



Pivotal Echo 5G™

Installation Manual

Version 1.0

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Safety and Regulatory Information

This manual should be read and used as a guideline for properly installing and operating the Pivotal Echo 5G device. This manual may be changed for system improvement, standardization, and other technical reasons without prior notice. Updated manuals are available at: <https://pivotalcommware.com/Echo5GUserManual.pdf>.

For questions on the manual or their content, contact support@pivotalcommware.com.

FCC Signal Booster User Information

WARNING. This is not a CONSUMER device. This device may not be sold at retail. You **MUST** have an FCC LICENSE or express consent of an FCC Licensee (or express consent of your service provider) to operate this device. Antennas must be installed at least 20 cm (8 inches) from any person. Unauthorized use may result in significant forfeiture penalties, including penalties in excess of \$100,000 for each continuing violation.

FCC Part 15 Information for User

Outdoor Unit (ODU) – FCC ID: **2AUVU-OES3**.

- This device contains FCC IDs: **2AUVU-UBR410M** and **Z64-WL18SBMOD**

Indoor Unit (IDU) – FCC ID: **2AUVU-IES3**

Pursuant to part §15.21 of CFR Title 47, you are cautioned that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Note: This equipment 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 equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment 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 one or more of the following measures

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment to an outlet on a circuit different from that which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

FCC Radiation Exposure Statement

To ensure the safety of users, the FCC has established criteria for the amount of radio frequency energy various products may produce depending on their intended usage. This product has been evaluated to comply with the FCC's exposure criteria. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

The installation of the Echo unit should allow at least **20 centimeters** between the device and persons to be in compliance with FCC RF exposure guidelines.

Use only Pivotal Commware approved power supplies and accessories that are specifically designed for your Echo device.

Intellectual Property

All Intellectual Property, as defined below, owned by or which is otherwise the property of Pivotal Commware, Inc. ("Pivotal") or its respective suppliers relating to the Pivotal device, i.e., Pivotal Echo 5G, including but not limited to, accessories, parts, or software relating thereto (the "Echo 5G"), is proprietary to Pivotal and protected under federal laws, state laws, and international treaty provisions. "Intellectual Property" means any Pivotal (or where applicable, Pivotal's supplier's) intellectual property including, but not limited to, inventions (patentable or unpatentable), patents, trade secrets, copyrights, software, computer programs, and related documentation and other works of authorship. You may not infringe or otherwise violate the rights secured by the Intellectual Property. Moreover, you agree that you will not (and will not attempt to) modify, prepare derivative works of, reverse engineer, decompile, disassemble, or otherwise attempt to create source code from the software. No title to or ownership in the Intellectual Property is transferred to you. All applicable rights of the Intellectual Property shall remain with Pivotal and its suppliers.

Disclaimer of Warranties; Exclusion of Liability

This document provides an introduction to features, functions, setup, and operation of Pivotal Commware's Echo 5G. For more information, refer to the [Warranty Information](#).

Contact Information

Headquarters:
10801 120th Ave NE #200
Kirkland, WA 98033 USA
www.pivotalcommware.com

Do you have questions about your Echo 5G device?

For 24-hour information and assistance, please contact Verizon's Automated Response System at:

www.verizonwireless.com/support/

Overview of Echo 5G

The Echo 5G is a self-installable, on-the-window, precision beamforming repeater designed to counteract mmWave penetration, reflection, and structural shadowing losses so it can gently flood an interior with native mmWave signal. Essentially, the Echo 5G acts as a portal between indoor and outdoor worlds.

For fixed wireless access (FWA) providers serving homes and enterprises, the Echo 5G facilitates Gigabit speeds and introduces a superior broadband choice and experience to cable and DSL end users. For 5G-connected devices, the Echo 5G enables outdoor-to-indoor signal transitions so users can ubiquitously enjoy the immersive 5G experiences that only mmWave capacity can deliver.

The Echo 5G product line accomplishes this using Pivotal's patented Holographic Beam Forming® (HBF) technology whose cost, size, weight, and power consumption (C-SWaP) profile is significantly lower than phased array beamformers; specifically, an order of magnitude less cost, less than half the weight, and less than one-third the power consumption.

With HBF, Echo 5G overcomes a major obstacle to cost-effectively delivering 5G broadband access to homes and businesses with mmWave-in-building penetration.

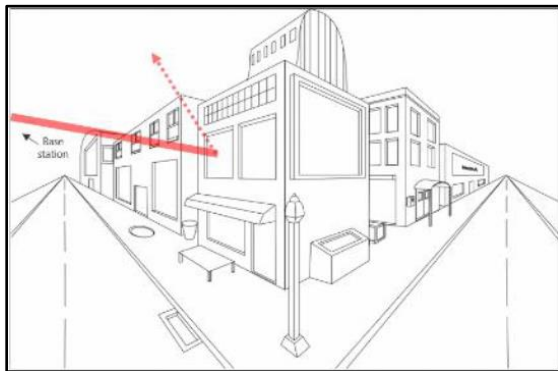


Figure 1: Millimeter wave signals bounce off windows

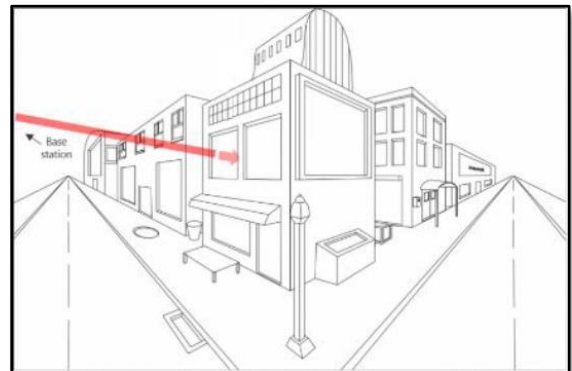


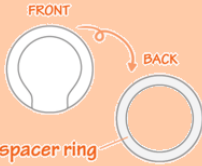








Figure 2: The Echo 5G boosts the signals through the glass

Installation & Setup

The Echo 5G is designed to be easily installed. The following material provides guidance to perform a typical installation. Subsequent sections offer additional assistance if needed.

