LANCOM™ Techpaper
WLAN Band Steering

Introduction

Band Steering enables WLAN clients to be controlled such that they operate on a preferred frequency band, usually 5GHz. Discussed in this technical paper are the benefits, such as the increase in transmission rates for 5GHz clients, and also the principle of operation and configuration options of LANCOM WLAN access points.

Requirements

WLAN Band Steering can be deployed in different scenarios depending on what you are trying to achieve. However, some basic prerequisites must be in place for deployment. The most important is the use of dual-band access points, which are equipped with two radio modules. These must broadcast the same SSID on both the 2.4 and the 5GHz frequencies.

Applications

Band Steering can be deployed for various purposes that address the typical problems that can arise within a WLAN environment.

Load balancing on 2.4 and 5GHz

Given the wider proliferation of clients supporting 2.4GHz WLAN, a WLAN operating on this frequency band can very quickly be subjected to heavy loads as a result of large numbers of clients. This situation is compounded by clients that also support 5GHz but have logged on in the 2.4GHz band. The consequence is that the available 2.4GHz bandwidth is divided between a large number of clients, while ample capacity remains available on 5GHz.

Band Steering can be employed for a more even load on the WLAN, and hence a more stable and faster connection for all clients. The access point can achieve this by referring to its internal data to check whether a client has already been seen in the 5GHz frequency range. If this is the case, the access point no longer sends this client a probe request response on 2.4GHz, and will send a response on 5GHz instead.

Increased bandwidth for 11n clients

The ability of an 802.11n WLAN client to use the full bandwidth of the network depends on the availability of 40MHz channels. They are required to attain the maximum gross data rate available with 802.11n, for example 450 Mbps when utilizing three spatial streams. However, this can only be guaranteed in the 5GHz frequency band because of the larger number of channels that are available and also the lower number of SSIDs broadcasted in the vicinity of the access point, meaning that fewer channels are used.

Example

Figure 1 is a schematic diagram of an access point that uses a single 2.4GHz radio module to broadcast two different SSIDs - the internal company network "INTERNAL" and the public spot "PBSPOT". The second radio module, working in 5GHz mode, only broadcasts SSID INTERNAL.

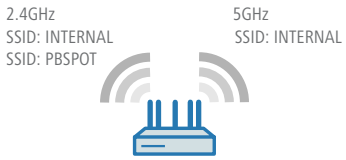

Fig.1 Dual-radio access point in operation

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Without Band Steering, a client wanting to connect to INTERNAL will use client-specific specifications to decide between 2.4GHz or 5GHz. The access points have no control over the decision, and neither do the users, because most clients do not have a corresponding configuration option. Assume a total of 20 clients are associated with the access point, divided up as follows (table 1). Five are connected to PBSPOT and the other 15 to INTERNAL, of which twelve use 2.4GHz and three 5GHz. This split shows the unequal distribution of the WLAN resources. If there is a dramatic increase in the usage of the public spot, all clients connected to INTERNAL on 2.4GHz would correspondingly experience performance losses.

Frequency	2.4 GHz		5 GHz
SSID	PBSPOT	INTERNAL	INTERNAL
Clients	5	12	3

Tab.1 Distribution of clients without Band Steering

However, if Band Steering is deployed in the WLAN, it can be assumed that the majority of clients supporting 5GHz would be steered to the preferred frequency band the next time they login. Assuming the same numbers as in the previous example, client distribution now looks as follows (table 2): Now eleven clients are registered on 5GHz, while a total of nine clients are registered on 2.4GHz.

Frequency	2.4 GHz		5 GHz
SSID	PBSPOT	INTERNAL	INTERNAL
Clients	5	4	11

Tab.2 Distribution of clients with Band Steering

The remaining four clients connected to INTERNAL on 2.4GHz may be clients not supporting 5GHz, or they may be clients that have not yet been detected by band steering. The bandwidth available to the nine clients that have switched from 2.4GHz to 5GHz has has risen because the medium is shared by fewer clients. The throughput rate may even have doubled for 11n clients, as they can now fully utilize the 40MHz channels. Also, the bandwidth available to the clients on 2.4GHz has improved because there are fewer clients sharing the channels. If usage of the public spots rises sharply in this case, only the clients of the internal network would be affected, whereas the clients in the 5GHz frequency band can continue to work unaffected.

Protocol details

When a probe request arrives, a LANCOM access point checks whether the sending client can also operate in the preferred frequency band. It refers to its station table to ascertain whether the client has already been detected in the preferred frequency band.

