



Intel® Wireless Gigabit VR

User Guide

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Revision History

Revision	Description	Date
1.0	Initial release	February, 2018



1 Introduction

1.1 Scope

This document is targeted for OEMs to get familiar with the Intel® WiGig VR solution components. It provides flows for setup, installation and configuration. In case further troubleshooting is required please refer to Ref 9.

1.2 References

Table 1-1 References

	Document name	Description
Ref 1	571416_Intel_WiGig-W11100_VR_PnP_EPS_Rev1.1	WiGig VR PnP External Product Specifications (EPS)
Ref 2	571415_Intel_WiGig_13110_VR_MpP_SNK_EPS_Rev 1.1	WiGig VR Maple Peak SNK External Product Specifications (EPS)
Ref 3	557232_WiGig_R-FEM_External_Product_Specification_Rev3.0	WiGig R-FEM2 External Product Specifications (EPS)
Ref 4	563709_Intel_Wireless_Gigabit_Antenna_M10101R_RFEM3_EPS_Rev0.7	WiGig R-FEM3 External Product Specifications (EPS)
Ref 5	571610_Intel_WiGig-W11100_VR_PnP_PDG_Rev0_8	WiGig VR PnP Platform Design Guidelines
Ref 5	571636_Intel_WiGig_13110_VR_MpP_SNK_PDG_Rev 0_8	WiGig VR MpP SNK Platform Design Guidelines
Ref 6	572100_Intel_WiGig_VR_PTG_Rev1_0	Intel WiGig VR Platform Testing Guidelines
Ref 8	Intel_WiGig_SDK_API (part of the SW package)	API for WiGig driver SDK
Ref 9	First Aid Debug Kit	

1.3 Terminology

Acronym	Description
VR-PnP	Intel® Wireless Gigabit W11100 Pine Peak WiGig-only module. Includes WiGig MAC/BB chip solution for VR-Client side.
VR-SNK	Intel® Wireless Gigabit Sink-M 13110 VR WiGig-only module. Includes WiGig MAC/BB chip solution for VR-SNK side.
R-FEM2	Intel® Wireless Gigabit Antenna-M 10042R
R-FEM3	Intel® Wireless Gigabit Antenna-M 10101R
LOS	Line of sight
NLOS	Non line of sight (single reflection)



Acronym	Description
TPT	Throughput
MA-USB	Media agnostic USB – WiGig USB PAL
SNK	Sink; receiver in A/V applications
HDMI	High definition multimedia interface
SKU	Stock keeping unit
VR	Virtual reality
HMD	Head-mounted display
HID	Human interface device
GPU	Graphics processing unit
IMU	Inertial measurement unit
WGA-P	WiGig gaming add-on
HMDA	HMD add-on, referring to WiGig solution for VR HMD side
WGE	WiGig gaming embedded, referring to the WiGig solution, embedded in VR PC laptops

1.4 VR usage model

The Virtual Reality (VR) tethered system is composed of a head-mounted display (HMD) that is cable-connected to a PC or Laptop. In such system, HMD user is limited to specific movement-types and distance due to the cable connection with the PC.

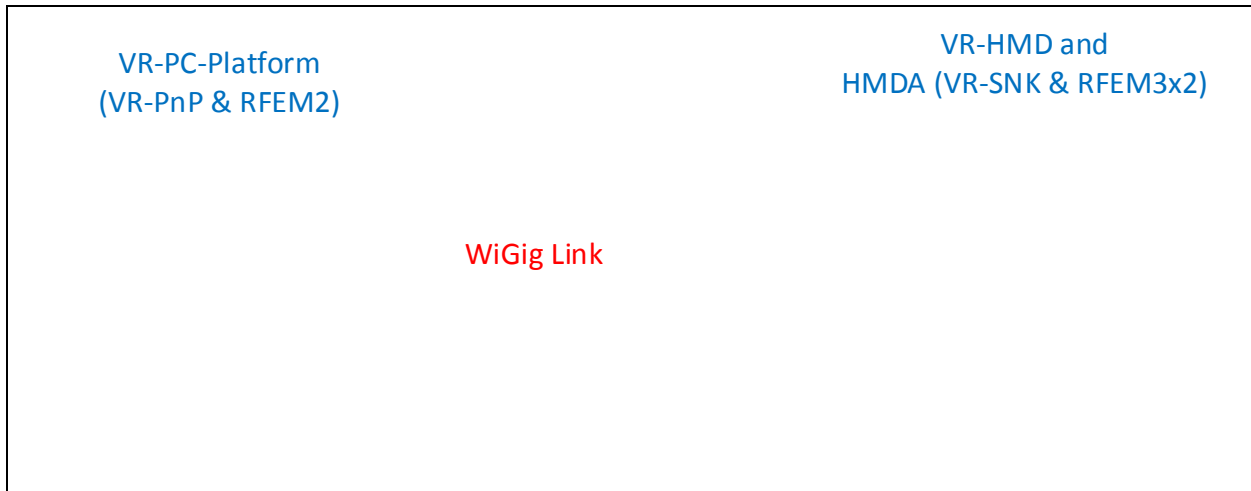
The VR-SNK product, together with the VR-PnP WiGig peer product (see Ref1 and Ref2), allows wireless tethering of the VR system. By communicating all video, audio and control content over a WiGig link, the HMD becomes a stand-alone component, providing freedom of movement and the best user experience. WiGig video latencies and ultra-short USB latencies, combined with superior video quality and low power consumption, allow for a wired-like gaming experience. A high-throughput USB back-channel allows for connection of state-of-the-art human interface devices (HIDs), such as motion detectors and HD cameras, without any quality degradation.

Figure 1-1 presents WiGig VR usage model setup. The components at each side are:

- VR-PC-Platform side, which is a client-side WiGig system, based on VR-PnP and R-FEM2 products. See more details in Table 1-1 1.
- VR-HMD side, connected to HMDA (HMD add on). HMDA is an SNK-side WiGig system, based on VR-SNK and R-FEM3 products. See more details in Table 1-1 2.



Figure 1-1 WiGig VR usage model



2 HW Setup

2.1 WGA

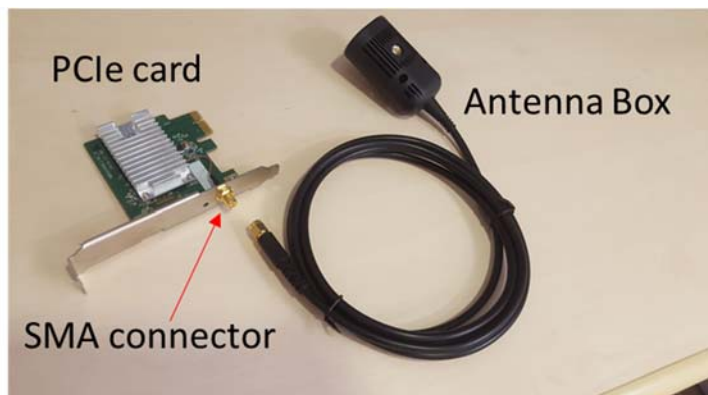
WGA is WiGig Gaming add-on, installed on the PC side. WiGig application is installed on the PC to control the connection with the HMDA side. See 3 for more details.

