21.1 GA RELEASE NOTES
TAG 17.10.188.1303

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v1

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General Notes

- **This release is intended to be paired with 5.04L02 (not with 5.02L07Px or any older SDK version)**

- **This release supports the 6715B0 (2/5/6G) and 6710 (2/5G) for GA**

- **This release supports the 6756 (2/5/6G) as early access**

- **This release does not support any other 11ax chips such as 43684B1/C0, 6750/2/5, 63178**

- **This release does not support any 11ac/n or earlier chips such as 68781/2, 4360/4352, 43217, 4366E, 43602A1/3, 43217**

- **This release includes features and fixes from the earlier 20.1.1/P1/P2 releases**

New Feature Highlights

- **Feature parity as 20.1.1 43684C0 2/5/6Ghz (11ax R1)**

- **New features for all supported chips in this release**

  – Addition of "Uplink Traffic Allocation Framework" (UL TAF) for enhanced uplink OFDMA scheduling

- **New features specific to 6715B0 (as compared to 43684B1/C0)**

  – Support for 11ax DL MU-MIMO in 160MHz (with dual-lane PCIe connection to SoC)

    – Only 80MHz with single lane PCIe connection to SoC

  – 11ax TDCS enabled for packet bandwidth 20/40/80MHz (not 160MHz)

  – Enable 2/5G TX shaper

    – Please refer to the TX shaper app note for more details about this feature and the additional regulatory testing required

  – Support 6715 2Ghz Digital Pre-Distortion (DPD), with compatible nonlinear PA

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21.1 Notable Details

- **As with 20.1.1, the Tx Beamformee (wl txbf_bfe_cap) setting is now configurable per BSSSID**
  - We have disabled BFE function by default to improve uplink performance for 1x1 and 2x2 clients
  - Customers should set txbf_bfe_cap setting to 0x8f (default = 0xf) on all 4x4 (43684/6715) AP to 4x4 (43684/6715) repeater backhaul BSSIDs

- **DL and UL OFDMA STA support for repeaters**
  - The "wl he features" settings applies per radio, and has a default value of 31 (0x1f)
    - Default value enables 11ax rates, DL OFDMA (AP and STA), UL OFDMA (AP), and 11ax DL MU-MIMO (AP) operations
  - If a device wants to do UL OFDMA as a STA (e.g. DWDS link) on any virtual interface
    - You must change the value of he features to 95 (0x5f) for that radio
    - This additional bit in he features enables UL OFDMA operation on the STA interface; it does not impact AP interfaces
  - If you want to disable 11ax Multi User operations on a radio (sometimes for debugging purpose)
    - Set the value of he features to 3, which enables 11ax rates but no 11ax multi user modes

- **Interop issues with TWT clients**
  - Although we have TWT enabled by default, we recommend that customers consider disabling it to avoid potential issues
    - Use the command "wl twt 0" to disable TWT
  - We have seen some TWT interop issues with certain non-Broadcom phones newly available in the market
    - Including OPPO Find X2, Xiaomi MI-10, and OnePlus 8
  - At the time of this release, all Samsung, Apple and Intel 11ax devices in the field still do not enable TWT
  - During WFA cert testing, Sigma scripts will enable TWT as needed, even if it is disabled in the DUT SW by default
  - Note that TWT follows the per-BSS bssaxmode setting, so if bssaxmode is disabled then TWT is disabled as well

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21.1 Known Key Issues

- **Functional issues impacting SmartMesh / Repeaters**
  - BCAWLAN-224522, RB:175301, SmartMesh : Deauth frames from AP was not going out resulting in repeaters forming a loop and remaining in that state till reboot
  - BCAWLAN-224621 & BCAWLAN-223253, RB:175462, SmartMesh : Kernel panic on repeaters during repeater roam / onboarding
  - BCAWLAN-224991, RB:175533, SmartMesh : ACSD crash on repeaters when root AP is rebooted
  - CS00011797870, BCAWLAN-225066, RB:175564 : Memory leak during scan

- **WFA Certification**

  - Easymesh R2
    - DUT side issue: WiFi EasyMesh R2 4.8.1 MAUT 11.1 BTM-based Client Steering test (BCAWLAN-225430); Request WLAN RB:175301
    - A number of failures (R1 cases 4.5.2, 4.6.3, 4.7.9, 4.8.1, 5.8.1, R2 cases 4.14.1, 4.13.11) which based on our analysis are due to fault on WFA script/testbed device side. WFA support cases have been filed but WFA has not resolved them yet.
      - Broadcom recommends not to start any Easymesh R2 certification testing before WFA resolves these cases

  - Wifi 6/11ax
    - 6710 only (not affecting 6715): WIFI 11ax Test Case 4.29.1 APUT DL OFDMA tests (BCAWLAN-225454); Request SDK CL#332509

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21.1 MU-MIMO, OFDMA, and TWT User Limits

- **Default maximum number of users admitted per technology type, per chip:**

	Default Max # of Users Per Technology		
Technology	6715	6756	6710
DL MU-MIMO	16	8	12
DL-OFDMA	MAXSCB	MAXSCB	MAXSCB
UL-OFDMA	8	8	8
TWT	16	4	4

MAXSCB = Max number of associated users per wifi chip

- **Maximum number of Users Per PPDU, when transmission BW = 20, 40, or 80 MHz:**

	Max # of Users Per PPDU Transmission		
Technology	6715	6756	6710
DL MU-MIMO	4	2	3
DL-OFDMA	4[1]	4	4
UL-OFDMA	4[2]	4	4

Note [1]:   When BW is 160 MHz, 6715 will pick up to 8 users out of the admitted users for each DL-OFDMA PPDU.

