# High Density Experience Features in Release 8.1

This section covers the following topics in depth:

## Dynamic Bandwidth Selection

Dynamic Bandwidth Selection (DBS) algorithm addresses smart switching between channel bandwidths in current and future 802.11ac radios and new coexistence scenarios. DBS will be a differentiating factor for enterprise WLAN networks that have 11ac APs along with legacy APs. DBS also signifies the flexibility of RRM in managing coexistence between 11ac and legacy APs and devices.

To provide much anticipated significant increase in data rates, 11ac introduces several new wide bandwidth modes, such as operation at 80 MHz and 160 MHz. Additionally, 11ac also allows an AP to switch from these modes to one of the existing narrower bandwidths, such as 20 MHz or 40 MHz. This is particularly useful for networks that have 11ac APs along with legacy APs and/or clients, which only have the narrower bandwidths. While it is obvious that the AP should do so to improve the performance, the exact conditions for when to do so are not specified in the standard and are open for innovations.

The DBS algorithm provides a smooth transition for various configurations as customers upgrade from 11n to 11ac. The core Dynamic Channel Assignment (DCA) algorithm deals with assignment of channels based on steady-state conditions, such as neighboring AP distances, rogue channel configurations, and AP types. But, to achieve the highest performance, it would be necessary to fine-tune the channel allocations based on relatively more transient parameters, namely to select between 40 MHz and 80 MHz bandwidths. The main objectives of the DBS and Core DCA are not to compete with different channel and bandwidth choices. DBS applies an additional layer of bias values on top of those applied in Core DCA, such that the net result of the final channel assignment will steer towards DBS's recommendations. To optimize the channel bandwidth along with the channel selection, DCA classifies overall channel metrics for all modes of channel widths. Along with the previously mentioned Wi-Fi metrics, it also takes into consideration adjacent channel penalties due to 40/80 MHz OBSS along with primary channel misalignment penalties. In certain cases, selecting 40 MHz can be more efficient depending on the number of 40 MHz 11n clients in a BSS. It may not be efficient to allocate 80 MHz to all 11ac BSSs from a frequency reuse point of view. Similarly, certain traffic flows may not benefit from having wider bandwidths.

To steer the deployment as described above, when a BSS or deployment is detected with a significant number of 11n clients or is completely made up of 11n clients, then DBS should steer the channel allocations as such:

- When client stations are all 11n (or above a certain preset threshold hysteresis) or there are traffic flow types that favor narrower bandwidth: Change the 80 MHz 11ac BSS to use 40 MHz channel widths (that is, DBS with BW constraint).

- When there is a mix of 11n and 11ac client stations (or above a preset certain threshold hysteresis): Allow sharing secondary40 between 80 MHz BSS (that is, DBS with misaligned primary40).

Both these can be accomplished by use of appropriate biases. Traffic based bias can be added as a function of the number of clients of each type and fractions of different types of traffic on a particular AP.

### Enabling Dynamic Bandwidth Selection (DBS)

**1** Disable 802.11a network.

**2** Go to **Wireless > 802.11a > RRM > DCA**.

**3** In the **Channel Width** field, click the **Best** radio button.

**Dynamic Channel Assignment Algorithm**

| | |
|---|---|
| Channel Assignment Method | ●Automatic    Interval: 10 minutes ⬍   AnchorTime: 0 ⬍ |
| | ○Freeze    Invoke Channel Update Once |
| | ○OFF |
| Avoid Foreign AP interference | ☑ Enabled |
| Avoid Cisco AP load | ☐ Enabled |
| Avoid non-802.11a noise | ☑ Enabled |
| Avoid Persistent Non-WiFi Interference | ☐ Enabled |
| Channel Assignment Leader | Cisco_da:78:24 (172.20.227.99) |
| Last Auto Channel Assignment | 300 secs ago |
| DCA Channel Sensitivity | Medium ⬍   (15 dB) |
| Channel Width | ○20 MHz ○ 40 MHz ○80 MHz ●Best |
| Avoid check for non-DFS channel | ☐ Enabled |