System Components

| | |
|---|---|
|  | <p>Echo 5G ODU (1)</p> <p>Outdoor unit (ODU) with HBF antenna and RF front-end functions:</p> <ul style="list-style-type: none"> Conveys wireless data between user devices and nearby base station |
|  | <p>Rail-mounting tool (1)</p> <p>For mounting the rails that hold the ODU – comes with pre-attached mounting rails and adhesive. ‘This Side Up’ text and arrow sticker indicate proper orientation.</p> |
|  | <p>Wireless Power IDU (1)</p> <p>Indoor Unit (IDU): transmits power through the glass to ODU equipment</p> |
|  | <p>Power Adapter (1)</p> <p>Provides power from wall outlet to IDU</p> |
|  | <p>Alignment cling (1)</p> <p>Mounts on indoor glass side of Echo 5G, helps with positioning IDU</p> |
|  | <p>Extra Rails (2)</p> <p>To replace rails pre-attached to rail-mounting tool, if necessary</p> |

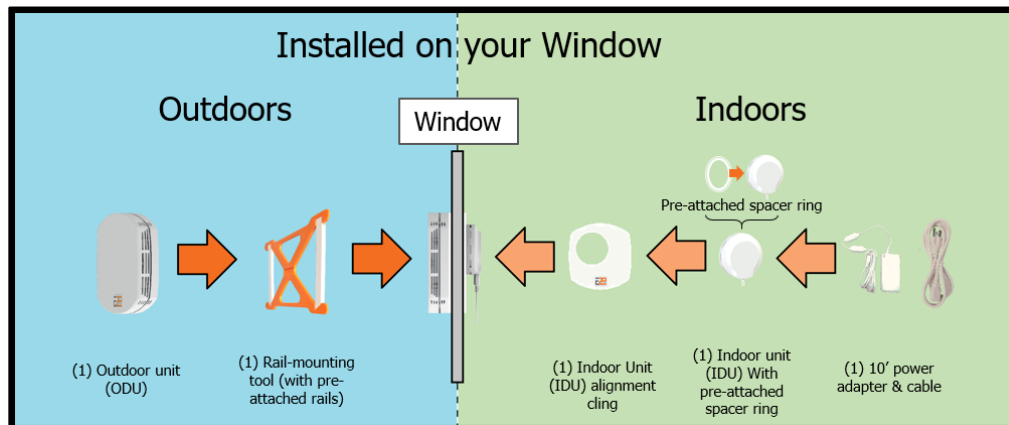
| | |
|---|--|
|  | Cleaning Wipes (1) To clean both sides of the window before mounting to ensure a good bond between the adhesive and the window |
|  | Allen Wrench (1) To tighten the set screws on each side of the ODU so it is secured to the rails |
|  | Removal Tool (1) To remove the rails and rail adhesive if necessary. |

General Configuration

Here's an example of the Echo 5G system configuration along with a diagram of the components that are installed on your window.



Figure 3: Window-mounted system: Echo Outdoor Unit (ODU) attaches to outside of window and smaller Indoor Unit (IDU) attaches to inside.



Note: The rail-mounting tool is only for installing the rails. It is not part of the final installation.

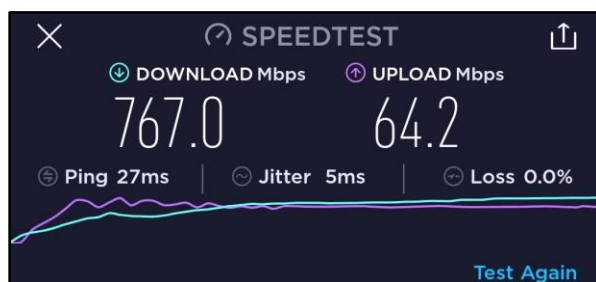
Choosing a Location for your Echo 5G

The window you choose for your Echo 5G must:

- Receive quality 5G reception
- Be large enough to mount the rails at least **5 inches** from any window edge or the ground (which positions the ODU so the window edges do not interfere with signal)
- Have an outlet within **10 feet** of the mounting location indoors for plugging in the IDU

Finding the Best Window for Reception

Identify the window with the best 5G reception by turning off your phone's wi-fi, downloading the SpeedTest App from your phone's App store, opening the app, and selecting 'Go.'



Pre-Installation Cleaning

Clean the **inside and outside** of the window glass according to the instructions on the back of the packet of wipes included with your Echo 5G.

- [1]** Wipe glass vertically and then horizontally to ensure complete coverage. Be sure pad is wetting the glass surface.
- [2]** While glass surface is still wet, wipe dry with a clean dry cloth or paper towel.

- [3] Apply the item(s) to be bonded within thirty minutes.

Installing Outdoor (ODU) and Indoor (IDU, alignment cling) Components

Make sure you have carefully [selected a good window](#) and performed the [required glass cleaning](#) before installing your Echo 5G.

IMPORTANT: Ensure the rails and window stay dry throughout the mounting process.

Installing the ODU on the outside of your window

- [1] Remove the strips to expose the adhesive on the rails that are pre-attached to the rail mounting tool.



- [2] Make sure the rail-mounting tool is aligned per the 'This Side Up' text at the top of the tool with the arrow in the upper-right facing up, that the rails are level, and that you are mounting the rails at least 5 inches from any window edge. Press the mounting tool so that the rails adhere to the outside of your window.

- [3] Run your thumbs up and down the rails, pressing hard for 30 seconds.



Repeat for
30 seconds



- [4] Pop the mounting tool off the rails by holding the rails and using the tabs on the side of the tool. Let the adhesive cure for one hour before sliding the ODU onto the rails.



Wait 60 minutes

- [5]** Slide the ODU onto the rails.



- [6]** Use the included Allen wrench to tighten the set screws on the ODU so the unit is secured to the rails.



Installing the IDU on the Inside of your Window

- [7]** Remove the alignment cling from its backing and attach it to the indoor side of the glass, lining up the cling inside with the ODU mounted on the outside.



- [8]** Remove the backing from the adhesive on the ring pre-attached to the IDU. Line the IDU up in the corresponding viewport in the cling.
- [9]** Press the IDU firmly to the window and hold for 30 seconds.



Note: the adhesive ring adheres to the spacer ring and IDU with Velcro so you can remove the IDU and adjust as necessary once the adhesive-backed Velcro is secured to the window as outlined above.



Disassembled IDU (velcro, one side), spacer ring (Velcro, both sides), and Velcro-to-window adhesive



Assembled IDU, spacer ring, and Velcro-to-window adhesive

- [10]** Once the IDU has been applied to the window, insert the power adapter and plug the IDU in to a standard 110V outlet. The IDU lights will blink before going solid. If the green IDU light continues blinking for more than 30 seconds, remove the spacer ring and re-attach the IDU.



Connecting to Echo 5G

You will activate the Echo 5G using the Echo 5G Manager web interface. In order to do this, you must first establish a wireless Bluetooth connection to the Echo device from your [laptop](#) or [smartphone](#).

