Dual Band Simultaneous (DBS) on Zebra Devices with Wi-Fi 6E

White Paper

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Introduction

This white paper explains the Dual Band Simultaneous (DBS) feature supported in the following Zebra Wi-Fi6E devices.

- TC53
- TC58
- TC73
- TC78

Wi-Fi operates in multiple frequency bands – 2.4GHz, 5GHz and 6GHz. Enterprises deploys Wi-Fi networks in one or more of these frequency bands. Wi-Fi client devices need to scan on all frequency bands to discover the best suitable Access Point (AP) for initial connection and subsequent roams.

Enterprise applications expect devices to have stable network connectivity throughout the network, including when a device is moving. If a device spends significant time away from connected AP for discovering next best AP, it impacts the application that is running on the device. This is where Dual Band Simultaneous (DBS) feature is most beneficial.

Dual Band Simultaneous

This section describes what the DBS feature does and how it works.

The Dual Band Simultaneous (DBS) feature allows a device to simultaneously communicate with Access Points on two different WLAN frequency bands. A DBS-supported device can simultaneously transmit and receive on two channels in different bands (2.4GHz and 5/6GHz), or simultaneously receive on two different channels in same band.

Devices supporting DBS can give better performance in different use cases. Improved performance is typically seen in Wi-Fi scanning and throughput. The most important aspect for enterprises is the improvement in roam scan.

Figure 1 Dual Band Simultaneous

DBS-supported devices have two radios, allowing such devices to operate them in two different bands simultaneously in the same air time, supporting both transmit and receive operations.

Importance of DBS

This section describes benefits of the DBS feature and applicable use cases.

For Enterprises, the most relevant aspect of DBS is its boost for scanning and roaming performance, which is applicable for the following use cases and environments.

- When the deployment includes time-sensitive applications using Wi-Fi, such as voice and video calls that need to maintain active registration and connectivity parameters with the backend servers.
- When users are using time-sensitive applications, such as voice calls, and moving across a building.
- When users are using applications that need to have good connection quality while moving within a building that does not have continuous Wi-Fi network coverage. The building layout and associated obstructions might impact the Wi-Fi network coverage.
- When the infrastructure channel plan has many channels, for example, more than fifteen channels.

Apart from scanning, DBS also helps a device to support below concurrent operations without impacting throughput for the Wi-Fi client connection.

- Wi-Fi Display for devices connected to internet when they are on different bands.
- Extend Wi-Fi connection in devices using Wi-Fi Hotspot (Hotspot and Wi-Fi client connection on different bands).

Wi-Fi Scanning

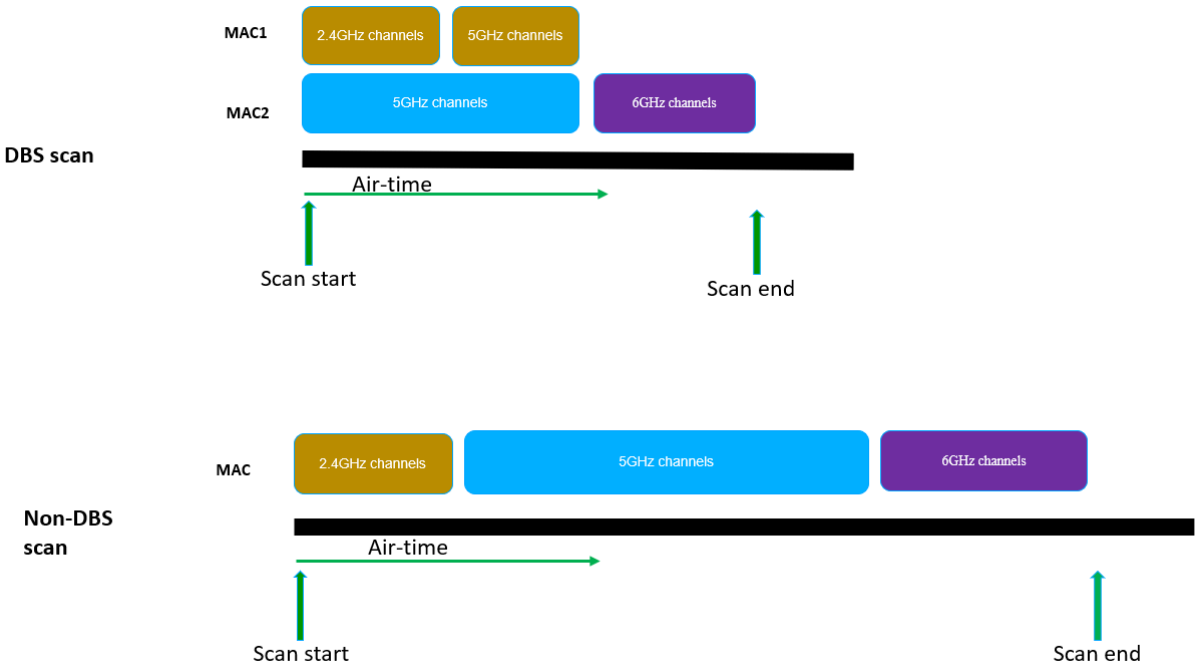
This section describes how using DBS reduces scan time to discover and roam in Wi-Fi networks.