**4** Enable 802.11a network.

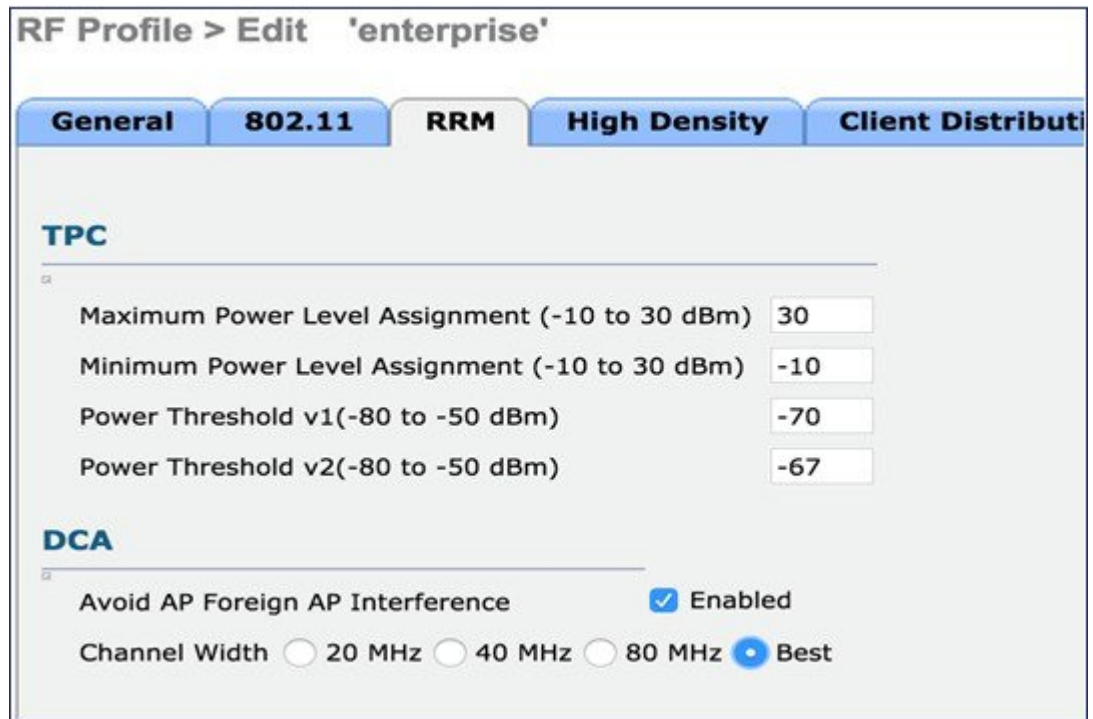### Enabling Dynamic Bandwidth Selection (DBS) in RF Profile

**1** Create an RF Profile on 802.11a radio.

**RF Profile > New**

| | |
|---|---|
| RF Profile Name | Enterprise |
| Radio Policy | 802.11a ⬍ |

**2** Edit the RF Profile you just created. On the **RRM** tab, in the **DCA** area, in the **Channel Width** field, click the **Best** radio button to enable DBS.



**3** Apply the RF Profile to AP groups.



### Dynamic Bandwidth Selection (DBS) Best Practices

Following are some of the best practices for dynamic bandwidth selection:

- Allow DCA with DBS to run every 10 minutes.

- DBS should be set globally.

- **Channel Width** should be set to **Best** on all deployments.

- A global restart should be initiated when DBS is enabled.

  - **config 802.11a channel globabl restart**.



# Dynamic Frequency Selection

Dynamic Frequency Selection (DFS) is created to increase the availability and usability of channels in the 5 GHz spectrum. Depending on regulatory domain, this can be from 4 to 12 additional channels. More channels imply more capacity. The DFS function detects radar signals and moves AP channel on valid detection, thus ensuring primary spectrum users (weather radar, military radar, and so on) that there will not be interference from the access point. DFS avoidance of radar also helps to prevent the AP from suffering from interference The DFS requirements also designates a Master AP as a monitor for the group that will steer clients away as well. Traditionally, there are some misgivings in North America about using DFS channels, but, there are only eight non DFS channels (each channel is 20 MHz wide). In the ETSI regulatory domain (Europe), there are only four non DFS channels and have been using DFS channels successfully for many years.

Although the 5 GHz band offers more channels, care should be given to the overall design as the 5 GHz channels have varying power and indoor/outdoor deployment restrictions. For example, in North America, the U-NII-1 can only be used indoors and it has power restriction of 50 mW maximum power (soon to be changed to much higher power). Both U-NII-2 and U-NII-2e are subject to Dynamic Frequency Selection.