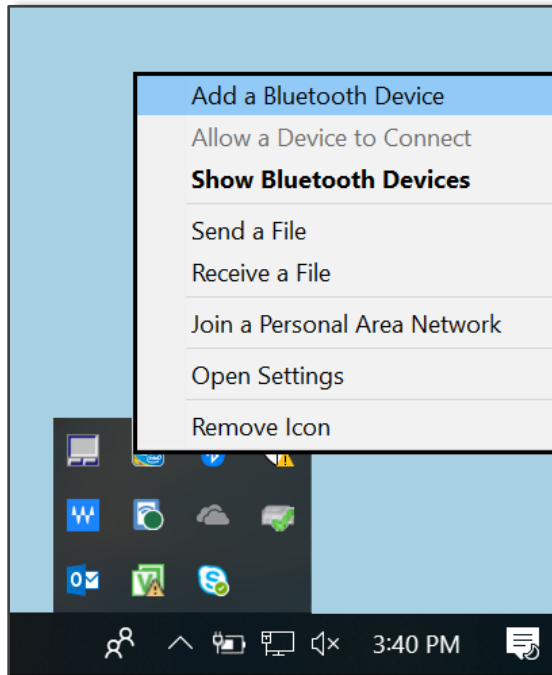
Your laptop/smartphone and the Echo will communicate via Bluetooth. (Specifically, they communicate via IP over a Bluetooth connection). Once connected, you will need to keep your laptop or smartphone within **10 feet** of the Echo unit until you are finished with activation.

Add the Echo 5G as a Recognized Device via Laptop

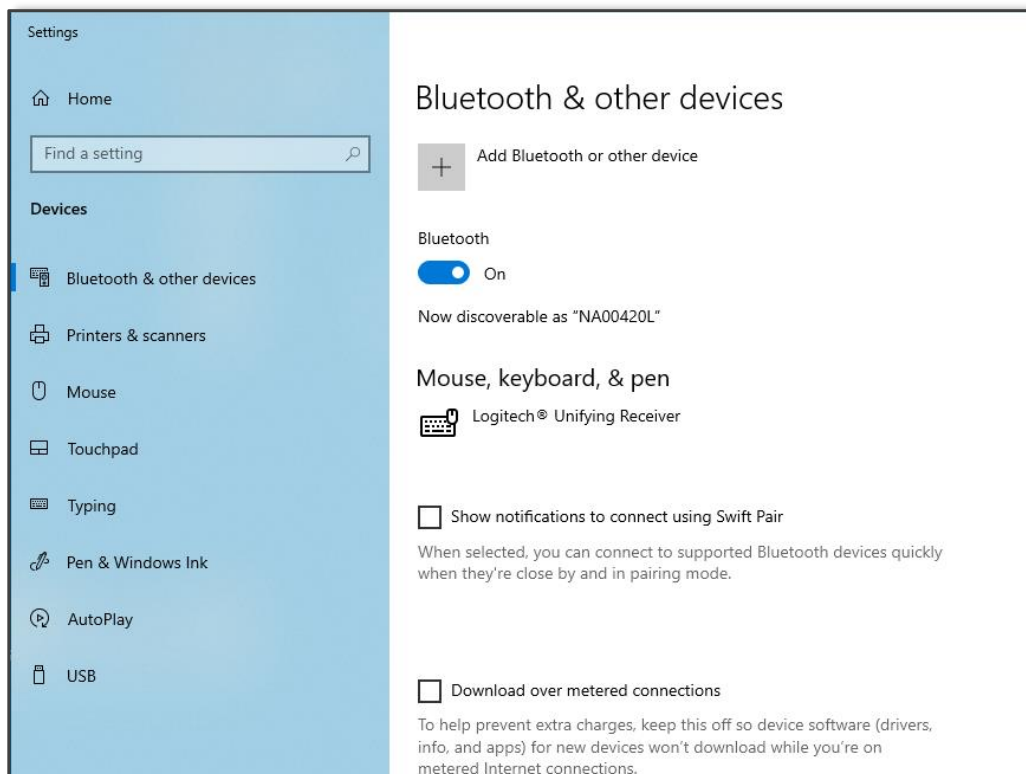
- [1] Power on the Echo 5G so the laptop can discover it as a nearby Bluetooth device.
- [2] On your laptop toolbar, right-click the Bluetooth icon:



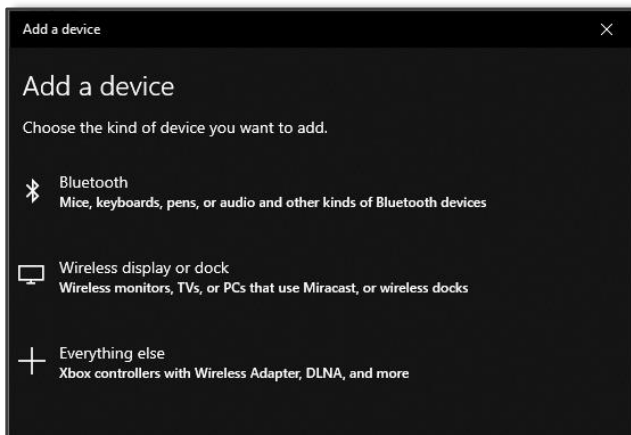
[3] In the pop-up list, select **Add a Bluetooth Device**.