2.1.1 WGA components

The WGA system includes the following components (see Figure 2-1):

- VR PC desktop platform – a VR-compatible platform
- PCIe card (with PnP module soldered-down)
- Antenna box – a standalone box connected over a ~2m coax cable to an SMA connector exposed by PCIe-WGA's external panel

Figure 2-1 – WGA components



2.1.2 WGA assembly

1. Open the PC cover and insert the WGA to one of the free PCIe slots. Close the PC cover.
2. Connect the antenna box to the SMA connector on the external panel
3. Position the PC in a clear gaming area of up to 7x7m, without line-of-sight obstacles
4. Position the Antenna box at a height of 0.75-1.25m, directed towards center of the room
5. You can check the device manager for "Network Controller" with the Hardware ID as in Figure 2-2, to make sure card is inserted correctly. (Note that after SW installation you should see WiGig driver, see Figure 3-1)

Figure 2-2 - Device manager - PCIe card device

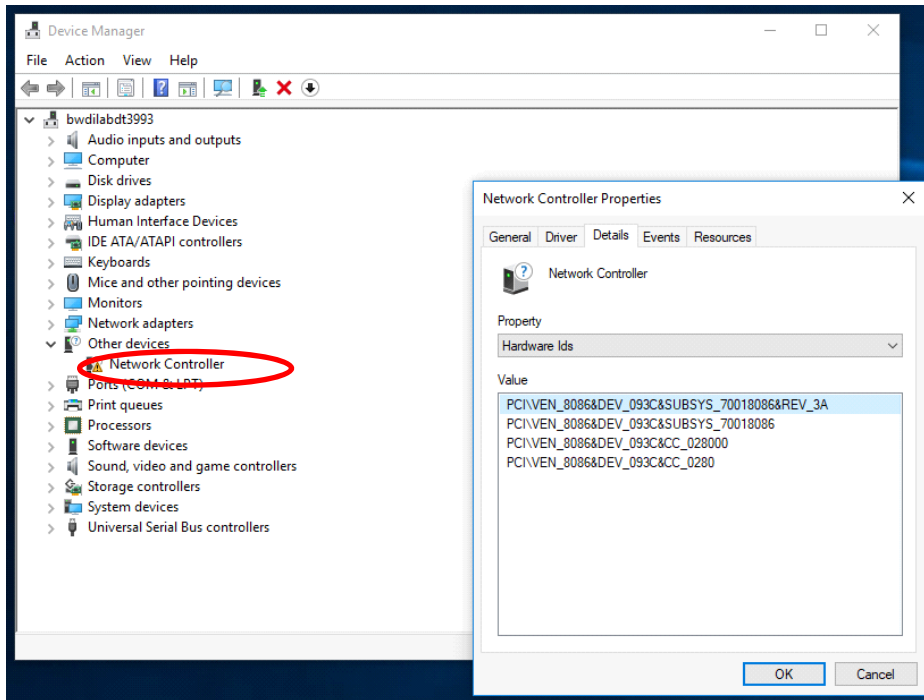
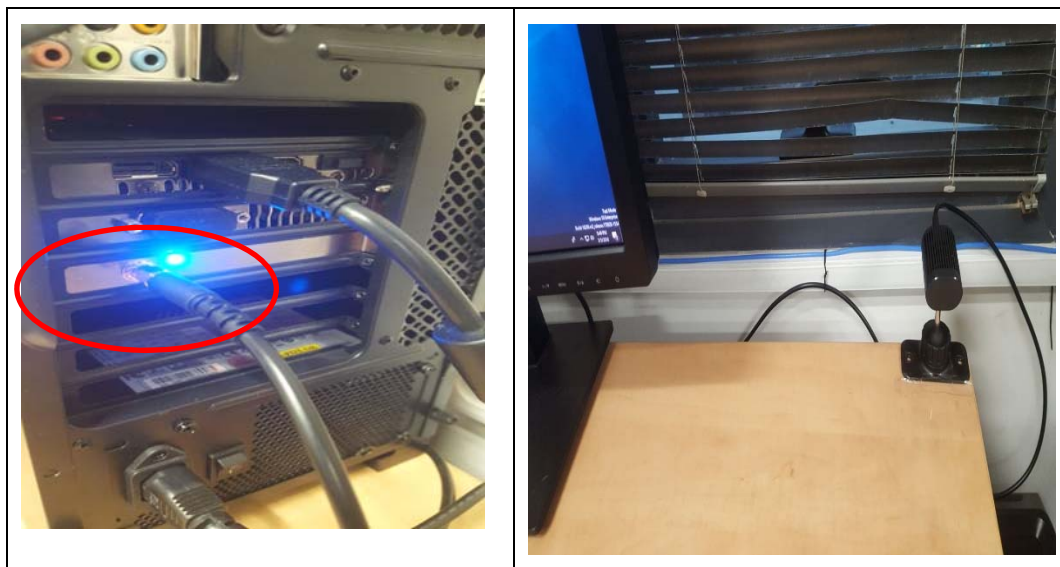


Figure 2-3 - WGA setup – SMA connector, Antenna box mounted on table



2.1.3 PC Requirements

- In order to run VR content smoothly there is minimum system requirements as below:



HW Setup

- CPU –
- GPU –
- OS – Win 7 or Win10 64bit..

2.1.4 Platforms limitations...??

AMD – only on PCH..

....

...

2.2 HMDA

The HMDA is a wireless HMD adapter, integrated on the HMD by the OEM, that allows untethering the HMD from the PC.

2.2.1 HMDA components

- MpL-SNK VR module
- 2 x RFEM3 modules connected over coax cable to MpL-SNK

The HMDA FW is burnt to flash by the OEM during production line process (See Ref 7 for more details). The FW is updated with new versions over the air by the WGA. (see 4.3)



3 Software Install (WGA)

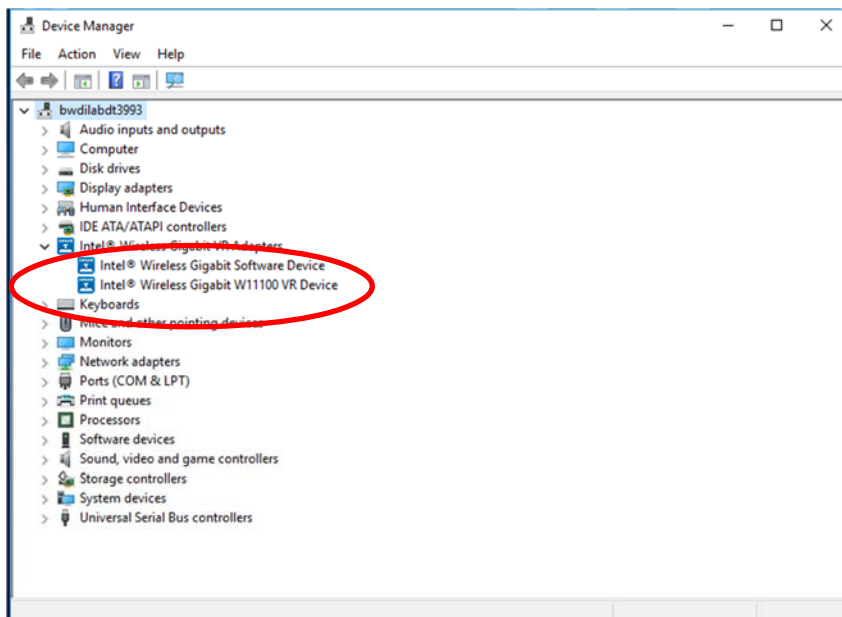
The SW package should be provided by the OEM for installation on the PC side (WGA). This package includes OEM drivers, WiGig driver and encoder driver. The PCIe card must be installed (see 2.1.2) before the SW installation, otherwise WiGig driver installation will fail.