The following figure shows current 5 GHz channels allocation in North America, Europe, and Japan.
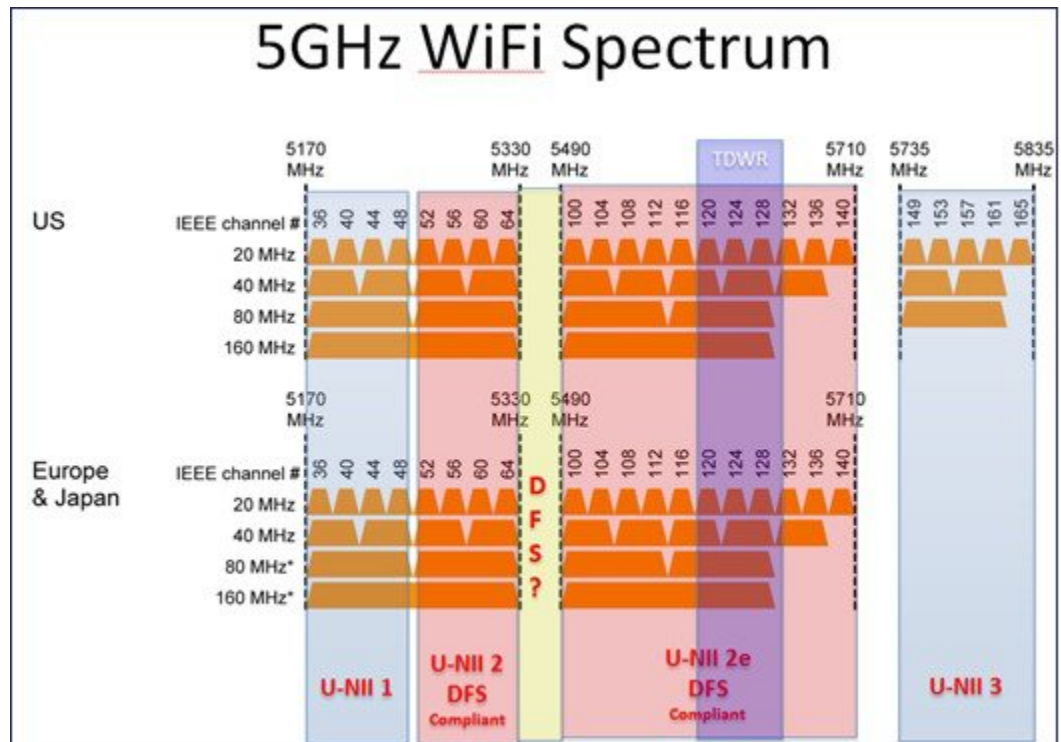
In the US, there are currently **22/10/5/1** channels with bandwidth 20/40/80/160 MHz channels respectively. With the proposed opening up of $5.35 - 5.47$ GHz and $5.85 - 5.925$ GHz spectrum, the number of channels increases to **34/16/8/3**. If the industry manages to take back the TDWR channels, the number of channels increases to **37/18/9/4**.
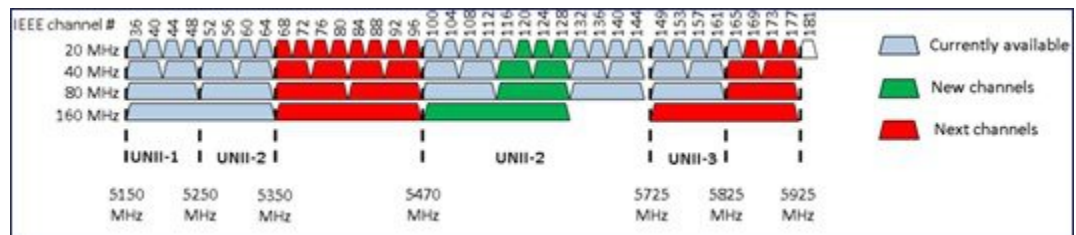


The following table displays the number of DFS channels supported.

| Reg. Domain | Total 20 MHz Channels | DFS Channels |
|---|---|---|
| -A | 22 | 11 |
| -E | 15 | 11 |

There is a huge demand for spectrum in US and all over the world. The more spectrum we have the more channels we will have to operate in and hence we get better solution and system performance. In the current implementation, if the DFS channel is chosen for operation in 20/40/80/160 MHz bandwidth, the following process occurs continuously.

DFS-enabled radios monitor the operating frequency for radar signals on DFS channels only. If radar signals are detected on the channel, the AP performs the following actions:

- Blocks new transmissions on the channel.

- Flushes the power-save client queues.

- Broadcasts an 802.11h channel-switch announcement to all one hop neighbors.

- Disassociates remaining client devices.

- Blocks DFS channel for 30 minutes.

- Starts Channel Availability Check (CAC) process and randomly selects a different channel.

- If the AP does not select a DFS-required channel, it enables beacons and accepts client associations on the new channel.

