QCS-AX

Always ON DFS

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USER MANUAL

Introduction

This document covers QCS Always ON DFS feature set which is introduced in its QCS−AX family of chipsets. This feature encompasses the use of CAC, WCAC, ZCAC, and S−DFS to clear DFS channels. These features can be controlled individually or as part of an algorithm controlled by the DFS Daemon. Refer to document QCS−AX−AN−DFS−Daemon.pdf.

ABBREVIATIONS AND ACRONYMS

Abbreviations and Acronyms	Description
DFS	Dynamic Frequency Selection
CAC	Channel Availability Check
S−DFS	Sub−Band Dynamic Frequency Selection
WCAC	Wideband Channel Availability Check
xCAC	Any of the CAC methods (CAC, WCAC, ZCAC)
ZCAC	Zero Wait Channel Availability Check (Zero Wait DFS)
QCS	Quantenna Connectivity Solutions Division
QCS−AX	QSR10GU−AX and QSR5GU−AX family of chipsets

Overview

Wi−Fi has become the default technology to access the internet within the home. The need for cleaner channels and higher available bandwidth has become crucial. Currently, there are two sets of 160 MHz channels from 5170 MHz – 5330 GHz and 5490 MHz – 5650 MHz. These are available in the 5 GHz spectrum which requires the use of DFS channels. Efficiently clearing DFS channels and maximizing the occupancy of these channels are crucial for high bandwidth applications.

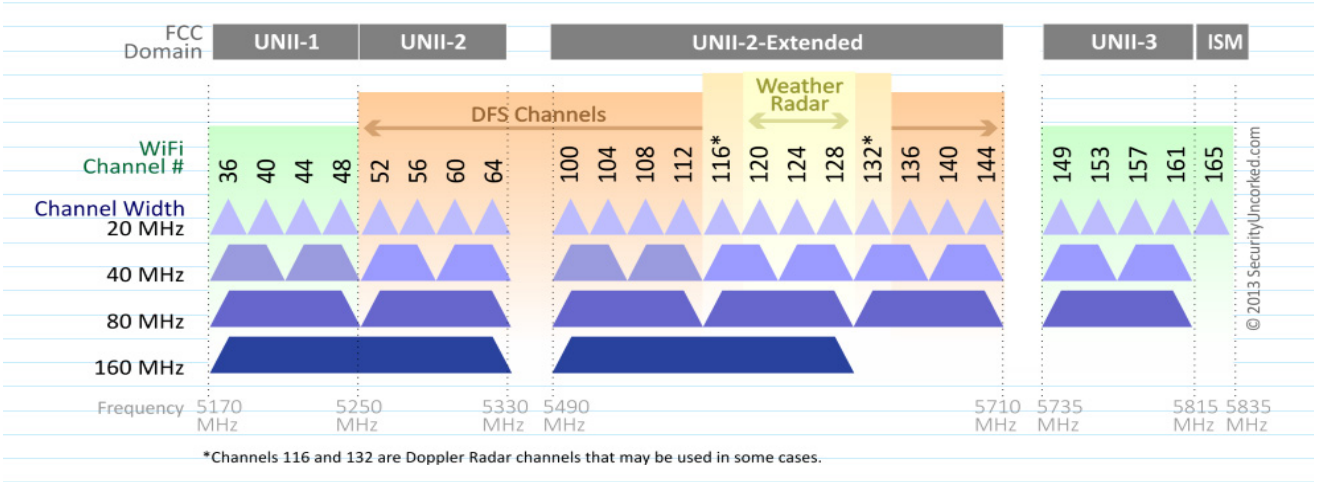

Figure 1. 802.11ac Channel Allocation (N America)

QCS has addressed these issues with QCS−AX generation of chipsets. QCS−AX chipsets using Always ON DFS provides a unique mechanism to efficiently enable the use of DFS channels. Table 1 below provides a high level overview of each of the mechanisms that Always ON DFS is comprised of.

Table 1. OVERVIEW OF THE COMPONENTS OF ALWAYS ON DFS

Feature	Problem Addressed	Description
Zero Wait DFS (ZCAC)	Channel Acquisition	Ability to take one or more antennas off channel to perform a CAC without disrupting traffic.
Wideband CAC (WCAC)	Channel Acquisition	Ability to clear an adjacent 80 MHz DFS channel without disrupting traffic.
Sub−Band DFS (S−DFS)	Maximizing occupancy of cleared DFS channel	Ability to identify which Sub−Channel a DFS event was detected on and collapse the affected 80 MHz channel.