Intel WiGig software has two installation options:

- Installer that includes Intel CU (Connection Utility) application
- Installer that installs only WiGig driver without Intel CU. For this option the OEM needs to develop its proprietary application which is integrated to WiGig SDK API

After installation check the Device Manager for “Intel Wireless Gigabit VR Adapters” as in Figure 3-1.

Figure 3-1 - WiGig driver in Device Manager



3.1 WiGig installation without Intel CU

If the OEM choose to develop their own CU application it requires an integration with Intel SDK (see Ref 8 for more details). OEM package for the end user should include OEM CU and Intel WiGig driver. WiGig driver should be installed by (OEM) calling to setup.exe from NOCU_VR layout\Win7Plus\.

For silent installation the following command should be used:

```
“Setup.exe -silent -norestart -I C:\WiGig\InstallationLogs\WiGig_VR_NB_Setup_exe.txt”
```

For silent uninstall the following command should be used:

```
“Setup.exe -silent -uninstall -norestart -I C:\WiGig\InstallationLogs\WiGig_VR_NB_Setup_exe.txt”
```

*Note that all CU features and user manual under 4 are related to Intel CU only and does not apply to OEM CU. Please refer to the OEM for guidelines on their CU.

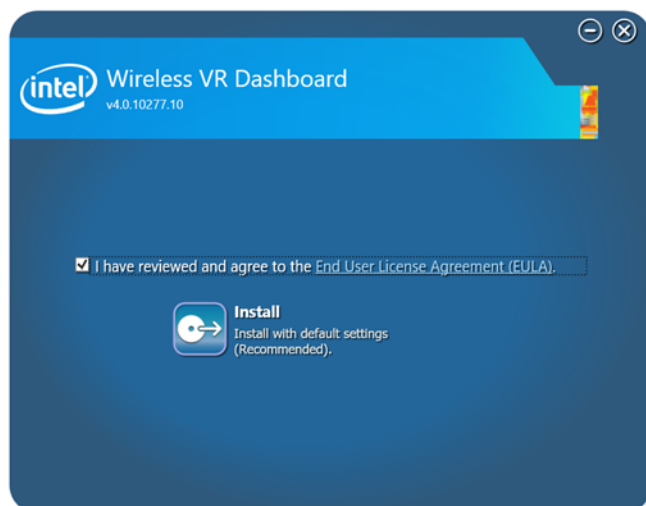


3.2 WiGig installation with Intel CU

3.2.1 WiGig installation (with Intel CU)

1. Go to G_VR Layout\Win7Plus\ and run Setup.exe.

Figure 3-2 - End User License Agreement dialog box



2. Check the "I have reviewed and agree to the EULA" box, and click *Install*. This will install the operational WiGig software for the WGA side.
3. When the application is successfully installed, Click *Finish*, see Figure 3-3.

Figure 3-3 - Success message



4. After installation you will be able to launch the Intel® Wireless VR Dashboard application from the desktop shortcut or by searching the PC programs.





3.2.2 WiGig uninstall (with Intel CU)

When uninstalling the Intel CU the user can select whether to keep the previous settings or discard them, i.e. HMDA profile and settings (see more details about profiles in 4.2.2 and about HMDA settings in 4.2.5)

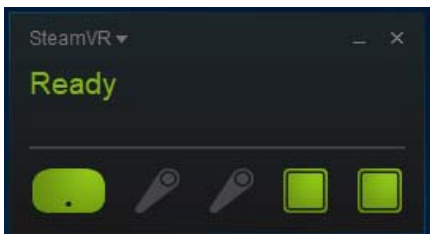
Figure 3-4 - Uninstall window



3.3 Flow for running VR

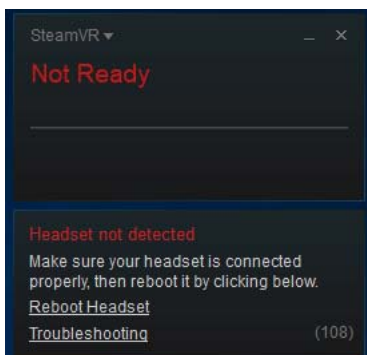
- Install SteamVR (please refer to SteamVR website)
- Install OEM package as described above
- Create a WiGig connection – see in 4.2.1 for WiGig connection creation through Intel CU
- Open SteamVR – It should recognize the HMD and show Figure 3-5

Figure 3-5 - SteamVR Ready



- If SteamVR is opened prior to the WiGig connection the HMD will not be detected and Figure 3-6 will be shown.

Figure 3-6 - SteamVR Not Ready





4 WiGig Application User Manual

Note that this Chapter is only relevant if the SW was installed including Intel CU, as described in paragraph 2.2. OEM CU will have different GUI and may or may not have similar functionalities. Please refer to the OEM for instructions on its proprietary application.

4.1 Launch the Intel® Wireless VR Dashboard



To invoke the Intel® Wireless VR dashboard, double-click the icon on the desktop, or search for this application under the PC programs.

4.2 CU functionalities

The Intel® Wireless VR is a dedicated application that runs on the PC (WGA side) and allows the user to find, connect to, and configure an HMDA.

The CU application has a menu, status bar for a general WiGig status and a notification bar for more information on the status. (See examples in below figures)

LEDs on the HMDA device provide additional feedback about the HMDA status.

The Function button on the HMDA device is used for controlling flows such as pairing and power down indication. A recovery button is used to restore factory FW in case of an issue in current running FW. (See 5 for more details on LEDs and Buttons)

4.2.1 First time connection

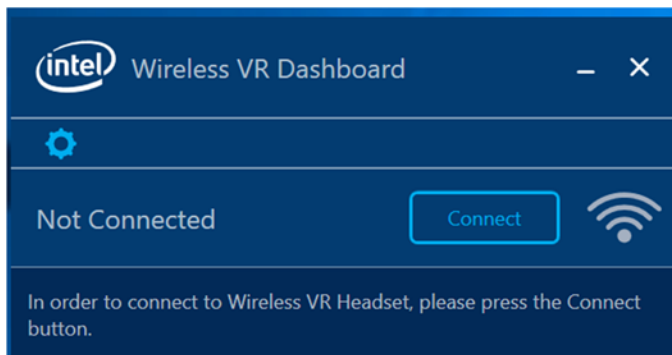
Every time that the WGA is connected to the HMDA, the CU application saves the HMDA profile to be able to connect to it automatically in the following connections (see more details in 4.2.2). When connecting to an HMDA for the first time, a pairing process will be initiated during connection.

4.2.1.1 Out-of-Box / No Profile flows

When the CU is launched for the first time, or when no profile is saved in the CU, the connection flow will be as follows:

1. Power on HMDA, verify functional LED is ON, displaying slow blinking green light (1 blinks/sec).
2. The CU will show “Not Connected” status and a “Connect” button, as can be seen in Figure 3-2.