Note [2]:   When BW is 160 MHz, 6715 will pick up to 8 users out of the admitted users for each UL-OFDMA PPDU.

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WFA Wi-Fi Certification - Sigma Support

- **The 21.1 release was tested for pre-cert for WFA 11ax Wi-Fi 6E (6715B0) and Wi-Fi 6 (6715B0 and 6710)**
  - Before submitting for WFA 6 / 6E certification please check with Broadcom for the latest Sigma package

- **Always use the latest Sigma Agent on docsafe as failures may be fixed with the latest Sigma agent.**
  - At the time of this writing, sigma-797393.tgz is the most recent package available, however please use the latest on DocSafe

- **Latest sigma agent on DocSafe currently supports the following WFA programs:**
  - Wi-Fi 6, 6E, 11ac, 11n, PMF, MBO, WPA3 including Suite B, EasyMesh R1/R2, DPP, OCE, WMMPS, Passpoint 2.0 and OWE

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6GHz WFA Certification

WFA Wi-Fi 6E Certification Prerequisites

- **WiFi6 (11ax) R1 Features**

- **Some WiFi6 R1.5 Features**
  - Triggered Beamforming Response Poll

- **WPA3**
  - No legacy WPA2/WPA or WEP or TKIP allowed

- **No open networks**
  - Opportunistic Wireless Encryption (OWE) used instead

- **Protected Management Frames (PMF)**

WFA Wi-Fi 6E Feature Support Matrix

Test Plan Feature	Required	Broadcom
Security configurability	M	Supported
Receive HE-LTF, and GI and packet extension	M	Supported
Transmit HE-LTF and GI test in 6GHz band	M	Supported
DL OFDMA	M	Supported
UL OFDMA using two spatial streams with LDPC	M	4 SS Supported
MU Beamforming Response Poll (BFRP)	C (MU-MIMO)	Supported
DL-MU-MIMO	C (>= 4 SS)	Supported
Individual TWT	M	Supported
In-band Discovery and Association	M	Supported
20 TU Unsolicited Probe Response	O	Supported
OoB Discovery with RNR and Discovery of a 6 GHz Multiple BSSID	CM	Supported
Transmits Beacon in HE SU PPDU format	O	Supported
Use of CCMP to protect unicast management frames in 6GHz test	M	Supported
Usage of non-preferred channels' information from STA	M	Supported
Unsolicited BSS Transition Management Request frame with and without Disassociation Imminent	M	Supported

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WFA Wi-Fi 6E Prerequisites

Feature	Broadcom
Wi-Fi 6 protocols from 2.4 and 5 GHz	Supported
WPA3, including all optional modes	Supported
Protected Management Frames (PMF)	Supported
Disallow legacy WPA2/WPA Personal and Enterprise	Supported
Disallow WEP and TKIP	Supported
Disallow open security	Supported
Disallow WPA3-Personal Transition Mode	Supported
Disallow OWE Transition Mode	Supported

6GHz AP Configuration Guideline

Summary of what's new in 6 GHz

- **Discovery**
  - STAs avoid extra probing by "fast passive scanning"
  - For APs with multiple radios, STAs can discover 6 GHz operating parameters by listening to 2.4 or 5 GHz and capture reduced neighbor report (RNR).
    - A.k.a. "out of band discovery"
    - AP's RNR in 2.4 or 5 advertises 6 GHz operation. Including responding to probe from STA.
  - Preferred scanning channel (PSC). 15 20 MHz channels. STAs look there before probing.
  - Unsolicited broadcast Probe Responses. AP sends these on preferred scanning channels.
  - FILS discovery frame. Alternative to unsolicited probe responses (we support both).

- **IEs (in Beacons, Probe Responses, Assoc Response, and others)**
  - HE (11ax) only. No VHT (11ac) , or HT (11n).
  - HE Operation, HE 6 GHz Capabilities elements.
  - Instead of sending multiple beacons (one per BSS), send only one that describes all BSSs.
  - Short SSID List. For Reduced Neighbor Report (RNR) and Unsolicited Probe Responses.

- **TXOP Duration in PHY header. Not processed by SW.**

- **Beacons**
  - HE format and non-HE format supported
  - MBSSID

Please refer to the "6GHz AP Configurations" section in this release note for more details. If your SW is not using the initialization in our reference SW, you will need to handle these configurations in your SW initialization.