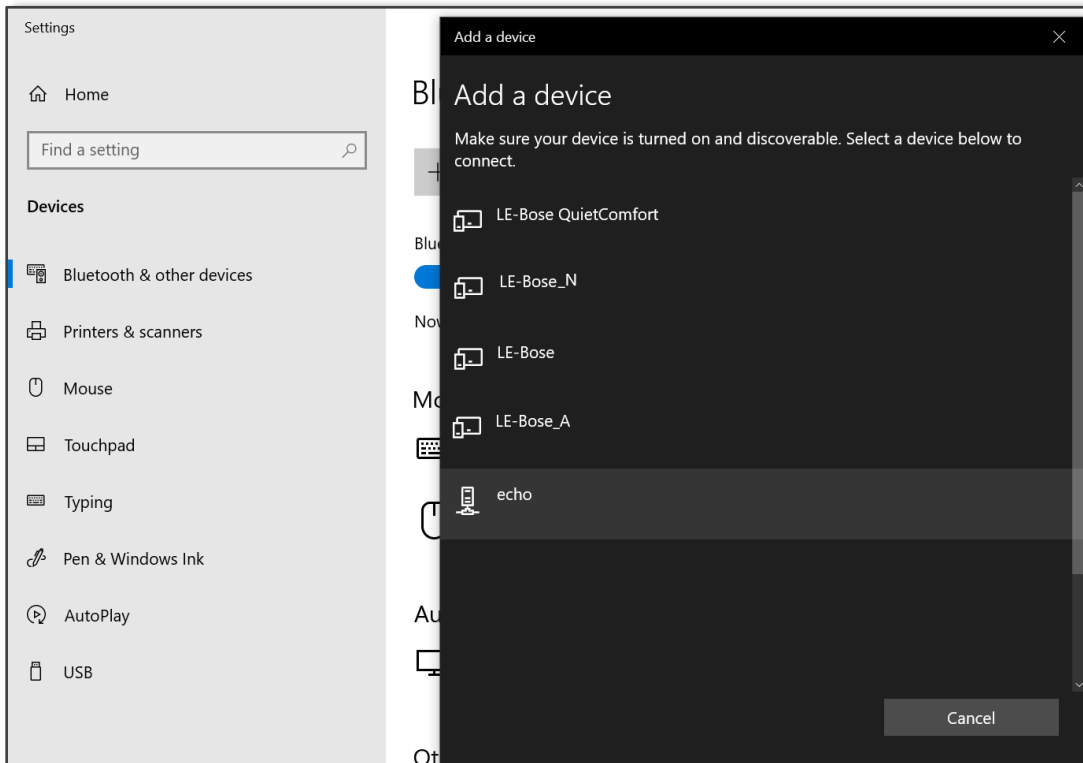
[4] A Settings screen will appear with a list of options (left side). Select **Bluetooth & other devices** if it doesn't show by default, then select **Add Bluetooth or other device**.



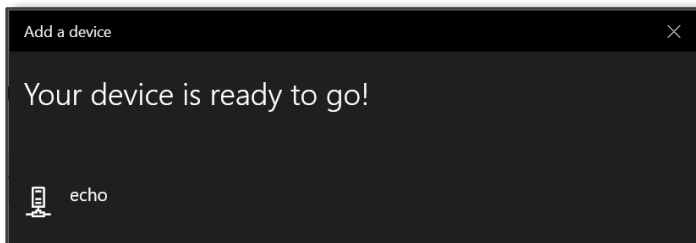
[5] Select **Bluetooth** as the intended device type.



[6] Select the Echo from the displayed list of nearby Bluetooth devices. It will show as 'echo.'



[7] This adds your Echo unit to the list of devices available for interaction with the laptop. You will see a confirmation message when the Echo and your laptop are finished pairing.



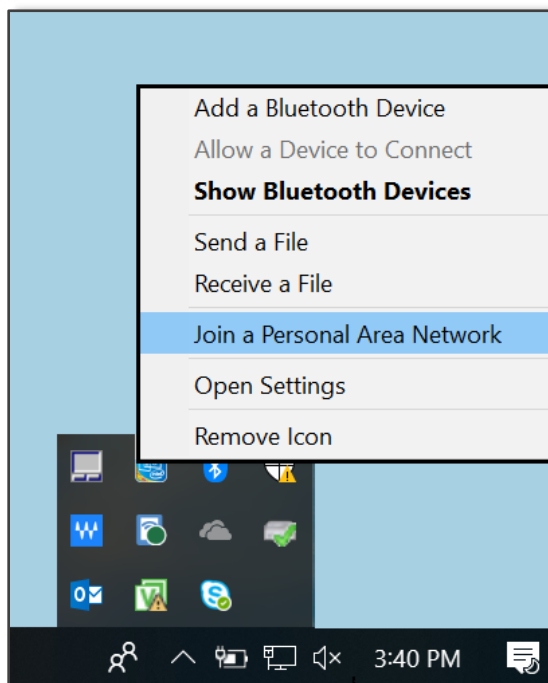
[8] Then select **Done**.

Establish Network Connection to the Echo 5G via Laptop

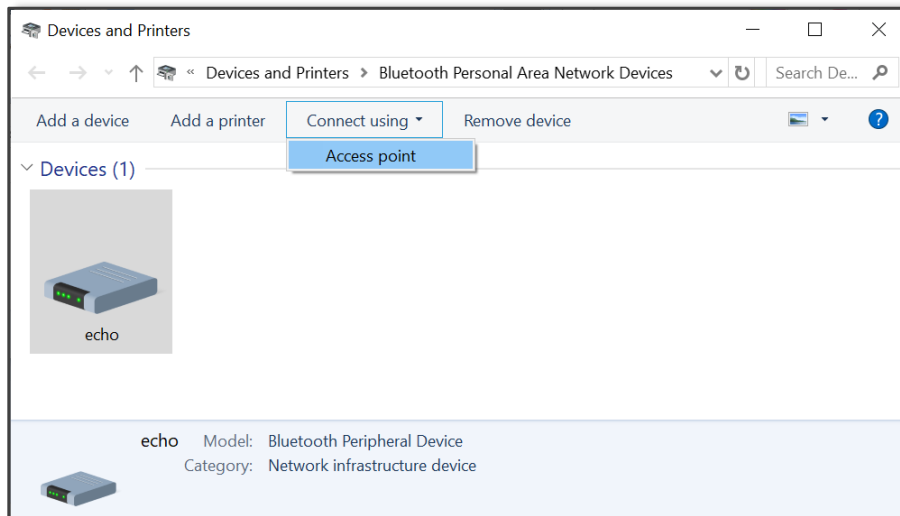
[1] Right click the Bluetooth icon in your laptop toolbar.



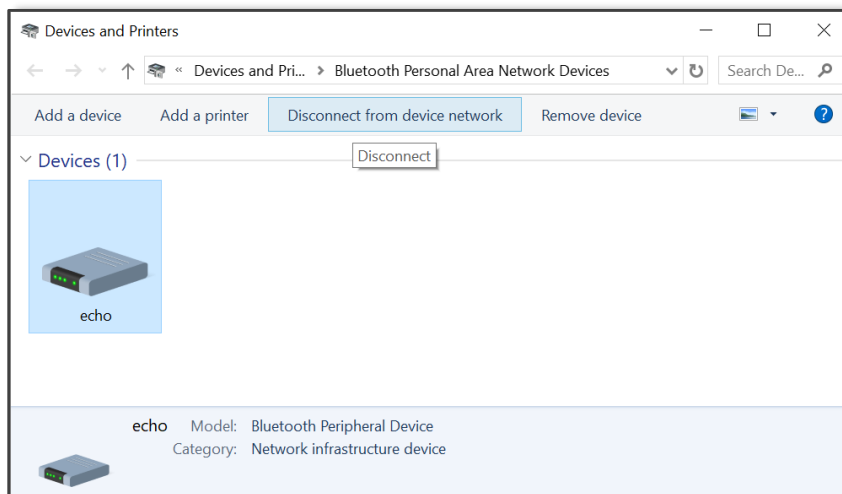
[2] In the pop-up list, select **Join a Personal Area Network**.