Figure 4-1 - OOB window



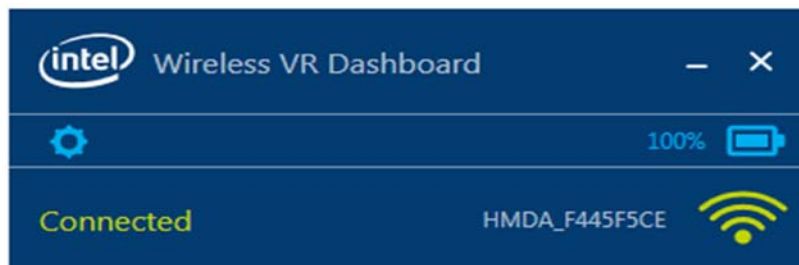
3. Press “Connect” in order to connect to an HMDA in the PC range (as written in the notification bar). A pairing is required since no HMDA profile is saved on the WGA side. The following screen will pop-up, see figure 3-4.

Figure 4-2 - Intel® Wireless VR First Time Connection



4. The HMDA LED will be fast blinking green light. Press your HMDA function button to confirm the connection.
5. Note that all HMDAs in range may blink, but only the one that its button is pressed will be connected.
6. After a successful pairing the status in the CU will be changed to Connected as in **Error! Reference source not found.** and the HMDA LED will become constant green.

Figure 4-3 - HMD connected message

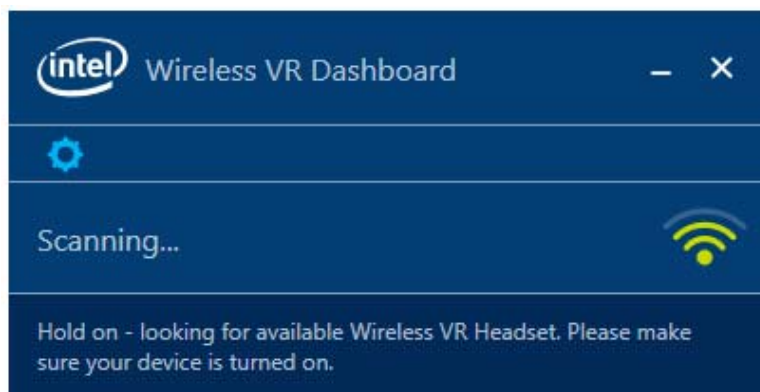


Congratulations! You’ve made your first wireless VR connection.

4.2.1.2 Add New Device

If the CU has a saved HMDA profile it will search for it and the CU will show “Scanning” as in Figure 4-4

Figure 4-4 – Scanning

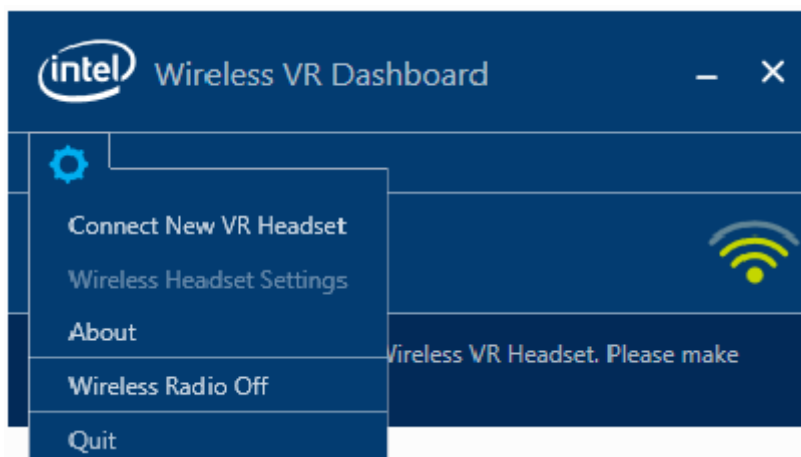


In case the saved HMDA is not in range, or if the user wants to connect to another HMDA, the user should press the Gear icon and select “Connect New VR Headset” (See **Error! Reference source not found.**). Since only one HMDA profile is saved in the WGA, this operation will delete the saved profile and search for HMDAs in range.

Similarly, if an HMDA is already connected and the user wishes to connect to another HMDA, he/she should press the Gear icon and select “Connect New VR headset”. This will disconnect the current HMDA and will start a connection process. The process will proceed as described in 16 similar to first time connection.

Note that the profile of the disconnected HMDA will be deleted and a new pairing will be required on next connection.

Figure 4-5 - Connect New VR Headset

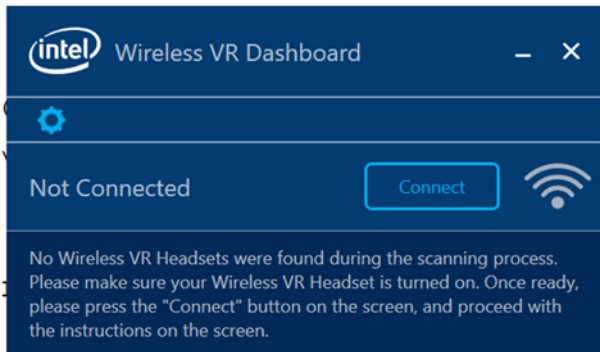


4.2.1.2.1 Add new device timeout

If there is no HMDA in range, or no one pressed the HMDA button to connect, within a predefined time (currently defined as 2 minutes), the connection attempt will stop, the CU status will be set to “Not connected” and the text as seen in Figure 4-6 will be in the notification bar.



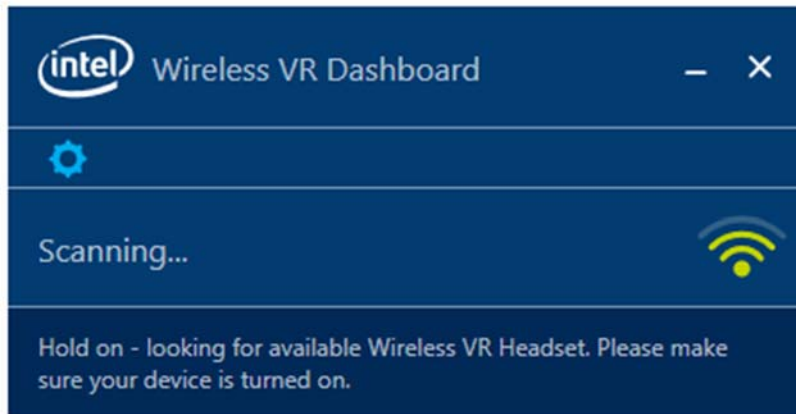
Figure 4-6 New connection timeout message



4.2.2 Automatic connections for existing profile

After first connection of the WGA with an HMDA, a profile will be created for this specific HMDA and the next time the CU is opened it will search for this specific HMDA and will connect to it automatically. When launching the CU with a saved HMDA the following screen will be seen:

Figure 4-7 - Scanning



If the saved HMDA is in range it will connect to it automatically. This automatic connection will occur either when opening the CU (and HMDA is in range) or when the HMDA is entering the range of the WGA (and CU is open).

4.2.2.1 Automatic connection in Sx

When the WGA enters Sx power state while connected to the HMDA, the WiGig will be disconnected and no video will be seen. When the WGA gets back to S0 mode the connection between HMDA and WGA is restored automatically.