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6 GHz - Configurations

- **Security**
  - For 6GHz SSIDs, security must be SAE-H2E or OWE
  - For SAE-H2E configuration, the following nvrams must be set
    ```
    # nvram set wl<x.y>_crypto=aes
    # nvram set wl<x.y>_akm=sae
    # nvram set wl<x.y>_wpa_psk=<key>
    # nvram set wl<x.y>_sae_pwe=1
    ```
  - For OWE configuration, the following nvrams must be set
    ```
    # nvram set wl<x.y>_crypto=aes
    # nvram set wl<x.y>_akm=owe
    # nvram set wl<x.y>_mfp=2
    ```

- **MBSSID**
  - Refers to the new Multi-BSS implementation where we use a single Beacon for all BSSIDs on this radio
  - MBSSID is mandatory on 6 GHz
  - To enable MBSSID, the following nvram must be set (only applicable with WLCONF)
    ```
    # nvram set wlx_mbssid 1
    ```
  - You could also enable it directly through
    ```
    # wl -i wlx mbssid 1

    * Driver default:"-1"/auto : implies 1 for 6G -and- 0 for 2.4G/5G
    ```
  - This is a radio-level setting and not per BSS

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6 GHz - Configurations

- **Unsolicited Probe Response (UPR) / FILS Discovery (FD)**
  - 6 GHz APs must send **either** UPR **or** FD every 20TU
  - NVRAMs needed (Radio level configuration) if using WLCONF :

```
# nvram set wlx_upr_fd_enable 1          # 1: UPR (default)
                                         # 2: FD

# nvram set wlx_upr_fd_method 2          # 1: Software based UPR/FD (not recommended)
                                         # 2: Ucode based UPR/FD (default)

# nvram set wlx_upr_fd_period 20         # 20 TU (default - per spec)
```

  - WL Commands

```
# wl -i wlx nbr_discovery_cap 32         # For UPR : 5th bit should be set (default)
                                         # For FD  : 6th bit should be set

# wl -i wlx upr_fd_sw 2                  # 1: Software based UPR/FD
                                         # 2: Ucode based UPR/FD (default)

# wl -i wlx fd_prb_rsp_period 20         # 20 TU (default - per spec)
```

6 GHz - Configurations

- **OOB Discovery of 6GHz APs (through RNR elements in 2.4G/5G)**
  - Needed to support OOB discovery of 6 GHz AP through co-located 2.4 / 5 GHz APs
  - 2.4 / 5 GHz APs must include co-located 6 GHz AP details through RNR report in beacons/probe responses
  - To support this, the following steps must be done **on both 2.4G and 5G APs** :

    ```
    # wl -i wlx nbr_discover_cap 1        // To enable RNR inclusion in beacons/probe response
    # wl -i wlx rrm 2                     // To enable RNR generation


    Manually add co-located 6 GHz APs to the RNR list

    # wl -i wlx rrm_nbr_add_nbr <6G_bssid> <6G_bssid info> <6G_regulatory class>
                                <6G_operating_channel> <6g_phytype> <6g_ssid>
                                <6g_chanspec> <6g_bss_trans_preference>
                                <6g_bss_param> <6g_transmit_power_in_dbm>

    eg. wl -i wlx rrm_nbr_add_nbr 00:90:4C:37:B5:FD 255 131 5 3 "mytest_ssid_1" 0x5005 0 64 -1
    ```

  - With 21.1 release, you need not explicitly add RRM neighbors if you use WLCONF and WPS_PBCD applications
    You only need to set this nvram for 2.4G / 5G radios

    ```
    # nvram set wlx_nbr_discovery_cap=1
    ```

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MBSSID MAC Address Restrictions

- **Implementation follows that defined in the 11ac/11ax specification when using a single beacon for all BSSIDs**
  - See section "9.4.2.46 Multiple BSSID element" of the IEEE 802.11 standard

- **Broadcom does not enable this new MBSSID implementation in 2.4G/5G implementations**

- **For 6G this is mandatory, and therefore is the default behavior for 6G**

- **For the new MBSSID implementation, the primary BSS and all the virtual BSS can differ only in the last few bits**
  - With the new restriction, for the primary and all virtual BSSIDs, the first 5 ½ bytes should be the same
  - If we support 16 BSS, the last 4 bits will cycle. If we support 8 BSS, the last 3 bits will cycle.

- **Example, showing previous approach, and new address:**
  - wl0:   00:10:18:00:00:01
  - wl0.1: ~~02:10:18:00:00:02~~ ==> ~~62:10:18:00:00:02~~ -- must be 00:10:18:00:00:02
  - wl0.2: ~~02:10:18:00:00:03~~ ==> ~~62:10:18:00:00:03~~ -- must be 00:10:18:00:00:03
  - wl0.3: ~~02:10:18:00:00:04~~ ==> ~~62:10:18:00:00:04~~ -- must be 00:10:18:00:00:04

- **For the primary (wl0) MAC, we can use either a globally unique MAC address, or a locally administered MAC address**
  - If a globally unique MAC is used for the primary, it means you must reserve global mac addresses for virtual BSS as well
  - This approach may consume globally assigned MAC addresses quickly
  - The alternative approach is to use a locally administered MAC for the primary address

- **Please review your MAC assignment scheme to make sure there are no conflicts across multiple devices**
  - This is a manufacturing requirement; BRCM cannot enforce this via SW.

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Thank You

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