A device needs to scan all channels for discovering Wi-Fi networks. Since there are many channels, Wi-Fi scanning is a time-consuming process. Some of the channels in 5GHz band are Dynamic Frequency Selection (DFS) channels, where a device needs to passively scan for a longer time, which further increases total scan time. In the United States, a device supports the following channels (supported channel list may be different in other countries).

- 2.4GHz: 11 channels
- 5GHz: 25 channels (includes 16 DFS channels)
- 6GHz: 59 channels (15 Preferred Scanning Channels and 44 non-PSC channels)

Using DBS, device can scan for Wi-Fi networks in 2.4GHz and 5/6GHz in parallel, thereby reducing overall scan time by up to 40%[1] compared to when DBS is not used in the same device.

Figure 2 Wi-Fi Scanning



Discovery and Connection Scan

This section describes how DBS improves discovery time in the Wi-Fi network.

A client device will initiate a Wi-Fi discovery in multiple scenarios, the most common of which are:

- When a user launches a Wi-Fi page from Settings application, or from a Quick Settings tile, the application will initiate a scan for discovering all surrounding Wi-Fi networks. When the scan is complete, it will display all the networks found.
- When a user returns to Wi-Fi coverage after being out of coverage, the device scans for available surrounding networks in the area to connect to the best network.
- When a user turns on Wi-Fi, the device will initiate a scan to search for Wi-Fi networks to make a connection.

Using DBS, a device can initiate a scan on two different bands in parallel, thereby completing the scan by up to 40%[1] less time, whether it be for listing them in the user interface or for making a connection. When a user launches the Android Wi-Fi settings page, a DBS device can show all available networks in almost half the time when it is not using DBS in the same device. A DBS device scans a greater number of channels in the same amount of time, so there is a higher chance of finding a better Access Point (AP) for a faster connection. When powering on Wi-Fi or when a user enters a Wi-Fi coverage area, a connection can be made more than one second faster.

Here are some use cases where a device will go through quick disconnect/reconnect scenarios. Reconnection can be faster by up to 26%[1] when DBS is used, compared to when DBS is not used in the same device. Some common disconnect/reconnect scenarios are listed below.

- When a user moves across buildings
- When a user moves around fringe coverage areas

Roam Scan

This section describes how DBS improves scan time during roaming in the Wi-Fi network.

When moving around, a device will need to roam from one AP to another AP to maintain Wi-Fi connectivity. This involves discovering all nearby APs and selecting the best AP to roam to when the current connection becomes weak. If a device takes too long to complete the scan, it could lead to delayed roams and/or selecting a weaker AP. Although 802.11k/v can provide the client device with a potential AP list and channel options, a device may still need to scan a full set of channels in cases where the WLAN layout of the environment is changing. Examples of this are when scanning occurs in hospitals, hotels, or any transition between environments/buildings.

Stable network connectivity and streaming traffic during roaming are important to time-sensitive applications, such as streaming voice and video. The device uses scanning to find better coverage on unconnected channels, also called off-channels, while the user moves around during the Application traffic. During these off-channel instances, the device cannot transmit or receive the Application traffic. Using DBS, the device can scan in both 2.4GHz and 5/6GHz bands in parallel, thereby reducing the total Scan Cycle-Time by up to 37%[1] compared to when the device is not using DBS. Reduced Scan Cycle-Time is critical for maintaining low latency, low jitter, and other quality performance requirements. Additionally, a DBS device spends up to 42%[1] less net downtime on the multiple off-channel scans compared to when device is not using DBS.