4.2.3 Disconnect from the HMDA

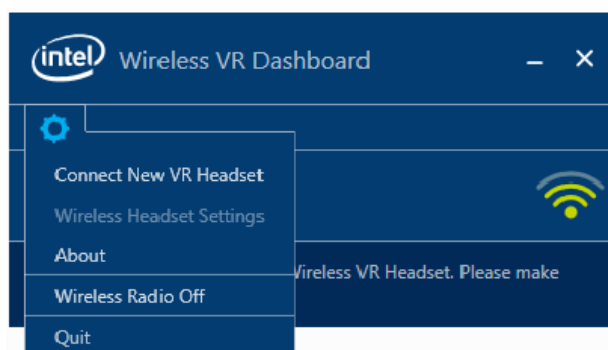
There is no specific command that disconnect the HMDA from the WGA but there are several ways to achieve disconnection:

1. Taking the HMDA out of range of the WGA will eventually cause a link loss and a disconnection. Getting in range again will auto-connect the HMDA, unless the profile was deleted.
2. Power off the HMDA will cause a WiGig disconnection
3. Closing the CU will disconnect the WiGig connection
4. "Add new device" menu will disconnect the current connection (in order to start a new connection)

4.2.4 WiGig Radio Off

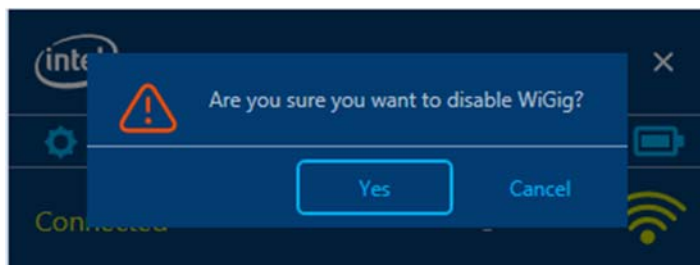
1. To turn the WiGig radio Off click on the Gear icon and select "Wireless Radio Off".

Figure 4-8 - Wireless Radio Off



2. When the popup-menu in **Error! Reference source not found.** appears select yes.

Figure 4-9 - Confirm Radio Off



3. When WiGig Radio is Off, you cannot find and connect to a wireless HMDAs; The CU shows "Not ready" as in Figure 4-10**Error! Reference source not found.**. Turn WiGig radio Off minimizes the power consumption of the WiGig radio in the WGA side.

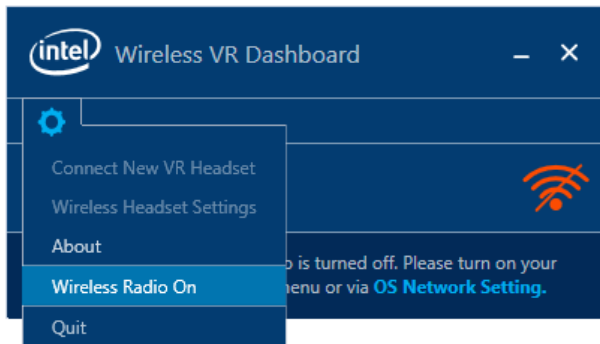


Figure 4-10 - Radio Off status



4. When the radio is off, the menu in the Gear icon will be changed as in Figure 4-11

Figure 4-11 - Wireless Radio On

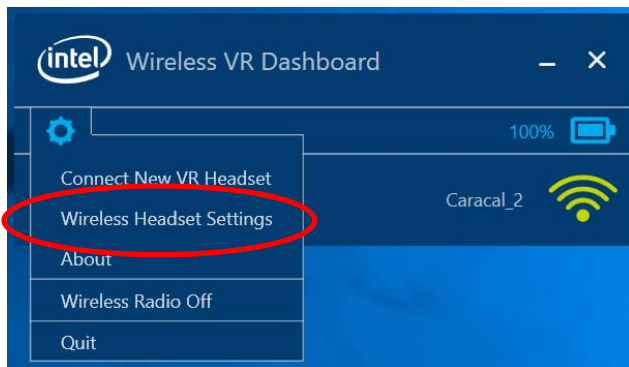


5. Press “Wireless Radio On” to Turn the radio On again.

4.2.5 HMDA settings

While the WGA is connected to an HMDA you can configure the HMDA with few settings through the CU. Click the Gear icon and select “Wireless Headset Settings”, see **Error! Reference source not found.**

Figure 4-12 - CU settings menu



When selecting the “Wireless Headset Settings” the window in **Error! Reference source not found.** pops up.

Figure 4-13 - Wireless Headset Settings



- Device name – Set the name of the HMDA. This is the name that is seen in the CU when this HMDA is connected. The name will be seen for this HMDA for connection with any WGA.
- Channel Selection – default option is Auto – Allows WiGig driver to decide on the channel to use after connecting to the WGA. Other options are Channel 1, Channel 2 or Channel 3 – this option set a fixed channel for this connection. It is helpful when working in dense environment to allow work on different channels for adjacent setups.
- Out Of Zone Indication – In extreme conditions, when the video quality is bad for a certain time, the HMD will show a bluish screen instead of the bad video. This feature can be disabled or enabled using this radio button in the HMDA settings.

4.2.6 About information

A general information such as WiGig and DL SW version can be seen under the Gear icon “About” menu. See **Error! Reference source not found.**

Figure 4-14 - ABout window



The Help link in the ‘About’ page is directed to WiGig page under Intel Customer Support website.

4.2.7 Connection Quality Indication (CQI)

When the PC and HMDA are connected there is an indication of the Channel Quality in the CU (red circle in **Error! Reference source not found.**

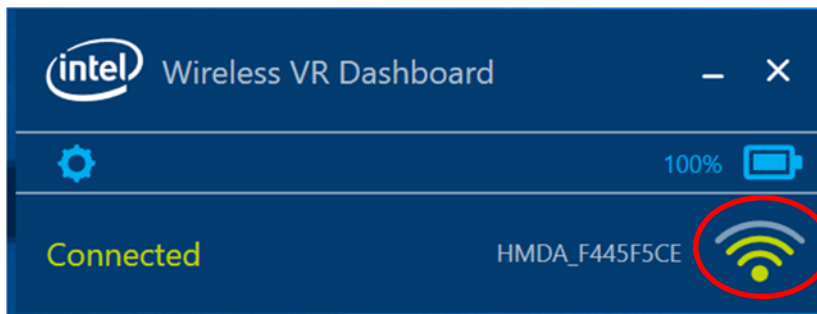


There are 5 levels of the connection quality that are represented by 4 bars as defined in the below table.

Table 4-1 CQI levels

Connection Quality Indication (# of Bars)	High-level Interpretation
4	Best
3	Good
2	Average
1	Poor
0	Insufficient

Figure 4-15 - Connection Quality Indication



4.3 HMDA FW Update

HMDA (VR-SNK) flash memory has 2 slots:

- Factory slot – In the production line the FW is burnt to this slot.
- Current slot – when upgrading the SW Over-The-Air (OTA) it is burnt to the current slot.