- If the AP selects a DFS-required channel, it scans the new channel for radar signals for 60 seconds.

- If there are no radar signals on the new channel, the AP enables beacons and accepts client associations.

- If a radar signal is detected, the AP selects a different new channel.

- If a preferred channel is configurable and available, it is selected first.

- DFS channels is continuously monitored for the radar interference when receiving data packets.

This existing behavior has a huge negative impact for wide band channel deployments that experience either real radar detection or DFS falsing. As shown in the following figure, an 80 or 160 MHz channel (4 to 820 MHz channels) can be completely disabled, off the air (for at least 30 minutes) if a narrowband radar is detected. This loss of spectrum can have a negative ripple effect throughout the rest of the wireless network.
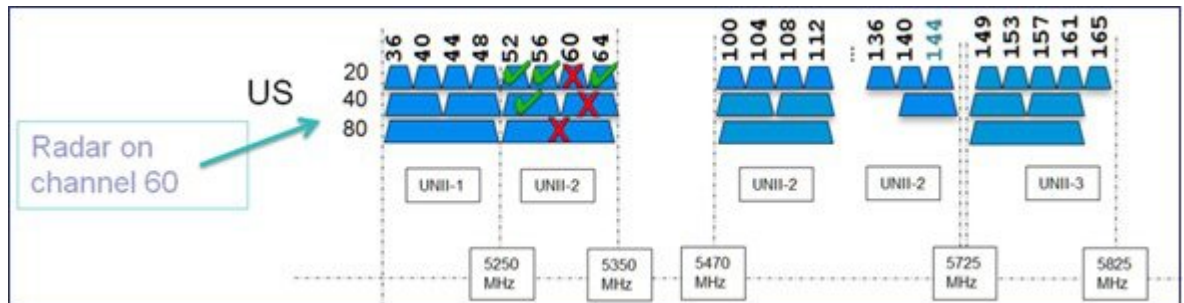


The solution to this collision scenario is the Cisco's patent pending Flex-DFS technology. This feature leverages the advanced signal processing capabilities within SAgE (Spectrum Analysis Engine ASIC) to accurately identify Wi-Fi channel location of a DFS radar signal. This information can be used by the access point and wireless controller to optimally select a new channel allocation. Thus, both access point and the wireless controller avoid the detected channel and then changes to a new channel and/or channel width that is least disruptive and widest.

The foundational technology to this feature is the accurate radar signal frequency estimation that SAgE provides. This accuracy is beyond what Cisco's competitors can support. With accurate knowledge of the radar signal frequency, the access point can turn off just that sub channel, and not the entire larger channel. The following steps, for an 160 MHz channel, illustrate this:

1 Identify radar frequency to 1 MHz accuracy.

2 Isolate radar event only to one 20 MHz channel and mark it as unavailable.

3 Continue using rest of the spectrum, that is, 40/80 MHz intelligently.

4 If possible, avoid rolling back to lower bandwidth, that is, 20/40 MHz if possible.

**5** Avoid running the CAC process and impacting system and clients performance.

You can envision a 5 GHz band wireless network, composed of a large number of access points and managed by a wireless controller. You can also imagine this network that serves a large number of clients (for example, a wireless-only corporate network) requiring reliable use of DFS channels set for wideband operation. Additionally, if there is weather radar, military radar or any RF signal that could cause a DFS detection in the vicinity, and that detection exceeds the DFS threshold in access points, then that wireless network is susceptible to significant client disruptions and traffic throughput degradation.

With FlexDFS feature incorporated on the access point, the wireless network has precise information regarding the frequency location of the interfering radar frequencies, and can steer the network channel allocation in a more optimal and efficient manner than before. So, this feature works integrally with wireless controller as it configures channel allocation and bandwidth optimally to serve the clients. RRM-DCA utilizes this new information to achieve better channel utilization and reuse across the network.

As mentioned previously, Cisco is the only wireless networking vendor with this capability.

Although FlexDFS has the most applicability for 11ac networks, it will become available on all SAgE based APs previously used for Clean Air capabilities: 3500, 3600, 3700, 2600, 2700, 1550, and 1570 Mesh APs. APs that support CA Express or other legacy AP are not currently planned to support FlexDFS. However, when a SAgE based AP detects radar interference on the DFS operated channels, it can inform all 802.11ac capable neighbor APs about the radar interference.

# Summary

Both DBS and FlexDFS provide better utilization of wideband .11ac rates in the enterprise network. Combined, they provide confidence to customers in operating their WLANs with wide channel widths and help give Cisco an advantage over the competition in real world wireless network performance.