- [3] The system displays the *Devices and Printers* panel. Select your Echo device. Then, from the **Connect using▼** button, select **Access point**.



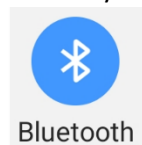
- [4] Confirm that the **Connect** button is now replaced with a **Disconnect from device network** button. This is evidence that the Echo device is currently connected.



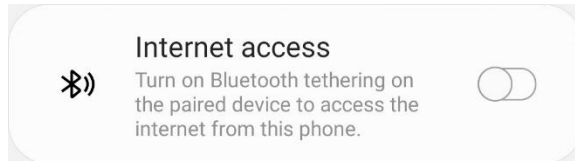
- [5] You will now be able to activate the Echo 5G device from this laptop using the Echo 5G Manager web interface.

Add the Echo 5G as a Recognized Device via Smartphone

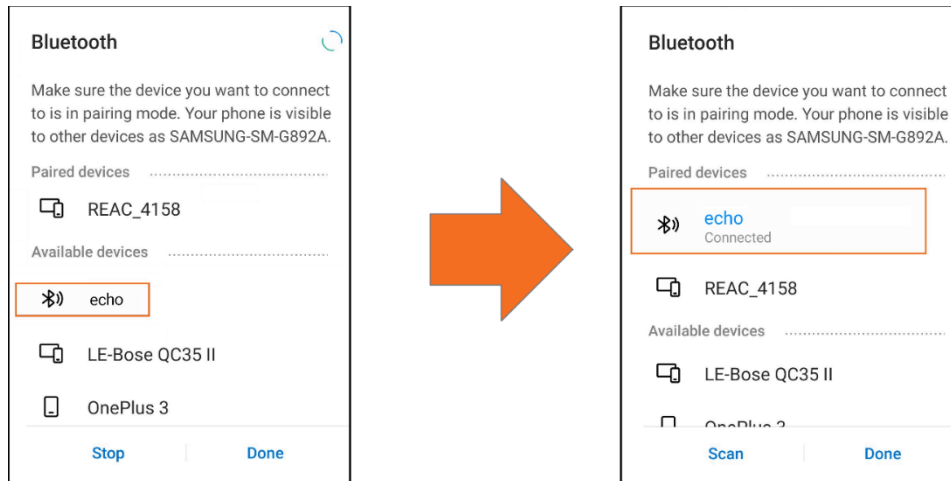
- [1] Turn on your phone's Bluetooth if it is not already on.



[2] You may also need to turn on Bluetooth tethering in your phone's Bluetooth settings.



[3] Select the Echo 5G from your list of available Bluetooth devices and wait for it to connect.



Echo 5G Web Interface

The Echo 5G Web Interface is the same whether it is on a Smartphone browser or laptop browser.

Connecting to Echo via Web Browser

- [1] Navigate to web address **10.0.0.1** on your phone's web browser. If this page does not load, you may first need to clear your browser cache.
- [2] Enter the **last six digits of your Echo 5G's serial number** as your password. The serial number can be found on the bottom of the ODU, the back of the IDU, or on the packaging box.



Serial number shown on bottom of ODU

- [3] Once you have entered your password, select **Submit**.



- [4] After submitting your password, the Echo setup will begin. Select **Go** for the Echo to scan and align with the strongest 5G beam source. Once scanning is complete, you will see the *Setup Complete* screen and can reset and rescan or view the details of the scan.
- [5] Should you wish to change your settings at any future time, simply go through this process again. The setup will skip the second and third screens in the image above and take you right to

the *Setup Complete* page (as the Echo retains the details of your previous scan). You should select **Reset** for the device to re-scan and re-align.

Echo 5G Settings (Details)

[6] If you select Details, you can view the Azimuth (Az) and Elevation (El) along with other details of the Echo 5G's alignment in either dB or raw format. You can also manually set the Azimuth and Elevation if your connection is weak using the heatmap below the details to identify strong signal sources (which will appear in orange, yellow, or red).

Setup Complete

Azimuth: Elevation:

Uplink

VPOL UL dB: HPOL UL dB:

Downlink

VPOL DL dB: HPOL DL dB:

Switch to Raw

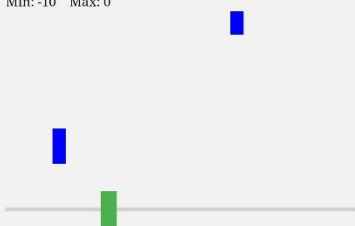
Submit

Save and Exit

DL VPOL: -15.2 dBm
DL HPOL: -15.1 dBm
UL VPOL: -21.8 dBm
UL HPOL: -19.0 dBm

Heat Map

Min: -10 Max: 0



Setup Complete

Azimuth: Elevation:

Uplink

VPOL UL 1: HPOL UL 1:

VPOL UL 2: HPOL UL 2:

VPOL UL 4: HPOL UL 4:

Downlink

VPOL DL 1: HPOL DL 1:

VPOL DL 2: HPOL DL 2:

VPOL DL 4: HPOL DL 4:

Switch to dB

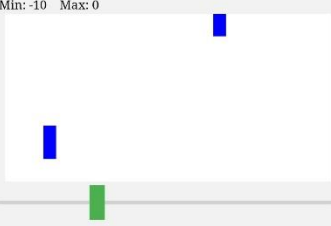
Submit

Save and Exit

DL VPOL: -15.2 dBm
DL HPOL: -15.1 dBm
UL VPOL: -21.8 dBm
UL HPOL: -19.0 dBm

Heat Map

Min: -10 Max: 0



Setting Azimuth or Elevation Manually

The Manual Setup tab provides access to beam-pointing (Az, El) control in degrees.

Azimuth can be adjusted in 2-degree increments and decrements, and Elevation in 5-degree increments. The inputs are bounded from -35 degrees to +35 degrees in Elevation and -76 degrees to +76 degrees in Azimuth. You can begin with an initial setting of 0 for both Az and El.