Zero Wait DFS

QCS's Wi−Fi 6 products have the ability to take one or more antennas off the operating channel to a DFS channel to perform the Channel Availability Check (CAC) required to occupy a DFS channel. This is done without disrupting user traffic. This enables devices to not have to wait 60 or 600 seconds to clear the DFS channel. Users can thus be moved to a cleaner and in some cases higher power channels faster, resulting in an overall better user experience. For an 8x8 design, second set of antennas 5,6,7,8 is taken off normal operation and is used for zero wait DFS. For a 5x5 design, the fifth antenna is used for zero wait DFS. This feature operates in AP mode only, and is not supported in repeater mode nor station mode. The operational bandwidth will be the same bandwidth of the scanned bandwidth. Table 2 shows the time required to perform radar detection in different scenarios.

Table 2.

	Power Up CAC Wait Time	Zero Wait DFS Wait Time (assuming low traffic load)
Regular Radar Channels	60 seconds	70 seconds
Weather Radar Channels	600 seconds	5400 seconds

An example use case is shown in Figure 2 below. The AP boots up on CH42 (non−DFS channel) and then uses Zero Wait DFS to clear CH106 without disrupting traffic on CH42 and move to CH106 once it has been cleared.

NOTE: Green represents non−DFS channels. Yellow represents DFS channels. Red represents Weather Radar channel.

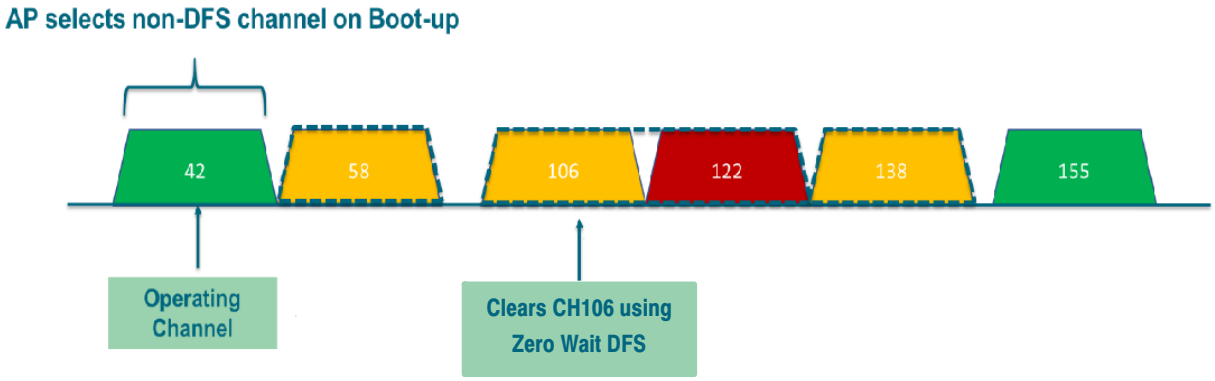

Figure 2. Zero Wait DFS Enables Clearing a DFS Channel Without Disrupting Traffic

Zero Wait DFS APIs

Relevant Zero Wait DFS APIs (See QCSAPI document for precise format):

- Configure ZCAC Feature Enable(1)/Disable(0):
  call_qcsapi set_zsdfs_param <interface> enable <0/1>
  quantenna # call_qcsapi set_zsdfs_param wifi0_0 enable 1
- Query ZCAC Feature Enable(1)/Disable(0):
  call_qcsapi get_zsdfs_param <interface> enable
  quantenna # call_qcsapi get_zsdfs_param wifi0_0 enable
- Configure Channel and Bandwidth to do ZCAC:
  call_qcsapi set_zsdfs_param <interface> chan_bw <channel><bandwidth>
  quantenna # call_qcsapi set_zsdfs_param wifi0_0 chan_bw 100 80
- Query Channel and Bandwidth setting of ZCAC:
  call_qcsapi get_zsdfs_param <interface> chan_bw
  quantenna # call_qcsapi get_zsdfs_param wifi0_0 chan_bw

- Debugging ZCAC(script will print additional information when executing above commands): ./scripts/set_zsdfs wifi0_0 dbg 5
- Status of current ZCAC settings: /scripts/get_zsdfs

NOTE: The sequence of programming ZCAC is setting the chan_bw, then enabling it. Setting a channel that is part of the channel set in operation is not allowed. It is recommended to use DFS Daemon for any xCAC control.