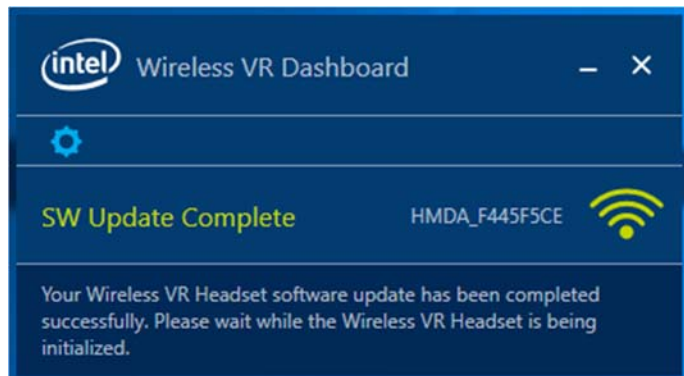
During connection process of the WGA and HMDA, if the SW versions of the WGA and HMDA are not identical, the version at the WGA side will be burnt to the HMDA side OTA, which will cause either upgrade or downgrade of the HMDA SW.

Figure 4-16 - HMDA SW Update progress



During the software update process the HMDA LED will be fast blinking Red.
Once the update process is complete, the HMDA SW is reset, and when reset complete, the WGA will automatically re-connect

Figure 4-17 - HMDA SW Update complete

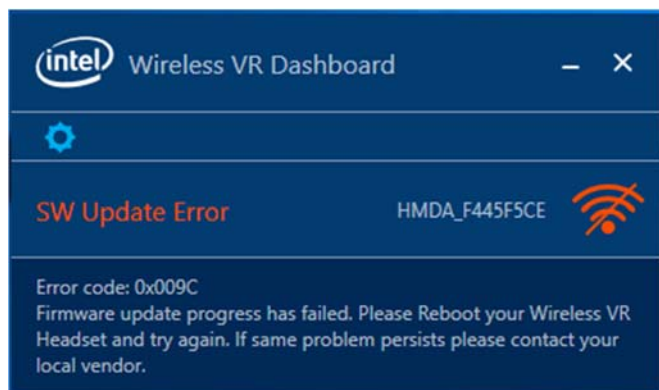


4.3.1 FWU errors

4.3.1.1 SW update progress error

In case of an error that occurred during the SW update process the Error in **Error! Reference source not found.** will be seen in the CU status bar:

Figure 4-18 - SW Update Error during FWU process



4.3.1.2 SW incompatibility error

In some cases there is incompatibility between the SW in the WGA and HMDA which does not allow a FWU. In such case the Error in **Error! Reference source not found.** will be shown and the user will have to install a different SW on the WGA side.



Figure 4-19 - SW Update Error due to SW incompatibility



4.4 Notification messages in CU

In cases of errors or possible limitations, the status bar in the CU (bottom of the CU window) will show a text describing the error and a potential workaround.

See some examples below and a full list in Table 4-2 and Table 4-3

4.4.1 Device status Errors

4.4.1.1 Driver Disabled

When the WiGig driver is disabled, the below Error will be seen. In order to fix this issue the driver should be enabled and a link to the Device Manager is provided.

Figure 4-20 - Driver disabled error message



4.4.1.2 RFEM not connected

When the RFEM of the WGA is not connected (e.g. the user unplugged the antenna) the below error message will be seen. Instructions for Antenna Setup (see figures below) are provided to help the user fix the problem.

Figure 4-21 - RFEM not connected error message

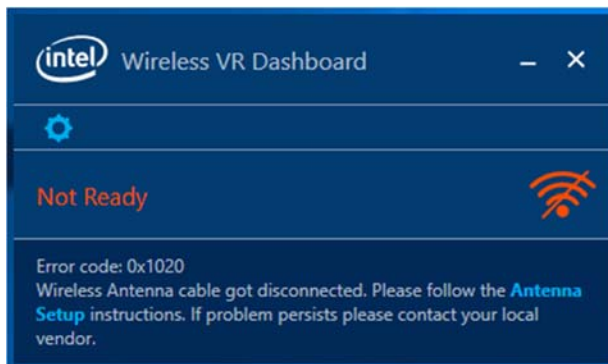


Figure 4-22 Antenna Setup instructions

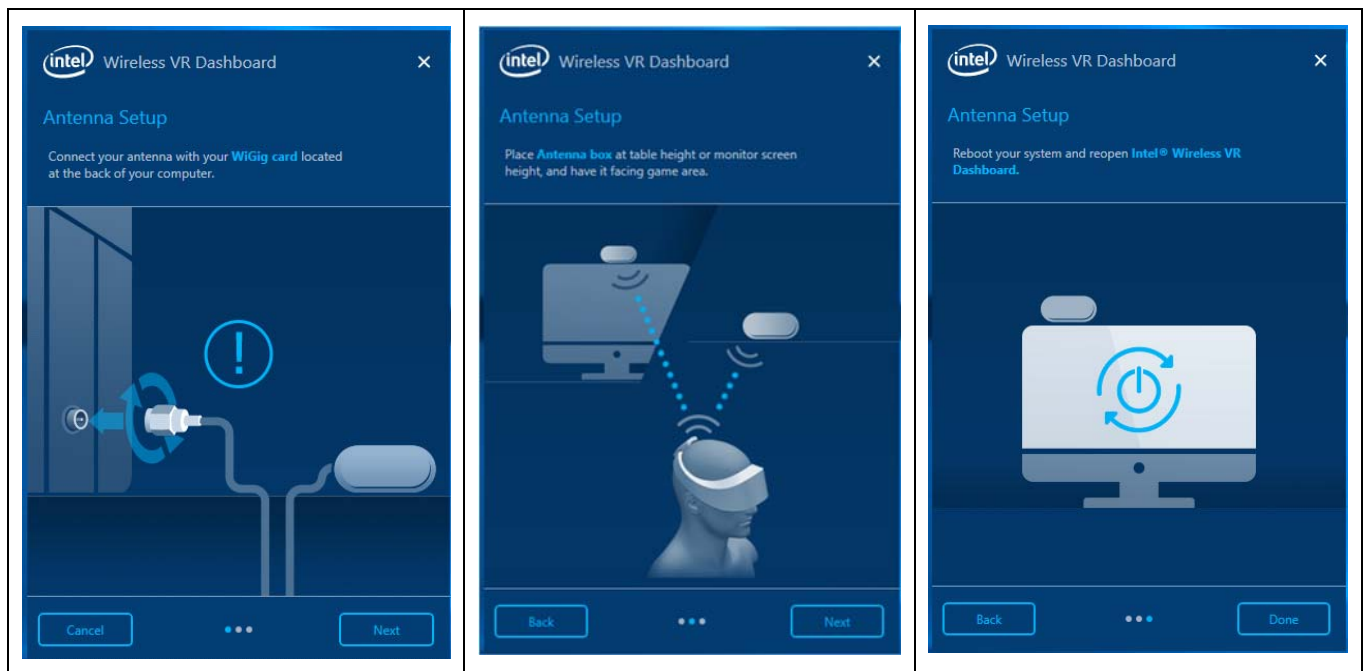




Table 4-2 Error code cases – device status

Item	Error Code	Description	Notification Text
1	0x1000	Device driver is disabled	Error code: 0x1000 It seems that your Wireless VR device driver was disabled. To enable it, please open Device Manager
2	0x1014	RFEM Gen Malfunction	Error code: 0x1014 Wireless Antenna cable got disconnected. Please follow the Antenna Setup instructions. If problem persists please contact your local vendor
3	0x1020	RFEM not connected	Error code: 0x1020 Wireless Antenna cable got disconnected. Please follow the Antenna Setup instructions. If problem persists please contact your local vendor.
4	0x1022	HW not detected	Error code: 0x1022 It seems that your Wireless VR Adapter is not properly connected to PCI interface. Please ensure that device is connected to PCI interface and try rebooting your computer. If problem persists please contact your local vendor.
5	0x1100	Generic Error	Error code: 0x1100 It seems that your Wireless connection experienced an unexpected error, please wait few minutes while we try to restore connection. If problem persist, please reboot your PC and your Wireless VR Headset. For further assistance please visit Help at intel.com

