi 4 mai 2010, 22:10:42 (UTC+0200)
          Mode:Managed Frequency:2.412 GHz Access Point: 00:1E:8C:4C:41:E6
          Bit Rate=54 Mb/s   Tx-Power=20 dBm
          Link Quality=36/70 Signal level=-74 dBm
mardi 4 mai 2010, 22:10:52 (UTC+0200)
          Mode:Managed Frequency:2.412 GHz Access Point: 00:1E:8C:4C:41:E6
          Bit Rate=54 Mb/s   Tx-Power=20 dBm
          Link Quality=35/70 Signal level=-75 dBm
mardi 4 mai 2010, 22:11:02 (UTC+0200)
          Mode:Managed Frequency:2.412 GHz Access Point: 00:1E:8C:4C:41:E6
          Bit Rate=54 Mb/s   Tx-Power=20 dBm
          Link Quality=35/70 Signal level=-75 dBm

Highest frequency – channel 14

We set the AP to channel 14, and wait for client to reconnect.
mardi 4 mai 2010, 22:19:02 (UTC+0200)
          Mode:Managed Frequency:2.484 GHz Access Point: 00:1E:8C:4C:41:E6
          Bit Rate=54 Mb/s   Tx-Power=20 dBm
          Link Quality=32/70 Signal level=-78 dBm
mardi 4 mai 2010, 22:19:12 (UTC+0200)
          Mode:Managed Frequency:2.484 GHz Access Point: 00:1E:8C:4C:41:E6
          Bit Rate=54 Mb/s   Tx-Power=20 dBm
          Link Quality=33/70 Signal level=-77 dBm
mardi 4 mai 2010, 22:19:22 (UTC+0200)
          Mode:Managed Frequency:2.484 GHz Access Point: 00:1E:8C:4C:41:E6
          Bit Rate=54 Mb/s   Tx-Power=20 dBm
          Link Quality=33/70 Signal level=-77 dBm
mardi 4 mai 2010, 22:19:32 (UTC+0200)
          Mode:Managed Frequency:2.484 GHz Access Point: 00:1E:8C:4C:41:E6
          Bit Rate=54 Mb/s   Tx-Power=20 dBm
          Link Quality=34/70 Signal level=-76 dBm
mardi 4 mai 2010, 22:19:42 (UTC+0200)
          Mode:Managed Frequency:2.484 GHz Access Point: 00:1E:8C:4C:41:E6
          Bit Rate=54 Mb/s   Tx-Power=20 dBm
          Link Quality=34/70 Signal level=-76 dBm

Conclusion

Let's resume theses values in a tab :

Channel	Best dBm	Worst m
6	-73	-75
1	-74	-75
14	-76	-78

That means that there's no big between differences between channels, but it seems that lower channels have a better signal quality than higher.

Theses tests should be completed with transfer tests on different channels.

Anyway, I would suggest to configure your AP with the lowest unused available channel on your place to get the maximum performance / reliability.