Wideband CAC

Wideband CAC (WCAC) is a unique QCS feature that seamlessly clears the adjacent 80 MHz DFS channel without disrupting traffic. Building on the Zero Wait DFS scenario shown above, once CH106 has been cleared, the AP can then use WCAC to clear CH122. Note, that CH122 is the Weather Radar channel and requires at least 600 seconds CAC to clear it. The ability to clear CH122 is crucial for 160 MHz operations. Figure 3 below shows how WCAC can be used to enable 160 MHz operations, or just move to CH122 and operate in 80 MHz mode.

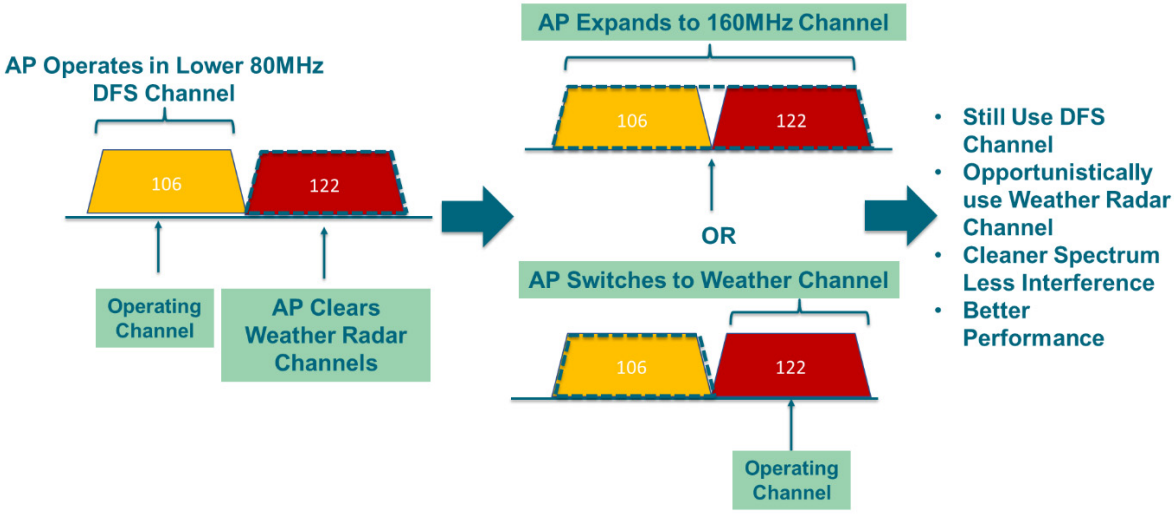

Figure 3. Wideband CAC (WCAC) Can Seamlessly Clear the Adjacent 80 MHz DFS Channel

WCAC APIs

Relevant WCAC APIs (See QCSAPI document for precise format):

- Configure WCAC Feature Enable(1)/Disable(0): call_qcsapi set_wifi_param <interface> wcac_cfg <0/1> quantenna # call_qcsapi set_wifi_param wifi0_0 wcac_cfg 1
- Query WCAC Feature Enable(1)/Disable(0): call_qcsapi get_wifi_param <interface> wcac_cfg quantenna # call_qcsapi get_wifi_param wifi0_0 wcac_cfg

Sub−Band DFS (S−DFS)

Sub−Band DFS is yet another advanced technique used by QCS to determine which 80 MHz channel the DFS event was detected. This is vital for staying in DFS channels longer. Once again, building on the WCAC example above, the AP has cleared CH106 and CH122 and is now operating in CH114, which is a 160 MHz channel. Radar pules are very narrow band pulses that do not occupy an entire 80 MHz channel. Without S−DFS, if a radar pulse were to occur in either CH106 or CH122, the entire 160 MHz spectrum would have to be vacated. With QCS's S−DFS feature, QCS can determine which sub−band the radar event happened. If it happened in CH122, AP would simply collapse the bandwidth to 80 MHz and operate completely in CH106. This way, DFS channel usage is maximized. Figure 4 below shows a visual representation of this feature.