4.4.2 Device RF state Errors

Table 4-3 Error code cases – RF state error

Item	Error Description	Notification Text
1	Airplane Mode is enabled	WiGig has been disabled by Airplane Mode. You must enable Intel WiGig to find and connect to



WiGig Application User Manual

		Wireless Headsets. To enable WiGig, turn Airplane Mode off.
2	RF Off due to Critical Temperature	Please wait few minute and reboot your Wireless VR Headset (should be changed)
3	WiGig disabled due to physical switch	WiGig has been disabled by a physical switch on your computer. You must enable Intel WiGig to find and connect to wireless Headsets. To enable WiGig, turn the physical switch back on.
4	WiGig disabled by SW	It seems that your Wireless Radio is turned off. Please turn on your Wireless Radio via the settings menu or via OS Network Setting.



5 LEDs and Buttons/GPIOs

WiGig VR-SNK provides two LED signals: Red and Green for status indication for the user. It also provides Two GPIO Input signals that allow the user to control the WiGig flows. OEM is responsible to implement the final UX based on these LEDs and signals. See REF 2 for more details.

5.1 LEDs

The following table provides details on the different states and LEDs behavior.

Table 5-1 LEDs behavior

System State	LED	Behavior
Discovery	Green	Slow Blink (1 blink/second)
Waiting PBC	Green	Fast Blink (4 blinks/second)
Connected	Green	Constant On
Errors: <ul style="list-style-type: none">• CT-Kill• FW Upgrade Error	Red	Constant On
FW Upgrade	Red	Fast Blink (4 Hz)

5.2 Buttons/GPIOs

There are 2 Input GPIO signals for the HMDA – Function signal and Recovery signal.

It is the OEM responsibility to define the UX for the buttons controlling these signals. The signals behavior is defined as below:

Table 5-2 Signals behavior

Signal	Pulse	Behavior
Function GPIO	Short	When in "Wait for PBC" state, it will trigger connection establishment
Function GPIO	Long	Power Down Indication – provides an indication that WiGig will be powered down within X secs. This allows the



LEDs and Buttons/GPIOs

		WiGig driver to complete all flows and have a safe power down.
Recovery GPIO	~2 secs high pulse during power cycle	HMDA FW is restored to factory slot, profile and HMDA settings are deleted

There is an additional GPIO which is defined as Output and allows the WiGig driver to indicate it is not connected. This allows OEM to implement HMDA power save.

For more details on all signals please see REF 2.



6 WiGig events in Windows Event Viewer (TBD for WiGig VR)

WiGig SW provides logging information to Windows Event Viewer, both for local PC and for the connected WiGig HMDA. This information appears in Windows Event Viewer under *Applications and Services Logs -> Intel® WiGig*.

6.1 WiGig Event Properties

The events are distinguished by the following list of properties:

- Log Name: Intel® WiGig
- Level: can be
 - Information – Events with this level provides informative data of WiGig flow.
 - Error - Event with this level provides data for erroneous WiGig flow.
- Source: can be
 - iWiGig-Local – Events logged from local WGA side
 - iWiGig-Remote – Events logged from remote HMDA side, that is, WiGig connected to the WGA
- Event ID: Will be always 256
- Task Category: The index for this parameter may belong to the groups listed in Table 6-1. TBD

Table 6-1 List of groups for Task Category parameter in WiGig Events

	<i>Task Category index range</i>	<i>Group type</i>
1	0-199	TBD
2	200-299	TBD
3	300-399	TBD
4	600-699	TBD

6.2 WiGig Event Data

The data per each event provides the following information:

- TBD.

6.3 Accessing WiGig Events Log

The steps to access the WiGig Events log are

1. Open the Windows Event Viewer.
2. On the left-hand pane, Go to *Applications and Services Logs-> Intel® WiGig*.
The middle pane displays the list of WiGig events.
3. The user can click on each event and see its specific details on the bottom pane.



WiGig events in Windows Event Viewer (TBD for WiGig VR)


4. By right-clicking on *Applications and Services Logs->Intel® WiGig* (on the left-hand pane), user may save the WiGig Events log or perform other operations as allowed by the Event Viewer.



7 End User Logging Utility (EULU)

- damage to the radio.
- Use in specific environments:
 - The use of wireless adapters in hazardous locations is limited by the constraints posed by the safety directors of such environments.
 - The use of wireless adapters on airplanes is governed by the Federal Aviation Administration (FAA).
 - The use of wireless adapters in hospitals is restricted to the limits set forth by each hospital.


Explosive Device Proximity Warning

 **Warning:** Do not operate a portable transmitter (including this wireless adapter) near unshielded blasting caps or in an explosive environment unless the transmitter has been modified to be qualified for such use.

Antenna Warnings

 **Warning:** The wireless adapter is not designed for use with high-gain directional antennas.

Use On Aircraft Caution


 **Caution:** Regulations of commercial airline operators may prohibit airborne operation of certain electronic devices equipped with radio-frequency wireless devices (wireless adapters) because their signals could interfere with critical aircraft instruments.

 **Caution:** 60 GHz/802.11ad equipment is not permitted on aircraft per FCC §15.255. OEM and host integrators should consider this FCC rule in host devices.

Other Wireless Devices

Safety Notices for Other Devices in the Wireless Network: See the documentation supplied with wireless adapters or other devices in the wireless network.

Local Restrictions on 802.11a, 802.11b, 802.11d, 802.11g, 802.11n, and 802.11ac Radio Usage

 **Caution:** Due to the fact that the frequencies used by 802.11a, 802.11b, 802.11d, 802.11g, 802.11n, and 802.11ac wireless LAN devices may not yet be harmonized in all countries, 802.11a, 802.11b, 802.11d, 802.11g, 802.11n, and 802.11ac products are designed for use only in specific countries, and are not allowed to be operated in countries other than those of designated use. As a user of these products, you are responsible for ensuring that the products are used only in the countries for which they were intended and for verifying that they are configured with the correct selection of frequency and channel for the country of use. The device transmit power control (TPC) interface is part of the Intel® PROSet/Wireless WiFi Connection Utility Software. Operational restrictions for Equivalent Isotropic Radiated Power (EIRP) are provided by the system manufacturer. Any deviation from the permissible power and frequency settings for the country of use is an infringement of national law and may be punished as such.