In the following example a probe request has been received in the 2.4GHz band and the preferred band is 5GHz. The access point carries out the following steps in the corresponding sequence as it runs through the Band Steering process. Figure 1 shows the sequence in the form of a flow diagram.

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- SSID also broadcasted on 5GHz?
  - Yes ▸ Next step
  - No ▸ AP sends probe response on 2.4GHz
- Client previously detected on 5GHz?
  - Yes ▸ Next step
  - No ▸ AP sends probe response on 2.4GHz
- Does client exceed the minimum signal strength?
  - Yes ▸ Probe response suppressed on 2.4GHz, AP sends probe response on 5GHz
  - No ▸ AP sends probe response on 2.4GHz

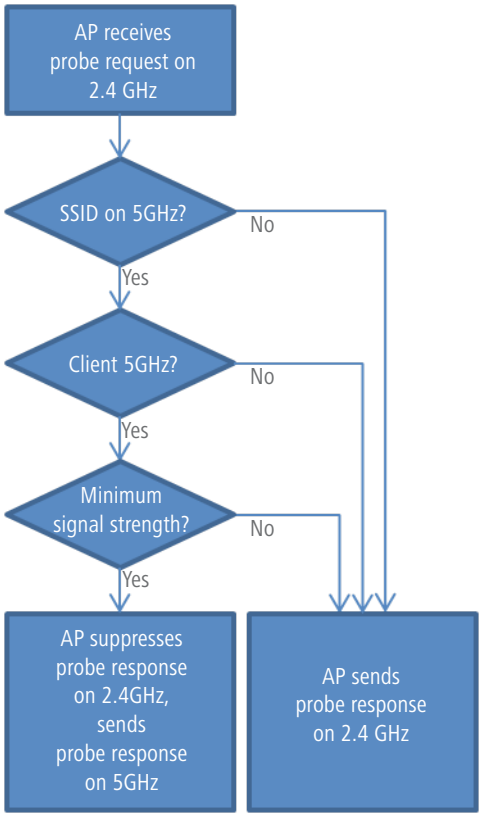

Fig.1 Band Steering flow diagram

Configuration

LANconfig makes it easy to configure Band Steering on a LANCOM access point. The necessary settings are in the menu item "Band Steering" under Wireless LAN. All you have to do is to enable Band Steering and select the preferred frequency band.

Optimization

LANCOM access points offer two additional mechanisms that can contribute towards optimization in scenarios where the basic Band Steering settings are insufficient: "Suppress SSID broadcast" and "Minimum client signal strength".

We will consider the option to suppress the SSID broadcast first. For each SSID, this function enables you to specify whether the access point sends the SSID in the broadcasts, and how it reacts to probe requests containing a blank or incorrect SSID. If the client sends a probe request with a blank SSID on 2.4GHz, for example, an access point that suppresses its SSID broadcast responds to the request with a probe response that also contains a blank SSID. If the access point is configured with the tightened setting for SSID broadcast suppression in this scenario, it will not respond at all to the probe request. This is useful for Band Steering inasmuch as a client will not attempt to connect to an SSID that it does not see.

Also, minimum signal strengths can be set for individual SSIDs. This threshold represents the minimum signal strength a client needs to be able to associate. If a client operates below this value, the access point will not send probe responses to this client and will discard the corresponding requests. This is useful for areas at the edges of signal coverage where, for example, the client signal strength in the 5GHz frequency band may be significantly lower than that for 2.4GHz. This defines a minimum client signal strength for the SSID on 5GHz, so that a client with a signal strength below this value can continue to use the SSID on 2.4GHz.

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Both of these configuration options can be found in LANconfig under WLAN ▸ General ▸ Logical WLAN settings. From the command line interface, the settings are accessed under /Setup /Interfaces /WLAN /Network, and in WEBconfig under LCOS menu tree ▸ Setup ▸ Interfaces ▸ WLAN ▸ Network.

It is important for the individual SSIDs to be configured with the same security settings.

The radio module for 5GHz should not be operated in Greenfield mode because this can result in clients that support only 802.11a and not 802.11n not being able to establish a connection on either 2.4GHz or 5GHz.

Summary

Band Steering is an excellent way of markedly improving the stability and performance of a WLAN. Firstly, the automatic distribution of clients to different frequency bands simplifies the use of wireless LANs in high density environments. Secondly, only in this way can the operator be sure of providing the full WLAN bandwidth for 802.11n-capable WLAN clients.