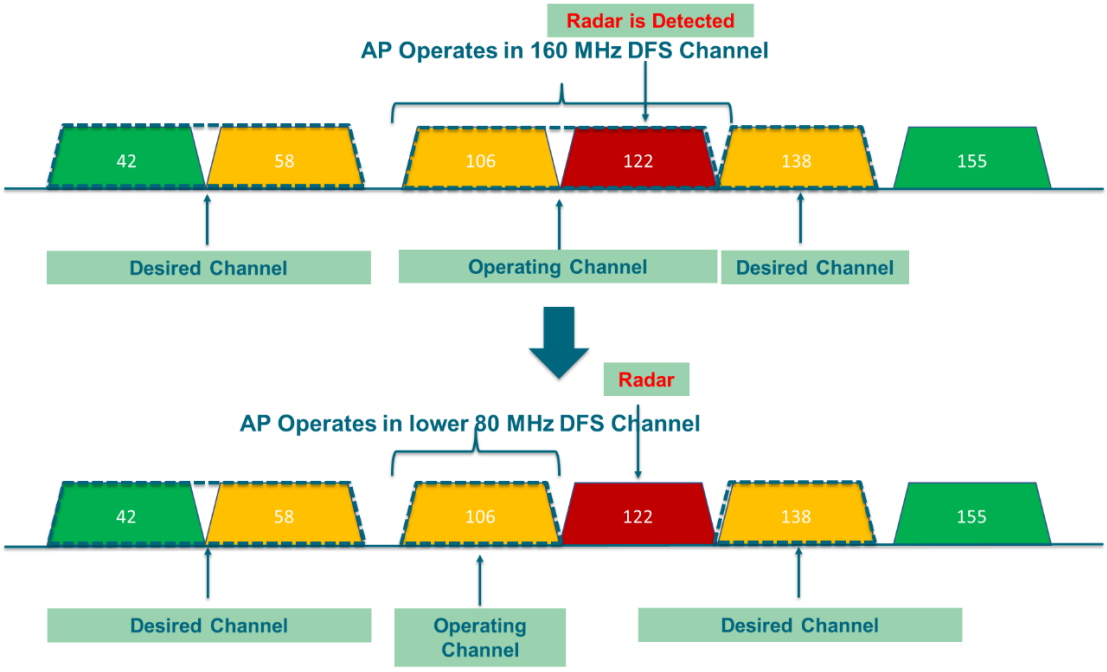

Figure 4. Sub−Band DFS (S−DFS) Can Identify Which Sub−Band the DFS Event Occurred on

Once the non−occupancy time for CH122 has expired, QCS can then make use of WCAC and once again seamlessly clear CH122 and resume 160 MHz operation.

Sub−Band DFS APIs

Relevant Sub−Band DFS APIs (See QCSAPI document for precise format):

- Configure Sub−Band Feature Enable(1)/Disable(0):
  call_qcsapi set_option <interface> subband_radar <0/1>
  quantenna # call_qcsapi set_option wifi0_0 subband_radar 1
- Query Sub−Band Feature Enable(1)/Disable(0):
  call_qcsapi get_option <interface> subband_radar
  quantenna # call_qcsapi get_option wifi0_0 subband_radar

General DFS Related APIs

APIs relating to DFS(See QCSPAI document for full list and details):

- Query for list of DFS channels supported:
  call_qcsapi get_list_DFS_channels <regulatory region> <0|1><20|40|80>
  quantenna # call_qcsapi get_list_DFS_channels us 1 40
- Query alternative DFS channel that will be switched to if radar is detected in current channel:
  call_qcsapi get_DFS_alt_channel <interface>
  quantenna # call_qcsapi get_DFS_alt_channel wifi0_0
- Query if channel was switched from and to, due to most recent DFS channel change event:
  call_qcsapi get_dfs_cce_channels<interface>
  quantenna # call_qcsapi get_dfs_cce_channels wifi0_0
- Query DFS channel for status:
  call_qcsapi get_radar_status <interface> <DFS−Channel>
  quantenna # call_qcsapi get_radar_status wifi0_0 132
- Query DFS CAC status:
  call_qcsapi get_cacstatus
  quantenna # call_qcsapi get_cacstatus wifi0_0
- Configure SCS:
  call_qcsapi enable_scs <interface><0 | 1>
  quantenna # call_qcsapi enable_scs wifi0_0 1
- Query SCS:
  call_qcsapi get_scs_status <interface>
  quantenna # call_qcsapi get_scs_status wifi0_0
- Query SCS Report to display channel information:
  call_qcsapi get_scs_report <interface> all
  quantenna # call_qcsapi get_scs_report wifi0_0 all

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