Wireless Interoperability

The wireless adapter is designed to be interoperable with other wireless LAN products that are based on direct sequence spread spectrum (DSSS) radio technology and to comply with the following standards:

- IEEE Std. 802.11b compliant Standard on Wireless LAN
- IEEE Std. 802.11g compliant Standard on Wireless LAN
- IEEE Std. 802.11a compliant Standard on Wireless LAN
- IEEE Std. 802.11n compliant Standard on Wireless LAN
- IEEE Std. 802.11ac draft compliant on Wireless LAN
- Wireless Fidelity certification, as defined by the Wi-Fi Alliance

The Wireless Adapter and Your Health

The wireless adapter, like other radio devices, emits radio frequency electromagnetic energy. The level of energy

emitted by the wireless adapter, however, is less than the electromagnetic energy emitted by other wireless devices such as mobile phones. The wireless adapter operates within the guidelines found in radio frequency safety standards and recommendations. These standards and recommendations reflect the consensus of the scientific community and result from deliberations of panels and committees of scientists who continually review and interpret the extensive research literature. In some situations or environments, the use of the wireless adapter may be restricted by the proprietor of the building or responsible representatives of the applicable organization. Examples of such situations may include:

- Using the wireless adapter on board airplanes, or
- Using the wireless adapter in any other environment where the risk of interference with other devices or services is perceived or identified as being harmful.

If you are uncertain of the policy that applies to the use of wireless adapters in a specific organization or environment (an airport, for example), you are encouraged to ask for authorization to use the adapter before you turn it on.

REGULATORY INFORMATION

USA - Federal Communications Commission (FCC)

This wireless adapter is restricted to indoor use due to its operation in the 5.15 to 5.25 and 5.470 to 5.75GHz frequency ranges. No configuration controls are provided for Intel® wireless adapters allowing any change in the frequency of operations outside the FCC grant of authorization for U.S. operation according to Part 15.407 of the FCC rules.

- Intel® wireless adapters are intended for OEM integrators only.
- Intel® wireless adapters cannot be co-located with any other transmitter unless approved by the FCC.

This wireless adapter complies with Part 15 of the FCC Rules. Operation of the device is subject to the following two conditions:

- This device may not cause harmful interference.
- This device must accept any interference that may cause undesired operation.

NOTE: The radiated output power of the adapter is far below the FCC radio frequency exposure limits. Nevertheless, the adapter should be used in such a manner that the potential for human contact during normal operation is minimized. To avoid the possibility of exceeding the FCC radio frequency exposure limits, you should keep a distance of at least 20cm between you (or any other person in the vicinity), or the minimum separation distance as specified by the FCC grant conditions, and the antenna that is built into the computer. Details of the authorized configurations can be found at <http://www.fcc.gov/oet/ea/> by entering the FCC ID number on the device.

Class B Device Interference Statement

This wireless adapter has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This wireless adapter generates, uses, and can radiate radio frequency energy. If the wireless adapter is not installed and used in accordance with the instructions, the wireless adapter may cause harmful interference to radio communications. There is no guarantee, however, that such interference will not occur in a particular installation. If this wireless adapter does cause harmful interference to radio or television reception (which can be determined by turning the equipment off and on), the user is encouraged to try to correct the interference by taking one or more of the following measures:

- Reorient or relocate the receiving antenna of the equipment experiencing the interference.
- Increase the distance between the wireless adapter and the equipment experiencing the interference.
- Connect the computer with the wireless adapter to an outlet on a circuit different from that to which the equipment experiencing the interference is connected.
- Consult the dealer or an experienced radio/TV technician for help.

NOTE: The adapter must be installed and used in strict accordance with the manufacturer's instructions

as described in the user documentation that comes with the product. Any other installation or use will violate FCC Part 15 regulations.

Safety Approval Considerations

This device has been safety approved as a component and is for use only in complete equipment where the acceptability of the combination is determined by the appropriate safety agencies. When installed, consideration must be given to the following:

- It must be installed into a compliant host device meeting the requirement of UL/EN/IEC 60950-1 2nd edition including the general provisions of enclosure design 1.6.2 and specifically paragraph 1.2.6.2 (Fire Enclosure).
 - The device shall be supplied by a SELV source when installed in the end-use equipment.
 - A heating test shall be considered in the end-use product for meeting the requirement of UL/EN/IEC 60950-1 2nd edition.
-

Low Halogen

Applies only to brominated and chlorinated flame retardants (BFRs/CFRs) and PVC in the final product. Intel components as well as purchased components on the finished assembly meet JS-709 requirements, and the PCB / substrate meet IEC 61249-2-21 requirements. The replacement of halogenated flame retardants and/or PVC may not be better for the environment.

Canada – Industry Canada (IC)

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Cet appareil se conforme aux normes Canada d'Industrie de RSS permis-exempt. L'utilisation est assujetti aux deux conditions suivantes: (1) cet appareil ne peut pas causer d'interférences, et (2) cet appareil doit accepter des interférences, y compris des interférences qui peuvent causer des opérations non désirées de l'appareil.

Caution: When using IEEE 802.11a wireless LAN, this product is restricted to indoor use due to its operation in the 5.15- to 5.25-GHz frequency range. Industry Canada requires this product to be used indoors for the frequency range of 5.15GHz to 5.25GHz to reduce the potential for harmful interference to co-channel mobile satellite systems. High power radar is allocated as the primary user of the 5.25- to 5.35-GHz and 5.65 to 5.85-GHz bands. These radar stations can cause interference with and/or damage to this device. The maximum allowed antenna gain for use with this device is 6dBi in order to comply with the E.I.R.P limit for the 5.25- to 5.35 and 5.725 to 5.85GHz frequency range in point-to-point operation. To comply with RF exposure requirements all antennas should be located at a minimum distance of 20cm, or the minimum separation distance allowed by the module approval, from the body of all persons.

Attention: l'utilisation d'un réseau sans fil IEEE802.11a est restreinte à une utilisation en intérieur à cause du fonctionnement dans la bande de fréquence 5.15-5.25 GHz. Industry Canada requiert que ce produit soit utilisé à l'intérieur des bâtiments pour la bande de fréquence 5.15-5.25 GHz afin de réduire les possibilités d'interférences nuisibles aux canaux co-existants des systèmes de transmission satellites. Les radars de puissances ont fait l'objet d'une allocation primaire de fréquences dans les bandes 5.25-5.35 GHz et 5.65-5.85 GHz. Ces stations radar peuvent créer des interférences avec ce produit et/ou lui être nuisible. Le gain d'antenne maximum permmissible pour une utilisation avec ce produit est de 6 dBi afin d'être conforme aux limites de puissance isotropique rayonnée équivalente (P.I.R.E.) applicable dans les bandes 5.25-5.35 GHz et 5.725-5.85 GHz en fonctionnement point-à-point. Pour se conformer aux conditions d'exposition de RF toutes les antennes devraient être localisées à une distance minimum de 20 cm, ou la distance de séparation minimum permise par l'approbation du module, du corps de toutes les personnes.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Selon les règlements de Canada d'Industrie, cet émetteur de radio peut seulement fonctionner en utilisant une antenne du type et de gain maximum (ou moindre) que le gain approuvé pour l'émetteur par Canada d'Industrie. Pour réduire les interférences radio potentielles avec les autres utilisateurs, le type d'antenne et son gain devraient être choisis de façon à ce que la puissance isotrope rayonnée équivalente (P.I.R.E.) ne soit pas supérieure à celle qui est nécessaire pour une communication réussie.