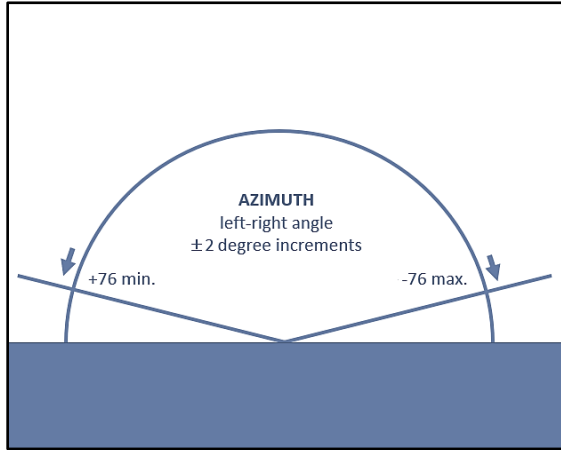


Figure 4: "Top-down view" of azimuth settings range
"Side view" of elevation settings range

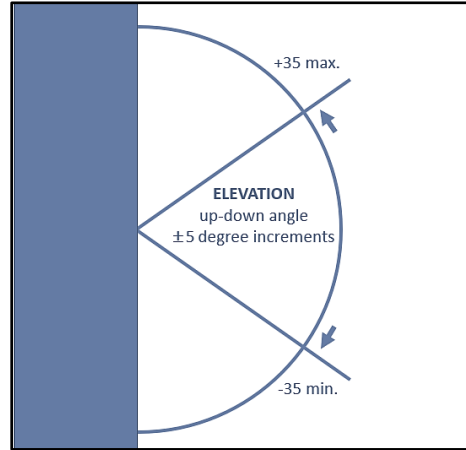


Figure 5: "Top-down view" of azimuth settings range
"Side view" of elevation settings range

Appendix A – 28 GHz Echo Technical Specifications

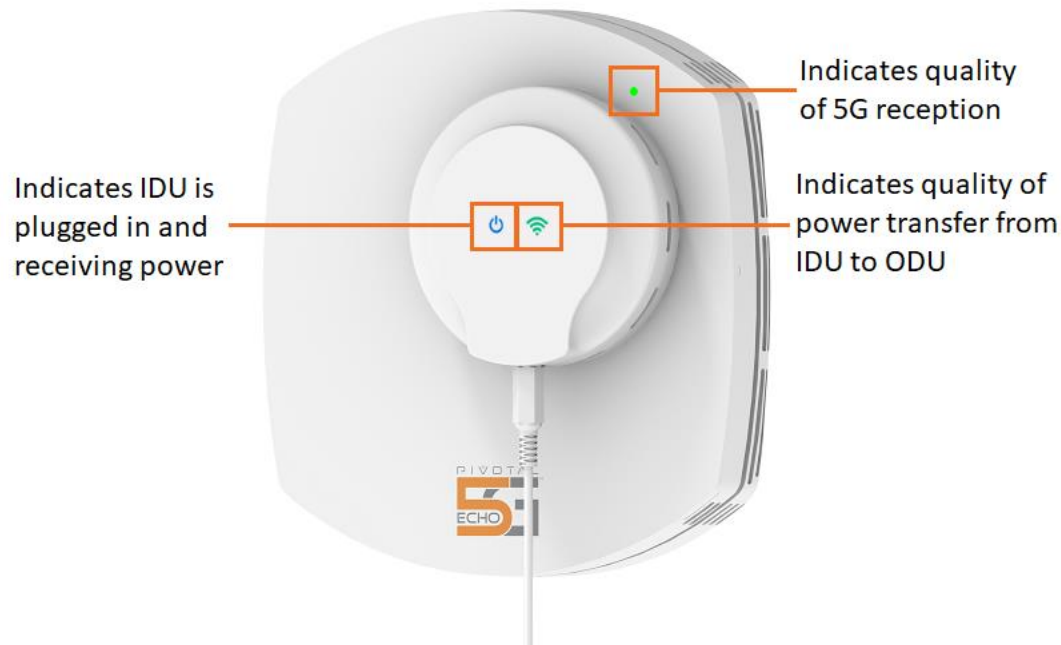
| Pivotal Echo 5G | Specifications |
|--------------------------------------|--|
| Frequency of operation | 27.5 to 28.35 GHz |
| HBF az scan envelope | +/-76° |
| HBF el scan envelope | +/-35° |
| HBF antenna gain (donor side) | 16 dB |
| HPBW towards gNB - azimuth | 5° |
| HPBW towards gNB - elevation | 20° |
| HBF scan loss | 6 dB at 76° |
| Static antenna (service side) | 6 dB |
| HPBW towards CPE/UE - azimuth | 100° |
| HPBW towards CPE/UE - elevation | 100° |
| Gain tunable range - DL | 15 dB |
| Gain tunable range - UL | 15 dB |
| Max electronic gain - DL | 55 dB |
| Max electronic gain - UL | 55 dB |
| Max EIRP - DL | 29.5 dBm |
| Max EIRP - UL | 29.5 dBm |
| Min noise figure - DL | 5 dB |
| Min noise figure - UL | 5 dB |
| In-band ripple (per 100 MHz channel) | 2 dB |
| Operating Temperature | -30 to 45° C |
| Maximum Donor Range (to gNB) | 3,000 ft |
| Maximum Indoor Range (to CPE/UE) | 30 ft |
| Dimensions | 7" x 7" x 1.5" for RF ODU, and 3.7" circle, 1.1" depth for IDU |
| Weight RF ODU | 2.4 lbs. |
| Weight IDU | 0.4 lbs. |
| IP Rating | IP54 for ODU; IP32 for IDU |
| Support Glass Type | Standard: single and double pane |
| Mounting | Adhesive, VHB |
| Max. Power Consumption | 36 Watts (from outlet) |
| Power Method | AC adapter for IDU and wireless power magnetically induced for ODU |
| Configuration Management Interface | Bluetooth® and LTE CAT M1 |
| Activation | Automated scan with setup via web-interface |
| Certifications | FCC, UL |