The goal for the device is to minimize total cycle time and downtime so it can transmit and receive traffic on the connected channel in the expected streaming cadence for time-sensitive applications, which is typically in intervals of 20 to 40ms. The application does have the ability to withstand small amounts of connectivity

loss and jitter, but if it happens repeatedly over a length of time, the application cannot tolerate it and scanning is negatively impacted

Reduced Scan Cycle-Time and downtime are especially critical in WLAN layouts in which the AP signal might have a hard time maintaining a good balance and continuity relative to the following application roaming use cases.

- Entering and exiting elevators or staircases and moving up or down to another floor
- Fast movement from one place to another within the same building
- Entering and exiting rooms with closed doors
- Using the device on a forklift

NOTE: [1] The mentioned comparison is between Test Results of the device using DBS and computed values not using DBS.

Traffic Capacity

This section describes how Dual Band Simultaneous affects traffic capacity during a roam scan.

A DBS device spends less time away from a connected AP during a roam scan and therefore these devices will have a higher traffic capacity. Actual impact varies depending on the number of Wi-Fi channels to be scanned while searching for the best AP to roam to, which generally depends on features like 802.11k and 802.11v. The impact on non-DBS traffic capacity is shown in the table below.

Use Case	Non-DBS Traffic Capacity Reduction During Scan (% per 10s duration)
802.11k utilized (typical case if 11k is enabled by the WLAN network)	1.2%
802.11k not utilized (typical case if 11k is not enabled by the WLAN network)	17%

Concurrent Use Cases

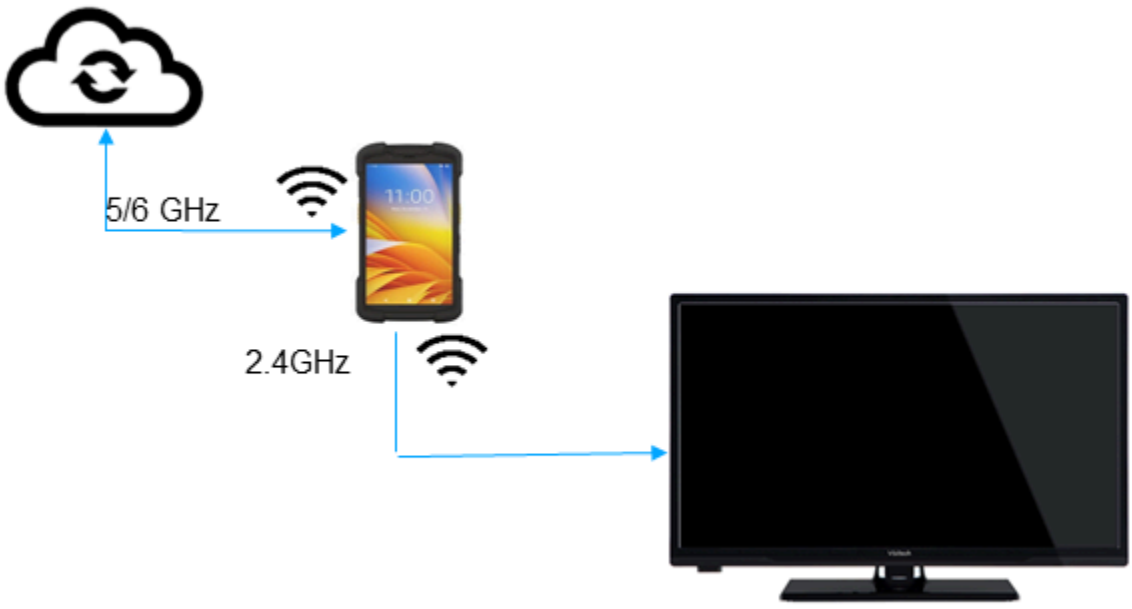
Dual Band Simultaneous is also used in multiple concurrent use cases as detailed in this section.

Wi-Fi Display

This section describes how a Wi-Fi client connection and Wi-Fi display connection can co-exist on different bands.

A device connected to the internet using a 5/6GHz band AP can perform screen mirroring on a 2.4GHz band. When using DBS-supported devices, the Wi-Fi client connection and Wi-Fi display connection are on different bands with both running concurrently. In this case, the Wi-Fi display connection does not impact the performance of the Wi-Fi client connection.

Figure 3 Wi-Fi Display



Wi-Fi Extender

A device can support a Wi-Fi AP connection in one band (for example, 5/6GHz band) and tethering on the other band (for example, 2.4GHz band). In this case, a device can support a Wi-Fi hotspot on the other band without affecting the Wi-Fi client connection.

Figure 4 Wi-Fi Extender