Appendix B – 39 GHz Echo Technical Specifications



| Pivotal Echo 5G | Specifications |
|--------------------------------------|--|
| Frequency of operation | 37.6 to 40 GHz |
| HBF az scan envelope | +/-76° |
| HBF el scan envelope | +/-35° |
| HBF antenna gain (donor side) | 16 dB |
| HPBW towards gNB - azimuth | 5° |
| HPBW towards gNB - elevation | 20° |
| HBF scan loss | 6 dB at 76° |
| Static antenna (service side) | 6 dB |
| HPBW towards CPE/UE - azimuth | 120° |
| HPBW towards CPE/UE - elevation | 120° |
| Gain tunable range - DL | 15 dB |
| Gain tunable range - UL | 15 dB |
| Max electronic gain - DL | 55 dB |
| Max electronic gain - UL | 55 dB |
| Max EIRP - DL | 30 dBm |
| Max EIRP - UL | 30 dBm |
| Min noise figure - DL | 5 dB |
| Min noise figure - UL | 5 dB |
| In-band ripple (per 100 MHz channel) | 2 dB |
| Operating Temperature | -30 to 45° C |
| Maximum Donor Range (to gNB) | Up to 3,000 ft |
| Maximum Indoor Range (to CPE/UE) | 100+ ft |
| Dimensions | 7" x 7" x 1.5" for RF ODU, and 3.7" circle, 1.1" depth for IDU |
| Weight RF ODU | 2.4 lbs. |
| Weight IDU | 0.4 lbs. |
| IP Rating | IP54 for ODU; IP32 for IDU |
| Support Glass Type | Low-E and Standard |
| Mounting | Adhesive, VHB |
| Max. Power Consumption | 30 Watts (from outlet) |
| Power Method | AC adapter for IDU and wireless power magnetically induced for ODU |
| Configuration Management Interface | Bluetooth® and LTE CAT M1 |
| Activation | Automated scan with setup via web-interface |
| Certifications | FCC, UL |

Appendix C – Troubleshooting & Support

Indicator Lights Overview

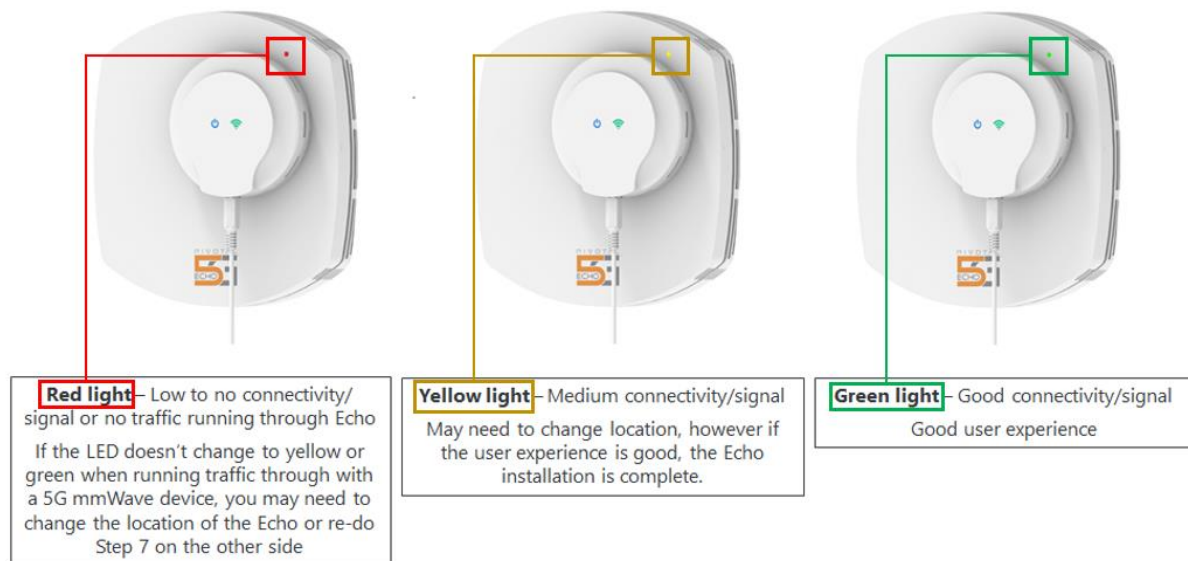


What the IDU Indicator Light Displays Mean

-  Solid blue light indicator
 - » DC power to the IDU
-  Green light indicator
 - » Blinking green: probing for an ODU
 - » Solid green: IDU is powering the ODU
 - » If the length of the blinking green LED is longer than 30 secs, the spacer needs to be removed or IDU needs repositioning



What the ODU Indicator Light Means



FAQ / Troubleshooting

What do I do if I have trouble accessing 10.0.0.1?

You may need to clear your browser cache, set your phone to airplane mode, or both.

What does it mean when the IDU's green light continues to blink?

The IDU is not connecting to the ODU. Make sure the alignment cling and IDU are properly aligned with the ODU. If the window glass is double-paned, pull the IDU and spacer ring off the Velcro adhered to the window, remove the spacer ring, and reattach the IDU directly to the Velcro on the window.

What does it mean when the ODU LED blinks red?

It means the ODU is searching for a signal. Once the ODU finds and assesses the signal it will turn a solid color to indicate the quality of traffic passing through the Echo.

Does a solid red LED on the ODU mean it is not receiving 5G?

A solid red light means there is no traffic running through the Echo. This could be due to a bad signal OR it could be because there are no user devices pulling traffic through the Echo.

You can try using one of your connected devices to see if the LED changes to yellow or green or redo the activation. This behavior will be refined to provide more intuitive guidance in a subsequent software update.

What if the ODU light is red and it is because the signal is weak?

Adjust [Azimuth \(Az\) and Elevation \(El\) settings](#) for better alignment with the gNB or find a better location for the ODU.

What if the Echo 5G is not transmitting?

Power the Echo 5G off, then power it back on.

What do I do if the Echo 5G loses connectivity during activation?

Your Bluetooth connection may have dropped if your laptop or smartphone was moved too far away from the Echo 5G during activation. Try getting closer to the Echo 5G with the device you are using for activation via Bluetooth. You may need to re-do the network connection portion of the [Laptop-to-Echo](#) connection process.

What do I do if the Echo 5G signal strength diminishes over time?

There may be a gradually increasing obstruction of the signal path to the gNB, such as leaves growing on trees that were not there during the initial Echo 5G setup. Re-do the [Connecting to Echo via Web Browser](#) steps of the Echo 5G Activation.

What if the Echo 5G is still not working?

Power the Echo 5G off, then power it back on.

Notes:

- The Echo does not lose any settings when GUI/Bluetooth connection has been dropped and subsequently restored.
- If the above listed solutions do not appear to resolve your concern, please [contact Pivotal Commware](#) for additional assistance.

Getting Technical Assistance

Pivotal Commware is dedicated to the success of your Echo 5G installation and operation. Feel free to contact us with any questions or concerns.

Before calling, gather the following details about your Echo 5G:

- [Serial Number](#) (located on the bottom of the ODU, back of the IDU, and on the packaging box)
- [Echo 5G settings](#)

Pivotal Echo 5G Technical Support:

- Phone – 1-855-956-2016
- Email – support@pivotalcommware.com
- File a Ticket – <https://pivotalcommware.freshdesk.com/support/home>
- Pivotal Support Resources: <https://pivotalcommware.com/echo-5g-installation-help/>



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Appendix D – Warranty Information

Your Pivotal Commware, Inc. ("Pivotal") Echo 5G has been designed to provide reliable, worry-free service. If for any reason you have a problem with your equipment, please refer to the manufacturer's warranty in this section. For information regarding the terms and conditions of service for your Echo 5G, please visit www.verizonwireless.com/support/ or call Verizon Wireless Customer Service at (800) 922-0204 or *611 from your Verizon Wireless mobile phone.

Standard Limited Warranty

What is Covered and For How Long?

Pivotal warrants to the original purchaser ("Purchaser" or "You") that the Pivotal Echo 5G and accessories ("Products") included in this package are free from defects in material and workmanship under normal use and service for the period commencing upon the date of purchase and continuing for the following specified period of time after that date: All components carry a one-year warranty.

What is Not Covered?

This Limited Warranty is conditioned upon proper use of Product by Purchaser. This Limited Warranty does not cover: (a) defects or damage resulting from accident, misuse, abuse, neglect, unusual physical, electrical or electromechanical stress, or modification of any part of Product, including antenna, or cosmetic damage; (b) equipment that has the serial number removed or made illegible; (c) any plastic surfaces or other externally exposed parts that are scratched or damaged due to normal use; (d) malfunctions resulting from the use of Product in conjunction with accessories, products, or ancillary/peripheral equipment not furnished or approved by Pivotal; (e) defects or damage from improper testing, operation, maintenance, installation, or adjustment; (f) installation, maintenance, and service of Product, or (g) Product used or purchased outside the United States.

What are Pivotal's Obligations?

During the applicable warranty period, Pivotal will repair or replace, at Pivotal's sole option, without charge to Purchaser, any defective component part of Product. To obtain service under this Limited Warranty, Purchaser must return Product to an authorized service facility in an adequate container for shipping, accompanied by Purchaser's sales receipt or comparable substitute proof of sale showing the date of purchase, the serial number of Product and the seller's name and address. To obtain assistance on where to deliver the Product, call Verizon Customer Care at (800) 922-0204. Upon receipt, Pivotal will promptly repair or replace the defective Product. Pivotal may, at Pivotal's sole option, use rebuilt, reconditioned, or new parts or components when repairing any Product or replace Product with a rebuilt, reconditioned or new Product. All other repaired/replaced Product will be warranted for a period equal to the remainder of the original Limited Warranty on the original Product or for 90 days, whichever is longer. All replaced parts, components, boards and equipment shall become the property of Pivotal. If Pivotal determines that any Product is not covered by this Limited Warranty, Purchaser must pay all parts, shipping, and labor charges for the repair or return of such Product.

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Appendix E – Glossary

| Term | Definition |
|--------------------------------------|---|
| 3GPP LTE | LTE protocol per “3rd Generation Partnership Project,” a mobile telephone standards org. |
| 5G-NR | The 5G radio system |
| 5G NSA | Non-Stand-Alone flavor of 3GPP 5G-NR ... requiring concurrent 4G capability to function (currently typical) |
| 5G SA | Stand-Alone flavor of 3GPP 5G-NR ... able to work without 4G capability (eventually, future) |
| 5G TF | Verizon 5G Task Force (aka pre-5G) |
| Activation | (Echo 5G) Installation and initial setup, which tunes the system to optimal functionality |
| ADC | Analog-Digital Converter (in electric circuitry) |
| Az, AZ, Azimuth | The “left-to-right” angle direction relative to nearby gNB location |
| BW | Bandwidth |
| CPE, Customer Premises Equip. | Typically: End-user obtained transceiver that distributes FWA broadband internet to devices within the home via WLAN (Wi-Fi). Effectively replaces cable/DSL internet |
| dB, decibel | A relative unit of power, used to express change in value as in “increase of 3 dB” -- presented on a logarithmic scale |
| dBm | A unit of level, indicating a power ratio expressed in decibels (dB) with reference to one milliwatt (mW) |
| DL, Downlink | Data/information transmitted in the direction from gNB to CPE/UE |
| KPI | Key performance indicators: set of useful parameters that (in this case) CPE would report to Echo 5G, and Echo 5G would display it for user |
| EIRP | Equivalent Isotropic Radiated Power, a measure of Transmit power |
| EI, EL, Elevation | The “up-to-down” angle direction relative to distant gNB location |
| EN-DC | E-UTRA NR dual connectivity (a flavor of NR NSA deployment) |
| EVM | Error Vector Magnitude, a measure of quality of received signal |
| FWA | Fixed Wireless Access. |
| Gigabit speed | A term of user-perceived throughput, as in Gigabits/second |
| gNodeB, gNB | 5G NR base station |
| HBF | Pivotal Commware’s Holographic Beam Forming technology that enables Gigabit speeds beyond the reach of cable and DSL |
| IDU | Indoor unit. The wireless power unit mounted on the interior side of the window. |
| Low-E glass | Low-Emissivity windowpanes, on which the coating that reflects sunlight also inhibits RF signals from passing into a building |
| LTE | Long-term Evolution, generally referring to technology path toward 4G speeds |
| LTE Cat M1 | A flavor of IoT (internet of things) technology under 3GPP LTE umbrella |

| Term | Definition |
|------------------------------------|---|
| Millimeter wave frequencies | Wavelength spectrum that correlates to ~24 GHz frequencies and higher |
| M&C | Monitoring and Controlling – or – Monitor and Control |
| OAM, OA&M | Operations, Administration & Management/Maintenance – the necessary processes for setting up and running a system |
| ODU | Outdoor unit. The unit mounted on the outdoor side of the window. |
| RF | Radio Frequency |
| SNR | Signal-to-Noise ratio |
| UE | User Equipment – typically CPE or a mobile device/smartphone |
| UL, Uplink | Data/information transmitted in the direction from CPE/UE towards gNB |

Appendix F – Removal Instructions

To remove your Echo 5G, take the following steps:

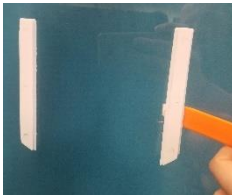
- [1] Loosen the set screws and slide the ODU off the rails



- [2] Slide the end of the removal tool under the rails, starting at the bottom and carefully lift the rails away from the window.



- [3] Work your way up the rails from the bottom or side.



- [4] When you have loosened the adhesive enough you can carefully remove the rails by hand.



- [5] Use a window cleaner and the rough side of a sponge to clean any remaining adhesive off your window.

